

2016-17 Catalog

ESF



Improve  
Your World

State University of New York  
College of Environmental Science and Forestry

Syracuse, New York

# SUNY-ESF

SUNY-ESF is the oldest and most distinguished institution in the United States that focuses on the study of the environment.

## About ESF

For complete information on ESF, explore the ESF web:

- [www.esf.edu](http://www.esf.edu)
- [www.esf.edu/welcome](http://www.esf.edu/welcome) (president's message, facts, history, mission, etc.)

## ESF Campuses

- [www.esf.edu/welcome/campus](http://www.esf.edu/welcome/campus)

SUNY-ESF is a multiple campus institution that includes approximately 1 million square feet of facilities in 186 buildings on 25,000 acres of land. Facilities for education and research are provided on the main campus in Syracuse and at five regional campuses and three field stations.

## About the State University of New York (SUNY)

- [www.suny.edu](http://www.suny.edu)

The State University of New York's 64 geographically dispersed campuses bring educational opportunity within commuting distance of virtually all New Yorkers and comprise the nation's largest comprehensive system of public higher education.

## Accreditation

The State University of New York College of Environmental Science and Forestry is accredited by:

### **Middle States Commission on Higher Education**

3624 Market St.

Philadelphia, PA, 19104-2680

215-662-5606.

The master of forestry degree; the bachelor of science degrees in forest resource management, forest ecosystem science and natural resources management; and the associate in applied science degree in forest technology are accredited by the Society of American Foresters (SAF). SAF is recognized by the Commission on Recognition of Postsecondary Accreditation as the specialized accrediting body for forestry in the United States:

### **Society of American Foresters**

5400 Grosvenor Lane

Bethesda, MD 20814-2198

301-897-8720

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The bachelor of science degrees in bioprocess engineering, environmental resources engineering and paper engineering, and the associate in applied science degree in land surveying technology are accredited by:

**Engineering Accreditation Commission of ABET**

111 Market Place, Suite 1050

Baltimore, MD 21202

410-347-7700

The bachelor of landscape architecture and master of landscape architecture degrees are accredited by:

**Landscape Architectural Accreditation Board**

603 Eye St. NW, Suite 500

Washington, D.C. 20001

## Admission

### Undergraduate Admission

- [www.esf.edu/admissions](http://www.esf.edu/admissions)

### High School Students

- [www.esf.edu/admissions/freshman](http://www.esf.edu/admissions/freshman)

High School seniors may apply for admission under one of the three pathways available: Early Decision (enrollment commitment required if admitted), Regular Freshman or Guaranteed Transfer. The level of the applicant's interest in ESF and the quality of their academic performance in high school will determine which pathway is most appropriate. Admissions staff members can assist applicants in selecting their admission pathway.

### Transfer Students

- [www.esf.edu/admissions/transfer](http://www.esf.edu/admissions/transfer)

SUNY-ESF welcomes transfer students in all of our undergraduate programs of study. Approximately 40 percent of our students transfer to SUNY-ESF. Applicants who have completed a minimum of one semester of college-level coursework following high school graduation will be considered transfer students.

### Graduate Student Admission

- [www.esf.edu/graduate/admission.htm](http://www.esf.edu/graduate/admission.htm)

Admission to graduate studies is conditional upon review and acceptance of an applicant's credentials by appropriate faculty members and upon the recommendation of the appropriate department chairman or program director to the Associate Provost for Instruction and Dean of the Graduate School.

## Faculty

- [www.esf.edu/faculty](http://www.esf.edu/faculty) (all faculty)
- [www.esf.edu/departments](http://www.esf.edu/departments) (faculty by department or program)

## International Education

- [www.esf.edu/international](http://www.esf.edu/international)

The Office of International Education (OIE) services include immigration advising for F-1 and J-1 students and J-1 visiting scholars, and immigration document processing for Admissions and the Graduate School. The office also offers study abroad advisement for all students wanting to have an international experience, and the office supports

international education programming and orientation for newly arrived international students and scholars. OIE serves as an emergency point of contact for students conducting research abroad, participating in international programs, and ESF faculty-led courses abroad.

## Outreach

- [www.esf.edu/outreach](http://www.esf.edu/outreach)

Outreach at ESF is teaching, research, and service that engages the college with external groups. Outreach activities support environmental, educational, social and economic development in ways that advance both the public good and ESF's mission.

To these ends, ESF faculty, staff and students, along with our partners, pursue a diverse range of programs and projects—all with an aim to enhance leadership, education, and practice in the science, design, engineering and management of natural resources and the environment. Programs include on-campus, off-campus, and online credit and non-credit opportunities for professionals, middle and high school students, ESF students, and lifelong learners.

## Research

- [www.esf.edu/research](http://www.esf.edu/research)

Research at ESF is remarkably diverse, current and challenging, with contributions being made in fields like aquatic ecosystems, bioenergy, biotechnology, biodiversity, ecology, genetic engineering, nanotechnology, remote sensing, wildlife disease prevention and many others.

ESF is a leader in integrating the energy and excitement of research with the formal requirements of degree and certificate programs. A high percentage of undergraduates and virtually all graduate students participate in research activity as part of their educational experience.

## Staff and Administration

- [www.esf.edu/administration](http://www.esf.edu/administration) (Administration)
- [www.esf.edu/help](http://www.esf.edu/help) (faculty & staff directory)
- [www.esf.edu/provost](http://www.esf.edu/provost) (Academic Affairs)
- [www.esf.edu/welcome/trustees.htm](http://www.esf.edu/welcome/trustees.htm) (ESF Board of Trustees)

## Student Affairs

- [www.esf.edu/students](http://www.esf.edu/students)

The Division of Student Affairs is guided by the College's strategic goal of providing an outstanding student experience. The creative and dedicated team of professionals in Student Affairs will work to achieve this goal by creating opportunities for personal and leadership development, through community-focused learning experiences, and by offering services to promote academic and career success.

## Key Policies and Data

- [www.esf.edu/au/pp.htm](http://www.esf.edu/au/pp.htm) (all college policies and procedures)

## Campus Safety Report

- [www.esf.edu/univpolice/crimereports](http://www.esf.edu/univpolice/crimereports)

A Campus Safety Report is filed as required by the federal "Crime Awareness and Campus Security Act," or "Clery Act." The purpose of this report is to provide our faculty, staff and students with campus safety information including crime statistics and procedures to follow to report a crime.

The report is prepared and published each Oct. 1 by our University Police, Judicial Affairs and Environmental Health and Safety Department. It is also available in printed format from the University Police Department in Room 19 Bray Hall on request.

## **Collegewide Smoking Policy**

- [www.esf.edu/au/documents/CollegeSmokingPolicy.pdf](http://www.esf.edu/au/documents/CollegeSmokingPolicy.pdf)

New York State legislation regulates smoking in all workplaces. Effective July 24, 2003, smoking is prohibited in all indoor areas on College property. Individuals who choose to smoke may do so outdoors, no closer than 20 feet from building openings such as doors, windows, air intakes, loading docks or similar structures, or in any area where flammable substances or combustible materials are used or stored. Smoking also is prohibited in all College vehicles.

## **Student Consumer Information**

- [www.esf.edu/onsumer](http://www.esf.edu/onsumer)

This website provides student consumer information as required by the Federal Higher Education Opportunity Act and the United States Department of Education.

## **Title IX**

- [www.esf.edu/administration/titleIX](http://www.esf.edu/administration/titleIX)

Title IX is the federal anti-discrimination law that states: "No person in the U.S. shall, on the basis of sex, be excluded from participation in, or denied the benefits of, or be subjected to discrimination under any educational program or activity receiving federal aid." (Title IX of the Education Amendments of 1972). This applies to all College programs and activities including, but not limited to, academic and athletic programs, financial aid and student records and accounts, health and counseling services, and housing and residence life programs.

Title IX prohibits sex discrimination against students, employees, or third parties. Sex discrimination includes sexual harassment, sexual assault, and sexual violence.

# Academic Calendar

- [Registrar website](#)

## 2016-17 Academic Year

### Fall 2016

#### Syracuse Campus

Classes Begin	August 29, Monday
Labor Day (no classes)	September 5, Monday
Last day to add a class	September 6, Tuesday
Last day to drop a class	September 23, Friday
Last day to withdraw from a class with a grade of W	October 28, Friday
Advising for Spring 2017	October 31-November 8, Monday-Tuesday
Registration for Spring 2017	November 9-18, Wednesday-Friday
Thanksgiving Recess	November 20-27, Sunday-Sunday
Last day to withdraw from a class with a grade of W or WF	December 2, Friday
December Commencement	December 9, Friday
Last Day of Classes	December 9, Friday
Reading Days	December 10-11, Saturday-Sunday
Final Exams	December 12, Monday
Reading Day (a.m.)	December 13, Tuesday
Final Exams (p.m.)	December 13, Tuesday
Final Exams	December 14, Wednesday
Reading Day (a.m.)	December 15, Thursday
Final Exams (p.m.)	December 15, Thursday
Final Exams	December 16, Friday
Grades Due	December 23, Friday

## Wanakena Campus

Summer Bridge classes end	August 5, Friday
Registration/Orientation	August 14-16, Sunday-Tuesday
Students Arrive/Move-in	August 14, Sunday
First Day of Classes	August 17, Wednesday
Labor Day - no classes	September 5, Monday
Columbus Day - no classes	October 10, Monday
Thanksgiving Break (No Classes)	November 19-27, Saturday-Sunday
Last day of fall semester	December 16, Friday

## Spring 2017

### Syracuse Campus

Classes Begin	January 17, Tuesday
Last day to add a class	January 24, Tuesday
Last day to drop a class	February 10, Friday
Spring Break	March 12-19, Sunday-Sunday
Advising for Fall 2017	March 20-29, Monday-Wednesday
Last day to withdraw from a class with a grade of W	March 21, Tuesday
Registration for Fall 2017	March 30-April 10, Thursday-Monday
Last day to withdraw from a class with a grade of W or WF	April 21, Friday
Last Day of Classes	May 2, Tuesday
Reading Day	May 3, Wednesday
Final Exams	May 4-5, Thursday-Friday
Reading Days	May 6-7, Saturday-Sunday
Final Exams	May 8-10, Monday-Wednesday
ESF May Commencement	May 13, Saturday
ESF/SU Joint Commencement	May 14, Sunday
Grades Due	May 17, Wednesday

### Wanakena Campus

Martin Luther King Day - No classes - students return	January 16, Monday
Ranger School Classes Begin	January 17, Tuesday
Spring Break (No Classes)	March 19-26, Sunday-Sunday
Graduation	May 20, Saturday

# Academic Policies

## Statement of Academic Integrity

The College of Environmental Science and Forestry is an institution of higher learning where growth and development are fostered, excellence is pursued and the highest standards of academic integrity are expected. The Code of Student Conduct (“the Code”) outlines the behaviors that are expected of all students at the College. As a condition of enrollment, all students are required to acknowledge that they have (a) received a copy of the Code; (b) read the Code; (c) understand the provisions of the Code; and (d) agree to abide by the provisions of the Code.

The ESF Student Judicial Handbook and Code of Student Conduct are available online:

- [www.esf.edu/students/handbook](http://www.esf.edu/students/handbook)

## College-wide Academic Policies

### General Requirements

A student seeking a degree must be in matriculated status. All degree requirements must be completed through a combination of formally accepted transfer credits and/or courses taken at ESF and Syracuse University.

### Attendance

Students are expected to adhere to the attendance policy stated by each course instructor. Instructors may make attendance part of the course requirement.

### Timely Feedback

Faculty shall provide all students with timely and appropriate feedback regarding their performance and progress toward meeting prescribed learning outcomes on all assigned coursework, projects and examinations.

### Course-numbering System

Courses at ESF are numbered according to the following system:

- 100-499 Undergraduate courses for which no graduate credit may be given.
- 500-599 Graduate courses designed expressly for areas of specialization in post-baccalaureate programs. Qualified undergraduate students may enroll with permission of the instructor.
- 600-699 Graduate courses designed expressly for advanced levels of specialization. Undergraduate students with a cumulative grade point average of 3.000 or better may enroll in these courses with an approved petition.
- 700-999 Advanced graduate level courses for which no undergraduate students may register.

Shared resources courses, designated as 400/500 or 400/600, are designed when the topic coverage of both courses is the same. Separate course syllabi are developed expressly differentiating the requirements and evaluative criteria between the undergraduate course and the graduate course. No type of cross listing may be offered unless approved by the ESF faculty.

Courses listed are offered subject to the availability of instructional faculty and sufficient student enrollment. Students and advisors should consult the actual schedule of courses published each semester to determine the availability and time of courses.

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## **Dropping or Adding Courses**

For those students receiving financial support through the College, dropping courses that result in the student being less than full time will have an impact on support received. Contact the Office of Financial Aid and Scholarships for more detailed information.

Students may add courses with the approval of both their academic advisor and the course instructor and may drop courses with their advisor/major professor's approval and notification to the course instructor using an appropriate drop/add form until the last day for program adjustments as listed in the ESF academic calendar. Courses dropped during this time will not appear on the student's transcript. Courses that begin after the published add date may be added prior to the start of the course. Courses that last for less than one semester may be dropped no later than halfway through the course. In either case, the student must submit a completed drop/add form. Following the last day to add a class, students may withdraw from individual courses. Withdrawal policies and deadlines are described in the **Withdrawal from Individual Courses** section below.

## **Incomplete and missing grades**

A temporary grade of I may be assigned by an instructor only when the student has nearly completed the course but because of significant circumstances beyond the student's control the work is not completed. Grades of I should be resolved within one academic year. If the incomplete is not resolved within one year, it will be changed to a grade of I/F or I/U, depending on the grading basis for the course. No degree will be conferred until all grades of I have been resolved.

## **Repeating Courses**

Students may repeat any course previously taken, either to earn a higher grade or because of a previous failure.

Courses taken at ESF or Syracuse University that contribute to the GPA may be repeated. Ability to repeat a course may be limited by available space, providing priority for first-time registrants. Upon completion of the repeated course, the grade earned will be included in the semester and cumulative grade point averages. The original grade received in the course will be shown in parentheses following the R [e.g. R (C)]. The cumulative grade point average will reflect the grade for the second time the course was taken if the course was repeated once. Grades for all subsequent attempts (including failed attempts) will be included in the calculation of grade point average. Semester and cumulative grade point averages will be calculated in accordance with SUNY and college policies. The course's credits can count only once toward degree requirements. The "R" grade may be applied to replace initial course grades higher than "F" only if the course was initially taken in the Fall 2009 semester or later.

For state-based financial aid, repeated courses in which students have received a passing grade will not count toward full-time status. Students retaking courses may find their financial aid reduced if they fall below 12 credits when the retaken courses are not included. Students should contact the Financial Aid Office to determine the impact of retaking courses on their financial aid.

## **Exceptions to Curriculum and Academic Policy Requirements**

Exceptions to academic policies stated in this document and curriculum requirements may be made by the Faculty Subcommittee on Academic Standards, which also may delegate this authority. Exceptions may not violate standards established by the State University of New York or the New York State Education Department.

Exceptions must be requested on a petition form and must have a recommendation from the student's advisor and department chair or designee. In those cases where an action is requested involving a specific course, the petition must also have a recommendation from the course instructor.

## Withdrawal from ESF

Students who withdraw from matriculation at the College on or before the deadline to drop a class for a semester will have their records marked: "Withdrew on (date)." Courses will appear for that semester with the grade of W.

Students who withdraw after the **end of the 4th week of the semester**, but on or before the last class day before the final examination period, will have either WP (withdraw passing) or WF (withdraw failing) listed after each uncompleted course. Students who do not withdraw on or before the last class day will have a grade on a scale of A-F, an I (incomplete), or I/F (unresolved incomplete) assigned by the instructor for each registered course.

Students who wish to withdraw from ESF should schedule a meeting to review the withdrawal process and complete an exit interview in the Office of Student Affairs.

- [www.esf.edu/students/support/services.htm](http://www.esf.edu/students/support/services.htm)

## Withdrawal from Individual Courses

Students may drop individual courses up until the **last day to add** as set by the Registrar in the ESF Academic Calendar using an **add/drop form**. Dropped courses during this period will be completely removed from the transcript when dropped on or before this deadline.

### Deadlines and actions to be taken after the last day to add deadline are:

- **Last day to add – Week 4:** After the **last day to add** (as per the academic calendar), students may drop a course without record of registration, until the end of the 4th week of classes.
- **Weeks 5-9:** A student who withdraws from a course after the last day of the **4th week and by the last day of the 9th week** will receive a W (Withdraw) grade on his or her permanent transcript, and the student will remain on the course roster. The W grade will not affect the GPA, and is not replaceable with an R grade.
- **Weeks 10-14:** A student who withdraws from a course after the last day of the **9th week and by the last day of the 14th week** will receive a W or a WF (withdraw failing) on his or her permanent transcript, and the student will remain on the course roster. The WF grade will not count in the student's GPA. W and WF grades are not replaceable with an R grade. The W (when assigned after the last day of the 9th week) and WF grade will be assigned by the instructor at the end of the semester.

Precise deadline dates noting the official end of weeks above shall be listed on the ESF Academic Calendar found on the Registrar's webpage ([www.esf.edu/registrar/calendar.asp](http://www.esf.edu/registrar/calendar.asp))

## Readmission to ESF

Students wishing to return to ESF **must** apply for Readmission by contacting the Office of Student Affairs.

Readmission applies to those students returning from a leave of absence (medical or military), who withdrew from the college, or have been dismissed for academic or disciplinary reasons.

- [www.esf.edu/students/support/services.htm](http://www.esf.edu/students/support/services.htm)

## Resumption of Degree Programs

Students who have withdrawn from matriculated status in a degree program at ESF may seek to resume or complete a degree program with the following conditions:

1. A former student **must** apply for either:
  - Readmission and resumption of the student's original degree program and curriculum as described in the college catalog at the time of the student's original matriculation; or transfer of additional credit from another university sufficient to complete content or credit-hour requirements of the student's original degree program.
  - Readmission to complete a current ESF degree program and curriculum as described in the current college catalog; or transfer of additional credit from another university sufficient to complete content or credit hour requirements of a current ESF degree program.
2. Resumption and completion of original degree programs is permissible only if application for readmission is made no more than **10 years** after the student's original matriculation at ESF.

3. Degree completion will be posted to the academic record in the term when the last program requirement was completed. Degrees may not be conferred retroactively.
4. Students whose case exceeds the statute of limitation for degree resumption (i.e. 10 years as noted in (2.) above) will be advised by the department regarding those current programs that the student may pursue that most closely match his or her previously completed coursework. Past coursework may be accepted toward completion of a current degree program at the discretion of the department.

In the event of a dispute resulting from departmental or administrative review of a returning student's academic record, final authority regarding the completion of curricular requirements for degree programs rests with the college President, within the limits prescribed by the New York State Department of Education (such as those requiring a minimum number of total credit hours, etc.).

### **Statement of Good Academic Standing**

The term "in good academic standing" means that a student is maintaining satisfactory progress toward a degree with a Cumulative Grade Point Average (Cum GPA) of at least 2.000. Students earning less than a 2.000 Cum GPA shall be placed on Academic Probation.

### **Syracuse University Courses**

Courses offered at ESF should be taken at Syracuse University only under extraordinary conditions authorized by the department chair or designee. Students who propose to register for Syracuse University courses and no courses at ESF during any semester may do so only upon acceptance to special ESF-SU cooperative programs that require block registration. Students who are in their final semester may register for no more than six credits of Syracuse University courses beyond those necessary to meet ESF requirements.

Syracuse University courses may be audited only under extraordinary conditions that must be approved by the department chair or designee. Physical education courses, when taken, must always be for credit and never audited. Students may not retake Syracuse University courses in which credit has been previously earned.

Upper-division undergraduate students are normally expected to take upper-division courses and graduate students are normally expected to take graduate-level courses at Syracuse University.

### **Religious Beliefs Law**

Students unable, because of religious beliefs, to attend classes on certain days are guided by Section 224a of the New York State Education Law, which is as follows:

- No person shall be expelled from or be refused admission as a student to an institution of higher education for the reason that one is unable, because of religious beliefs, to attend classes or to participate in any examination, study or work requirements on a particular day or days.
- Any student in an institution of higher education who is unable, because of religious beliefs, to attend classes on a particular day or days shall, because of such absence on the particular day or days, be excused from any examination or any study or work requirements.
- It shall be the responsibility of the faculty and of the administrative officials of each institution of higher education to make available to each student who is absent from school because of religious beliefs an equivalent opportunity to make up any examination, study or work requirements which may have been missed because of such absence on any particular day or days. No fees of any kind shall be charged by the institution for making available to the said student such equivalent opportunity.
- If classes, examinations, study or work requirements are held on Friday after four o'clock post meridian or on Saturday, similar or makeup classes, examinations, study or work requirements shall be made available on other days, where it is possible and practicable to do so. No special fees shall be charged to the student for these classes, examinations, study or work requirements held on other days.
- In effectuating the provisions of this section, it shall be the duty of the faculty and of the administrative officials of each institution of higher education to exercise the fullest measure of good faith. No adverse or prejudicial effects shall result to any student because of implementation of the provisions of this section.

- Any student, who is aggrieved by the alleged failure of any faculty or administrative officials to comply in good faith with the provisions of this section, shall be entitled to maintain an action or proceeding in the supreme court of the county in which such institution of higher education is located for the enforcement of rights under this section.

## Undergraduate Academic Policies

### General Requirements

While a student is matriculated at ESF, all courses taken at ESF and Syracuse University to meet degree requirements must be graded on a scale of A-F, and the grades will be computed in the grade point average. As an exception, at the discretion of the instructor, courses numbered 132, 496 and 497 may be graded on a Satisfactory/ Unsatisfactory basis. This must be announced on the first day of class and will apply to all students enrolled in that course section.

### Curriculum Requirements

The development and administration of course offerings, prerequisites, sequencing and program requirements are primarily the responsibility of each program with the approval of the ESF faculty.

Students must satisfy the requirements for graduation presented in the catalog in effect as of the date they first matriculated at ESF. Students may graduate under the requirements stated in any catalog issued subsequent to the one in effect the date they matriculated, but they may not use a prior catalog.

Supplementary courses are available to ESF students at Syracuse University. However, these courses may be limited only to those specifically required by a particular program.

Students who change majors are required to submit a completed change of curriculum form approved by representatives of both programs and must complete all the requirements of their new major.

### Dual Majors

Students who are pursuing undergraduate degrees may pursue dual majors. Program requirements must be satisfied concurrently (i.e., a student cannot graduate from ESF and return later to complete coursework for a second major). The diploma will state the completion of a single degree. The transcript will state the completion of two majors. Admission to a dual major will be accomplished by petition to the primary degree department or academic unit that has been endorsed (approved) by the secondary degree department.

#### Inter-department dual majors:

Students must satisfy requirements of both majors.

#### Intra-department dual majors:

- **SCME:** Construction Management and Wood Products Engineering allowed with each other;
- **PBE:** Bioprocess Engineering allowed with either Paper Engineering or Paper Science;
- **FNRM:** no dual majors between the three majors (FRM, NRM, and FES); forest technology and surveying technology degrees allowed for A.A.S. degrees;
- **EFB:** Only Biotechnology with other EFB majors **except environmental biology.**

Students may petition for admission to a dual major A.A.S. degree after completing 18 credits and before 45 credits with an unambiguous GPA of 2.000 or greater (no grades of incomplete or missing grades).

Students pursuing the B.S. degree may petition admission to a dual major after completing 30 credits and before completing 90 credits in the primary major with an unambiguous GPA of 2.000 or greater (no grades of incomplete or missing grades).

## Physical Education and ROTC

Physical Education and ROTC course credits may be used to satisfy elective requirements with the permission of the student's academic advisor.

## General Education

Resolution 98-241 (December 1998) of the State University Board of Trustees requires general education coursework for all University baccalaureate candidates in specific knowledge and skill areas and in two competencies. Each ESF undergraduate program meets or exceeds the general education requirements. These general education requirements are in effect for all students who began college courses during or after the fall semester 2000, exclusive of any courses taken while in high school. A complete listing of ESF and Syracuse University courses that meet the general education standards established by SUNY is available on the Internet

at [www.suny.edu/provost/generaleducation/courselist/coursefiles/ESFGERCourses.pdf](http://www.suny.edu/provost/generaleducation/courselist/coursefiles/ESFGERCourses.pdf)

## Credit-Hour Load

To be classified as full time, a student must register for at least 12 credit hours during a semester. A student may not register for more than 18 credits during a semester unless permission from the student's advisor is obtained.

## Audits

Students may audit ESF courses informally with the permission of the course instructor. No record will be maintained of the informal audit nor will any grade be assigned. No fee is required for informal audits.

Students may audit courses formally with the permission of their academic advisor and the course instructor. Formally audited courses may not be used to satisfy any graduation requirements. They will appear on a student's transcript and will be graded either SAU (satisfactory audit) or UAU (unsatisfactory audit). The grade will be assigned based on the criteria for audit established by the course instructor. Registration guidelines for audited courses are the same as for courses taken for credit.

## Evaluation

For each course completed, one of the following grades will be awarded:

Grade	Definition	Grade Points
A	Excellent	4.000
A-		3.700
B+		3.300
B	Good	3.000
B-		2.700
C+		2.300
C	Passing	2.000
C-		1.700
D	Minimum Passing	1.000
F	Failure	0.000
I/F	Unresolved Incomplete	0.000

In order to receive a bachelor's degree, a student must complete all courses taken as a matriculated student at ESF with a cumulative grade point average of at least 2.0.

Under conditions defined elsewhere, the following grades may be assigned, none of which yield grade points:

Grade	Definition
S	Satisfactory (equal to C or better)
U	Unsatisfactory (equal to below C)
W	Withdraw
WP	Withdraw Passing
WF	Withdraw Failing
SAU	Audit (Satisfactory)
UAU	Audit (Unsatisfactory)
I	Incomplete
R	Failed course which was repeated
NR	[Grade] Not Received

### **Grade Point Averages**

Semester and cumulative averages are computed by dividing the total grade points earned by the total credit hours completed for all courses graded A-F.

### **Academic Advising**

Each undergraduate student is assigned a faculty academic advisor in the student's major. The advisor assists the student in developing a program of study and approves course registration each semester. The advisor serves as a mentor and counselor and makes referrals to appropriate offices and resources as needed. The curriculum coordinator of each of the departments also assists the student by clarifying program and course requirements and providing additional advising and career-planning information.

### **Academic Honors**

#### **Dean's List**

Students who carried 12 or more credits of coursework graded on a scale of A-F, with no grades of I or F in that semester, with a minimum grade point average of 3.500 will be placed on the Dean's List for that semester. Any grade changes, resolution of grades, or repeated courses after Dean's List Honors are awarded do not qualify a student to be placed on the Dean's List retroactively. A commendation is sent by the Dean to the student.

#### **President's List**

Students who carried 12 or more credits of coursework graded on a scale of A-F with no grades of I or F in that semester, with a grade point average of 3.850 or better will be placed on the President's List for that semester. Any grade changes, resolution of grades, or repeated courses after President's List Honors are awarded do not qualify a student to be placed on the President's List retroactively. A commendation is sent by the President to the student.

Students who carried 12 or more credits of coursework graded on a scale of A-F with no grades of I or F in that semester, with a grade point average of 4.000 will receive an additional commendation from the President.

### **Graduation Requirements**

Students are responsible for meeting the following requirements for graduation:

- Matriculated status as an undergraduate student;
- All program requirements must be satisfied;

- A minimum cumulative grade point average of 2.000 (4.000=A) for all courses taken as a matriculated student at ESF;
- At least 24 of the last 30 credits must be registered for through ESF;
- Successful completion of a total of at least 120 appropriate college-level credits.

## Graduation Honors

Students will be graduated with the appropriate honor if the following criteria have been met:

- Students have completed a minimum of 30 credits of ESF and Syracuse University courses as a matriculated, upper-division student, and
- Students have earned a cumulative grade point average of 3.000-3.333 (*cum laude*); 3.334-3.829 (*magna cum laude*); or 3.830-4.000 (*summa cum laude*).

## Academic Performance

Students who earn less than a 2.000 cumulative grade point average are placed on academic probation and are subject to suspension from ESF. A student may be academically suspended only after having been placed on academic probation for at least one semester\*. Students will be suspended if they have been on academic probation for two successive semesters without achieving a 2.000 cumulative grade point average, or when their cumulative grade point average falls below the minimum values in the following index:

<b>Total Hours applied Toward Degree</b> (credit earned while matriculated at ESF, including SU courses)	<b>Minimum Cumulative Grade Point Average</b> (includes credit hours accepted for transfer to ESF degree program and courses taken while matriculated at ESF)
0-30	1.700
31-60	1.850
61-120 or more	2.000

Each student suspended will be given the opportunity to appeal this action based on any extraordinary conditions that may have contributed to the unsatisfactory performance. This appeal must be made in writing and submitted within the stated time limit in accordance with guidelines provided by the Office of Instruction and Graduate Studies. Every appeal will be reviewed by the Faculty Subcommittee on Academic Standards, which will recommend to the dean of Instruction and Graduate Studies either to accept the appeal or sustain the suspension. The dean of Instruction and Graduate Studies will inform the student in writing of the Subcommittee action. There is no appeal beyond this process.

Students who have been suspended for unsatisfactory academic performance may not enroll in any courses at ESF or Syracuse University until at least one semester has elapsed. If suspension occurs following the spring semester, suspended students may not enroll in a summer program at ESF or SU. Suspended students who wish to be reinstated must apply for readmission through the Office of Student Affairs.

Students suspended a second time for unsatisfactory academic performance without successful appeal will be dismissed from the College and may not normally be considered again for readmission. If, however, after a period of not less than 10 years has elapsed, a previously dismissed student should desire to return to ESF, he or she may then apply for readmission. Candidates for readmission under these unusual conditions will be considered on a limited, case-by-case basis, and may be required to provide substantial additional justification for readmission.

ESF students who receive Federal, State and/or ESF financial aid must be achieving Satisfactory Academic Progress toward their degree completion. The standards review a student's Grade Point Average as well as successful completion of credit hours attempted. These standards can be found in the Financial Aid section of the College catalog.

Students who fall below these standards will be reviewed by the Associate Provost for Instruction and the Financial Aid Director. Students who are in jeopardy of losing their financial aid due to poor academic performance will be notified by the College.

*\*Due to the unique accelerated nature of programs offered at The Ranger School in Wanakena, students matriculated in these programs are not subject to these policies and may be placed on probation or suspended at any time their Cum GPA falls below 2.000.*

## **Graduate Academic Policies**

### **General Requirements**

While a student is matriculated at ESF, all coursework taken at ESF and Syracuse University to meet degree requirements must be graded on a scale of A-F, and the grades will be computed in the grade point average. As an exception, at the discretion of the instructor, courses numbered 796 and 797 may be graded on a Satisfactory/Unsatisfactory basis. This must be announced on the first day of class and will apply to all students enrolled in that course section. Courses numbered 898, 899 and 999 are graded on a Satisfactory/Unsatisfactory basis.

### **Curriculum Requirements**

The development and administration of course offerings, prerequisites, sequencing and program requirements are primarily the responsibility of each program with the approval of the ESF faculty.

Students must satisfy the requirements for graduation presented in the catalog in effect as of the date they first matriculated at ESF. Students may graduate under the requirements stated in any catalog issued subsequent to the one in effect the date they matriculated, but they may not use a prior catalog.

### **Transfer Credit**

Credit hours appropriate to the graduate degree in which a minimum grade of B was earned from an accredited institution can be transferred to the College, but grades and grade points cannot be transferred.

Up to six credits of graduate coursework not used to complete another degree may be accepted toward completion of a master's or doctoral degree as approved by the steering committee.

Up to 30 credits of graduate level coursework earned as part of a conferred master's degree may be transferred (by petition) to a doctoral degree with approval of the steering committee.

Students may transfer no more than nine credits of credit-bearing non-degree ESF coursework to graduate degree programs.

All transfer credit will remain tentative until official, final transcripts are received. It is the student's responsibility to ensure that official, final transcripts are sent to and received by the College.

### **Credit-Hour Load**

To meet academic requirements, graduate students must be registered for at least one credit each semester, excluding summers, from the first semester of matriculation until all degree requirements have been completed. Failure to register for each semester will result in the student being withdrawn from graduate study and, if the student wishes to return in the future, a new application must be filed and reviewed prior to readmission. Students are required to register for at least one credit of thesis/dissertation research, professional experience, or independent study in the summer if they will complete all requirements during that time. Graduate students who hold an assistantship and/or a tuition scholarship must be in full-time status each semester while holding such an award.

Registration for nine credits usually equates to full-time status for a student holding an assistantship. Graduate students not holding an assistantship are considered full-time if they are registered for at least 12 credits each semester. To maintain valid F-1 or J-1 student status in compliance with SEVIS, international students are required to maintain the institutional equivalent of full-time enrollment status during all required academic semesters. Audited courses may not be used to satisfy full-time status. Undergraduate courses may not be used to satisfy full-time status requirements for federal and state financial aid (TAP) but may be applied toward full-time status requirements for SEVIS. Student loan deferrals may be maintained by achieving half-time status for graduate students, or approximately 6 credit hours, if full-time status is not required for other reasons.

Doctoral candidates (i.e., those who have successfully completed their doctoral candidacy examination), master's students (M.P.S., M.L.A., and M.F.) who have met all academic coursework requirements, and master of science (M.S.) students who have requested the appointment of a defense committee and intend to defend a thesis may be considered full time if registered for at least one credit of thesis/dissertation research, professional experience, or independent study and submit a "Request for Full-time Certification Form" to the Office of Instruction and Graduate Studies.

### **Part-Time Study**

During any semester, students who are enrolled in part-time graduate degree programs (M.F. or M.P.S.) may register for the equivalent of full-time study. Graduate students who are enrolled in part-time degree programs are held to the policy for continuous registration, but not to the policy for time to degree (delimitation).

### **Audits**

ESF Courses may be audited formally or informally, and informally with special audit status. Each is defined as follows:

- **Formal Course Audit:** A course may be audited formally by registering for a course using the standard course registration process. Formally audited courses do not carry course credit and may not be used to satisfy any graduation requirements. They will appear on a student's transcript and will be graded either SAU (satisfactory audit) or UAU (unsatisfactory audit). The grade will be assigned based on the criteria for audit established by the course instructor. Both matriculated and non-matriculated students may formally audit courses.
- **Informal Course Audit:** A course may be informally audited by gaining permission of the instructor. No record will be maintained of the informal audit nor will any grade be assigned. No fee is required for informal audits. Only matriculated ESF students may informally audit courses.
- **Special Informal Course Audit:** "Special audit status" is granted to all New York state citizens of age 60 and over. Courses may be audited informally with special audit status by requesting confirmation of available space from the Office of Outreach and Instructional Quality. A record of the number of special auditors participating in each course is kept, however, no individual transcript is maintained of special informal audits nor will any grade be assigned. No fee is required for informal special audits.

## Evaluation

For each course completed, one of the following grades will be awarded:

Grade	Definition	Grade Points
A	Excellent	4.000
A-		3.700
B+		3.300
B	Satisfactory	3.000
B-		2.700
C+		2.300
C		2.000
C-	Minimum Passing	1.700
F	Failure	0.000
I/F, I/U	Unresolved Incomplete	0.000

Under conditions defined elsewhere, the following grades may be assigned, none of which yield grade points:

Grade	Definition
W	Withdraw
WP	Withdraw Passing
WF	Withdraw Failing
S	Satisfactory (equal to B or better)
U	Unsatisfactory (equal to below B)
SAU	Audit (Satisfactory)
UAU	Audit (Unsatisfactory)
I	Incomplete
NR	[Grade] Not Received

## **Grade Point Average**

Semester and cumulative averages are based on graduate-level courses only and are computed by dividing the grade points earned by the credit hours completed in all courses graded A-F.

## **Time Limits**

Graduate students must complete all requirements for the master of forestry, master of professional studies, the master of landscape architecture, and the master of science degree within four years of the first date of matriculation or they may be withdrawn from graduate study. For the doctoral degree, students must complete the candidacy exam within three years of the first date of matriculation. Students must pass the doctoral candidacy examination covering selected fields of study at least one year prior to dissertation defense. Doctoral candidates must successfully defend the dissertation and complete all degree requirements within seven years of matriculation, or they will be required to retake the candidacy examination or be withdrawn from their program of graduate study.

## **Graduation Requirements**

Students are responsible for meeting the following requirements for graduation:

- Matriculated status as a graduate student;
- All requirements for the appropriate program and degree level must be satisfied, and
- A minimum cumulative grade point average of 3.000 (4.000 = A) for all courses taken as a matriculated student at ESF.

## **Academic Performance**

Students who earn less than a 3.000 cumulative grade point average for graduate-level courses, or who receive two or more grades of Unsatisfactory (U) for work on their thesis or dissertation shall have their records reviewed by the dean of Instruction and Graduate Studies. These students shall be either placed on academic probation or suspended from ESF. The action taken will be based on recommendations from the students' major professors, department chairs and other appropriate faculty and staff. The dean of Instruction and Graduate Studies will inform each student in writing of actions taken.

Each student suspended will be given the opportunity to appeal this action based on any extraordinary conditions which may have contributed to the unsatisfactory performance. This appeal must be made in writing and submitted to the Office of Instruction and Graduate Studies within the stated time limit. Each appeal will be reviewed by the Faculty Subcommittee on Academic Standards which will recommend to the dean of Instruction and Graduate Studies either to sustain the suspension or place the student on probation. The dean of Instruction and Graduate Studies will inform each student in writing of the Subcommittee action. There is no appeal beyond this process.

Students who have been suspended for unsatisfactory academic performance may not reapply until at least one semester has elapsed. Students may not take any courses at ESF or Syracuse University during this first semester following suspension. Suspended graduate students who wish to be readmitted must apply for readmission through the Office of Instruction and Graduate Studies.

Students suspended from a graduate degree program for a second time for unsatisfactory academic performance may not be considered for readmission.

# Admission Policies & Requirements

**NOTE:** The following information on admission to SUNY-ESF is limited to specific policies and requirements necessary for inclusion in a catalog of record. **For complete, current information on admission to ESF, visit our admission websites:**

- [Undergraduate Admission website](#) (includes Ranger School)
- [Graduate Admission website](#)
- [International Student Admission website](#) (undergraduate and graduate)

## Undergraduate Admission Policies & Requirements

- [www.esf.edu/admissions](http://www.esf.edu/admissions) (complete, current information for prospective students)

### Required Application Materials

All applicants for freshman or transfer entry are required to submit the online admissions application (choose either the SUNY Application or the Common Application), official documentation of high school graduation (or equivalent) and any college-level coursework (or equivalent) completed, even if it does not pertain to their intended program of study at ESF. Additional required credentials for each admission pathway are outlined below. Failure to submit this documentation by the stated deadlines may result in the withdrawal of the application or denial of admission.

### Early Decision Freshman Admission for High School Seniors

Outstanding high school seniors who select SUNY-ESF as their first-choice institution may apply for Early Decision admission and, if admitted, must commit to enroll at SUNY-ESF. Early Decision students may apply to other institutions under Regular consideration, and if admitted to SUNY-ESF, must withdraw their other applications and commit to enroll at SUNY-ESF no later than March 15. Early Decision candidates must have a completed application on file by December 1. This must include submission of either the SUNY Application or the Common Application, official high school transcripts, including 12th-year first-quarter grades, results of either the SAT I or ACT, supplemental application information, and ESF essay question response. Please refer to the next section, "Regular Freshman Admission for High School Seniors," for additional information on the freshman application process.

Early Decision applicants who wish to apply for Financial Aid from SUNY-ESF must have submitted the Free Application for Federal Student Aid (FAFSA) and any supporting information requested by the Office of Financial Aid and Scholarships by February 1. Please refer to the [Financial Aid website](#) of this catalog for more information on financial support.

Should a student who applies for financial aid not be offered an award that makes attendance possible, the student may decline the offer of admission and be released from the Early Decision commitment.

### Regular Freshman Admission for High School Seniors

High school seniors may apply for Regular Freshman admission. High school seniors who are not offered freshman entry may be offered Guaranteed Transfer. Please refer to the next section, "Guaranteed Transfer Option for High

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- **Undergraduate**
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  - [Deferred Admission](#)
- **Graduate**
- **International Students** (undergraduate & graduate)

School Seniors," which explains this process.

Freshman applicants should present strong academic credentials in a college preparatory high school curriculum. A minimum of three units each of college preparatory mathematics and science are required for all majors. For most programs of study completion of additional units of math and science, or design or art sequences for Landscape Architecture applicants, as well as advanced level coursework (honors or college level) indicates strong preparation for the academic rigor students will experience at ESF. An official high school transcript, including 12th-year first-quarter grades, must be submitted as part of the student's application credentials. Applicants are required to forward the results of either the SAT I or ACT examination. SAT II tests are not required, but in some cases they may highlight the special talents of an applicant. Freshman applicants are also required to submit supplemental application information, and ESF essay question response.

### **Guaranteed Transfer Option for High School Seniors**

Under this option, admitted students are guaranteed admission to ESF for either their sophomore or junior year provided they meet the conditions specified in the offer of Guaranteed Transfer. Guaranteed Transfer applicants may file the SUNY application or the Common Application as outlined in the section above and send an email to [esfinfo@esf.edu](mailto:esfinfo@esf.edu) indicating the entry semester for which they wish to be considered. Applicants must submit the same credentials as outlined under "Regular Freshman Admission for High School Seniors" (see preceding section). Successful applicants for this option must present a strong academic background including at least three years each of college preparatory mathematics and science. To satisfy the guarantee of admission, students must satisfactorily complete, with a minimum cumulative grade point average of 2.80 for bachelor's degree programs and 2.50 for associate degree programs (A=4.000), any of the lower-division requirements, which are part of their program of study. Only coursework with grades of C or higher will transfer to meet ESF degree requirements.

### **Regular Transfer Admission for College Students**

Transfer students' admissibility is based on how much of their previous college-level coursework applies to the requirements of their intended major at ESF, overall academic performance at their previous colleges and specific interest in ESF programs. For most programs, a significant emphasis is placed on students' backgrounds in mathematics and science.

Transfer applicants must submit official transcripts and examination scores from all college-level coursework completed, an official high school transcript or equivalent, supplemental application information, and essay question response. Students who have completed less than 30 semester hours of college-level coursework are required to submit copies of their high school transcript and SAT I or ACT test scores as part of the admissions process.

Students who apply as transfers to ESF are expected to have successfully completed some portion of the established required sequence of courses appropriate to their intended major at the College. Applicants to Landscape Architecture should have some background in art or graphic design, and they are required to submit a portfolio for studio placement ([information on portfolio preparation](#)). Students attending one of our pre-ESF cooperative transfer colleges will find information on course equivalencies for all of our programs of study on our web page.

Transfer students applying for bachelor degree programs at the Syracuse campus should have a 2.80 (A=4.00) or higher cumulative grade point average at the last institution they attended in full-time status. Those applying for associate degree programs at The Ranger School campus should have a 2.50 or higher cumulative grade point average at the last institution they attended in full-time status. Applicants with cumulative grade point averages below these thresholds will be considered on a case-by-case basis. In some cases, transfer applicants may be updated for consideration for a future entry date, for one or two semesters beyond their original entry date, to allow them the opportunity to complete additional core degree requirements and/or improve academic performance. Students with cumulative grade point averages less than 2.00 will not be considered for transfer admission to SUNY-ESF. Only

coursework with grades of C or higher will transfer to meet ESF degree requirements.

### **Transfer Credit**

Coursework appropriate to the ESF curriculum can be transferred to the College, but grades and grade points cannot be transferred. Courses to be transferred to meet graduation requirements for any curriculum must be acceptable in content, and credit will be awarded only for those completed with a grade of C or higher (a C- is not acceptable).

All transfer credit will remain tentative until official, final transcripts are received. It is the student's responsibility to ensure that official, final transcripts are sent to and received by the College.

Only coursework completed at institutions that are fully accredited by one of six regional accrediting agencies will be considered for possible transfer credit toward ESF degree requirements. These agencies are the Middle States Association of Colleges and Schools, New England Association of Schools and Colleges, North Central Association of Colleges and Schools, Northwest Association of Schools and Colleges, Southern Association of Colleges and Schools, and Western Association of Schools and Colleges.

### **Policy for Students Transferring from Syracuse University to SUNY-ESF**

With the approval of the home institution and subject to availability, SUNY-ESF students may take Syracuse University courses, and SU students may take SUNY-ESF courses.

For Syracuse University transfer students, Syracuse University is the college of record. SUNY-ESF does not maintain a transcript record of ESF courses taken by Syracuse University students. A student previously matriculated at Syracuse University, who is subsequently admitted to SUNY-ESF, except graduate students admitted to concurrent master's degree programs between the universities, will have all coursework taken while a Syracuse University student, including SUNY-ESF courses, treated and evaluated as transfer credit from Syracuse University. Such Syracuse University courses will not appear or calculate on the SUNY-ESF transcript, except as they are included in a block of transfer credits, i.e., total credit hours, accepted from Syracuse University. However, such Syracuse University courses do not count toward the SUNY-ESF residency requirement. Departments at their discretion include such courses in manual calculations, e.g., for determination of subsequent intra-university transfer eligibility.

Syracuse University courses taken by matriculated ESF students appear on the SUNY-ESF transcript and calculate in the same way as ESF courses, except for graduate students admitted to concurrent master's degree programs between the institutions. Syracuse University courses do not count toward the SUNY-ESF undergraduate residency requirement.

The ESF transfer credit policy requiring a minimum grade of C will be waived for Syracuse University students only and any coursework taken at Syracuse University with a passing grade will be treated as if it was taken at SUNY-ESF.

## Advanced Placement

The College will consider for advanced standing credit the results of examinations from standardized testing agencies such as the College Entrance Examination Board's Advanced Placement Program (AP) or the College Level Examination Programs (CLEP) as well as the Higher Level Exams of the International Baccalaureate (IB) program.

AP Course Score Requirements	
Course	Score
Art History	3 or higher
Biology	4 or higher
Chemistry	4 or higher
Chinese	3 or higher
Computer Science A	3 or higher
Computer Science AB	3 or higher
English: Language & Composition	3 or higher
English: Literature & Composition	3 or higher
Environmental Science	3 or higher
European History	3 or higher
United States History	3 or higher
Economics: Microeconomics	3 or higher
Economics: Macroeconomics	3 or higher
French Language	3 or higher
French Literature	3 or higher
German Language	3 or higher
Human Geography	3 or higher
Italian	3 or higher
Japanese	3 or higher

IB Requirements	
Course	Score
Arabic Language B (HL)	5 or higher
Biology (HL)	5 or higher
Business Management (HL)	5 or higher
Business Organization (HL)	5 or higher
Chemistry (HL)	5 or higher
Chinese A-1 (HL)	5 or higher
Classical Languages (HL)	5 or higher
Computer Science (HL)	5 or higher
Design Technology (HL)	5 or higher
Economics (HL)	5 or higher
English A1 (HL)	5 or higher
English A2 (HL)	5 or higher
Film (HL)	5 or higher
Geography (HL)	5 or higher
French A2 (HL)	5 or higher
French B (HL)	5 or higher
History (HL) – Africa	5 or higher
History (HL) – Americas	5 or higher
History (HL) – East and South Asia	5 or higher

CLEP Requirements	
Course	Score
<b>COMPOSITION AND LITERATURE</b>	
American Literature	50
Analyzing and Interpreting Literature	50
College Composition	50
College Composition with Modular	50
Freshman College Composition	50
English Composition with or without Essay	50
English Literature	50
Humanities	50
<b>FOREIGN LANGUAGES</b>	
French - Level 1	50
French - Level 2	59
German - Level 1	50
German - Level 2	60
Spanish - Level 1	50
Spanish - Level 2	63
<b>HISTORY AND SOCIAL SCIENCES</b>	
American Government	50
Introduction to Educational Psychology	50
History of the United States I: Early Colonization to 1877	50
History of the United States II: 1865 to the Present	50
Human Growth and Development	50
Principles of Macroeconomics	50
Principles of Microeconomics	50
Introductory Psychology	50
Social Sciences and History	50
Introductory Sociology	50

Latin	3 or higher
Latin: Literature	3 or higher
Mathematics: Calculus AB	4 or higher
Mathematics: Calculus BC	4 or higher
Music Theory	3 or higher
Physics B	4 or higher
Physics 1 (effective fall 2014)	4 or higher
Physics 2 (effective fall 2014)	4 or higher
Physics C (Mechanics)	4 or higher
Physics C (Electricity & Magnetism)	4 or higher
Psychology	3 or higher
Spanish Language	3 or higher
Spanish Literature	3 or higher
Statistics	3 or higher
Government & Politics: United States	3 or higher
Government & Politics: Comparative	3 or higher
Art 2D design	3 or higher
Art 3D design	3 or higher
Art Drawing	3 or higher
World History	3 or higher

History (HL) – Europe	5 or higher
History (HL) – South Asia and the Middle East	5 or higher
Islamic History (HL)	5 or higher
Information Technology (HL)	5 or higher
Japanese B (HL)	5 or higher
Korean (HL)	5 or higher
Mongolian A1	5 or higher
Music (HL)	5 or higher
Philippino Language (HL)	5 or higher
Philosophy (HL)	5 or higher
Physics (HL)	5 or higher
Psychology (HL)	5 or higher
Social and Cultural Anthropology (HL)	5 or higher
Spanish Language A2 (HL)	5 or higher
Spanish Language B (HL)	5 or higher
Theater Arts (HL)	5 or higher
Visual Arts (HL)	5 or higher

Western Civilization I: Ancient Near East to 1648	50
Western Civilization II: 1648 to the Present	50
<b>SCIENCE AND MATHEMATICS</b>	
College Algebra	50
College Algebra – Trigonometry	50
Calculus	50
Natural Sciences	50
Trigonometry	50
Pre-calculus	50
<b>BUSINESS</b>	
Principles of Accounting	50
Introductory Business Law	50
Financial Accounting	50
Information Systems and Computer Applications	50
Principles of Management	50
Principles of Marketing	50

## Ranger School Admission

The SUNY-ESF Ranger School does not enroll freshmen. Students complete their freshman year requirements at ESF's Syracuse campus or at the college of their choice. They complete the sophomore year of their A.A.S. program in residence at The Ranger School campus. Candidates may apply for acceptance into these programs under the guaranteed transfer option or as a regular transfer admission student.

High school students who wish to enroll in these programs should apply during their senior year to receive a guaranteed entry date one year later. A limited number of freshman applicants will be offered admission to the Syracuse campus for the first year of the A.A.S. program, if desired, and eventual completion of the bachelor degree, usually in a program of study in the Department of Forest and Natural Resources Management. Transfer students apply for sophomore year entry during the academic year prior to their intended fall semester entry at The Ranger School (spring admission is not available). For further information on The Ranger School, visit the website or refer to The Ranger School section of this catalog.

### **Educational Opportunity Program**

Offered only to full-time students who are New York state residents, freshmen and transfer students who qualify, both academically and economically, may be eligible for the EOP program. Students cannot apply for both EOP and Early Decision programs.

High school seniors who wish to apply for freshman enrollment and EOP status at the College must file a SUNY application or The Common Application and indicate they want to be considered for EOP. In addition, they must submit a copy of the Free Application for Federal Student Aid (FAFSA), indicating ESF as a receiving institution.

In order for transfer students to participate in the program at the College, they must have been enrolled in or qualified for EOP, Higher Education Opportunity Program (HEOP), Search for Education Elevation and Knowledge (SEEK) or similar program at their prior college. Therefore, students who are applying to ESF as high school seniors through the Guaranteed Transfer option should also apply for EOP, HEOP or SEEK at their lower-division college, and must enroll in or be qualified for such a program in order to continue in EOP at ESF.

All EOP applicants must file applications for undergraduate admission and financial aid as described in those two sections of this catalog.

### **Deferred Admission**

Students accepted to ESF who wish to defer their enrollment for one or two semesters beyond their original entry date must make this request in writing directly to the Office of Undergraduate Admissions. Students will receive written notification if their request has been approved.

## **Graduate Admission Policies & Requirements**

- [www.esf.edu/graduate/admission.htm](http://www.esf.edu/graduate/admission.htm) (complete, current information for prospective students)

Admission to graduate studies is conditional upon review and acceptance of an applicant's credentials by appropriate faculty members and upon the recommendation of the appropriate department chairman or program director to the Associate Provost for Instruction and Dean of the Graduate School.

INSTITUTION CODE FOR OFFICIAL SCORE REPORTS: 2530

## **Application Requirements**

- Transcripts of an earned bachelor's degree from a recognized institution with an academic record showing at least a "B" average for junior and senior years of the baccalaureate program or for the master's program;
- The graduate application;
- A nonrefundable \$60(US) application fee;
- Scores from the Graduate Record Examination (GRE) and for some degree programs, advanced test scores;
- Three letters of recommendation from individuals who can attest to your academic or professional skills. This should NOT include personal friends and family;

- A resume; and
- A statement of educational and professional goals.

Students whose primary language is not English are also required to provide evidence of English language proficiency.

## Applying for Admission

Faculty seek graduate students who are well prepared for rigorous study, responsive and receptive to constructive feedback, and a good fit with their programs. The most effective way for applicants to demonstrate these qualities is to communicate with faculty prior to applying and to understand the programs ESF has to offer. Therefore, individuals who are interested in applying for graduate study should contact ESF faculty to discuss degree programs and learn about specific opportunities for study and research at ESF. Faculty Web pages provide contact information and additional insights about ESF degree programs. We also encourage applicants to visit campus and meet with faculty and current graduate students.

Semester of Matriculation	Application Deadline *
Fall	January 15
Spring	November 1

\*Applications completed by these deadlines by these dates will normally receive decisions by mid-March for fall matriculation and by early December for spring matriculation.

## Application Deadlines

While the following dates are particularly important for applicants wishing to be considered for fellowships, assistantships, and other forms of financial assistance, ESF will continue to accept and fully consider graduate applications beyond each of the noted deadlines:

## Graduate Record Exam Subject Tests

Subject tests are recommended by the following programs:

Graduate Program	Subject Test
Environmental and forest chemistry	Chemistry - recommended
Biochemistry area of study within environmental and forest chemistry	Chemistry or Biology - recommended
Environmental and forest biology	Biology - recommended

## Transfer Credit

Credit hours appropriate to the graduate degree in which a minimum grade of B was earned from an accredited institution can be transferred to the College, but grades and grade points cannot be transferred.

Up to six credits of graduate coursework **not used to complete another degree** may be accepted toward completion of a master's or doctoral degree as approved by the steering committee.

Up to 30 credits of graduate level coursework **earned as part of a conferred master's degree** may be transferred

(by petition) to a doctoral degree with approval of the steering committee.

Students may transfer no more than nine credits of credit-bearing **non-degree ESF** coursework to graduate degree programs.

All transfer credit will remain tentative until official, final transcripts are received. It is the student's responsibility to ensure that official, final transcripts are sent to and received by the College.

## Part-time Study

Part-time study at the graduate level provides an excellent opportunity for working professionals to extend their educational credentials or broaden their general knowledge by enrolling for courses on a part-time basis. The M.P.S. or M.F. professional degrees are available for students who are initially matriculated on a part-time basis. Part-time students apply, matriculate and register through the same processes that all ESF graduate students complete. During any semester, students who enroll in part-time programs may register for the equivalent of full-time study, which is at least 12 credit hours. Part-time students are held to the policy for continuous registration, but not to the policy for time to degree (delimitation).

## Deferred Admission

Students accepted to graduate programs at ESF who wish to defer their enrollment beyond their original entry date must make this request in writing directly to the Office of Instruction and Graduate Studies.

## Faculty as Students

Employees of the College who carry faculty status in accordance with SUNY-ESF Faculty Bylaws and are at or above the rank of assistant professor or equivalent, may not enter into matriculated status at the College.

## International Student Admission Policies & Requirements

- [www.esf.edu/international/admissions.htm](http://www.esf.edu/international/admissions.htm) (complete, current information for prospective international students)

### Requirements for International Applicants

In addition to the admission requirements that all prospective students must meet, international applicants must provide the following:

1. **Evidence of proficiency in the English language** that meet one of the following standards established by the faculty of SUNY-ESF:

Standard	Undergraduate Admission Score (Minimum)	Graduate Admission Score (Minimum)
TOEFL (paper-based)	550	550
TOEFL (computer-based) Scores accepted until October 2008	213	213
TOEFL (internet-based) As of September 2007	79	80 (with no individual component score < 17)
IELTS	Total: 6 (with no less than 5 in Writing)	Total: 6 (with no less than 5 in Writing)

STEP EIKEN	Grade pre-1	(University level) Grade 1
Syracuse University - English Language Institute (ELI)	Successful completion of ELI "Level 4"	Successful completion of ELI "Level 4"
ELS	Successful completion of Level 112	Successful completion of Level 112
Previous college-level instruction in English	Completion of at least one three-credit English course at an institution where the language of instruction is in English. ESL courses will not count toward meeting this requirement.	<ul style="list-style-type: none"> <li>◦ Completion of at least two years of college (academic studies, not English language instruction) at an institution where the courses were taught in English.</li> <li>◦ Successful completion of at least one semester at SUNY-ESF</li> </ul>

2. **Transcripts and international academic credentials**—International applicants must provide complete translations into English of all transcripts required by the admissions application without any additions or deletions by the translators. Translations of documents by the applicant will not be accepted. Credential evaluator and translation services for academic documents may be found through the [National Association of Credential Evaluation Services \(NACES\)](#).
  - **International freshman applicants** are required to demonstrate the completion of a college preparatory secondary school program by submitting academic credentials translated into English. This evaluation must be completed by an approved international credentials evaluation agency.
  - **International transfer applicants** are required to submit a detailed course-by-course evaluation of all international academic credentials in English. This evaluation must be completed by an approved international credentials evaluation agency.
3. **Submission of the [SUNY International Student Applicant Forms](#)**. No fee is required for processing these forms.
4. **Copy of the passport** should be submitted with application materials.

### International Students Currently Attending an Educational Institution in the U.S.

In addition to the entrance requirements for other international students, international students who are currently enrolled at a U.S. educational institution must obtain permission (usually through a Transfer-In Form) from their current educational institution to transfer their SEVIS record to ESF. Students will also have to complete a [SUNY-ESF SEVIS Transfer-In Form](#) (F-1 Students / J-1) so that ESF is aware of when your current institution will release your SEVIS record to ESF so that a new I-20 or DS-2019 can be issued for the ESF program of study. Additional information about transferring your SEVIS record to ESF is available [online](#).

### I-20 Issuance for International Students

An I-20, required for the F-1 student [visa application](#), will be issued once a student has:

1. **Been officially admitted to ESF;**
2. **Submitted adequate financial support documentation for at least one year of [expenses at ESF](#);**  
In order to obtain an I-20 from ESF, a potential F-1 student must complete the "[FSA-4 - Financial Statement](#)" and submit credible documentary evidence that they have enough readily available funds to meet all [expenses](#) (tuition, fees, and living expenses) for the entire first year of study. (It is expected that barring unforeseen circumstances, students will have adequate funds available for each subsequent year of study from the same source or from one or more other specifically identified and reliable financial sources.)

Documentation of sufficient funding may come from any combination of dependable sources, including scholarships, assistantships, fellowships, sponsoring agencies, personal funds, or funds from a student's family. Documentation of scholarships, assistantships, and fellowships must be in the form of an official award letter from the school or sponsoring agency; documentation of personal or family funds should be on an official signed letter of support from the bank that includes the U.S. dollar amount of support and certified bank statements which indicate that the sponsor has sufficient funds to meet a student's first-year expenses at ESF (the bank statement does not have to show the full amount of the account), or in the form of a legally binding affidavit. The [Form I-134](#), "Affidavit of Support," can be used to document support being provided by a U.S. citizen or U.S. legal

permanent resident. Government-sponsored applicants should submit a certified copy of the award letter that includes the U.S. dollar amount of the award per year, the duration of the award and a list of expenses covered by the award.

3. **Submitted the "Commitment to Enroll Form"** (included in the acceptance materials) **indicating that you will attend ESF in the upcoming semester;**
4. **Submitted the New Graduate or Undergraduate International Student Information Form received with your ESF acceptance letter.**
5. **Submitted a passport copy.**

Once all of the above materials have been received, an I-20 will be issued and mailed to the prospective international student by the Office of International Education.

### **Health Insurance Requirement**

ESF students who are not U.S. citizens or permanent residents are required by SUNY policies to maintain [comprehensive health insurance with medical evacuation and repatriation coverage](#) for themselves (and their dependents in the United States) for the duration of their ESF program of study. International students are automatically enrolled in the SUNY Health Insurance Plan unless proof of comparable health insurance is provided to the Bursar's Office within 30 days of the start of each semester.

# Student Financial Information

**NOTE:** All information regarding college expenses and financial aid is subject to change without notice by official action.

## College Expenses

- [www.esf.edu/bursar](http://www.esf.edu/bursar)

The ESF tuition and college fee structure is set by the State University of New York Board of Trustees and generally covers the costs associated with instruction and the use of facilities and services at the College.

## Tuition Schedule

- [www.esf.edu/bursar/costs.htm](http://www.esf.edu/bursar/costs.htm)

## Residency

For purposes of tuition, “residence” refers to the principal or permanent home to which the student returns. Students who believe they qualify as New York residents may apply for a change in residency after they are accepted by ESF. Application forms are available in the Office of Business Affairs in 102 Bray Hall.

## Tuition Schedule as of the beginning of the 2016-17 Academic Year

**NOTE:** Tuition is **subject to change** at any time by official action.

## Page Contents

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  - [Tuition Schedule](#)
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Status	New York State Resident Students	Out-of-State Students
Undergraduate Full-time	\$3,235 per semester (maximum total tuition for 12 credit hours or more)	\$8,160 per semester (maximum total tuition for 12 credit hours or more)
Undergraduate Part-time	\$270/credit hour	\$680/credit hour
Graduate Full-time	\$5,435 per semester (maximum total tuition for 12 credit hours or more)	\$11,105 per semester (maximum total tuition for 12 credit hours or more)
Graduate Part-time	\$453 per credit hour	\$925 per credit hour

## Additional Expenses

### Fees and Other Expenses

- [www.esf.edu/bursar/costs.htm](http://www.esf.edu/bursar/costs.htm)

Several mandatory, optional and/or program-specific fees add to the cost of attendance. In addition to the costs of books and supplies, there may be expenses associated with a specific degree program, including summer field experience costs, study abroad expenses, Syracuse University course or lab fees, etc. Personal expenses include clothing, transportation, recreation, etc. Details are found on the bursar website:

### Housing and Meal Plans

- [www.esf.edu/housing](http://www.esf.edu/housing)
- [www.esf.edu/mealplans](http://www.esf.edu/mealplans)

Most entering freshmen are required to live in college housing and sign on to a meal plan (offered by Syracuse University). Students are not required to live on campus after their freshman year. Entering transfer students and continuing ESF students may choose to live on campus or off campus, with housing and meal costs charged accordingly. Visit the ESF housing website for details.

### Ranger School Expenses

- [www.esf.edu/rangerschool/admission.htm](http://www.esf.edu/rangerschool/admission.htm)

Please see the Ranger School site for detailed expenses for The Ranger School at the Wanakena campus.

### Terms of Payment

- [www.esf.edu/bursar](http://www.esf.edu/bursar)

New undergraduate students pay an advance payment deposit and must pay ensuing bills according to a payment schedule set by the college. Information on the deposit, payment schedule, late fees, refunds and all other topics related to student financial obligation are available on the Bursar's website.

## Financial Aid

- [www.esf.edu/financialaid](http://www.esf.edu/financialaid)
- [www.esf.edu/consumer](http://www.esf.edu/consumer) (student consumer information, including student financial assistance resources)

The College offers these basic forms of student financial assistance: scholarships or grants; part-time employment; educational loans; diversity student scholarships and fellowships; assistantships, tuition scholarships, and fellowships for graduate students; a deferred tuition payment plan; and sources of non-need loans to students and parents.

Federal and state financial aid programs are for United States citizens, permanent residents or holders of I-151 cards. International students will be considered for academic merit-based scholarships, assistantships and fellowships, but are not eligible for need-based student financial assistance. Aid programs are coordinated to supplement parental support, summer work, savings, and assistance from other sources. The sources of funds for financial assistance programs, the guidelines for determining the recipients, the procedures for applying, and the method of disbursement of funds vary from one program to another. This information is presented in detail in the *ESF Financial Aid and Scholarships Guide*, which is a separate publication that is mailed to all applicants and is available through the Office of Financial Aid and Scholarships.

Financial aid is awarded primarily on the basis of financial need. Some scholarships and fellowships, however, are based on other criteria, such as academic achievement or minority status. Assistantships, tuition scholarships and fellowships for graduate students are awarded based upon academic achievement.

In order for students to receive aid, they must be making satisfactory academic progress toward a degree. Please refer to the appropriate sections under New York State Awards and Federal Awards later in this chapter for satisfactory academic progress requirements.

In addition, students are only eligible to receive most types of aid for courses that are required for degree completion. Students enrolled in credits beyond the number required for the degree or enrolled in courses that are not applicable to a degree requirement will have financial aid adjusted accordingly.

Financial aid advisors are aware of the many problems associated with financing higher education and meeting living expenses for both undergraduate and graduate students and are available to discuss individual problems. All students are encouraged to apply for financial aid.

## Applying For and Receiving Aid

- [www.esf.edu/financialaid](http://www.esf.edu/financialaid)

### How to Apply

- [www.esf.edu/financialaid/apply.htm](http://www.esf.edu/financialaid/apply.htm)

Students interested in receiving financial assistance, with the exception of graduate assistantships, tuition scholarships, and fellowships, must complete the [Free Application for Federal Student Aid \(FAFSA\)](#). The FAFSA should be completed as soon as possible after October 1, **prior** to the academic year of attendance at ESF. The application must be submitted, processed and **received by ESF** by February 1. FAFSA data will be accepted after February 1, but available funds may already be committed to other students. Prospective students do not need to receive notification of acceptance to ESF before applying for financial aid, however, they must be accepted to the College before a financial aid package can be created.

Students interested in receiving financial assistance for the summer must complete the separate SUNY ESF Summer Aid Application.

Paper versions of the FAFSA are available for download in PDF format at <http://studentaid.ed.gov/resources> or in the SUNY-ESF Office of Financial Aid, high school guidance offices, and other college financial aid offices. Students are highly encouraged to consider using the on-line version of the FAFSA, available at [www.fafsa.gov](http://www.fafsa.gov). **Students and parents** should also apply for a Federal Student Aid ID, which enables the use of electronic signatures and provides access to on-line financial aid records. FSA IDs can be requested at any of the Federal Student Aid websites.

Application procedures and eligibility status can frequently change. Applicants are encouraged to contact the Financial Aid Office for the latest information and requirements.

## New York State Tuition Assistance Program (TAP)

- [www.esf.edu/financialaid/stategrant.htm](http://www.esf.edu/financialaid/stategrant.htm)

A separate application is required for students interested in TAP. Students who are New York State residents and list a New York State school while completing the FAFSA will be given the opportunity to complete an online Express Tap Application (ETA). In order to start the application, simply click on the TAP link which appears on the FAFSA Confirmation Page. The online application may also be accessed at <https://www.tapweb.org/totw>. New York State residents using the paper FAFSA and indicating a New York State school may complete the online TAP application

using the previous link or complete the ETA which will be mailed automatically following the processing of the FAFSA. TAP eligibility is determined by the New York State [Higher Education Services Corporation](#) (HESC).

## Graduate Student Assistantships

- [www.esf.edu/graduate/awards.htm](http://www.esf.edu/graduate/awards.htm)

The Financial Aid Office does not award assistantships or tuition scholarships for graduate students. Students interested in these forms of financial assistance should contact the [Office of Instruction and Graduate Studies](#).

## Verification of Information

- [www.esf.edu/financialaid/verification.htm](http://www.esf.edu/financialaid/verification.htm)

All students who request financial assistance may be required to submit information about their and/or their family's personal financial situation prior to aid disbursement. The College may request copies of parents' and/or students' federal tax transcripts, along with other statements which will be used to verify other sources of income, family size, number of dependents in college, and other pertinent information.

Requests for verification information are authorized by the FAFSA signature process. **Failure to comply with a request to verify pertinent information will result in the cancellation of any aid offered, and the possibility of legal action being taken by the U.S. Department of Education.**

## Satisfactory Academic Progress

- [www.esf.edu/financialaid/sap.htm](http://www.esf.edu/financialaid/sap.htm)

In order for students to receive federal, state, and institutional aid, they must be making "satisfactory academic progress" toward a degree. The rules for satisfactory academic process depend upon the type of aid involved:

## ESF College Aid

- [www.esf.edu/financialaid/sap.htm](http://www.esf.edu/financialaid/sap.htm)

Full-time undergraduate students receiving any of the following ESF awards are eligible to have their awards renewed in future years if they maintain an overall Grade Point Average (GPA) as indicated:

- ESF Transfer Scholarship - 2.50 GPA
- ESF College Aid Grant - 2.50 GPA
- ESF Foundation Renewal Grant - 2.50 GPA
- ESF Presidential Scholarship - 3.00 GPA
- ESF in the High School Scholarship - 3.00 GPA
- ESF National Scholarship - 3.00 GPA
- ESF Phi Theta Kappa Scholarship - 3.00 GPA
- ESF Centennial Hall Scholarship - 2.50 GPA (student must also reside in Centennial Hall to remain eligible for this scholarship)
- ESF OCC/ECC Transfer Scholarship - 3.00 GPA
- ESF Legacy Scholarship - 2.50 GPA

## Federal Student Aid

- [www.esf.edu/financialaid/sap.htm](http://www.esf.edu/financialaid/sap.htm)

Undergraduate and graduate students must meet specified criteria in order to be eligible for Title IV Federal Student Assistance, which includes Federal Pell Grants, Federal Supplemental Educational Opportunity Grants, Federal

Student Loans, the Federal College Work-Study Program, and the Federal Parent Loan for Undergraduate Students.

The criteria that students must meet to be eligible for Title IV student aid are the same criteria all ESF students must adhere to in terms of institutional academic policies and, specifically, academic progress requirements.

The evaluation criteria are the following:

- an appropriate grade point average to ensure satisfactory academic progress;
- the successful accumulation of credits toward a degree;
- receipt of a degree within the prescribed time limit for that program. (Limits vary for individual programs; see below for standard).

Students receiving federal student aid funds must make steady academic progress toward their degrees. While most students pursue their degrees on a full-time basis, others do not. In order to allow for maximum flexibility to complete a degree, federal regulations state that students' maximum time to be eligible for federal aid shall not exceed 150 percent of the published length of time it takes to complete that degree on a full-time basis.

Additionally, federal student aid (Title IV) eligibility is related to the successful completion of credit hours earned versus attempted. This component of eligibility is referred to as Pursuit of Program. Pursuit of Program is defined as: The number of credit hours attempted divided by the number of credit hours earned. This equation is tied back into the overall credits needed to be earned to graduate for any of our degrees. Generally, the number of credits a student must earn each semester and year to remain fully eligible is 67 percent (.67).

This measurement is reviewed each semester and again at the end of each academic year. Students receiving federal student aid from Title IV programs must be making progress towards their degree at a rate of .67 earned out of hours attempted. An example is:

Fall Semester Credits Attempted = 15  
Fall Semester Credits Earned = 12  
Pursuit of Program = 12 divided by 15 = .80

The earned credits exceed .67 and the student is eligible for continuing to receive Title IV aid by successfully meeting the Pursuit of Program component.

An example of an unsuccessful attempt is:

Fall Semester Credits Attempted = 15  
Fall Semester Credits Earned = 6  
Pursuit of Program = 6 divided by 15 = .40

The credits earned fall below the standard of .67 and therefore the student does not meet the Pursuit of Program standard and will be reviewed by the Financial Aid office and Academic Standards Committee to determine if the student can be placed on probation or given a warning in order to continue to receive Title IV aid.

In severe cases the student may indeed lose eligibility for all Title IV aid.

### **Title IV Aid : Warning – Probation – Suspension and Appeals**

Students receiving Federal Title IV aid will be reviewed by the College as stated above in order to comply with our responsibility with the regulations. This review will monitor progress towards a student's degree as well as their overall grade point average. As a result of this semester or annual review, the student may receive a warning that indicates they are in danger of not making progress. Some students may be placed on probation yet allowed to receive aid. Students in this category will receive a suggested academic path to ensure their continued progress toward the degree. Students will remain eligible as long as they stay on target with the recommendation provided.

Some students may have their eligibility for Title IV aid revoked. If that occurs, the student can appeal that decision.

Students who make an appeal of their loss of Title IV aid must contact the director of Financial Aid in written form. The appeal must contain information regarding:

- Why the student failed to make progress toward the degree
- What has changed for the student that will allow the student to make progress
- What corrective action the student has taken to ensure successful completion toward the degree?

The following chart lists the maximum number of credit hours a student may take and still receive federal student aid. These figures are based on 150 percent of the credit hours required to complete each of the degrees offered by the College—regardless of the time it takes to complete that degree.

### Standard of Satisfactory Academic Progress for Purpose of Determining Eligibility for Federal Aid

<b>Degree</b>	<b>Credit Hours Required</b>	<b>Maximum Hours Allowed</b>
<b>Associate in Applied Science</b>		
Environmental and Natural Resources Conservation	64	96
Forest Technology	64	96
Land Surveying Technology	64	96
<b>Bachelor of Science</b>		
Aquatic and Fisheries Science	126	189
Bioprocess Engineering	128	192
Biotechnology	123	184
Chemistry	121	181
Conservation Biology	126	189
Construction Management	124	186
Environmental Biology	126	189
Environmental Education and Interpretation	126	189
Environmental Health	126	189
Environmental Resources Engineering	128	192
Environmental Science	126	189
Environmental Studies	121-124	186
Forest Ecosystems Science	124	186
Forest Health	126	189
Forest Resources Management	125	187
Natural Resources Management	122	183
Paper Engineering	128	192
Paper Science	124	186
Sustainable Energy Management	120	180
Wildlife Science	126	189
<b>Bachelor of Landscape Architecture</b>		
	150	225
<b>Bachelor of Landscape Architecture (Effective Fall 2016)</b>		
	141	211
<b>Bachelor of Landscape Architecture/Master of Science</b>		
	141/30	211/225

<b>Master of Forestry</b>	37	55
<b>Master of Landscape Architecture</b>	70	105
<b>Master of Professional Studies (unless otherwise noted)</b>	30	45
Applied Ecology	36	54
Chemistry	33	49
Environmental and Forest Biology	42	63
Plant Biotechnology	36	54
<b>Master of Science (unless otherwise noted)</b>	30	45
Environmental Studies	37	55
<b>Doctor of Philosophy</b>	60	90

### **Appeal, Probation, Reinstatement**

Students who fall below the minimum standards may appeal to the Associate Provost for Instruction and Dean of the Graduate School to retain their academic eligibility to receive Title IV Federal Student Assistance.

Appeals will be evaluated for mitigating circumstances such as injury or illness, and the likelihood that the student will be able to return to the appropriate standard. If the Associate Provost for Instruction and Dean of the Graduate School places a student on “academic probation,” the student remains eligible for Title IV aid as defined by the Statement of Good Academic Standing.

### **Title IV Aid : Degree Applicable Courses and Repeated Courses**

**Degree Applicable Courses :** Students may only receive federal aid for courses which are required for degree completion. Students enrolled in credits beyond the number required for the degree or enrolled in courses that are not applicable to a degree requirement will have financial aid adjusted accordingly. Students with remaining degree requirements less than 12 credits (typical full-time enrollment) may wish to contact the Registrar's Office to evaluate previously approved transfer or advanced placement credits.

**Repeated Courses :** Students may repeat a previously passed course one time and still receive aid. Students may receive aid for previously failed courses that are repeated more than once. All repeated courses count as attempted credits for the purposes of measuring Satisfactory Academic Progress.

### **New York State Aid**

- [www.esf.edu/financialaid/sap.htm](http://www.esf.edu/financialaid/sap.htm)

All students who are awarded financial assistance will be required to maintain satisfactory academic progress each semester in order to keep their awards. Academic progress standards for all awards provided by New York are listed below. Recipients of a New York state award must adhere to the following state requirements:

- **Academic Progress:** Students must meet the minimum standards listed in the following charts to be eligible for an award the next semester.

- Program Pursuit: Students must complete a minimum number of credit hours each semester based on a full-time course load of 12 credit hours.
  - Bachelor's degree students must complete 100 percent of a full-time credit load (12 credit hours) each semester.
  - Graduate degree students must complete 100 percent of a full-time credit load (12 credit hours) unless they have an assistantship. Graduate students with an assistantship should see the section on credit hour load in the graduate academic policies section of this catalog for the definition of full-time status.
  - C Average: Students having completed their second academic year (or 24 payment points) *must have* a cumulative C (2.000) grade point average to retain their New York State Tuition Assistance Program (TAP) Award.

### Waivers for New York State Awards

Students who fall below the credit or grade point average requirements listed on the following charts may apply for a waiver to continue their eligibility for financial aid. Students are allowed only one waiver during undergraduate work and only one waiver during graduate work. A waiver will be granted only after the student and College officials agree that a waiver is in the best interest of the student. The waiver is *not* automatic. The waiver must be filed within the academic period it should cover. Requests are made through the director of Financial Aid and Scholarships.

Waivers for the cumulative grade point average requirement may be granted only when failure to meet this requirement is due to:

- the death of a relative of the student;
- the personal injury or illness of the student;
- other extenuating circumstances.

Requests for a waiver are made through the director of Financial Aid and Scholarships.

### Standard of Satisfactory Academic Progress for Purpose of Determining Eligibility for New York State Student Aid

The following charts list the credit hours a student must complete and the grade point average a student must maintain to receive the award payment.

#### For students pursuing an associate degree program at ESF:

Payment	Credit Hours	Grade Point Average
#1	0	.000
#2	6	1.300
#3	15	1.500
#4	27	1.800
#5	39	2.000
#6	51	2.000

Noncredit remedial instruction can be counted toward a full-time academic load as set forth in 145-2.1 of the Commissioner's Regulations. The number of credits in this chart refers to work completed toward the degree.

**For students pursuing a bachelor's degree program at ESF:**

Payment	Credit Hours	Grade Point Average
#1	0	.000
#2	1	1.500
#3	15	.1.800
#4	27	1.800
#5	39	2.000
#6	51	2.000
#7	66	2.000
#8	81	2.000
#9	96	2.000
#10	111	2.000

Noncredit remedial instruction can be counted toward a full-time academic load as set forth in 145-2.1 of the Commissioner's Regulations. The number of credits in this chart refers to work completed toward the degree.

**For students pursuing any graduate degree program at ESF:**

Payment	Credit Hours	Grade Point Average
#1	0	.000
#2	6	2.000
#3	12	2.500
#4	21	2.750
#5	30	3.000
#6	45	3.000
#7	60	3.000
#8	75	3.000

**New York State Aid : Degree Applicable Courses and Repeated Courses**

**Degree Applicable Courses :** Students may only receive NY State aid for courses which are required for degree completion. Students enrolled in credits beyond the number required for the degree or enrolled in courses that are not applicable to a degree requirement will have financial aid adjusted accordingly. Students with remaining degree requirements less than 12 credits (typical full-time enrollment) may, in the final term of the degree program only, enroll in additional non-required credits to maintain full-time enrollment.

**Repeated Courses :** A student can repeat a course and have the course count as part of the minimum full-time or part-time course load for NY State financial aid purposes when the student did not previously earn credit for the course.

**Types of Available Awards**

**NOTE:** In the tables below, the term "Full-Time Undergraduate Student" in this chart means one taking at least 12 credit hours per semester in a degree/ certificate program; "Three-Quarter-Time Undergraduate Student" means one

taking at least 9 credit hours per semester in a degree/ certificate program; “Half-Time Undergraduate Student” means one taking at least 6 credit hours per semester in a degree/certificate program. Graduate students not holding an assistantship are considered full-time if registered for 12 credit hours each semester. Graduate students holding an assistantship and/or tuition scholarship are full-time if registered for 9 credit hours each semester. This information is accurate as of 7/26/2016.

- [www.esf.edu/financialaid](http://www.esf.edu/financialaid)

## ESF Scholarships and Grants

- [www.esf.edu/financialaid/esfgrant.htm](http://www.esf.edu/financialaid/esfgrant.htm)

Scholarship Program	Eligibility	Amount	Where to Apply
<b>ESF Presidential Scholarships</b>	Winners are selected based on academic records, recommendations, and academic program requirements.	Up to \$3,000 per year for N.Y. residents and up to \$8,000 per year for out-of-state residents.	All freshman and transfer applications submitted to ESF by February 1 will be reviewed for possible selection.
<b>ESF National Scholarships</b>	Awarded to outstanding students from outside NY State.	Up to \$8,000 per year. Renewable.	All freshman and transfer applications submitted by February 1 will be reviewed for possible selection.
<b>ESF Legacy Scholarships</b>	Children or grandchildren of ESF alumni enrolled in full-time undergraduate study. Up to five winners selected each year.	\$250 per semester for up to ten semesters. Renewable with cumulative GPA of 2.5 or higher.	Complete family question on ESF's Supplemental Application for Admission to be considered.
<b>Paper Science and Engineering Scholarships</b>	United States citizens enrolled in or admitted to the Paper Science or Paper Engineering programs.	Entering freshmen are awarded a \$1,000 scholarship for their first year. Amounts for transfer and continuing students are based on GPA.	Students must apply annually by completing the FAFSA, available at <a href="http://www.fafsa.gov">www.fafsa.gov</a> .
<b>ESF College Foundation Awards</b>	Students with financial need or academic merit enrolled at least half-time.	Amounts for these awards vary from \$100 - \$5,000, depending upon need.	Student must complete the FAFSA, available at <a href="http://www.fafsa.gov">www.fafsa.gov</a> .
<b>Haudenosaunee Scholar Awards</b>	Certified citizenship in Mohawk, Oneida, Onondaga, Cayuga, Seneca or Tuscarora nations.	\$5,000 per year (full-time study only). Two scholarships awarded each year.	Application available on Office of Financial Aid and Scholarships website: <a href="http://www.esf.edu/financialaid/">www.esf.edu/financialaid/</a> .
<b>Phi Theta Kappa Scholarships</b>	Community college transfer students who are members of PTK honor society.	\$1,500 per year. Renewable with GPA of 3.25 or higher.	Proof of PTK membership submitted with application for admission.
<b>National Merit, National Achievement, and National Hispanic Scholarships</b>	Semifinalists or finalists in any of these three national scholarship programs.	Combined ESF Presidential and Merit Scholarships totaling up to \$8,000 per year. Renewable.	High school records provided for admission must indicate student's semifinalist or finalist selection.
<b>Centennial Hall Scholarships</b>	Students with financial need who reside on campus in Centennial Hall.	Amount varies based upon financial need.	Students must complete the FAFSA, available at <a href="http://www.fafsa.gov">www.fafsa.gov</a>

## State and Federal Government Grants

- [www.esf.edu/financialaid](http://www.esf.edu/financialaid)

Need-based Grant	Eligibility	Amount	Where to Apply
<b>Federal Pell Grant</b>	Accepted or enrolled full-time, three-quarter-time, half-time, or less than	From \$583 to \$5,815. Cannot exceed one-half the cost of college	Students must submit the FAFSA, available at <a href="http://www.fafsa.gov">www.fafsa.gov</a> .

	half-time undergraduate students who demonstrate financial need.	expenses.	
<b>Federal Supplemental Educational Opportunity Grant (FSEOG)</b>	Full-time, three-quarter-time, or half-time undergraduate students with exceptional need.	Up to \$4,000, depending upon need and college expenses.	Students must submit the FAFSA, available at <a href="http://www.fafsa.gov">www.fafsa.gov</a> .
<b>New York State Tuition Assistance Program (TAP)</b>	Full or part-time students at any accredited college in New York State. Resident of New York State. Must demonstrate financial need.	\$500 to \$5,165 for undergraduates, depending on NYS net taxable income and dependency status.	Students must complete the FAFSA using the TAP section, available at <a href="http://www.fafsa.gov">www.fafsa.gov</a> .
<b>Part-Time New York State Tuition Assistance Program (TAP)</b>	TAP eligible undergraduate students enrolled in 6-11 credit hours per semester.	\$250 to \$4,735 based on a prorated percentage of the full-time TAP grant equivalent.	Students must complete the FAFSA and the TAP application.
<b>Educational Opportunity Grant (EOP)</b>	Undergraduate students. Resident of New York State. For educationally and economically disadvantaged students.	Varies according to individual need. Applicants must submit the Federal Income Tax Form.	Guidelines are in the SUNY Application for Admission. Submit the FAFSA.
<b>New York State Science, Technology, Engineering and Mathematics Incentive (STEM)</b>	Undergraduate students. Resident of New York State. Top 10% of high school class. Must enroll in STEM approved major, reside and work in STEM related field in New York State for 5 years following graduation. 2.5 cumulative GPA each semester. <ul style="list-style-type: none"> <li>• <a href="#">List of NY STEM approved SUNY-ESF majors</a></li> </ul>	Up to full tuition, depending on eligibility for other New York State grants and scholarships. May affect eligibility for SUNY-ESF grants and scholarships.	Students must complete the NY STEM Scholarship application, available at <a href="http://www.hesc.ny.gov">www.hesc.ny.gov</a> . Recipients must also sign a service contract.

## Federal Student Loans

- [www.esf.edu/financialaid](http://www.esf.edu/financialaid)

Loan Program	Eligibility	Amount	Where to Apply
<b>Federal Perkins Loan</b>	For all full-time, three-quarter-time, or half-time undergraduate students with financial need. Students borrow from the College on their own signature (no cosigner required).	Amount varies according to student's need. The total loan limit is \$27,500 for an undergraduate program. No interest while in school. Repayment at 5% interest begins 9 months after leaving school. Up to 10 years to repay. Average loan in 2015-2016 was \$1,531	Students must submit the Free Application for Federal Student Aid (FAFSA). <a href="http://www.fafsa.gov">www.fafsa.gov</a>
<b>Federal Direct Loan</b>	For all full-time, three-quarter-time, or half-time students. There are subsidized loans (interest-free while in school) and unsubsidized loans (student responsible for interest while in school). Students borrow from the Federal Government. Loans are processed through the College.  <b>NOTE:</b> Direct loans may be subsidized or unsubsidized or a combination. A subsidized loan is	<b>Dependent Students:</b> The maximum per year is \$5,500 for freshmen, with no more than \$3,500 subsidized; \$6,500 for sophomores, with no more than \$4,500 subsidized; \$7,500 for juniors and seniors, with no more than \$5,500 subsidized. The borrowing limit for dependent undergraduate students is \$31,000, with no more than \$23,000 subsidized.	Students must submit the Free Application for Federal Student Aid (FAFSA). <a href="http://www.fafsa.gov">www.fafsa.gov</a>

**NOTE:** Repayment begins 6 months after you graduate or fall below half-time status. You have up to 10 years to repay the loan. There is a 1.068% origination fee (for

the federal government) deducted proportionately from your loan proceeds. The 2016-2017 interest rate is 3.76% for undergraduate student loans and 5.31% for graduate student loans.	such that interest does not accrue while the borrower is in school. An unsubsidized loan is such that the borrower must make interest-only payments while in school or allow interest payments to be added to the principal.  <b>NOTE:</b> Average subsidized loan was \$4,071 for undergraduate students in 2015-16. Average unsubsidized loan was \$3,877 for undergraduate students and \$12,108 for graduate students in 2015-16.	<b>Independent students or students whose parents cannot borrow under the Federal Direct PLUS Loan Program:</b> The subsidized and unsubsidized maximum per year is \$9,500 for freshmen, \$10,500 for sophomores, and \$12,500 for juniors and seniors. The borrowing limit for independent undergraduate students is \$57,500, with no more than \$23,000 subsidized.  <b>Graduate or Professional Students:</b> The unsubsidized maximum is \$20,500 per year (borrowing limit is \$138,500 over lifetime in school). Interest subsidized loans will not be available to new borrowers after 7/1/12.	
<b>Federal Direct PLUS Loan</b>	For parents or guardians of financially dependent undergraduate students. Graduate students may also borrow Direct PLUS loans.	The maximum is the cost of education at ESF minus any estimated financial aid. Borrowers must meet established credit criteria. Loan repayment begins 60 days after the loan is fully disbursed. The 2016-2017 interest rate is 6.31%. There is a 4.272% loan origination fee.	Students must submit the Free Application for Federal Student Aid (FAFSA). <a href="http://www.fafsa.gov">www.fafsa.gov</a>

## Student Employment

- [www.esf.edu/financialaid](http://www.esf.edu/financialaid)

Employment Program	Eligibility	Amount	Where to Apply
<b>Federal Work-Study</b>	For full-time, three-quarter-time, or half-time students with financial need.	Opportunities for employment are offered during the academic year and/or summer. Students may work up to 20 hours per week when classes are in session or up to 40 hours per week during vacations. Hourly wages up to \$10.75 per hour.	Students must submit the FAFSA application at <a href="http://www.fafsa.gov">www.fafsa.gov</a> , and the appropriate tax forms.
<b>Job Location and Development Program</b>	For all ESF students. Students are connected to job opportunities with local employers.	Wage and hours will vary according to job offers.	Apply by visiting the ESF job locator in the Financial Aid Office.

## Graduate Student Assistantships

- [www.esf.edu/graduate/awards.htm](http://www.esf.edu/graduate/awards.htm)

Assistantships	Eligibility	Amount	Where to Apply
<b>Graduate Assistantships</b>	Assistantships sponsored by N.Y. State and various research projects are available. Students assist with instruction, research, and support operations for an assigned program area.	Graduate assistants normally work for 10–20 hours per week. The award range is generally \$11,000–\$30,000 per year, and a tuition scholarship may also be provided. Financial need is not a criterion for qualification.	The application for admission serves as the application for graduate assistantships for beginning students. Continuing students should contact their department chair.

# Degree Programs and Areas of Study

## Undergraduate Programs

- **Other Undergraduate Study Pages:**
  - [General Education](#)
  - [Minors](#)
  - [Special Academic Options](#)

ESF is authorized by the New York State Department of Education to offer undergraduate and graduate degree programs as described in this catalog. A comprehensive list of degree programs is provided below.

The Higher Education General Information Survey (HEGIS) code is the number assigned to programs registered by the commissioner of the New York State Department of Education. The Classification of Instructional Programs (CIP) Code allows the U.S. Department of Education to track educational programs for financial aid eligibility. Enrollment in programs that are not registered or otherwise approved may jeopardize a student's eligibility for certain financial aid programs.

### Associate in Applied Science (A.A.S.)

- [Environmental and Natural Resources Conservation](#) ([requirements](#), HEGIS Code 0115, CIP Code 030101)
- [Forest Technology](#) ([requirements](#), HEGIS Code 5403, CIP Code 030599)
- [Land Surveying Technology](#) ([requirements](#), HEGIS Code 5309, CIP Code 151102)

### Bachelor of Landscape Architecture (B.L.A.)

- [Landscape Architecture](#) ([requirements](#), HEGIS Code 0204, CIP Code 040601)
  - [B.L.A./M.S. Fast-Track](#) ([requirements](#), HEGIS Code 0204, CIP Code 040601)

### Bachelor of Science (B.S.)

- [Aquatic and Fisheries Science](#) ([requirements](#), HEGIS Code 0115, CIP Code 261304)
- [Bioprocess Engineering](#) ([requirements](#), HEGIS Code 0905, CIP Code 140501)
- [Biotechnology](#) ([requirements](#), HEGIS Code 0499, CIP Code 261201)
- [Chemistry](#) ([requirements](#), HEGIS Code 1905, CIP Code 400501) with options in biochemistry and organic chemistry of natural products, environmental chemistry, or natural and synthetic polymer chemistry.
- [Conservation Biology](#) ([requirements](#), HEGIS Code 0420, CIP Code 261307)
- [Construction Management](#) ([requirements](#), HEGIS Code 0599, CIP Code 469999) with elective concentration in sustainable construction and renewable materials.
- [Environmental Biology](#) ([requirements](#), HEGIS Code 0420, CIP Code 261305 )
- [Environmental Education and Interpretation](#) ([requirements](#), HEGIS Code 0499, CIP Code 269999)
- [Environmental Health](#) ([requirements](#), HEGIS Code 0420 )
- [Environmental Resources Engineering](#) ([requirements](#), HEGIS Code 0999, CIP Code 140101)
- [Environmental Science](#) ([requirements](#), HEGIS Code 0420, CIP Code 030104 ) with options in renewable energy, environmental information and mapping, watershed science, health and the environment, earth and atmospheric systems science or environmental analysis.

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- [Undergraduate Programs](#)
  - [Associate in Applied Science](#)
  - [Bachelor of Landscape Architecture](#)
  - [Bachelor of Science](#)
- [Graduate Programs](#)

- [Environmental Studies](#) ([requirements](#), HEGIS Code 0201, CIP Code 030101) with options in biological science applications; environmental policy, planning and law; or environment, communication and society.
- [Forest Ecosystem Science](#) ([requirements](#), HEGIS Codes 0114, CIP Code 030502)
- [Forest Engineering](#) ([requirements](#), HEGIS Code 0999, CIP Code 140101)
- [Forest Health](#) ([requirements](#), HEGIS Code 0114, CIP Code 030599)
- [Forest Resources Management](#) ([requirements](#), HEGIS Code 0115, CIP Code 030501)
- [Natural Resources Management](#) ([requirements](#), HEGIS Code 0115, CIP Code 030201)
- [Paper Engineering](#) ([requirements](#), HEGIS Code 0999, CIP Code 149999)
- [Paper Science](#) ([requirements](#), HEGIS Code 0999, CIP Code 149999)
- [Sustainable Energy Management](#) ([requirements](#), HEGIS Code 0115, CIP Code 030201)
- [Wildlife Science](#) ([requirements](#), HEGIS Code 0107, CIP Code 260709)

## Graduate Programs

- [Graduate Study: Degrees & Options](#)

## Environmental and Forest Biology

(HEGIS Code 0499, CIP Codes 261305)

- [EFB website](#)

### M.S., M.P.S. and Ph.D. with areas of study in:

- [Applied Ecology](#) (M.P.S. only)
- [Chemical Ecology](#)
- [Conservation Biology](#)
- [Ecology](#)
- [Entomology](#)
- [Environmental Interpretation](#)
- [Environmental Physiology](#)
- [Fish and Wildlife Biology and Management](#)
- [Forest Pathology and Mycology](#)
- [Plant Biotechnology](#) (M.P.S. only)
- [Plant Science and Biotechnology](#)

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## Chemistry

(HEGIS Code 1905, CIP Code 400599)

- [Chemistry website](#)

### M.S., M.P.S. and Ph.D. with areas of study in:

- [Biochemistry](#)
- [Environmental Chemistry](#)

- [Organic Chemistry of Natural Products](#)
  - [Polymer Chemistry](#)
- 

## Environmental Resources Engineering

(HEGIS Code 0999, CIP Code 141401)

- [ERE website](#)

**M.S., M.P.S. and Ph.D. with areas of study in:**

- [Ecological Engineering](#)
  - [Environmental Management](#) (M.P.S. only)
  - [Environmental Resources Engineering](#)
  - [Geospatial Information Science and Engineering](#)
  - [Water Resources Engineering](#)
- 

## Environmental Science

(HEGIS Code 0420, CIP Code 030104)

- [Environmental Science website](#)

**M.S., M.P.S. and Ph.D. with areas of study in:**

- [Biophysical & Ecological Economics](#)
- [Coupled Natural and Human Systems](#)
- [Ecosystem Restoration](#)
- [Environmental and Community Land Planning](#)
- [Environmental Communication and Participatory Processes](#) (Ph.D. only)
- [Environmental Monitoring and Modeling](#)
- [Environmental & Natural Resources Policy](#) (Ph.D. only)
- [Human Dimensions of the Environment](#)
- [Water and Wetland Resource Studies](#)

## Environmental Studies

(HEGIS Code 0201, CIP Code 030101)

- [Environmental Studies website](#)

**M.S. and M.P.S. in:**

- [Environmental Communication](#)
- [Environmental Policy](#)

- [General Environmental Studies](#)
- 

## Forest and Natural Resources Management

(HEGIS Code 0115, CIP Code 030506)

- [FNRM website](#)

M.S., M.P.S. and Ph.D. with areas of study in:

- [Construction Management](#) (M.S. and M.P.S. only)
- [Ecology and Ecosystems](#)
- [Economics, Governance and Human Dimensions](#)
- [Management](#)
- [Monitoring, Analysis and Modeling](#)
- [Sustainable Construction](#) (M.S. and M.P.S. only)
- [Sustainable Energy](#)

Master of Forestry (M.F.)

- [Forest Management and Operations](#)
- 

## Landscape Architecture

(HEGIS Code 0204, CIP Code 040601)

- [LA website](#)

M.L.A. and M.S. with areas of study in:

- [Community Design and Planning](#)
  - [Cultural Landscape Studies and Conservation](#)
  - [Landscape and Urban Ecology](#)
- 

## Paper and Bioprocess Engineering

(HEGIS Code 0999, CIP Code 141401)

- [PBE website](#)

M.S., M.P.S. and Ph.D. with areas of study in:

- [Bioprocess Engineering](#)
- [Biomaterials Engineering](#)
- [Paper Science and Engineering](#)

# General Education

## Undergraduate Study

- [Undergraduate Degree Programs](#)
- [Minors](#)
- [Special Academic Options](#)

## About General Education

- [www.esf.edu/provost/gened.asp](http://www.esf.edu/provost/gened.asp)

The State University of New York requires graduates of bachelor degree programs to successfully complete 30 credit hours of general education coursework distributed among 10 different knowledge and skill areas; students pursuing a degree at ESF are required to complete at least 3 credit hours of coursework each, from at least 7 of the 10 knowledge and skill areas to fulfill the SUNY requirement. The core of the curricula for all ESF undergraduate degree programs satisfies several of the requirements, including those for the natural science, basic communications, mathematics, and humanities general education knowledge and skill areas. For the remaining general education knowledge and skill area requirements, students must complete an additional 15 credit hours distributed among courses chosen from at least three of the five remaining knowledge and skill areas, or as specifically designated by their degree programs.

The courses listed below may be chosen to satisfy SUNY general education requirements in each of the nine knowledge and skill areas. Please note that more than 40 of these courses are taught in the College of Arts and Sciences at Syracuse University. General education courses listed with the prefix APM, EFB, FOR, LSA, or PSE are taught at SUNY-ESF and can be found in the Course Descriptions section of this catalog. Course descriptions for Syracuse University courses can be found online at <http://coursecatalog.syr.edu/>.

## General Education Requirements

### Mathematics

Course		Credits
APM 103	Applied College Algebra and Trigonometry	3
APM 104	College Algebra and Precalculus	3
APM 105	Survey of Calculus and Its Applications I	4
APM 106	Survey of Calculus and Its Applications II	4
APM 115	Essential Calculus	4
APM 205	Calculus I for Science and Engineering	4
APM 206	Calculus for Science and Engineering II	4
APM 391	Introduction to Probability and Statistics	3
MAT 112	Algebraic Operations and Functions	3
MAT 117	Foundational Mathematics via Problem Solving I	3
MAT 118	Foundational Mathematics via Problem Solving II	3

MAT 121	Probability and Statistics for the Liberal Arts I	4
MAT 122	Probability and Statistics for the Liberal Arts I	4
MAT 194	Precalculus	4
MAT 295	Calculus I	4
MAT 296	Calculus II	4

## Natural Sciences

Course		Credits
EAR 101	Dynamic Earth	4
EFB 101	General Biology I: Organismal Biology and Ecology	3
EFB 102	General Biology I Laboratory	1
EFB 103	General Biology II: Cell Biology and Genetics	3
EFB 104	General Biology II Laboratory	1
EFB 120	The Global Environment and the Evolution of Human Society	3
EFB 320	General Ecology	4
FCH 110	Survey of Chemical Principles	3
FCH 150	General Chemistry I	3
FCH 151	General Chemistry Laboratory I	1
FCH 152	General Chemistry II	3
FCH 153	General Chemistry Laboratory II	1
FCH 210	Elements of Organic Chemistry	4
FCH 221	Organic Chemistry I	3
FCH 222	Organic Chemistry Laboratory I	1
FCH 223	Organic Chemistry II	3
FCH 224	Organic Chemistry Laboratory II	1
FOR 232	Natural Resources Ecology	3
PHY 211	General Physics I	3
PHY 212	General Physics II	3
PHY 221	General Physics I Laboratory	1
PHY 222	General Physics II Laboratory	1
SRE 225	Physics of Energy	3

## Social Sciences

Course		Credits
EFB 120	The Global Environment and the Evolution of Human Society	3
EST 221	Introduction to American Government	3
EST 366	Attitudes, Values and the Environment	3
EST 390	Social Processes and the Environment	3

FOR 202	Introduction to Sociology	3
FOR 207	Introduction to Economics	3
GEO 103	America and the Global Environment	3
MAX 132	Global Community	3
PAF 101	An Introduction to the Analysis of Public Policy	3
PSC 123	Comparative Government and Politics	3
PSC 124	International Relations	3
PSC 125	Political Theory	3
PSY 205	Foundations of Human Behavior	3
SOC 248	Ethnic Inequalities and Intergroup Relations	3
SOC 281	Sociology of Families	3

## American History

For all students:

Course		Credits
EST 201	US History Reconstruction to the Present	3
EST 202	American History: From Discovery to Civil War	3
FOR 204	Natural Resources in American History	3
HST 101	American History to 1865	3
HST 102	American History Since 1865	3

For students scoring above 84 on the U.S. History Regents examination:

Course		Credits
EST 361	History of the American Environmental Movement	3

## Western Civilization

Course		Credits
FOR 203	Western Civilization and the Environment	3
HOA 105	Arts and Ideas I	3
HOA 106	Arts and Ideas II	3
HST 111	Early Modern Europe, 1350-1815	3
HST 210	The Ancient World	3
HST 211	Medieval and Renaissance Europe	3
HST 212	Religion in Medieval and Reformation Europe	3
LIT 203	Greek and Roman Epic in English Translation	3
LIT 211	Greek and Roman Drama in English Translation	3
LSA 205	Art, Culture and Landscape I	3
LSA 206	Art, Culture and Landscape II	3

LSA 305	History of Landscape Architecture I	3
PSC 125	Political Theory	3
REL 114 OR JSP 114	The Bible	3
	The Bible	3
REL 205	Ancient Greek Religion	3
REL 206	Greco-Roman Religion	3
REL 215 OR JSP 215	The Hebrew Bible	3
	The Hebrew Bible	3

## Other World Civilizations

Course		Credits
AAS 241	African Religions: An Introduction	3
ANT 121	Peoples and Cultures of the World	3
ANT 185	Global Encounters:Comparing World Views & Values Cross-Culturally	3
ANT 324 OR SAS 324 OR WGS 324	Modern South Asian Cultures	3
	Modern South Asian Cultures	3
	Modern South Asian Cultures	3
ANT 326	Africa Through the Novel	3
BPE 230 OR EST 230	China Experience	3
	China Experience	3
EFB 217	Peoples, Plagues, and Pests	3
EFB 305	Indigenous Issues and the Environment	3
EST 140	Introduction to Native Peoples, Lands & Cultures	3
EST 200	Cultural Ecology	3
GEO 272	World Cultures	3
HST 320	Traditional China	3
HST 321	Modern China	3
PSE 201	The Art and Early History of Papermaking	3
REL 101	Religions of the World	3
REL 185 OR SAS 185	Hinduism	3
	Hinduism	3
REL 186 OR SAS 186	Buddhism	3
	Buddhism	3

## Humanities

Course		Credits
AAS 231	African American Literature to 1900: An Introduction	3

AAS 235	African American Drama	3
EST 245	Foundations of Environmental Communication	3
ETS 107	Living Writers	3
ETS 151	Interpretation of Poetry	3
ETS 153	Interpretation of Fiction	3
ETS 192	Gender and Literary Texts	3
EWP 290	Research Writing and Humanities	3
LIN 201	The Nature and Study of Language	3
LIT 203	Greek and Roman Epic in English Translation	3
PHI 107	Theories of Knowledge and Reality	3
PHI 111	Plato's Republic	3
REL 135	Judaism	3
REL 156	Christianity	3
REL 217	The New Testament	3
REL 231	Judaic Literature	3
REL 252	Religious Ethics and Social Issues	3

## The Arts

Course		Credits
APH 261	Art Photography, Introduction	3
ETS 215	Introductory Poetry Workshop	3
ETS 217	Introductory Fiction Workshop	3
EWP 350	Eco-Cinema: Perspectives & Practices (Honors)	3
HOA 105	Arts and Ideas I	3
HOA 106	Arts and Ideas II	3
HOA 201	Masterpieces of Art	3
HOA 276	Visual Arts in North America	3
HOA 377	Nineteenth-Century American Art	3
HOM 125	Introductory Music Theory	3
HOM 165	Understanding Music I	3
HOM 166	Understanding Music II	3
LSA 182	Drawing Studio	3
LSA 205	Art, Culture and Landscape I	3
LSA 206	Art, Culture and Landscape II	3
PSE 201	The Art and Early History of Papermaking	3

## Basic Communication

Course	Credits
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EWP 190	Writing and the Environment	3
EWP 405	Writing for Science Professionals	1 - 3

# Minors

## Undergraduate Study

- [Undergraduate Degree Programs](#)
- [Special Academic Options](#)
- [General Education](#) (GenEd)

In addition to academic majors available at ESF, many departments offer academic “minors” for undergraduate students to build an area of additional breadth outside their major program of study.

Admission to undergraduate minors for ESF students is via petition, with additional application requirements as noted in the descriptions of the minors below.

Successful completion of a minor will be noted on the transcript of each student.

### Applied Statistics Minor

Coordinator: Dr. Eddie Bevilacqua

This minor provides students with an opportunity to extend their understanding of and ability to apply statistical methods beyond the basic techniques presented in introductory courses. The minor is intended to provide students with a strong background in statistical design (both sampling design and experimental design) and analysis. The 12-credit minor consists of two required courses (6 credits), APM 391 (or APM 395) and FOR 323 and 6 credits of directed electives of advanced courses, independent study, or teaching experience related to applied statistics.

#### Courses:

This minor requires 12 credits and includes the required courses (6 credits) and directed electives (6 credits) listed below. Other applied statistics courses may be substituted by petition for any course in the directed elective list with the approval of the FNRM Undergraduate Education Committee.

Required Courses (6 credits):

Course		Credits
APM 391 OR APM 395	Introduction to Probability and Statistics Introduction to Statistics in Engineering	3 (cannot use both)

## Minors Menu

- [Applied Statistics](#)
- [Bioprocess Science](#)
- [Biotechnology](#)
- [Chemistry](#)
- [Computer and Information Technology](#)
- [Construction Management](#)
- [Economics](#)
- [Environmental Biology](#)
- [Environmental Health](#)
- [Environmental Writing & Rhetoric](#)
- [Food Studies](#)
- [Forestry](#)
- [Information Management and Technology](#)
- [Landscape Architecture Studies](#)
- [Management](#)
- [Marine Science](#)
- [Mathematics](#)
- [Microscopy](#)
- [Native Peoples and the Environment](#)
- [Paper Science](#)
- [Physics](#)
- [Recreation Resource and Protected Area Management](#)
- [Renewable Energy](#)
- [Sustainable Construction](#)
- [Urban Environmental Science](#)
- [Urban Forestry](#)
- [Water Resources](#)

FOR 323	Forest Biometrics	3
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Choose from the following directed electives (6 credits):

Course		Credits
APM 620	Experimental Design and Analysis of Variance	3
APM 625	Sampling Methods	3
FOR 495	Undergraduate Teaching Assistance (must be in association with APM 391 or FOR 323)	1
FOR 498	Independent Study (under guidance of instructor of APM applied statistics courses)	2-3

### Eligibility requirements:

Students from all programs at ESF are eligible for this minor if they have a cumulative grade point average of 2.70 or better after one semester at ESF (or as a transfer student with same standing).

## Bioprocess Science Minor

Coordinator: Dr. Gary Scott

The bioprocess science minor gives students an understanding of the rapidly developing bioprocessing industry, which uses the chemical, physical and biological processes developed by living organisms or their cellular components in a type of advanced manufacturing of specialty commercial products. Bioprocess science will influence diverse fields as it becomes widely used, such as for producing energy from sustainable sources.

The bioprocess science minor is available to all ESF undergraduate students (**except students in the bioprocess engineering program**) who maintain a minimum cumulative grade point average of 2.70, and who desire to develop greater knowledge of bioprocess science and its related fields. Interested students must submit a petition and application form, with courses listed, to their academic advisor and the chair of their department, with final approval from the dean of Instruction and Graduate Studies. Students should declare the minor by the end of the sophomore year, but may petition to their home department for enrollment at any time after that. Successful completion of the minor will be noted on the student's transcript.

Eighteen credit hours (6 courses) are required to satisfy the minor. Specified courses: PSE 370 Principles of Mass and Energy Balance (3); BPE 310 Colloid and Interface Science (3); BPE 420 Bioseparations (3); and at least three directed elective courses available from both ESF and Syracuse University including biology, forestry, chemical engineering, chemistry, paper science and engineering, bioprocess engineering, and environmental and biological engineering. Students are required to complete at least one course from a list of biological and chemistry electives and at least one course from a list of engineering electives. The complete list of courses is available from faculty advisors.

## Biotechnology Minor

Coordinator: Dr. William Powell

The minor in biotechnology is for students who wish to add knowledge of biotechnology theories and methodologies to the experiences and qualifications gained from their undergraduate program. Required courses develop a basis for understanding biotechnology, both at the theoretical and practical levels. Directed electives allow students to focus on an area of interest in the field. The minor is available to all ESF undergraduate students except those in the biotechnology major.

Twenty credit hours of coursework are required for completion of the minor. Seventeen credits of specified courses include EFB 307 Principles of Genetics (3); EFB 308 Principles of Genetics Lab (1); BTC 401 Molecular Biology

Techniques (4); EFB 325 Cell Biology (3); FCH 530 Biochemistry I (3); and FCH 532 Biochemistry II (3). One directed elective course (for a minimum of three credits) must be selected from the following list. A maximum of eight credits can count toward both major and minor requirements; overlap in excess of this number must be offset by taking additional courses from the directed elective list.

- BTC 425 Plant Biotechnology (3)
- BTC 426 Plant Tissue Culture Methods (3)
- BTC 498 Research Problems in Biotechnology (3-6)
- BTC 420 Internship in Biotechnology (3)
- EFB 303 Introductory Environmental Microbiology (4)
- FCH 531 Biochemistry Lab (3)
- BIO 464 Applied Biotechnology (4) (SU)
- MEDT 439 Applied Techniques in Medical Biotechnology (2) (SUNY Upstate)

## Chemistry Minor

- [www.esf.edu/chemistry/minor](http://www.esf.edu/chemistry/minor)

Coordinator: Dr. Mark Teece

The Minor in Chemistry is open to all undergraduates at SUNY-ESF. Admission to the Chemistry minor requires sophomore, or higher, status, students to have completed one year of General Chemistry (I and II) with lab (8 credits) and one year of Organic Chemistry (I and II) with lab (8 credits).

## Requirements

Fifteen credit hours of upper division chemistry credits (300 level or above) are required from a list of suggested courses, including:

- FCH 325 Organic Chemistry III - 4
- FCH 360 Physical Chemistry I - 3
- FCH 380 Analytical Chemistry I - 3
- FCH 361 Physical Chemistry II - 3
- FCH 381 Analytical Chemistry II - 3
- FCH 384 Spectrometric Identification of Organic Compounds - 2
- FCH 399 Introduction to Atmospheric Sciences - 3
- FCH 410 Inorganic Chemistry - 3
- FCH 530 Biochemistry I - 3
- FCH 531 Biochemistry Laboratory - 3
- FCH 532 Biochemistry II - 3
- FCH 510 Environmental Chemistry I - 3
- FCH 511 Environmental Chemistry II - 3
- FCH 515 Methods of Environmental Chemical Analysis - 3
- FCH 550 Polymer Science: Synthesis and Mechanisms - 3
- FCH 551 Polymer Techniques - 3
- FCH 552 Polymer Science: Properties and Technology - 3

## Computer and Information Technology Minor

Coordinator: Dr. Gary Scott

The computer and information technology minor is available to all ESF undergraduates who want to develop greater skill in computer science and information technology applications. By understanding the basic principles behind software development, students can more effectively use these tools in their chosen fields. To be eligible for this minor, a student must have a cumulative grade point average of 2.700 or better by the end of the sophomore year. Interested students must submit a petition form and plan sheet, with courses listed, to their academic advisor and undergraduate coordinator, with final approval from the Dean of Instruction and Graduate Studies. Eighteen credit hours (6 courses) in computer science and information technology courses are required to complete the minor.

**Required Courses:** (12 credits)

- Choose One:
  - GNE 160 Computing Methods for Engineers and Physical Scientists (3)
  - APM 360 Introduction to Computer Programming (3)
  - ERE 335 Numerical and Computing Methods (3)
- ESF 200 Information Literacy (1)
- CIS 252 Introduction to Computer Science (4)
- CIS 351 Data Structures (4)

**Elective Courses: (6 credits)**

- CME 410 Computer-Aided Design and Drafting (3)
- ERE 622 Digital Image Analysis (3)
- ESF 300 Introduction to Geospatial Information Technologies (3)
- CIS 3xx Any CIS course offered at the 300, 400, and 500 level
- CSE 282 Systems Software Design (3)
- CSE 283 Introduction to Object-Oriented Design (3)
- CSE 351 Mathematical Analysis of Digital Systems (3)
- CSE 381 Computer Architecture (3)
- CSE 458 Data Networks: Basic Principles
- CSE 464 Introduction to VLSI Design (3)
- CSE 471 Introduction to Embedded System Design (3)
- CSE 482 Principles of Software Engineering (3)
- CSE 483 C# and Windows Programming (3)
- CSE 484 Introduction to Computer and Network Security (3)
- CSE 486 Design of Operating Systems (3)
- CSE 561 Digital Machine Design (3)
- CSE 565 Introduction to VLSI Testing and Verification (3)
- CSE 571 Switching Theory (3)
- CSE 581 Introduction to Database Management Systems (3)
- CSE 588 Translator Design (3)

**Construction Management Minor**

Coordinators: Paul Crovella and Dr. Susan Anagnost

The construction management minor is available to all ESF undergraduates (except students in construction management) and prepares students for management careers in the construction industry. Admission to the minor requires sophomore status, with a cumulative grade point average of 2.70 or higher.

Eighteen credit hours (6 courses) are required to complete the minor. Four courses are specified, with an additional two courses selected from the list of six courses given below. A cumulative grade point average of 2.000 or higher is required for the construction management courses.

Specified courses: CME 255 Plan Interpretation and Quantity Takeoff (3); CME 343 Construction Estimating (3); CME 453 Construction Planning and Scheduling(3); CME 454 Construction Project Management(3).

Two additional courses are chosen from the following: CME 330 Building Codes and Zoning Practices (3); CME 331 Construction Safety (3); CME 335 Cost Engineering (3); CME 350 Construction Methods and Equipment (3); CME 444 Materials Marketing (3); CME 455 Construction Contracts and Specifications (3).

## **Economics Minor**

Coordinator: Dr. John Wagner

Economics analyzes how people with limited resources make choices and provides the fundamentals for good decision-making. The minor in economics provides students with common microeconomic models and tools that can be used to analyze optimal management and policy decisions in natural resources management.

The Economics minor totals 15 credits. Required courses are FOR207 Introduction to Economics (3) and ECN301 Intermediate Microeconomic Theory (3) or ECN311 Intermediate Math Microeconomics (3).

In addition, students must choose from the following directed electives (a minimum of 9 credits): FOR333 Natural Resources Managerial Economics (3); SRE454 Renewable Energy Finance and Analysis (3); FOR495 Undergraduate Teaching Assistant (must be in association with FOR207 or FOR333) (3); FOR670 Resource and Environmental Economics (3) or ECN437 Resource and Environmental Economics (3); ESC422 Energy Markets and Regulation (3); ERE430 Engineering Decision Analysis (3) or FIN301 Essentials of Finance (3). It is the responsibility of the student to meet any prerequisites associated with courses in the minor.

Admission to the minor requires students to have a cumulative grade point average of 2.70 or better after one semester at ESF (or as a transfer student with the same standing).

## **Environmental Biology Minor**

Coordinator: Dr. Greg McGee

This minor provides students the opportunity to explore fundamentals of molecular, cellular and organismal biology and ecology and to develop laboratory and field proficiencies in the discipline. The minor is open to ESF undergraduate students, including those in biotechnology but excluding all other EFB programs, who maintain a GPA of at least 2.70 after completing at least one semester at ESF and who have completed the following prerequisite courses or their equivalents: EFB 101/102 and 103/104 General Biology (8); and FCH 150/151 and 152/153 General Chemistry (8).

Eighteen credit hours of biology courses are required to satisfy the minor, including EFB 320 General Ecology (4); EFB 307/308 Principles of Genetics w/ laboratory (4); EFB 311 Principles of Evolution (3); 7 credits of directed biology electives that may include EFB 202, 210 and 211 and any 300+ level EFB course except EFB 420, 495 and 498.

## **Environmental Health Minor**

**Coordinator: Dr. Lee Newman**

The Environmental Health minor will introduce students to environmental health with a core context of epidemiology and toxicology; the minor requires 15-17 credit hours. There are 3 required courses (7 credit hours): EHS250 Foundations of Environmental Health(1), EFB360 Epidemiology(3), and EFB400 Toxic Health Hazards(3). Students will

have the flexibility to explore a variety of components by selecting an additional three courses (8-10 credit hours) from among the following: EHS440 Occupational Health and Safety(3), EHS350 Environmental Health Management(3), EHS320 Disease Prevention(2), FST102 Food fights: Contemporary Food Issues(3), FCH399 Introduction to Atmospheric Science(3), ENS470 Environmental Risk Assessment(3), EST245 Foundations of Environmental Communication(3), EHS480 Hazardous Waste Management(3), EFB303 Introductory Environmental Microbiology(4).

The Environmental Health minor will be available to students in all majors (except Environmental Health) who want to increase their knowledge of the impact of the physical environment on human health.

Some of the courses have additional pre-requisites, and students should investigate this before selecting courses to fulfill the minor requirements.

Students must have a minimum GPA of 2.7 to apply. Interested students should submit the minor enrollment form accompanied by a list of courses to fulfill the minor requirements to their faculty advisor and the Environmental Health minor coordinator, with final approval from the Dean of Instruction and Graduate Studies.

## Environmental Writing and Rhetoric Minor

- [www.esf.edu/writingprogram/writingminor.htm](http://www.esf.edu/writingprogram/writingminor.htm)

Coordinator: [Christina Limpert](#)

The minor in Environmental Writing & Rhetoric is open to all undergraduates at SUNY-ESF. To be eligible for entry into the minor, students need a minimum GPA of 2.70 and have successfully completed the prerequisite courses EWP 190 and EWP 290 or their equivalent (Students may apply for entry to the minor prior to completion EWP 290).

**Coursework** (12 credits total):

- **Required Core Course** (3 Credits)
  - EWP 300: Survey of Environmental Writing
- **Literature & Film Courses** (3 Credits) Choose from:
  - EWP 311: Urban Environmental Literature
  - EWP 350: Eco-Cinema: Perspectives and Practices
  - EWP 390: Literature of Nature
  - EWP 490: Contemporary Literature of Nature
- **Advanced/Professional Writing Courses** (3 Credits) Choose from:
  - EWP 407: Writing for Environmental & Science Professionals
  - EWP 420: Advanced Public Presentation Skills
  - EWP 494/694: Creative Non-Fiction for the Sciences
  - EWP 495: Environmental Journalism
- **Directed Electives** (3 credits) Choose from:
  - EWP 401: Capstone Experience (with permission of instructor), or
  - Another three-credit, upper-division EWP course (300 or 400-level)

## Food Studies Minor

The food studies minor will be available to students in all majors who want to increase their knowledge of the impact of food production systems, food security and food systems on human society and individual human health.

Some of the directed elective courses have additional pre-requisites, and students must investigate this before making up their proposed course plan.

Interested students (GPA 2.7 required in order to apply) must submit a petition, with a list of potential courses to fulfill

the minor requirements to (a) their faculty advisor, (b) the undergraduate curriculum coordinator of their home department and (c) the food studies minor coordinator, with final approval from the Dean of Instruction and Graduate Studies.

Many of these courses are offered at Syracuse University. Students pursuing this minor may incur additional fees as required for exceeding their SU accessory instruction allocation.

## Requirements

For the Minor, all students must take 6 courses distributed as follows among 3 categories:

Two required lower division courses:

- FST 102 Food Fights: Contemporary Food Issues (3)
- FST 202 Agroecology (3)

Select one among the following courses:

- EFB 337 Field Ethnobotany (3)
- EFB 437 Plant Propagation (3)
- EST 361 History of the American Environmental Movement (3)

Select three among the following courses:

- FST 204: Food, identity and Power (3)
- FST 303 Food Movements (3)
- FST 304 Farm to Fork (4)
- FST 306 Food Cooperatives (3)
- FST 307 Feeding the World: Global Agri-food Governance (3)
- FST 309 Philosophy and Practice of Locavorism (3)
- FST 310 Will Work for Food: Labor Across the Food System (3)
- FST 312 Emergency Food Systems (3) \*\*\*Note: This course is not offered each year.
- FST 402 Feeding the City: Urban Food Systems (3)
- FST 403 The Human Right to Adequate Food and Nutrition (3)
- FST 421 Morality of a Meal: Food Ethics (3)
- FST 423 Food in History (3)
- NSD 555 Food, Culture and Environment (3) \*\*NOTE\*\* This has prerequisites that will add to SU credits.

## Forestry Minor

Coordinator: Dr. Rene Germain

The minor in forestry draws from the biological, physical, social, and managerial sciences. The curriculum aids in understanding the biological complexities of the forest and the interactions between the forest and social and economic demands. The minor is designed to provide students with an appreciation of forest resources management. Course themes include forest measurements, forest ecology, forest management and silviculture, and forest policy and economics.

Admission to the minor requires students to have a cumulative grade point average of 2.70 or better after one semester at ESF (or as a transfer student with same standing).

The minor in Forestry requires 16 credits. It is the responsibility of the student to meet any prerequisites associated with courses in the minor. Required courses are FOR 322 Forest Mensuration (3) (prerequisite of FOR 304 or

equivalent); FOR 332 Forest Ecology (3) (prerequisite of FOR 232 or EFB 320 or equivalent); FOR 334 Silviculture (4); FOR 370 Forest Management Decision Making and Planning (3) or FOR 373 Forest Operations (3) (prerequisites for FOR 370: FOR 322 and FOR 334; prerequisites for FOR 373: FOR 322 and FOR 334); FOR 333 Natural Resource Managerial Economics (3) or FOR 465 Natural Resources Policy (3) (prerequisite for FOR 333: FOR 207 or equivalent; no prerequisites for FOR 465).

## **Information Management and Technology Minor**

Coordinator: Dean Scott Shannon

In collaboration with the Syracuse University School of Information Studies (the i-School), ESF also offers an undergraduate minor in Information Management and Technology for ESF students. This minor is designed to give students knowledge of information technology and an understanding of information and communications problems. It complements many majors because all organizations need people who understand information resources and information technology. To be eligible for this minor, students must have a cumulative grade point average of 2.70 or better and apply for the minor after completing at least one semester at ESF, but as soon after that as possible to ensure all courses can be completed. It is preferable students begin the minor during their sophomore year.

The following 18 credits of courses are required: ITS 195 Information Technologies (3); 9 credits of ITS elective coursework; and one course from each of the following two general areas of study:

Technology:

- IST 233 Introduction to Computer Networking (3)
- IST 352 Applications of Information Systems (3)
- IST 459 Introduction to Database Management Systems (3)

Management:

- IST 335 Introduction to Information-based Organizations (3)
- IST 352 Information Analysis of Organizational Systems (3)
- IST 445 Managing Information Systems Projects (3)

For questions regarding the selection of elective coursework, please contact Elaine Morgan with the i-School at 443-1830 or [emmorgan@syr.edu](mailto:emmorgan@syr.edu)

## **Landscape Architecture Studies**

The minor in Landscape Architecture Studies provides an understanding of the natural and human factors and the role of design in shaping our physical environment. This minor is available to SU and ESF students. To complete this minor, students must complete 15 credit hours (5 courses) with a cumulative grade point average of 2.5. One course is specified, with an additional four courses to be selected from the list of seven approved courses listed below.

Admission to the minor requires a cumulative grade point average of 2.7 or higher and permission (ESF petition) of the Landscape Architecture Undergraduate Curriculum Director (331 Marshall Hall).

### **Required Courses (3 Credits)**

- LSA 220 - Introduction to Landscape Architecture

### **Approved Courses (3 Credits each)**

- LSA 311 - Natural Processes in Planning and Design
- LSA 312 - Place/Culture/Design
- LSA 305 - History of Landscape Architecture I (meets Gen Ed)

- LSA 306 - History of Landscape Architecture II
- LSA 321 - Ecological Applications in Planning and Design
- LSA 451 - Comprehensive Land Planning
- LSA 497 - Contemporary Issues in Landscape Architecture

**Total credits required: 15**

## Management Minor

Coordinator: Rene Germain

The management minor is available to all ESF undergraduate students who want to develop greater skills and knowledge of business fundamentals. In addition to understanding basic financial and managerial accounting principles, students can further develop focus in their minor through coursework in entrepreneurship, finance, marketing, human resources, and other topics.

Admission to the minor requires sophomore status, a cumulative grade point average of 2.70 or better and permission (via the ESF Minor Enrollment Form) of the Coordinator of the minor. Normally, students are allowed to take only one management course at Syracuse University's Whitman School per semester, so careful planning is required.

The management minor requires fifteen (15) credits, six (6) credits from a required course and nine (9) credits of elective courses. It is the responsibility of the student to meet any prerequisites associated with any courses in the minor.

### Required Course (6 credits):

FOR 360 - Principles of Management (3)

- and -

FOR 205 - Principles of Accounting (3)

- or -

CME 151 - Introduction to Financial Accounting (3)

### Elective Courses (9 credits):

CME 252 - Introduction to Managerial Accounting (3)

CME 444 - Materials Marketing (3)

ENS 422 - Energy Markets and Regulation (3)\*

EST 450 - Sustainable Enterprise (3)

FOR 485 - Business and Managerial Law (3)

SRE 454 - Renewable Energy Finance and Analysis (3)\*

ERE 519 - Green Entrepreneurship (3)

PSE 456 - Management in the Paper Industry (3)

### SU courses:

BUA100 & BUA200 - Business Essentials I & II (Must take both courses: credit will not be given if students only complete one course) (6)

EEE 370 - Introduction to Entrepreneurship and Emerging Enterprises (3)

EEE 375 - Entrepreneurial and Family Business Management (3)

EEE 382 - Entrepreneurial Marketing (3)

EEE 442 - Emerging Enterprise Law (3)

EEE 443 - Emerging Enterprise Consulting (3)

FIN 301 - Essentials of Finance (3)

MAR 301 - Essentials of Marketing (3)

SHR 247 - Introduction to Strategic Management (3)

\*Students in the Sustainable Energy Management major may not use ENS 422 and FOR 454 to satisfy the requirements in the Management minor.

## Marine Science Minor

Coordinator: Dr. Kim Schulz

The marine science minor is available to students in all majors who want to increase their knowledge of marine systems. Prior to admission students must have completed one year of General Biology (EFB 101/102 and EFB 103/104) and one year of General Chemistry (FCH 150/151), or equivalent, and have earned a cumulative GPA of 2.70. Some of the directed elective courses have additional pre-requisites, which will not count toward the minor.

Courses:

This minor requires at least 12 credits from the list below, with no more than 3 courses taken from any one department, and no more than 3 credit hours of lower division credits counted. Other marine science courses may be substituted by petition for any course in the directed elective list with approval of the marine science curriculum coordinator.

Although not required, all participants in the marine science minor are encouraged to incorporate a field or hands-on component in their choice of courses. Such courses include EFB 423 Marine Ecology (weekend field trip), the Sea Education Association courses, approved field courses from other marine stations or institutions, and approved internship (e.g., EFB 420) or approved independent research (e.g., EFB 498, ENS 498, FCH 498) opportunities related to marine topics (must be approved in advance by the marine science minor coordinator).

Directed Electives:

Course number	Course title	Credit hours
EFB 355	Invertebrate Zoology	4
EFB 423	Marine Ecology	4
EFB 486	Ichthyology	3
EFB 487	Fisheries Science and Management	3
FCH 520	Marine Biogeochemistry	3
FCH 525	Oceanography	3
BIO 100	Ocean Life	3
EAR 117	Oceanography	3
EAR 205	Water and Our Environment	3
EAR 210	History of Earth and Life	3
EAR 325	Introduction to Paleobiology	4
EAR 429	Topics in Paleobiology	3
EAR 432	Seafloor Spreading and Oceanographic Lithosphere	3
EAR 544	Quaternary Environmental and Climate Change	3
GEO 327	Geography of Coastal Environments	3

In addition, the following Sea Education Association courses would count toward the minor without petition, and not

subject to the lower division requirement described above (221 Oceanography, 224 Practical Oceanographic Research, 225 Practical Oceanography I, 226 Practical Oceanography II, 320 Ocean Science and Public Policy, 321 Oceans in the Global Carbon Cycle, 324 Advanced Oceanographic Field Methods, 325 Directed Oceanographic Research, 326 The Ocean and Global Change, 327 Toward a Sustainable Ocean: Conservation and Management, 450 Advanced Topics in Biological Oceanography: Biodiversity).

## **Mathematics Minor**

Coordinator: Dr. Gary Scott

The mathematics minor is available to all ESF undergraduates who have an interest in developing greater knowledge in the field of mathematics. To be eligible for this minor, a student must have a cumulative grade point average of 2.700 or better by the end of the sophomore year. Interested students must submit a petition form, with courses listed and plan sheet, to their academic advisor and undergraduate coordinator, with final approval from the Dean of Instruction and Graduate Studies. Sixteen credit hours (5 courses) in mathematics courses are required to complete the minor. Admission to the mathematics minor requires students to have completed Calculus I and Calculus II.

### **Required Courses: (7 credits)**

- APM 307 Calculus III for Scientists and Engineering (4)
- Choice of:
  - APM 485 Differential Equations for Engineers and Scientists (3)
  - MAT 331 First Course in Linear Algebra (3)

### **Elective Courses: (9 credits)**

- APM 395 Probability and Statistics for Engineers (3)
- APM 485 Differential Equations for Engineers and Scientists (3)
- APM 585 Partial Differential Equations for Engineers and Scientists (3)
- APM 635 Multivariate Statistical Methods (3)
- APM 645 Nonparametric Statistics and Categorical Data Analysis (3)
- MAT 4xx Any MAT course numbered 400 or above (3)

## **Microscopy Minor**

Coordinators: Rob Smith, MS and Susan Anagnost, PhD

The Microscopy Minor is available to all undergraduates at ESF, surrounding Universities and interested scientists who desire the latest information on sample preparation methods, practical use and understanding of all microscopes and interpretation of results. Covered within these classes are the following techniques and microscopies: live imaging by light, fluorescence, confocal, polarized, phase, Nomarski, super resolution, Raman, Biacore, Atomic Force and the more involved sample preparation for Electron Microscopy. All scopes are explained in a correlative and interactive approach to each other so that cellular and subcellular image interpretation with digital recordings can be interpreted correctly. Also covered is their ancillary equipment needed for effective use: microtomes (paraffin, cryostat and ultra), freeze substitution and freeze fracture devices, metal evaporation equipment, staining methods emphasizing the advantages of each. Practical experience will be given in identifying the various cellular histology components, immunology, antibody tagging and identification of cell ultrastructure organelles (mostly animals but some plants) in healthy and diseased states. In all courses, current topics are covered citing new publications in high impact journals by noted scientists. This Minor will prepare students to effectively use and align a variety of microscopes for applications in biology, nanotechnology, clinical medicine, chemistry, materials science, engineering, pulp and paper, pharmaceuticals and others.

Admission requires junior status and 2.70 GPA.

The minor requires 12 credits of coursework:

- MCR 480 Fundamentals of Microscopy (3)
- MCR 484 Scanning Electron Microscopy (3)
- MCR 485 Transmission Electron Microscopy (3)
- MCR 570 Medical and Industrial Applications of Microscopy (3)

In addition to the required courses, we offer an introductory lab class into transmission electron microscopy—alignment, illumination, calibration and imaging of nanoparticles:

- MCR 682 Transmission Electron Microscopy for Nanoparticle Research (2)

## **Native Peoples and the Environment Minor**

Coordinator: Dr. Robin Kimmerer

The Native Peoples and the Environment minor is available to all ESF undergraduates. The interdisciplinary suite of courses provides students with a cohesive introduction to Indigenous cultures, worldviews and knowledge systems and their application to environmental thought. The minor creates a conceptual framework for integrating traditional ecological knowledge with western scientific approaches in service to the science of sustainability. Through the breadth of courses and experiences, students will gain an appreciation for both the global nature and the local context of indigenous issues and the environment. The minor includes a required team taught seminar which enhances opportunities for interdisciplinary and cross-cultural integration.

Fourteen credit hours (5 courses) taken in residence are required to complete the minor. Two courses are specified, with an additional two or three courses selected from the list below. An internship may be used to fulfill a course requirement, if focused on Native peoples and the environment

Admission to the minor requires sophomore status with a cumulative GPA of 2.70 or better. Fourteen credit hours of courses are required.

Two required courses: (6 credits)

- EST140 Introduction to Native Peoples, Lands and Cultures (3)
- EFB 305 Indigenous Issues and the Environment (3)

Two or three courses (8 credits) selected from the following list:

- EFB 306 Plants and Culture
- EFB 337 Field Ethnobotany
- EST 390 Social Processes and the Environment
- EST 497 Onondaga Land Rights and our Common Future
- SOC 444 Contemporary Native American Movements
- NAT 142 Native American Religion
- NAT 400 Haudenosaunee/New York State Relations
- EFB 420 Internship (on Indigenous Issues)
- EFB 496 Ecosystem Restoration Design
- EFB 496 Indigenous Stewardship Seminar
- EFB 496 Indigenous Values and Environmental Decisions

Relevant 496 and 497 courses may be acceptable for inclusion in the minor, by petition to the minor coordinator.

## Paper Science Minor

**Coordinator: Dr. Gary Scott**

The paper and related industries (including pulp, mineral, chemical and machinery suppliers) continually seek knowledgeable and skilled employees. Each year, companies hire numerous graduates of chemical, mechanical and environmental engineering programs as well as chemists and other environmental professionals in addition to paper science and engineering graduates. Salaries for new hires are among the highest for all fields of study at the bachelor's degree level. This minor gives students a thorough understanding of the paper industry that will allow them to apply their major field of study to this growth industry.

The paper science minor is available to all ESF undergraduate students (**except students in the paper science and paper engineering programs**) who maintain a minimum cumulative grade point average of 2.70 and who desire to develop greater knowledge of paper science and its related fields. It is recommended that a student enter the minor by the end of the sophomore year, but entry at a later date is possible if course coverage is already in progress.

Eighteen credit hours (6 courses) in paper science courses are required. Specified courses: PSE 300 Introduction to Papermaking (3); PSE 302 Pulp and Paper Laboratory Skills (1); PSE 370 Principles of Mass and Energy Balance (3); and directed electives courses (at least 11 credits): PSE 350 Fiber Processing (3); PSE 437 Troubleshooting and Maintenance (3); PSE 465 Paper Properties (4); PSE 466 Paper Coating and Converting (2); PSE 467 Papermaking Wet End Chemistry (3); PSE 468 Papermaking Processes (6).

## Physics Minor

Coordinator: Dr. Gary Scott

The physics minor is available to all ESF undergraduates who have an interest in developing greater knowledge in the field of physics. To be eligible for this minor, a student must have a cumulative grade point average of 2.7000 or better by the end of the sophomore year. Interested students must submit a petition form, with courses listed and plan sheet, to their academic advisor and undergraduate coordinator, with final approval from the Dean of Instruction and Graduate Studies. Sixteen hours (6 courses) in physics courses are required to complete the minor. Admission to the physics minor requires students to have completed General Physics I (with lab).

### **Required Courses: (4 credits)**

- PHY 212 General Physics II (3)
- PHY 222 General Physics Laboratory II (1)

### **Elective Courses: (12 credits)**

- PHY 3xx Any PHY courses numbered 300 or above

## Recreation Resource and Protected Area Management Minor

- [www.esf.edu/fnrm/undergrad/rrmminor.htm](http://www.esf.edu/fnrm/undergrad/rrmminor.htm)

Coordinator: Dr. Diane Kuehn

This minor provides students with the opportunity to combine visitor management with protected area management. Understanding the need to balance the opportunity for visitor experiences with protecting and stewarding protected areas provides professional insight into planning and managing those areas for limited visitor access. Understanding the motivations, preferences, and behavior of recreational users is necessary to integrate the human dimensions into protected area management with consideration of the social and environmental factors related to such management. Protected area managers need to be able to manage both the resource itself as well as a wide variety of users, such as campers, hikers, bird watchers, boaters, nature photographers and others who enjoy nature-based experiences in

extensive protected area environments owned by public agencies, private landowners, or NGOs.

Students from all programs at ESF are eligible for this minor if they have completed a general ecology course and have a cumulative grade point average of 2.70 or better in their major program of study after one semester at ESF (or as a transfer student with same standing). Overlap between the minor and both one required course and one directed elective for a student's major is permitted; other courses taken for the minor can not overlap with the major.

This interdisciplinary minor requires 15 credits and includes the following courses taught at ESF in the Departments of Forest and Natural Resources Management and Environmental and Forest Biology:

#### Required Courses (9 credits)

Course number	Course title	Credit hours
EFB 312	Introduction to Personal Environmental Interpretation Methods	3
FOR 372	Fundamentals of Outdoor Recreation	3
FOR 475	Human Behavior and Recreation Visitor Management	3

#### Required independent study or internship (3 credits)

Course number	Course title	Credit hours
FOR 498 Section 20, OR FOR 499 Section 20, OR EFB 420 Section 28	Independent study or internship related to minor	3

#### One of the following management/protected area courses (3 credits)

Course number	Course title	Credit hours
EFB 413	Introduction to Conservation Biology	3
FOR 403	Humans and the Environment: New Zealand	4
FOR 476	Ecotourism and Nature Tourism	3
FOR 478	Wilderness and Wildlands Management	3
FOR 523	Tropical Ecology	3

### Renewable Energy Minor

Coordinator: Dr. Tim Volk

The development of sustainable sources of energy has become a critical national and global issue due to concerns about the quality and quantity of the different potential resources, energy security, and potential impacts of each on the environment and human health. It is essential that our society and energy professionals gain an understanding of production and conversion of different forms of energy, their current and future supplies, the markets and policy mechanisms that regulate their supply, and the associated impacts on the environment for each fuel. In the past both traditional and renewable energy sources have been studied one resource at a time and usually from the perspective of a single discipline. This minor will provide students an opportunity to examine different sources of traditional and renewable energy simultaneously in the context of our total energy use using a systems perspective. Students will be exposed to views from a variety of disciplines as they wrestle with a wide array of issues related to current and future energy supply and use.

The Renewable Energy minor is available to all ESF undergraduate students (**except students who are in the Sustainable Energy Management Major or the Renewable Energy option in Environmental Science**) who

have a GPA of 2.70 or better by the end of their sophomore year. The minor will require a minimum of 15 credits, 12 of which are required courses. The remaining 3 credits can be selected from a list of suggested courses.

Fifteen credit hours of courses are required. Specified courses: SRE 325 Energy Systems (3); SRE 335 Renewable Energy (3); SRE 479 Life Cycle Assessment (3); Either CME 305 Sustainable Energy Systems for Buildings (3) or SRE 441 Biomass Energy (3) and a minimum of three credits from the following list of suggested courses: CME 305 Sustainable Energy Systems for Buildings (3) OR SRE 441 Biomass Energy; SRE 422 Energy Markets and Regulation (3); SRE 454 Renewable Energy Finance and Analysis (3); SRE 416 Sustainable Energy Policy (3); SRE 419 Policy Assessment Methodologies (3); ERE 351 Basic Engineering Thermodynamics (2); ERE 380 Energy Systems Engineering; ERE 519 Green Entrepreneurship (3); FCH 360 Physical Chemistry I (3); PSE 361 Engineering Thermodynamics (3); PSE 370 Principles of Mass and Energy Balance (3).

## **Sustainable Construction Minor**

Coordinators: Paul Crovella & Dr. Susan Anagnost

The sustainable construction minor is available to all ESF undergraduates (except students in construction management) and prepares students for careers related to sustainable construction. The objective of the minor is to provide a fundamental understanding of the concepts and methods used to take a design into the field and build a quality sustainable structure in the most efficient and effective manner with minimal environmental impact. Admission to the minor requires sophomore status and a cumulative grade point average of 2.70 or higher.

A cumulative grade point average of 2.000 or higher is required for the sustainable construction management courses in order to obtain the minor.

Fifteen credit hours are required to complete satisfy the minor. Choose 5 courses (15 credits) from the following:

- CME 215 Sustainable Construction (3)
- CME 387 Renewable Materials for Sustainable Construction (3)
- CME 305 Sustainable Energy Systems for Buildings (3)
- CME 306 Engineering Materials for Sustainable Construction (3)
- CME 304 Environmental Performance Measures for Buildings (3)
- CME 343 Construction Estimating (3)
- CME 405 Building Information Modeling (3)
- CME 422 Composite Materials for Sustainable Construction (3)
- CME 565 Sustainable Innovations in Residential Construction (3)
- CME 444 Materials Marketing (3)
- CME 453 Planning and Scheduling (3)
- CME 454 Project Management (3)
- EST 426 Community Planning and Sustainability (3)
- EST 427 Environmental & Energy Auditing (3)
- EST 460 Land Use Law (3)
- EST 550 Environmental Impact Analysis (3)

## **Urban Environmental Science Minor**

- [www.esf.edu/urban/minor.htm](http://www.esf.edu/urban/minor.htm)

Coordinator: Dr. Margaret Bryant

Twelve credit hours (4 courses) of urban concentration courses are required to satisfy the minor: 6 credits of required

courses and 6 credits of electives outside the student's major. Entry into the minor requires a minimum cumulative GPA of 2.70 in residence at ESF.

### Core Course Requirements

To satisfy the Minor in Urban Environmental Science, the student must take the following core courses:

Course #	Course Title	Credits	Expected time of completion (Semester/Year)
EST/EFB 220	<a href="#">Urban Ecology</a>	3 credits	(offered Autumn)

and three credits of a "Capstone" project accomplished from among the following:

xxx 496	Approved 'experimental' course	3 credits
xxx 498	Approved Independent Research Project	3 credits
xxx 499	Approved Internship	3 credits
Established Course	Approved Course	3 credits

A student enrolled in the minor, will present to the advisory committee in the sixth week of the semester prior to engagement in the learning endeavor, a plan for a "capstone" experience, which will be undertaken working in conjunction with a faculty member(s) who will oversee an off-campus internship (courses numbered 499), independent-study project (courses numbered 498), or completion of a final project undertaken in a special topic (courses numbered 496) or established 3-credit course. All students will present their completed projects to the advisory committee and their peers in the last week of classes, depending on the semester of completion (fall or spring). All students currently enrolled in the minor are expected to attend capstone presentations.

### Elective Course Requirements

**Outside** the student's Major, **6 additional** credits selected from the [list of approved courses](#), which are offered in a faculty other than that of the student's major, and which are above and beyond those courses being used to satisfy a student's major, general education or professional requirements.

### Urban Forestry Minor

**Coordinator: Dr. Doug Morrison**

The Urban Forestry minor will provide students with the opportunity to better understand complex human-dominated ecosystems where trees and people coexist in close proximity. Understanding and attempting to manage this complexity requires a basic knowledge of plant physiology, nutrition, and tending at the individual tree level (arboriculture). In addition, the urban forester also must understand the changing dynamic of groups of trees and the effects of those trees on numerous ecosystem services and human health and well-being in a city (urban forestry). Because human activity is so dominant in the urban ecosystem, it is essential that the urban forester have some understanding of ecological interactions and human motivations for sustaining and maintaining existing trees (urban ecology). The courses listed below will provide the professional knowledge required for careers in these and related fields.

Fifteen credit hours are required: FOR 480 Urban Forestry (3), FOR 481 Introduction to Arboriculture (3), EST 220 Urban Ecology (3), ESF 300 Introduction to Geospatial Information Technologies (3) and LSA 480 Seminar in Urban Design (3).

The interdisciplinary minor includes courses taught in the Departments of Forest and Natural Resources Management, Environmental Studies, and Landscape Architecture. Admission to this minor requires students to have (1) completed

a general ecology course (e.g. EFB 320 General Ecology), (2) a cumulative grade point average of 2.70 or greater after one semester at ESF (or as a transfer student with the same GPA).

## **Water Resources Minor**

Coordinators: Dr. John Stella, Dr. Kim Schulz and Dr. Chuck Kroll

Water resources is a multi-disciplinary field that integrates the physical, geochemical and biological processes of the water cycle and their application to management of water resources, water policy, and human dimensions of water quality and quantity. The interdisciplinary minor in water resources is designed as a flexible program for undergraduate students to study and integrate principles of physical hydrology, geochemistry, aquatic and terrestrial ecology, natural resources management, and environmental policy. This interdisciplinary minor can include SUNY ESF courses in the Departments of Forest and Natural Resources Management, Environmental Resources and Forest Engineering, Environmental and Forest Biology, Chemistry, and Environmental Studies, as well as courses at Syracuse University in relevant departments including Earth Sciences, Geography, Civil and Environmental Engineering, and Biology. The minor comprises 15 credit hours total, including one required course, FOR 442 Watershed Ecology and Management (3). The remaining twelve units must be taken from a list of approved elective courses in at least two separate departments. Admission to this minor requires that a student from any ESF program has a cumulative grade point average of 2.70 or better after one semester at ESF (or as a transfer student with same GPA). Students are responsible for meeting the prerequisite requirements for individual courses, as applicable.

Core course:

- **FOR 442 Watershed Ecology and Management (3)**

Approved elective courses are:

- **CIE 471 Environmental Chemistry (3, at SU)**
- **EFB 415 Ecological Biogeochemistry (3)**
- **EFB 423 Marine Ecology (4)**
- **EFB 424 Limnology (3)**
- **EFB 486 Ichthyology (3)**
- **EFB 487 Fisheries Science and Management (3)**
- **EFB 488 Fisheries Science Practicum (3)**
- **EFB 492 Senior Synthesis in Aquatic and Fisheries Science (1)**
- **EFB 496 Watershed Ecology with Focus on the Hudson River (2)**
- **EFB 500 The Hudson River Watershed: Source to Sink in Eight Days (1-2)**
- **EFB 525 Limnology Practicum (2)**
- **EFB 542 Freshwater Wetland Ecosystems (3)**
- **EFB 554 Aquatic Entomology (3)**
- **ENS 601 Water Resources Management**
- **ENS 607 Wetland Practicum**
- **ERE 340 Engineering Hydrology and Hydraulics**
- **ERE 440 Water Pollution Engineering**
- **ERE 412 River Form and Process**
- **ERE 445 Hydrologic Modeling**
- **ERE 475 Ecological Engineering for Water Quality**
- **ERE 496 Water - An Incredible Journey (3)**

- **ERE 527 Stormwater Management**
- **EST 796 Human Dimensions of Water Problems**
- **EST 625 Wetland Management Policy (3)**
- **EST 628 Great Lakes Policy and Management (3)**
- **FCH 510 Environmental Chemistry I (3)**
- **FCH 515 Methods in Environmental Chemical Analysis (3)**
- **FCH 520 Marine Biogeochemistry (3)**
- **FCH 525 Oceanography (3)**
- **FOR 338 Meteorology (3)**
- **FOR 340 Watershed Hydrology (3)**
- **GEO 316 River Environments (3, at SU)**
- **EAR 400 Contaminant Hydrogeology (3, at SU)**
- **EAR 400 Aqueous Geochemistry (3, at SU)**
- **EAR 541 Hydrogeology (3, at SU)**

# Special Academic Options

## Undergraduate Study

- [Undergraduate Degree Programs](#)
- [Minors](#)
- [General Education](#) (GenEd)

## Honors Programs

- [www.esf.edu/honors](http://www.esf.edu/honors)

The ESF Honors Program is a two-way street: the College provides enrichment, experience and special opportunities for our most promising students and our honors students provide leadership and service to the Honors Program, the College, and the broader community. Honors students translate their academic skills into leadership, service or both (e.g., undergraduate student government, leadership or membership on special committees, student clubs), or in campus service (e.g., Orientation Leaders, student mentors, ESF ambassadors). We hope former honors students will return to campus after graduation to share their post-graduate experiences with their younger peers.

In line with these broad goals, ESF offers two distinct honors programs:

- [Lower Division Honors Program](#) (for freshmen and sophomores)
- [Upper Division Honors Program](#) (for juniors and seniors)

The Lower Division Honors Program provides first- and second-year students with value-added educational experiences that engage students in unique challenges. Academic components of the program strengthen exploration and communication skills through interdisciplinary assignments and discussion.

The Upper Division Honors Program provides opportunities for junior and senior students to complete intensive research and creative projects under the guidance of faculty, emphasizing and encouraging holistic and multidisciplinary awareness of the problems and opportunities in studying the environment.

## Service-Learning Program

- [www.esf.edu/students/service](http://www.esf.edu/students/service)

Service-learning is a form of structured experiential education in which students engage with the community to be active learners, enrich their sense of civic responsibility and explore a practical application for course content. Faculty oversight, students' reflective thinking and college/community reciprocity are key components of service-learning.

For a list of courses that have incorporated service learning in the past, please refer to the [service-learning website](#).

## International Study Abroad

- [www.esf.edu/studyabroad](http://www.esf.edu/studyabroad)

SUNY-ESF is committed to enhancing the internationalization of ESF students' academic experiences. ESF believes strongly that international experiences provide students with the opportunity to develop the skills necessary to be

## Special Academic Options

- [Dual Majors](#)
- [Honors Programs](#)
- [Service-Learning Program](#)
- [International Study Abroad](#)
- [Pre-professional Advising](#)
  - [Medical and Health Professions](#)
  - [Law](#)
  - [Public Administration](#)
- [Coordinated Programs](#)
  - [SUNY Upstate Medical University Entry Level Doctor of Physical Therapy Program \(DPT 3+3\)](#)

informed, active, responsible, and culturally-sensitive global citizens.

The Office of International Education assists students who wish to participate in the College's diverse study and research abroad opportunities noted below.

- [SUNY-ESF Faculty-led, Short-term International Academic Courses](#)
- [SUNY-ESF Exchange Programs](#)
- [Additional Study Abroad Programs](#) (SUNY system, Syracuse University, affiliated programs and non-affiliated programs)
- [Student Research and Volunteering Abroad](#)

## Pre-professional Advising

- [www.esf.edu/prepro](http://www.esf.edu/prepro)

## Medical and Health Professions (medicine, dentistry, optometry & veterinary medicine)

- [www.esf.edu/prehealth](http://www.esf.edu/prehealth)

ESF students interested in medicine, dentistry, optometry and veterinary medicine are encouraged to identify themselves to the ESF Pre-Health Coordinator who can then assist them in exploring these pathways, advising them on academic qualifications and preparing for the application process.

Additionally, several academic departments pair pre-health interested students with academic advisors who have particular expertise in these areas. ESF pre-professional interested students may also participate in the Health Professions Advisory Program (HPAP) offered through Syracuse University.

## Law

- [www.esf.edu/prelaw](http://www.esf.edu/prelaw)

ESF offers pre-professional advising to students interested in pursuing law as a profession.

Unlike some other professional programs, law schools do not require or recommend a specific program of study or specific coursework. Instead, the Law School Admissions Council advises students who are interested in the legal profession to pursue undergraduate education that demonstrates success in intellectually challenging curricula that enhance students' critical thinking skills.

## Public Administration

- [www.esf.edu/prepa](http://www.esf.edu/prepa)

Students considering graduate studies in public administration are encouraged to meet with ESF's pre-PA advisor as early in their academic careers as possible to discuss how a MPA program may help them achieve their educational goals and to take advantage of services, such as ESF's M.P.A. articulation agreement with **Binghamton University** and ESF's joint degree program with **Syracuse University's** top-rated Maxwell School M.P.A. program.

## Binghamton University M.P.A.

Binghamton University's M.P.A. program specializes in preparing students to work in local government or the nonprofit sector. The program offers students the option of starting in either the fall or spring and has both full and part-time students.

ESF undergraduate students earning a 3.300 GPA and completing one course each from the following table of core competency areas are assured entry into Binghamton's Master of Public Administration program.

<b>MPA Competency</b>	<b>ESF Course(s) Providing Foundation in Competency</b>
Management and Administration	FOR 360: Principles of Management
Statistics	APM 391: Intro. to Probability and Statistics
Economics	FOR 333: Managerial Economics for Env. Professionals
Government Policy	FOR 465: Natural Resources Policy or EST 321: Government and the Environment
Accounting, Budgeting, and/or Finance	FOR 205: Principles of Accounting

Please meet with the pre-PA advisor Dr. Robert Malmshemer ([rwmalmsh@esf.edu](mailto:rwmalmsh@esf.edu)) or the dean of Instruction & Graduate Studies for additional information regarding BU's ESF-MPA articulation agreement.

## Coordinated Programs

- [www.esf.edu/academics/coordinated.htm](http://www.esf.edu/academics/coordinated.htm)

### SUNY Upstate Medical University Entry Level Doctor of Physical Therapy Program (DPT 3+3)

- [www.esf.edu/academics/coordinated.htm](http://www.esf.edu/academics/coordinated.htm)

In collaboration with SUNY Upstate Medical University (UMU), ESF students may apply to an entry-level doctor of physical therapy program (DPT 3+3). ESF undergraduates who are completing bachelor of science degrees within the [Department of Environmental and Forest Biology](#) are eligible for admission.

### Joint BS/MD Program for High School Students

- [www.esf.edu/prehealth/umu.htm](http://www.esf.edu/prehealth/umu.htm)

This program addresses the shortage of physicians in rural communities of New York State. There is evidence that people who grow up in rural communities or who trained there will later return to set up medical practice in a rural setting. This program will also attempt to provide a more diverse student population for entry into physician training programs. Acceptance into this program indicates willingness to participate in the [Rural Medical Scholars Program \(RMSP\)](#). Students who enroll in this program will be assigned to the RMSP track as a medical student at SUNY Upstate Medical University.

Interested students who have been admitted to SUNY-ESF for freshman entry and meet the specified criteria may apply for the Joint BS/MD program. Those nominated by the SUNY-ESF Selection Committee will be reviewed by the Admissions Committee at SUNY-UMU and, if selected for consideration, will be required to participate in an on-campus interview at SUNY-UMU. The SUNY-UMU Admissions Committee selects candidates for the Joint BS/MD program.

For more information regarding any of these coordinated programs, please go to the [SUNY-ESF "Pre-Health"](#) web site and contact the Admissions Offices at both SUNY-ESF and SUNY-UMU.

# Graduate Study: Degrees and Options

- [Degree Programs and Areas of Study](#) (list of all programs)
- [Graduate School website](#)

Graduate academic programs at ESF share a foundation of rigorous science and dedication to wise use of natural resources. ESF offers advanced degrees in six program areas. Each program provides a unique opportunity for you to further your education with professors who are dedicated to both their teaching and research endeavors.

Ecosystems all over the world benefit from the professionalism and expertise of ESF graduates and the faculty members at the College of Environmental Science and Forestry. You will study with professors whose work improves and sustains the environment from the Yucatan Peninsula to Alaska and whose expertise is sought by government and corporations. That same faculty will be personally concerned with your progress. The professors' cutting-edge research will become part of your classes, and your classes will merge with the world beyond the College.

## Degree Programs

ESF is authorized by the New York State Department of Education to offer undergraduate and graduate degree programs as described in this catalog. The Higher Education General Information Survey (HEGIS) code is the number assigned to programs registered by the commissioner of the New York State Department of Education. The Classification of Instructional Programs (CIP) Code allows the U.S. Department of Education to track educational programs for financial aid eligibility. Enrollment in programs that are not registered or otherwise approved may jeopardize a student's eligibility for certain financial aid programs.

## Areas of Study

The general area of study for each master's or doctoral student is implied by the title of the program in which the degree is awarded. Areas of study may be established within degree programs by individual departments that further define the student's area of specialization. The student's area of study is listed on the student's transcript if identified on the study plan.

Additionally, each department may offer minors identifying ancillary areas of study that may be appropriate for the degree program. A minor is equivalent to 12 or more graduate credits earned in the minor area. Courses in a minor area must be taken outside of the student's area of study. A minor is identified on the student's transcript. A minor professor must be appointed to the student's steering committee for each minor elected, in addition to the minimum complement of steering committee members. Each minor professor can replace an additional examiner.

## Graduate Degrees

Ph.D., M.S., M.P.S., M.L.A. & M.F.

- [www.esf.edu/graduate](http://www.esf.edu/graduate)

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  - [Master of Landscape Architecture](#)
  - [Master of Professional Studies](#)
  - [Master of Science](#)
  - [Doctor of Philosophy](#)
- **Advanced (Graduate) Certificates**
- **Concurrent and Cooperative Programs**
  - [Concurrent Graduate Degrees with Syracuse University & Upstate Medical University](#)
  - [Concurrent Programs for Syracuse University Students](#)
  - [Cooperative Programs at Cornell University and SUNY Upstate Medical University](#)
  - [Intra-ESF Concurrent Degree Programs](#)

Four master's degrees are offered at ESF—master of science, master of forestry, master of landscape architecture, and master of professional studies—as well as the doctor of philosophy degree. The following section describes the requirements for graduate degree programs offered by the College.

## **Master of Forestry (M.F.)**

- [www.esf.edu/graduate/mf.htm](http://www.esf.edu/graduate/mf.htm)

The Master of Forestry (MF) graduate degree program enables students to integrate knowledge and expertise drawn from both the natural and social sciences, and to apply their knowledge to solve practical forest management problems.

The primary focus of the program is to provide an opportunity for graduates coming from diverse academic backgrounds with non-forestry baccalaureates to gain a professional education in forestry. As such, the program is designed to be the first professional degree in forestry attained by a student. Graduates will successfully function as professional foresters on multi-disciplinary forest management teams and respond to the challenges related to the sustainable management of local, regional, and global forest resources.

The degree requires 37 graduate credits of coursework, of which at least 24 must be taken in residence at ESF. The degree meets the accreditation standards of the Society of American Foresters, recognized by the Council on Higher Education as the specialized accrediting body for forestry in the United States.

The program is open to both students with some prior background in forestry and natural resources, and for those without such background. More than four (4) semesters may be required for students from non-science backgrounds who need additional basic undergraduate coursework as part of their degree program. The MF program is designed for May admission to accommodate a 4-week summer field course.

## **Master of Landscape Architecture (M.L.A.)**

- [www.esf.edu/graduate/mla.htm](http://www.esf.edu/graduate/mla.htm)

Graduate studies in landscape architecture attract a broad range of people. Those with undergraduate degrees in landscape architecture may seek specialization within the profession, advanced exploration or an academic career. Others, with degrees in related fields such as architecture, city and regional planning, and environmental design, enter the program to broaden or redirect their design and planning skills. Some students with degrees in fields less closely related (such as humanities or arts and sciences) seek new career options or to focus prior interests through a licensed design and planning profession.

### **The degree is accredited by the Landscape Architectural Accreditation Board (LAAB).**

A three-year program for applicants who have no design or planning background leads to the fully accredited professional degree of master of landscape architecture (M.L.A.). This program is for students who intend to complete coursework full time. Applicants with a related design or planning degree may enter the three-year program with advanced standing.

The M.L.A. program, for the student seeking a first professional degree in landscape architecture, is a more tightly structured curriculum because it leads to the prerequisite work experience that qualifies the graduate for the Landscape Architecture Registration Examination (L.A.R.E.).

## **Master of Professional Studies (M.P.S.)**

- [www.esf.edu/graduate/mps.htm](http://www.esf.edu/graduate/mps.htm)

The Master of Professional Studies (M.P.S.) degree is intended to be a terminal degree. The M.P.S. is offered in the following degree programs: chemistry, environmental and forest biology, forest resources management, environmental

resources engineering, environmental science, and environmental studies.

This degree requires the successful completion of a minimum of 30 credits at the graduate level, of which at least 24 must be in course work. The student's program of study must be approved by the major professor, steering committee and Department Chairperson.

In addition, individual programs may require an integrative experience such as an internship, team project and/or comprehensive examination. If an examination is required, it is developed and managed by the department responsible for the program.

## **Master of Science (M.S.)**

- [www.esf.edu/graduate/ms.htm](http://www.esf.edu/graduate/ms.htm)

The master of science (M.S.) degree is an academic degree offered in the following programs: environmental and forest chemistry, environmental and forest biology, environmental studies, forest resources management, environmental resources engineering, environmental science, and landscape architecture.

To complete this degree, in addition to completion of necessary coursework, students must investigate a problem that initiates, expands, or clarifies knowledge in the field and prepare a thesis based on this study. Students are required to define an appropriate problem for investigation; review relevant information; develop a study plan incorporating investigative techniques appropriate to the problem; implement the plan; and relate the results to theory or a body of knowledge in the field.

The minimum credit-hour requirement is the successful completion of 30 graduate credits distributed between coursework and thesis. The applicable distributions will be determined by individual departments to suit program objectives, with the understanding that a minimum of 18 credits is awarded for graduate-level coursework and a minimum of six credits is awarded for the thesis. All steering committee members should sign the student's study plan (Form 3B) before the end of the last year of the student's program. The student must successfully defend the thesis for degree completion. The thesis is prepared and bound according to college standards and submitted to ProQuest.

## **Doctor of Philosophy (Ph.D.)**

- [www.esf.edu/graduate/phd.htm](http://www.esf.edu/graduate/phd.htm)

The doctor of philosophy (Ph.D.) degree is an academic degree offered in the following degree programs: environmental and forest chemistry, environmental and forest biology, forest resources management, environmental resources engineering, and environmental science. The doctor of philosophy degree requires a minimum of 60 graduate credits, of which 30 to 48 credits are for coursework and 12 to 30 credits are awarded for dissertation. Individual departments will determine the applicable credit hour requirements within these ranges to reflect individual program requirements and emphases. The graduate credits earned for a master's degree that are applicable to a student's doctoral study plan (Form 3B) are determined on an individual basis by the steering committee. All steering committee members should sign the 3B form before the end of the last year of the student's program. Students may not use master's thesis credits to fulfill doctoral program coursework requirements.

Students must pass the doctoral candidacy examination covering selected fields of study at least one year prior to dissertation defense and successfully defend the dissertation. The dissertation must be prepared according to college standards and submitted to ProQuest.

# Advanced (Graduate) Certificates

In addition to degree programs for matriculated students, ESF offers study towards the earning of advanced certificates for professionals in:

- [Advanced Study of Conflict Resolution](#)
- [Advanced Study of Sustainable Enterprise](#)
- [Bioprocessing](#)
- [Environmental Decision Making](#)
- [Radiation Curing](#)

## Concurrent and Cooperative Programs

### Concurrent Graduate Degrees with Syracuse University & Upstate Medical University

- [www.esf.edu/graduate/special.htm](http://www.esf.edu/graduate/special.htm)

ESF has formal agreements for the following concurrent degrees in conjunction with Syracuse University:

- the master of public administration (M.P.A.) in the Maxwell School of Citizenship and Public Affairs,
- the master of arts (M.A.) or master of science (M.A.) in the S.I. Newhouse School of Public Communications,
- the master of science (M.S.) in the School of Education, and
- the master of business administration (M.B.A.) in the School of Management.

Other concurrent degree programs may be developed with approval by the Associate Provost for Instruction and Dean of the Graduate School. To be eligible for admission, matriculated students must complete at least twelve credits of graduate-level coursework and earn a 3.75 grade point average or better at ESF and complete the application materials required by the particular program.

Beginning in the 2015-2016 Academic Year, ESF students may now also participate in concurrent degree programs with Upstate Medical University, beginning with the Central New York Master of Public Health (CNYMPH) degree program

### Concurrent Programs for Syracuse University Students

- [www.esf.edu/fnrm/graduate/mpssulaw.htm](http://www.esf.edu/fnrm/graduate/mpssulaw.htm)

The joint Juris Doctor (J.D.) and Forest and Natural Resources Management (FNRM) Master of Professional Studies (M.P.S.) degree is designed for Syracuse University students who are interested in legal careers involved with forest, natural, and environmental resources. As human demands on the environment increase, society needs attorneys who understand the economic, demographic, social, and political issues that drive resource use allocation. Students learn the complexities of managing both resources and people recognizing that resource and environmental decisions involve value-driven conflicts. The degree provides a comprehensive foundation in forest, natural, and environmental resources issues and an understanding of both biophysical and social science.

Students enrolled in the joint J.D./FNRM degree program must earn a minimum of ninety-six (96) credits at both the College of Law and ESF. The J.D. normally requires eighty-seven (87) credits, but joint-degree students must take at least seventy-two (72) Law School credits. Students can transfer fifteen (15) credits from ESF to the College of Law. The M.P.S. degree requires thirty (30) credits, a minimum of twenty-four (24) of which must be ESF courses and six (6) of which may be applied by transfer from coursework at the College of Law.

Students can apply to the joint J.D./FNRM degree program at two points: 1) simultaneously, before entering the

College of Law, or 2) after completing the fall semester of study at the College of Law. Applicants applying simultaneously must complete a College of Law application and an ESF graduate application. Applicants applying after enrolling at the College of Law must complete an “internal” College of Law application and ESF graduate application.

Graduate students at Syracuse University may also consider the certificate of graduate studies in environmental decision-making offered through the Department of Environmental Studies.

### **Cooperative Programs at Cornell University & SUNY Upstate Medical University**

- [www.esf.edu/graduate/special.htm](http://www.esf.edu/graduate/special.htm)

ESF and the New York State College of Agriculture and Life Sciences at Cornell University provide exchange opportunities so that graduate students can take advantage of special courses, faculty, and research facilities found at the two institutions. Cornell University is in Ithaca, N.Y., about 50 miles southwest of Syracuse.

ESF and the SUNY Upstate Medical University provide opportunities for graduate students at each institution to enroll in graduate coursework or pursue coordinated M.D./Ph.D. degrees in environmental medicine. SUNY Upstate Medical University is located within walking distance of ESF.

Graduate students interested in these opportunities should contact the ESF Office of Instruction and Graduate Studies.

### **Intra-ESF Concurrent Degree Programs**

- [www.esf.edu/graduate/special.htm](http://www.esf.edu/graduate/special.htm)

ESF graduate students have engaged in concurrent degree programs with Syracuse University for three decades. As of 2009, ESF graduate students may now undertake formal concurrent graduate degrees in two different departments or academic units within the College.

Concurrent degrees magnify the strengths of academic program offerings within ESF. Pairing an academic degree (Ph.D. or M.S.) with a professional degree (M.L.A., M.P.S., M.F.), or pairing two professional degrees (M.L.A., M.P.S., M.F.) are attractive choices for ESF students. Please consult with individual departments for details regarding specific degree or program combinations. Concurrent degrees require a minimum of 80 percent of the credit hour requirements of each of the paired degrees. Students may apply for admission to both degrees at matriculation, or they may apply to add the second degree following completion of at least 12 credit hours of coursework with a minimum GPA of 3.5. Graduate students interested in these opportunities should contact the ESF Office of Instruction and Graduate Studies.

# Department of Chemistry

Ivan Gitsov, Chair

217 Jahn Laboratory

315-470-6851

- [www.esf.edu/chemistry](http://www.esf.edu/chemistry)

The Department of Chemistry at SUNY-ESF is unique in that it is organized around the interdisciplinary areas of biochemistry and natural products chemistry, environmental chemistry and polymer chemistry. It stresses a strong foundation in the traditional areas of chemistry (analytical, inorganic, organic and physical chemistry) plus integration of these areas into its specialties. Thus, students at all levels enjoy the advantages of a chemistry program with specialties aligned with the needs of the 21st century.

The department is committed to maintaining its leading role in extending the state of knowledge in its specialties. The department's home is the 71,000-square-foot Edwin C. Jahn Laboratory. This state-of-the-art facility for research and teaching is well equipped with instruments needed for modern chemical research. The department involves all of its students in research, giving them familiarity with the actual practice of chemistry.

## Bachelor of Science in Chemistry

- [www.esf.edu/chemistry/undergrad](http://www.esf.edu/chemistry/undergrad)

In pursuing a bachelor of science in chemistry, students first receive a strong foundation in analytical, physical, organic and inorganic chemistry before selecting one of three options leading to the degree: biochemistry and natural products, environmental chemistry, and natural and synthetic polymer chemistry.

Each option offers an advanced course of studies beyond the basic courses of the classical undergraduate chemistry curriculum. All options are excellent grounding for professional work at the B.S. level or for advanced graduate study.

### Biochemistry and Organic Chemistry of Natural Products

- [www.esf.edu/chemistry/bocnp](http://www.esf.edu/chemistry/bocnp)

This option stresses a chemical approach to problems in the life and health sciences. Students take advanced courses in natural products chemistry, chemical analysis, and biochemistry. Professional electives in botany, chemical ecology, genetics and molecular biology strengthen connections in the life and health sciences.

Research areas include the elucidation of chemical signals by which organisms communicate with each other, the role of trace metals in the growth of microorganisms, the origin and function of biologically active natural compounds, and synthetic biology and metabolic engineering for the production of value-added products and antimicrobial compounds.

### Environmental Chemistry

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    - Environmental Chemistry (M.P.S., M.S., Ph.D.)
    - Organic Chemistry of Natural Products (M.P.S., M.S., Ph.D.)
    - Polymer Chemistry (M.P.S., M.S., Ph.D.)
    - Chemical Ecology (M.S., M.P.S., Ph.D.)
    - Structural Biology, Biochemistry and Biophysics (Ph.D.)

- [www.esf.edu/chemistry/environmental](http://www.esf.edu/chemistry/environmental)

Environmental chemistry stresses applications of fundamental chemical principles to describe and predict behavior of chemicals in the environment. After obtaining a strong foundation in analytical, physical and organic chemistry, students pursue advanced study in air and water chemistry.

Students in the undergraduate program in the Environmental Chemistry option take all the core chemistry courses as outlined on the chemistry curriculum. In their senior year, they take two lecture courses and one laboratory course in Environmental Chemistry:

- FCH 510 Environmental Chemistry I - Aquatic Chemistry
- FCH 511 Environmental Chemistry II - [Atmospheric Chemistry](#)
- FCH 515 Methods of Environmental Chemical Analysis

The senior year culminates in a senior research project undertaken under the supervision of one of the chemistry faculty. This gives students the opportunity to experience research ranging from laboratory work to field-intensive studies.

## Natural and Synthetic Polymer Chemistry

- [www.esf.edu/chemistry/undergrad/polychem.htm](http://www.esf.edu/chemistry/undergrad/polychem.htm)

Students take advanced courses in mechanisms of polymerization and polymer synthesis, physical properties and characterization of polymers, and laboratory techniques of polymer synthesis and characterization. Special topics courses in contemporary polymer and material science are available as electives. In addition, courses in carbohydrate chemistry provide a solid background for chemists planning careers in paper, plastic, high-tech, energy, membranes, and related areas. Biochemistry is an appropriate elective for students interested in the growth of biotechnologies while environmental chemistry complements this program for students interested in working on problems of biodegradation.

## Lower Division Required Courses

Course		Codes*	Credits
APM 205	Calculus I for Science and Engineering	G	4
APM 206	Calculus for Science and Engineering II	G	4
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 103	General Biology II: Cell Biology and Genetics	G	3
EFB 104	General Biology II Laboratory	G	1
ESF 200	Information Literacy		1
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 132	Orientation Seminar: Chemistry		1
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
FCH 221	Organic Chemistry I		3

FCH 222	Organic Chemistry Laboratory I		1
FCH 223	Organic Chemistry II		3
FCH 224	Organic Chemistry Laboratory II		1
FCH 232	Career Skills for Chemists		1
PHY 211	General Physics I	G	3
PHY 212	General Physics II		3
PHY 221	General Physics I Laboratory		1
PHY 222	General Physics II Laboratory		1

### Lower Division Electives

Course	Codes*	Credits
Math Elective (Calculus III [APM307] or Statistics [APM391])		3
Free Elective		2
General Education Courses	G	9

### Upper Division Required Courses

Course	Codes*	Credits
EWP 405	Writing for Science Professionals	1 - 3
FCH 325	Organic Chemistry III	4
FCH 360	Physical Chemistry I	3
FCH 361	Physical Chemistry II	3
FCH 380	Analytical Chemistry I: Gravimetric, Titrimetric and Potentiometric Analysis	3
FCH 381	Analytical Chemistry II: Spectroscopic, Chromatographic and Electroanalytical Instrumental Technique	3
FCH 384	Spectrometric Identification of Organic Compounds	1 - 2
FCH 410	Inorganic Chemistry	3
FCH 495	Introduction to Professional Chemistry	1
FCH 497	Undergraduate Seminar	1
FCH 498	Introduction to Research	1 - 5

**NOTE:** FCH 384 is a 2 credit course

**NOTE:** FCH 498 is a 5 credit course

### Upper Division Electives

Course	Codes*	Credits
Professional Electives <i>Students should complete a three-semester set of professional electives chosen from a list of courses available in the Department of Chemistry office. The courses provide a wide range of study including biology, chemistry, ecology, forestry, environmental law, mathematics, geology, physics, biophysics, and various engineering disciplines.</i>		9
Electives		9

## Option Courses

### Biochemistry and Natural Products Option

Course		Codes*	Credits
FCH 530	Biochemistry I		3
FCH 531	Biochemistry Laboratory		3
FCH 532	Biochemistry II		3

### Environmental Chemistry Option

Course		Codes*	Credits
FCH 510	Environmental Chemistry I		3
FCH 511	Atmospheric Chemistry		3
FCH 515	Methods of Environmental Chemical Analysis		3

### Natural and Synthetic Polymer Chemistry Option

Course		Codes*	Credits
FCH 550	Polymer Science: Synthesis and Mechanisms		3
FCH 551	Polymer Techniques		3
FCH 552	Polymer Science: Properties and Technology		3

**Total Minimum Credits For Degree: 121**

## Graduate Programs

- [www.esf.edu/chemistry/graduate](http://www.esf.edu/chemistry/graduate)

The Department of Chemistry at ESF is unique in that it is structured around four areas of application:

- [Biochemistry](#)
- [Environmental Chemistry](#)
- [Organic Chemistry of Natural Products](#)
- [Polymer Chemistry](#)

Faculty members in the department are internationally recognized experts and are well funded by federal agencies (NSF, DOE, NASA, etc.), industry, government, and NGOs. Graduate students commonly receive national fellowships. The environment for graduate students is challenging but supportive, as faculty are invested in student success.

Graduate degrees require an appropriate program of courses at ESF and Syracuse University. Master of Science and doctoral students must complete a minimum of 18 credit hours and 30 credit hours of graduate level coursework, respectively. In addition, doctoral students must pass a doctoral candidacy examination.

Current research projects encompass natural and synthetic polymer chemistry, biochemistry and microbiology; organic chemistry of natural products and chemical ecology; environmental chemistry of air and water; climate change.

## Masters in Professional Studies (M.P.S.) Degree

- [www.esf.edu/chemistry/graduate/mps.htm](http://www.esf.edu/chemistry/graduate/mps.htm)

The Masters in Professional Studies is designed as a coursework-based program intended for students who need additional courses in Chemistry, but who are not planning on pursuing a research career in the field. M.P.S. students take courses in any of the subject areas of the department: Biochemistry, Environmental Chemistry, Inorganic Chemistry, Natural Products/Organic Chemistry and Polymer Chemistry. The curriculum is sufficiently flexible to allow a student interested in specializing in one of these areas to take the core sequence in that area, although this is not strictly required. Students who have taken any of these courses as undergraduates may not repeat them for graduate credit.

All students entering graduate programs at ESF are expected to be proficient in communication skills, including technical writing and library skills. This applies to M.P.S. students also and they are required to have completed at least one course in technical writing and one course in library usage, either as an undergraduate or as a graduate student. Alternatively, graduate students can meet the requirement by demonstrating the equivalent in experience in writing and library skills, as determined by the steering committee.

In addition to the formal coursework, the M.P.S. program also requires an integrative experience that allows one to synthesize one's knowledge. This can be a detailed analysis of one particular area of chemistry, an independent study, internship with industry, or work in a research laboratory. The integrative experience should be approved by the student's steering committee prior to starting and the student will be expected to present a written final report on the integrative experience.

### M.P.S. Program Requirements

The Master of Professional Studies (M.P.S.) degree requires a total of 30 credits (minimum) in the following configuration:

Area	Credits
Chemistry, in the areas of Biochemistry, Environmental Chemistry, Inorganic Chemistry, Natural Products Chemistry or Polymer Chemistry.	15
Other sciences, engineering and mathematics	6
Seminars	3
Integrative experience (internship or independent study)	3
Elective coursework, seminars, internships or research experience	3
	<b>Total (minimum) 30</b>

- **15 credits of advanced chemistry courses**, including graduate chemistry courses are available at ESF and Syracuse University.
- **6 credits of graduate coursework in Science, Mathematics or Engineering.** These may include graduate courses offered at ESF or Syracuse University in physical or biological sciences, mathematics (including statistical analysis), or any area of engineering. Courses must be approved by the student's steering committee.
- **3 credits of seminar:** Either of following, one-credit courses may be repeated, or students may choose seminars offered in other departments with approval of the advisor.

- FCH 997 Seminar (all students)
- FCH 797 Graduate Seminar
- **3 credits for an integrative experience** as FCH 898, Professional Experience/Synthesis in Chemistry.
- **3 credits of additional graduate coursework:** These remaining three credits may be drawn from additional graduate level coursework, seminars, internships and research experience as approved by the student's steering committee.

## M.S. & Ph.D. Degrees

- [www.esf.edu/chemistry/graduate/msphd.htm](http://www.esf.edu/chemistry/graduate/msphd.htm)

The Biochemistry, Environmental Chemistry, and Polymer Chemistry options each have a core sequence of courses that are required for all graduate students in that option. All graduate students must present a department seminar (FCH 997) plus a capstone seminar; the capstone seminar is usually given on the day of the thesis or dissertation defense.

### General Requirements

Steering committee and program of study: By the end of their first year of study, all graduate students must formally identify the two faculty who, in addition to their major professor, will provide guidance for their graduate school career. These two faculty and the major professor constitute the steering committee. These faculty must approve the student's program of study: the list of courses the student will take for their degree. This approval must also occur by the end of the first year. Forms are available online at students' MyESF page.

- [Complete Description of Degree Requirements for Chemistry M.S., M.P.S. and Ph.D.](#) (PDF)
  - [Version for students who entered before Fall 2012](#) (PDF)

### M.S. Program Requirements

M.S. students are required to take at least 18 credits of coursework or non-thesis research; some options require additional credits. While a certain number of research credits are required, successful completion of an M.S. thesis project is determined by effort and effectiveness, not by credits.

### Ph.D. Program Requirements

Ph.D. students are required to take at least 30 credits of coursework or non-dissertation research; some options require additional credits. While a certain number of research credits are required, successful completion of a Ph.D. dissertation project is determined by effort and effectiveness, not by credits.

The [candidacy exam](#) at ESF has three formats, but Chemistry usually uses format 2 (research report) or format 3 (the thesis proposal). After authoring the document, students defend it orally in front of their steering committee and one or two examiners.

## Areas of Study

- [www.esf.edu/chemistry/graduate](http://www.esf.edu/chemistry/graduate)

There are six graduate areas of study in Chemistry:

### Biochemistry (M.P.S., M.S., Ph.D.)

- [www.esf.edu/chemistry/graduate/biochemistry](http://www.esf.edu/chemistry/graduate/biochemistry)

Graduate studies in biochemistry reflect the College's interests in microbial, insect, bio-based fuel, and plant biochemistry.

After completing a one-year sequence in general biochemistry, students select advanced courses from a range of offerings in chemistry, organismal biology and molecular biology. Advanced courses in biochemistry are available both at ESF and Syracuse University.

### **Environmental Chemistry (M.P.S., M.S., Ph.D.)**

- [www.esf.edu/chemistry/graduate/environmental](http://www.esf.edu/chemistry/graduate/environmental)

The ESF program offering M.S. and Ph.D. degrees in chemistry with an emphasis in environmental chemistry is one of the few doctoral programs of its type within a chemistry department in the United States. The six core faculty and five participating faculty make it one of the largest such programs in the world.

Students take three core courses in environmental chemistry and one course in biochemistry. Subsequent coursework is carefully selected from regularly offered courses on oceanography, biogeochemistry, analytical methods, and basic areas of chemistry. Coursework is also available in ecology, biology, geology, and engineering.

Research in environmental chemistry spans a wide range, from fieldwork to laboratory work to computer modeling. Areas of research include global climate change, coral reef ecosystems, biogeochemistry, atmospheric chemistry, regional and global air quality, and transient and persistent organic pollutants. The program avoids a "pollutant of the week" approach that would leave graduates unprepared for future developments. Instead, it emphasizes a framework wherein students can incorporate new knowledge as it becomes available and deal with new problems as they appear.

### **Organic Chemistry of Natural Products (M.P.S., M.S., Ph.D.)**

- [www.esf.edu/chemistry/graduate/organic](http://www.esf.edu/chemistry/graduate/organic)

Graduate students in organic chemistry of natural products take a one-year course sequence in mechanistic organic chemistry and another in synthetic organic chemistry. Additionally, one-semester courses are required in advanced physical chemistry and the organic chemistry of natural products.

Courses in biochemistry, inorganic chemistry, statistics and specialized courses in chemistry or biology may be arranged and selected by the student in consultation with faculty.

Research in the field of organic chemistry of natural products takes three paths. These paths are the isolation and characterization of new natural substances; the synthesis of new or improved syntheses of better-known natural substances; and the study of the relation of molecular structure to biological response. Chemical research in each of these areas is coupled with biological testing. Research involving isolation and synthetic chemistry requires the student to develop expertise in separation techniques, such as the several methods of chromatography and spectrometric identification of molecules. Successful investigation in structure/activity relationships requires the student to become familiar with statistical methods of analysis.

### **Polymer Chemistry (M.P.S., M.S., Ph.D.)**

- [www.esf.edu/chemistry/graduate/polymer](http://www.esf.edu/chemistry/graduate/polymer)

Graduate students in polymer chemistry select their courses from a range of offerings in chemistry, chemical engineering, mathematics, physics, and other appropriate areas. These courses will include the one-year sequence in the physical and organic chemistry of polymers and such additional courses as the student and advisor consider necessary.

Special topics in a spectrum of polymer fields are offered or can be arranged in consultation with the faculty.

Research is an essential component of any graduate degree program in polymer chemistry.

## **Chemical Ecology (M.S., M.P.S., Ph.D.)**

- [www.esf.edu/efb/chemeco](http://www.esf.edu/efb/chemeco)

As a relatively new interdisciplinary endeavor, workers in this field attempt to understand organismal interactions, both intra- and interspecific, mediated by chemical substances such as hormones, pheromones, kairomones and phytoalexins.

These interactions occur at all taxonomic levels: between uni- and multicellular organisms, microbes and plants, plants and plants, plants and animals, microbes and animals and various species of animals. Study of such interactions has accelerated in recent years through joint efforts of biologists and chemists in basic and applied research in the laboratory and field.

The area of study in chemical ecology is offered through collaboration between the Department of Environmental and Forest Biology and the Department of Chemistry. Interested students should apply to the department of major interest, which will have prime responsibility for setting requirements. Faculty from both areas contribute to the development of a plan of study enabling a student to acquire sophisticated skills in either chemistry or biology and an ample understanding of the other field to grapple with problems requiring an understanding of both.

## **Structural Biology, Biochemistry and Biophysics (Ph.D.)**

- [www.esf.edu/chemistry/graduate/sb3](http://www.esf.edu/chemistry/graduate/sb3)

Structural Biology, Biochemistry and Biophysics (SB3) is a joint program between Syracuse University, SUNY Upstate Medical University and SUNY-ESF. The SB3 doctoral degree program was created in response to the growing need for researchers in structural biology caused by the completion of the Human Genome Project. Determining the structure, function and relationships of thousands of newly discovered biomolecules will be among the most important scientific accomplishments of the 21st century. See <http://sb3.syr.edu/> for full details of this multi-university program.

# Department of Environmental and Forest Biology

Donald J. Leopold, Chair

242 Illick Hall

315-470-6760

315-470-6934 (fax)

- [www.esf.edu/efb](http://www.esf.edu/efb)

The critical importance of natural resources and environmental quality to modern society demands that aspiring biologists both understand natural ecosystems and learn to be effective problem solvers. The Department of Environmental and Forest Biology (EFB) is committed to ensuring these educational outcomes.

The department offers a dynamic array of professional opportunities in biology via course work enriched by an active program of research. Through a suite of electives in addition to a required core, undergraduate students may customize their studies toward a particular field of interest. Graduate students may pursue master's or doctoral degrees within several areas of study.

## Undergraduate Programs

- [www.esf.edu/efb/undergrad](http://www.esf.edu/efb/undergrad)

The Department of Environmental and Forest Biology (EFB) offers seven undergraduate majors. Environmental biology is the broadest major and the degree program to which most students apply. The other six majors are specialized and are recommended only for students with strongly focused educational goals. They are aquatic and fisheries science, biotechnology, conservation biology, environmental education and interpretation, forest health, and wildlife science. For the first year or two the requirements of these programs are similar to those of environmental biology and internal transfer among them is simple.

### Field Study and Training

A hallmark of the EFB curriculum is its emphasis on field study and training.

All majors offered by the Department of Environmental and Forest Biology are intended to be hands-on programs that emphasize laboratory and field experience in addition to classroom studies. To this end, every student in each major except Biotechnology is required to complete **at least six credit-hours** of approved field-based instruction in biology. Three of these six credits are associated with a required core course, EFB 202 (Ecological Monitoring and Biodiversity Assessment), which is offered twice each summer at the Cranberry Lake Biological Station (CLBS) in the Adirondack Mountains. ***We recommend students enroll in EFB 202 during the summer between freshman and sophomore years, or as early as possible if you are a transfer student.***

The remaining credit hours of Field Experience are elective, and can be obtained in one of the following ways. The following lists identify recent course offerings that satisfy the EFB field elective requirement. Be aware that some of these courses may not be offered every year.

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  - Graduate Areas of Study:
    - Applied Ecology
    - Conservation Biology
    - Ecology
    - Entomology Environmental
    - Interpretation Environmental
    - Physiology
    - Fish and Wildlife Biology and Management
    - Forest Pathology and Mycology
    - Plant Biotechnology
    - Plant Science and Biotechnology
    - Chemical Ecology

- Courses offered at CLBS during summer session:
  - Field Ethnobotany (EFB337)
  - Forest Health (EFB345)
  - Field Herpetology (EFB384)
  - Adirondack Fishes (EFB388)
  - Fisheries Science Practicum (EFB488, 1-cr)
  - Wildlife Techniques (EFB496)
  - Ecology of Adirondack Aquatic Ecosystems (EFB496)
  - Wetland Plants and Communities of the Adirondacks (EFB496)
  - Ecology of Adirondack Insects (EFB496)
  - *Please note that, although Philosophy and Environmental Writing (EFB496) is frequently offered at CLBS, this course **does not** fulfill the field elective requirement.*
  - For more information about the CLBS program, visit: [www.esf.edu/clbs](http://www.esf.edu/clbs)
- Courses offered at the Adirondack Ecological Center:
  - Research Methods: Understanding the Adirondack Ecosystem (EFB411)
  - Mammalian Winter Ecology (EFB484)
- Courses offered during Maymester at the Syracuse or regional campuses:
  - Interpreting Field Biology (EFB418)
  - Forest Health Monitoring (EFB439)
  - Field Ornithology (EFB496)
  - Flora of Central New York (EFB496)
- Other courses offered by ESF faculty:
  - Restoring Ecosystems: Principles and Practice (EFB496)
  - Periodic field trips courses (EFB500) to locations such as Costa Rica, Ireland, Russia, New Zealand, Australia
  - Adirondack Forest Ecology and Management (EFB/FOR 513, 2-cr)
  - Tropical Ecology (EFB 523)
  - Ecological Engineering in the Tropics (ERE311)
- Field courses, **approved by petition**, from another accredited university, including but not limited to the following affiliated programs. Acceptable biology field courses will have at least 50% of instruction conducted in the field (out-of-classroom, out-of-laboratory, out-of-clinic, out-of-captivity); and include content that focuses on organismal biology, ecology theory, and/or training in field methodologies for studying populations, ecological communities or ecosystem processes:
  - SEA Semester (through Boston University)
  - The School for Field Studies (through University of Minnesota)
  - Wildlands Studies (through California State University Monterey Bay)
- An independent research project (EFB 498) or internship (EFB 420) **that has received prior departmental approval via petition, and that meets the following departmental criteria.**
  - At least 50% of student effort (including contact time with instructor and self-directed study) must be conducted in the field (out-of-classroom, out-of-laboratory, out-of-clinic, out-of-captivity).
  - Student must demonstrate learning gains in organismal biology, ecological theory, and/or application of field methodologies to study populations, ecological communities or ecosystem processes.
  - Students must complete a research or professional product for evaluation.
  - 40 hours of effort will garner 1 academic credit-hour.

## Bachelor of Science in Aquatic and Fisheries Science

- [www.esf.edu/efb/fisheries](http://www.esf.edu/efb/fisheries)

Aquatic and fisheries science is the study of aquatic ecosystems to increase scientific understanding and to apply

basic ecological principles to their management, thereby sustaining them for multiple uses.

Aquatic ecosystems include wetlands, streams, lakes, estuaries and oceans. Aquatic science professionals study and manage valued natural systems for seafoods, drinking water, recreation, transportation and aesthetics.

## Required Courses

Course		Codes*	Credits
APM 105	Survey of Calculus and Its Applications I	G	4
APM 391	Introduction to Probability and Statistics	G	3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 103	General Biology II: Cell Biology and Genetics	G	3
EFB 104	General Biology II Laboratory	G	1
EFB 120	The Global Environment and the Evolution of Human Society	G	3
EFB 132	Orientation Seminar: Environmental and Forest Biology		1
EFB 202	Ecological Monitoring and Biodiversity Assessment		3
EFB 210	Diversity of Life I		3
EFB 211	Diversity of Life II		3
EFB 307	Principles of Genetics		3
EFB 308	Principles of Genetics Laboratory		1
EFB 311	Principles of Evolution		3
EFB 320	General Ecology		4
EFB 325	Cell Biology		3
EFB 424	Limnology: Study of Inland Waters		3
EFB 486	Ichthyology		3
EFB 492	Senior Synthesis in Aquatic and Fisheries Science		1
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
FCH 210	Elements of Organic Chemistry		4
FOR 207	Introduction to Economics	G	3
PHY 101	Major Concepts of Physics I		4
PHY 102	Major Concepts of Physics II		4
<b>OR</b> FCH 223	Organic Chemistry II		3
<b>AND</b> FCH 224	Organic Chemistry Laboratory II		1
<b>OR</b> APM 106	Survey of Calculus and Its Applications II		4

## Electives

Course	Codes*	Credits
General Education Course in two of the following categories: American History, The Arts, Western Civilization, Other World Civilizations	G	6
Directed Electives		27
Open Electives		15

### Directed Electives

To ensure both strength and breadth of knowledge, 27 elective credit hours must be obtained through courses in the following subject areas (S=spring semester, F=fall semester).

#### A. Field Experience Elective

At least three elective credits must come from an approved field course in biology (this is in addition to the core field course, EFB 202). These credits may be obtained through an elective course at our Cranberry Lake Biological Station, an approved internship (EFB 420) or field trip course (EFB 500). Winter Mammalian Ecology (EFB 484) and Tropical Ecology (EFB 523) meet this requirement, as can approved field courses from other institutions.

#### B. Structure and Function

At least 3 credit hours must be in the subject area of organism-level physiology, anatomy, or development. The list of allowable courses below may vary slightly from year to year.

- EFB 385—Comparative Vertebrate Anatomy (4 cr.) S
- EFB 427—Plant Anatomy and Development (3 cr.) F
- EFB 462—Animal Physiology: Environmental and Ecological (3 cr.) F
- EFB 530—Plant Physiology (3 cr.) S
- EFB 570—Insect Physiology (3 cr.) S
- BIO 447—Immunology (3 cr.) S
- BIO 503—Developmental Biology (3 cr.) S

#### C. Organismal Diversity

To encourage breadth in organism-level biology, students must complete (in addition to the core requirement of EFB 486 or EFB 388) at least 3 credit hours in each of the following two categories:

- **1. Plants and Microbes:**
  - EFB 303—Introductory Environmental Microbiology (4 cr.) F
  - EFB 326—Diversity of Plants (3 cr.) S
  - EFB 336—Dendrology (3 cr.) F
  - EFB 340—Forest and Shade Tree Pathology (3 cr.) S
  - EFB 428—Mycorrhizal Ecology (3 cr.) F even years
  - EFB 435—Flowering Plants: Diversity, Evolution, and Systematics (3 cr.) F
  - EFB 440—Mycology (3 cr.) F
  - EFB 446—Ecology of Mosses (3 cr.) S
- **2. Invertebrate and Vertebrate Animals:**
  - EFB 351—Forest Entomology (3 cr.) F, even years
  - EFB 352—Elements of Entomology (3 cr.) F, odd years
  - EFB 355—Invertebrate Zoology (4 cr.) S
  - EFB 388—Ecology of Adirondack Fishes (3 cr.) CLBS
  - EFB 453—Parasitology (3 cr.) F
  - EFB 482—Ornithology (4 cr.) S
  - EFB 483—Mammal Diversity (4 cr.) F
  - EFB 485—Herpetology (3 cr.) S

- EFB 554—Aquatic Entomology (3 cr.) F
- EFB 566 Systematic Entomology (3 cr.) F

#### D. **Physical/Chemical Environment**

To encourage understanding and familiarity with the aquatic habitat, students must complete at least 3 credit hours from one of the following courses:

- EFB 415—Ecological Biogeochemistry (3 cr.) F
- EST 231—Environmental Geology (3 cr.) S
- FCH 510—Environmental Chemistry I (3 cr.) S
- FCH 515—Methods of Environmental Chemical Analysis (3 cr.) F
- FOR 338—Meteorology (3 cr.) S
- FOR 340—Watershed Hydrology (3 cr.) S
- FOR 345—Introduction to Soils (3 cr.) F
- EAR 101—Dynamic Earth (3 cr.) F
- EAR 105—Earth Science (3 cr.) S

#### E. **Environmental Systems Science**

To further promote understanding of the systems approach to aquatic ecosystems and an integration of environmental and biological factors, students must complete at least 3 credit hours from one of the following courses.

- EFB 423—Marine Ecology (4 cr.) S, even years
- EFB 516—Ecosystems (3 cr.) S
- EFB 518—Systems Ecology (4 cr.) F
- EFB 542—Freshwater Wetland Ecosystems (3 cr.) S
- ERE 275—Ecological Engineering I (3 cr.) S

#### F. **Management**

At least 3 credit hours in resource or ecosystem management must be obtained through a course in the following list.

- EFB 487—Fisheries Science and Management (3 cr.) F
- EFB 390—Wildlife Ecology and Management (4 cr.) F
- FOR 360—Principles of Management (3 cr.) F
- FOR 372—Fundamentals of Outdoor Rec. (3 cr.) F,S
- FOR 442—Watershed Ecology & Management (3 cr.) F

#### G. **Analytical Tools**

To increase the breadth of practical skills and knowledge students must complete at least 3 credit hours, obtained through one of the following courses:

- BTC 401—Molecular Biology Techniques (3 cr.) F
- EFB 488—Fisheries Science Practicum (1 cr.) F
- EFB 519—Geographic Modeling (3 cr.) S
- EFB 525—Limnology Practicum (2 cr.) F
- ERE 445—Hydrological Modeling (3 cr.) F
- ESF 300—Introduction to Geospatial Information Technologies (3 cr.) F,S

#### H. **Communications**

Students must complete at least 3 credit hours from one of the following communication or interpretation courses.

- EFB 312—Introduction to Personal Environmental Interpretation Methods (3 cr.) F
- EWP 220—Public Presentation Skills for Environmental Professionals (3 cr.) F,S
- EWP 407—Writing for Environmental and Science Professionals (3 cr.) F

**Total Minimum Credits For Degree: 126**

# Bachelor of Science in Biotechnology

- [www.esf.edu/biotech](http://www.esf.edu/biotech)

Biotechnology is the application of biological organisms, cells, or molecules to create products or services for the betterment of humans.

The bachelor of science degree in biotechnology prepares students to tackle environmental, natural resource, agricultural and medical problems through training in molecular biology, cell biology, biochemistry, genetic engineering and related biological disciplines. As biotechnology is increasingly used to address such issues, it offers diverse career opportunities. The curriculum emphasizes the basic sciences with a strong foundation in biology, chemistry, calculus, and physics that prepares students for upper-level biology and chemistry courses, but encourages elective breadth in the social sciences, humanities, and environmental studies. The degree program provides sufficient breadth for a student to enter a clinical medical career, or other health profession. Students who complete this major will be qualified to enter the growing biotechnology-related job market or continue their studies in graduate or professional school.

## Internships, Independent Research, and Senior Project Synthesis

The biotechnology major features a strong practical experience component. Each student is required to fulfill an internship, which could be in a local, national, or international company, medical unit, or government research laboratory. The objective of this internship is to give students experience working outside a purely academic setting. In addition, each student is required to perform one independent research project in a local, national, or international academic laboratory. The objective of the research requirement is to teach the student to develop and meet a research goal using the scientific method. During the senior year, each student is required to complete a senior project synthesis in which the results from either the internship or independent research—or both—will be organized and presented as a seminar or poster.

## Required Courses

Course		Codes*	Credits
APM 105	Survey of Calculus and Its Applications I	G	4
APM 106	Survey of Calculus and Its Applications II		4
APM 391	Introduction to Probability and Statistics	G	3
BTC 132	Orientation Seminar		1
BTC 401	Molecular Biology Techniques		4
BTC 420	Internship in Biotechnology		1 - 5
BTC 497	Research Design and Professional Development		1
BTC 498	Research Problems in Biotechnology		1 - 9
BTC 499	Senior Project Synthesis		1
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 103	General Biology II: Cell Biology and Genetics	G	3
EFB 104	General Biology II Laboratory	G	1
EFB 210 OR EFB 211	Diversity of Life I		3
	Diversity of Life II		3

EFB 303	Introductory Environmental Microbiology		4
EFB 307	Principles of Genetics		3
EFB 308	Principles of Genetics Laboratory		1
EFB 320	General Ecology		4
EFB 325	Cell Biology		3
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
FCH 221	Organic Chemistry I		3
FCH 222	Organic Chemistry Laboratory I		1
FCH 223	Organic Chemistry II		3
FCH 224	Organic Chemistry Laboratory II		1
FCH 530	Biochemistry I		3
FCH 532	Biochemistry II		3
PHY 101	Major Concepts of Physics I		4
PHY 102	Major Concepts of Physics II		4

**NOTE:** BTC 420 (Internship in Biotechnology) is typically done in the summer.

**NOTE:** EFB 498 is a 3 credit course.

## Electives

Course	Codes*	Credits
General Education Course in three of the following categories: American History, The Arts, Western Civilization, Other World Civilizations	G	9
Directed Electives		9
Open Electives		19

### Directed Electives - Biotechnology

A minimum of 9 credits of directed elective courses required. New biotechnology related courses not currently on the list may also fulfill this requirement with permission of your advisor.

Although any combination of courses below may satisfy the minimum 9 credits required, the following list has been categorized into 3 of the most common subject areas of interest to BTC students. These groupings of elective courses are guidelines. Probably no two students in the biotechnology program have exactly the same career goals or interests. Consult your advisor if your subject interests vary.

Areas of study:

#### Plant Biotechnology

- BTC 425 Plant Biotechnology (3 cr.) S

- BTC 426 Intro. Plant Tissue Culture (3 cr.) F
- EFB 311 Principles of Evolution (3 cr.) S
- EFB 427 Plant Anatomy and Development (3 cr.) F
- EFB 530 Plant Physiology (2 cr.) S
- FCH 380 Analytical Chemistry I (3 cr.) F
- FCH 381 Analytical Chemistry II (3 cr.) S
- FCH 531 Biochemistry (3 cr.) S
- BIO 422 Bioinformatics for Life Scientists (3 cr.) S - SU course

### **Microbial Biotechnology**

- EFB 311 Principles of Evolution (3 cr.) S
- EFB 340 Forest and Shade Tree Pathology (3 cr.) S
- EFB 403 Microbiol Diseases/Fish & Wildlife (1 cr.) S
- EFB 428 Mycorrhizal Ecology (3 cr.) F
- EFB 440 Mycology (3 cr.) F
- EFB 505 Microbial Ecology (2 cr.) S
- FCH 380 Analytical Chemistry I (3 cr.)
- FCH 381 Analytical Chemistry II (3 cr.)
- FCH 531 Biochemistry Lab (3 cr.) F
- BIO 422 Bioinformatics for Life Scientists (3 cr.) S - SU Course

### **Prehealth or PreVet**

- EFB 311 Principles of Evolution (3 cr.) S
- EFB 385 Comparative Vertebrate Anatomy (4 cr.) S
- EFB 400 Toxic Health Hazards (3 cr.) F
- EFB 403 Microbiol Diseases/Fish & Wildlife (1 cr.) S
- EFB 453 Parasitology (3 cr.) F
- EFB 462 Animal Physiology: Environmental & Ecological (3 cr.) F
- FCH 390 Drugs from the Wild (3 cr.) F
- BIO 211 Introduction to Neuroscience (3 cr.) S - SU Course
- BIO 355 General Physiology (3 cr.) S - SU Course
- BIO 447 Basic Immunology (3 cr.) F - SU Course
- BIO 448 Evolutionary Medicine (3 cr.) F - SU Course
- BIO 501 Biology of Cancer (3 cr.) S - SU course

### **Other Acceptable Directed Electives**

- BPE 441 Biomass Energy (3 cr.) S
- FCH 510 Environmental Chemistry (3 cr.)
- BIO 464 Applied Biotechnology (4 cr.) S - SU Course

<b>Total Minimum Credits For Degree: 123</b>
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# Bachelor of Science in Conservation Biology

- [www.esf.edu/efb/consbio](http://www.esf.edu/efb/consbio)

Conservation biology is the application of science to conserve the earth's imperiled species and ecosystems.

The field is a relatively young one that is growing rapidly in response to the biodiversity crisis, perhaps the most critical environmental issue of our time. Conservation biologists view all of nature's diversity as important and having inherent value. This diversity spans the biological hierarchy and includes variation at the level of genes, populations, communities, ecosystems, and biomes.

## Required Courses

Course		Codes*	Credits
APM 105	Survey of Calculus and Its Applications I	G	4
APM 391	Introduction to Probability and Statistics	G	3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 103	General Biology II: Cell Biology and Genetics	G	3
EFB 104	General Biology II Laboratory	G	1
EFB 120	The Global Environment and the Evolution of Human Society	G	3
EFB 132	Orientation Seminar: Environmental and Forest Biology		1
EFB 200	Physics of Life		3
EFB 202	Ecological Monitoring and Biodiversity Assessment		3
EFB 210	Diversity of Life I		3
EFB 211	Diversity of Life II		3
EFB 307	Principles of Genetics		3
EFB 308	Principles of Genetics Laboratory		1
EFB 311	Principles of Evolution		3
EFB 320	General Ecology		4
EFB 413	Introduction to Conservation Biology		3
EFB 414	Senior Synthesis in Conservation Biology		3
EFB 419	Problem-solving in Conservation Biology		3
EFB 420	Internship in Environmental and Forest Biology		1 - 5
<b>OR</b> EFB 498	Research Problems in Environmental and Forest Biology		1 - 5
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1

**NOTE:** EFB 498 is a 3 credit course.

## Electives

Course	Codes*	Credits
General Education Course in two of the following categories: American History, The Arts, Western Civilization, Other World Civilizations	G	6
Directed Electives		30
Open Electives		22

### Directed Electives

To ensure that Conservation Biology undergraduates obtain both strength and breadth of knowledge, 30 elective credit hours must be distributed in a way that satisfies seven requirements (A-F, below).

#### A. Field Experience Elective

At least three elective credits from an approved field course in biology (in addition to the core field course, EFB 202). These credits are typically obtained through an elective course at our [Cranberry Lake Biological Station](#), an approved internship (EFB 420) or field trip course (EFB 500). Approved field courses from other institutions can also fulfill this requirement. No single class may be used to fulfill directed elective requirements of A and B.

#### B. Biodiversity Specialization (at least three courses from the following list)

*The availability of courses that satisfy this requirement varies. The suggestions below are pre-approved courses that are typically taken - consult with your advisor or the curriculum coordinator about other possibilities. Many other courses can potentially substitute (by petition) for those listed. No single class may be used to fulfill directed elective requirements of A and B.*

- EFB 303 Introductory Environmental Microbiology (4 cr.) F
- EFB 326 Diversity of Plants (3 cr.) S
- EFB 327 Adirondack Flora (3 cr.) **CLBS**
- EFB 336 Dendrology (3 cr.) F
- EFB 340 Forest and Shade Tree Pathology (3 cr.) S
- EFB 342 Fungal Diversity and Ecology (3 cr.) **CLBS**
- EFB 351 Forest Entomology (3 cr.) **F, even years**
- EFB 352 Elements of Entomology (3 cr.) **F, odd years**
- EFB 355 Invertebrate Zoology (4 cr.) S
- EFB 384 Field Herpetology (3 cr.) **CLBS**
- EFB 388 Ecology of Adirondack Fisheries (3 cr.) **CLBS**
- EFB 428 Mycorrhizal Ecology (3 cr.) **F, even years**
- EFB 435 Flowering Plants: Diversity, Evolution, and Systematics (3 cr.) F
- EFB 440 Mycology (3 cr.) F
- EFB 441 Field Plant Pathology (3 cr.) **CLBS**
- EFB 446 Ecology of Mosses (3 cr.) S
- EFB 453 Parasitology (3 cr.) F
- EFB 479 Field Ornithology (3 cr.) **CLBS**
- EFB 482 Ornithology (4 cr.) S
- EFB 483 Mammal Diversity (4 cr.) F
- EFB 485 Herpetology (3 cr.) F
- EFB 486 Ichthyology (3 cr.) S
- EFB 554 Aquatic Entomology (3 cr.) F
- EFB 566 Systematic Entomology (3 cr.) F

#### C. Applied Conservation Biology (at least 6 credits)

- EFB 390 Wildlife Ecology and Management (4 cr.) F

- EFB 423 Marine Ecology (4 cr.) S, even years
- EFB 424 Limnology (3 cr.) F
- EFB 444 Biodiversity and Geography of Nature (3 cr.) F
- EFB 480 Animal Behavior (3 cr.) S
- EFB 487 Fisheries Science & Management (3 cr.) F
- EFB 493 Management of Wildlife Habitats & Populations (3 cr.) F
- EFB 502 Ecology and Management of Invasive Species (3 cr.) F
- EFB 522 Ecology, Resources and Development (2 cr.) S
- EFB 542 Freshwater Wetland Ecosystems (3 cr.) S
- FOR 321 Forest Ecology and Silviculture (3 cr.) F
- FOR 332 Forest Ecology (3 cr.) F
- FOR 442 Watershed Ecology and Management (3 cr.) F

**D. Human Dimensions (at least 3 credits)**

- EFB 404 Nat Hist Museums of Modern Sci (3 cr.) S
- EST 353 Environ Psychology (3 cr.) S
- EST 366 Attitudes, Values, & Env. (3 cr.) S
- EST 390 Social Processes and Environment (3 cr.) S
- EST 460 Land Use Law (3 cr.) S
- EWP 390 Intro to Literature of Nature (3 cr.) F
- FOR 312 Sociology/Natural Resources (3 cr.) S
- FOR 360 Principles of Management (3 cr.) F
- FOR 465 Natural Resources and Environ. Policy (3 cr.) F
- FOR 487 Environmental Law and Policy (3cr.) F
- FOR 489 Natural Resources Law and Policy (3cr.) S

**E. Communications and Interpretation (at least 3 credits)**

- EFB 312 Introduction to Personal Environmental Interpretation Methods (3 cr.) F
- EFB 417 Non-Personal Environmental Interpretation Methods (3 cr.) S
- EWP 220 Public Presentation Skills (3 cr.) F,S
- EWP 407 Writing for Environmental and Science Professionals (3 cr.) F,S

**F. Technical Skills (at least 3 credits)**

- BTC 401 Molecular Biol. Techniques (3 cr.) F
- BTC 425 Plant Biotechnology (3 cr.) S
- BTC 426 Plant Tissue Culture Methods (3 cr.) F
- EFB 518 System Ecology (4 cr.) F
- ERE 445 Hydrological Modeling (3 cr.) F
- ESF 300 Introduction to Geospatial Information Technologies (3 cr.) F,S
- ERE 563 Photogrammetry (3 cr.) S

**Total Minimum Credits For Degree: 126**

## Bachelor of Science in Environmental Biology

- [www.esf.edu/efb/envbio](http://www.esf.edu/efb/envbio)

The curriculum for the bachelor of science degree in environmental biology is built around a core of required courses that provides a general education, a background in the principles of biological and physical science, and an orientation to natural resources and other environmental concerns.

From this common foundation, the large number of elective credits allows each student to develop a unique plan of study, with the help of an assigned advisor who is expert in the student's general area of interest. In keeping with the hands-on, field orientation of our curriculum, students also must complete six credit hours of field experience.

## Required Courses

Course		Codes*	Credits
APM 105	Survey of Calculus and Its Applications I	G	4
APM 391	Introduction to Probability and Statistics	G	3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 103	General Biology II: Cell Biology and Genetics	G	3
EFB 104	General Biology II Laboratory	G	1
EFB 120	The Global Environment and the Evolution of Human Society	G	3
EFB 132	Orientation Seminar: Environmental and Forest Biology		1
EFB 200	Physics of Life		3
EFB 202	Ecological Monitoring and Biodiversity Assessment		3
EFB 210	Diversity of Life I		3
EFB 211	Diversity of Life II		3
EFB 307	Principles of Genetics		3
EFB 308	Principles of Genetics Laboratory		1
EFB 311	Principles of Evolution		3
EFB 320	General Ecology		4
EFB 325	Cell Biology		3
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
FCH 210	Elements of Organic Chemistry		4
PHY 102	Major Concepts of Physics II		4
<b>OR</b> FCH 223	Organic Chemistry II		3
<b>AND</b> FCH 224	Organic Chemistry Laboratory II		1
<b>OR</b> APM 106	Survey of Calculus and Its Applications II		4

## Electives

Course	Codes*	Credits

General Education Course in two of the following categories: American History, The Arts, Western Civilization, Other World Civilizations	G	6
Directed Electives		25
Open Electives		28

## Directed Electives

To ensure that ENB undergraduates obtain both strength and breadth of knowledge, 25 elective credit hours in biology must be obtained through courses designed for juniors or seniors (i.e., courses numbered 300 or higher). Among them must be courses that satisfy requirements A-C (below).

### A. Field Experience Elective

At least 3 elective credits must come from an approved field biology course (in addition to the core field course, EFB 202). These credits may be obtained through an elective course at [Cranberry Lake Biological Station](#); an approved field course from another accredited institution; an approved internship (EFB 420) or independent research project (EFB498); or a field trip course (EFB 500). Some courses at CLBS meet both requirement A and a diversity requirement.

### B. Structure and Function

At least 3 credit hours must be in the subject area of organism-level physiology, anatomy, or development. The list of allowable courses below may vary slightly from year to year.

- EFB 385 Comparative Vertebrate Anatomy (4 cr.) S
- EFB 427 Plant Anatomy and Development (3 cr.) F
- EFB 462 Animal Physiology: Environmental and Ecological (3 cr.) F
- EFB 530 Plant Physiology (3 cr.) S
- EFB 570 Insect Physiology (3 cr.) S
- BIO 447 Immunology (3 cr.) F
- BIO 503 Developmental Biology (3 cr.) S

### C. Organismal Diversity

To encourage breadth in organism-level biology, students must complete at least one course from two of the four groups. (A course from each of the groups is strongly recommended).

#### 1. Diversity of Microorganisms

- EFB 303 Introductory Environmental Microbiology (4 cr.) F
- EFB 340 Forest and Shade Tree Pathology (3 cr.) S
- EFB 342 Fungal Diversity and Ecology (3cr.) CLBS
- EFB 428 Mycorrhizal Ecology (3 cr) F even years
- EFB 440 Mycology (3 cr.) F

#### 2. Diversity of Plants

- EFB 326 Diversity of Plants (3 cr.) S
- EFB 336 Dendrology (3 cr.) F
- EFB 327 Adirondack Flora (3 cr.) CLBS
- EFB 435 Flowering Plants: Diversity, Evolution, and Systematics (3 cr.) F
- EFB 446 Ecology of Mosses (3 cr.) S

#### 3. Diversity of Invertebrate Animals

- EFB 351 Forest Entomology (3 cr.) F, even years
- EFB 352 Elements of Entomology (3 cr.) F, odd years
- EFB 355 Invertebrate Zoology (4 cr.) S
- EFB 453 Parasitology (3 cr.) F
- EFB 554 Aquatic Entomology (3 cr.) F
- EFB 566 Systematic Entomology (3 cr.) F

#### 4. Diversity of Vertebrate Animals

- EFB 384 Field Herpetology (3 cr.) CLBS
- EFB 388 Ecology of Adirondack Fishes (3 cr.) CLBS
- EFB 479 Field Ornithology (3 cr.) CLBS
- EFB 482 Ornithology (4 cr.) S
- EFB 483 Mammal Diversity (4 cr.) F
- EFB 485 Herpetology (3 cr.) S
- EFB 486 Ichthyology (3 cr.) S

*Note that some courses at CLBS meet both requirement A and a diversity requirement.*

**Total Minimum Credits For Degree: 126**

## Bachelor of Science in Environmental Education and Interpretation

- [www.esf.edu/efb/eei](http://www.esf.edu/efb/eei)

Environmental Education teaches people of all ages about the natural environment, so that they can make informed decisions on how to care for it.

Interpretation is a communications process that reveals meanings and relationships about natural, cultural, historical, and recreational resources. Interpretation and environmental education work hand-in-hand to help make connections between the world of science and the public. Through the art of interpretation, students will learn how to help people make connections with the natural world and science through educational programs and materials.

### Required Courses

Course		Codes*	Credits
APM 105	Survey of Calculus and Its Applications I	G	4
APM 391	Introduction to Probability and Statistics	G	3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 103	General Biology II: Cell Biology and Genetics	G	3
EFB 104	General Biology II Laboratory	G	1
EFB 120	The Global Environment and the Evolution of Human Society	G	3
EFB 132	Orientation Seminar: Environmental and Forest Biology		1
EFB 200	Physics of Life		3
EFB 202	Ecological Monitoring and Biodiversity Assessment		3
EFB 210	Diversity of Life I		3
EFB 211	Diversity of Life II		3
EFB 307	Principles of Genetics		3
EFB 308	Principles of Genetics Laboratory		1
EFB 311	Principles of Evolution		3
EFB 312	Introduction to Personal Environmental Interpretation Methods		3
EFB 320	General Ecology		4
EFB 404	Natural History Museums and Modern Science		3
EFB 417	Non-Personal Environmental Interpretive Methods		3

EFB 420	Internship in Environmental and Forest Biology		1 - 5
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
EWP 390	Literature of Nature		3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
FOR 372	Fundamentals of Outdoor Recreation		3

## Electives

Course	Codes*	Credits
General Education Course in one of the following categories: American History, The Arts	G	6
Directed Electives		27
Open Electives		22

### Directed Electives - Environmental Education & Interpretation

#### A. Conservation Biology

At least 3 credit hours must be in the subject area of advanced conservation biology. Allowable courses are listed below. The list may vary slightly from year to year.

- EFB 390 Wildlife Ecology & Management (4 cr.) F
- EFB 413 Introduction to Conservation Biology (4 cr.) S

#### B. Advanced Communication

At least 3 credit hours must be in the subject area of advanced communication. Allowable courses are listed below. The list may vary slightly from year to year

- CMN 420 Advanced Public Presentation Skills (3 cr.) F
- EST 496 Science Communication (3cr.) S
- EWP 407 Writing for Environmental and Science Professionals (3 cr.) F,S
- EWP 494 Creative Non-fiction in the Sciences (3 cr.) S
- LSA 300 Digital Methods and Graphics I (3 cr.) F

#### C. Advanced Interpretation

At least 3 credit hours must be in the subject area of advanced interpretation. Allowable courses are listed below. The list may vary slightly from year to year.

- EFB 418 Interpreting Field Biology (3 cr.) Maymester
- EFB 560 Electronic Technology in Interpretation & Environmental Education (3 cr.) S

#### D. Organismal Diversity

To encourage breadth in organism-level biology, students must complete 12 credit hours including at least one course from each of the four groups listed in the catalog. No single class may be used to simultaneously fulfill directed electives D & E.

##### 1. Diversity of Microorganisms

- EFB 303 Introductory Environmental Microbiology (4 cr.) F
- EFB 340 Forest and Shade Tree Pathology (3 cr.) S
- EFB 342 Fungal Diversity and Ecology (3 cr.) CLBS
- EFB 428 Mycorrhizal Ecology (3cr.) F, even years
- EFB 440 Mycology (3 cr.) F

## 2. Diversity of Plants

- EFB 326 Diversity of Plants (3 cr.) S
- EFB 327 Adirondack Flora (3 cr.) CLBS
- EFB 336 Dendrology (3 cr.) F
- EFB 435 Flowering Plants: Diversity, Evolution, and Systematics (3 cr.) F
- EFB 446 Ecology of Mosses (3 cr.) S

## 3. Diversity of Invertebrate Animals

- EFB 351 Principles of Forest Entomology (3 cr.) S
- EFB 352 Elements of Entomology (3 cr.) F
- EFB 355 Invertebrate Zoology (4 cr.) S
- EFB 453 Parasitology (3 cr.) F
- EFB 554 Aquatic Entomology (3 cr.) F

## 4. Diversity of Vertebrate Animals

- EFB 388 Ecology of Adirondack Fishes (3 cr.) CLBS
- EFB 482 Ornithology (4 cr.) S
- EFB 483 Mammal Diversity (4 cr.) F
- EFB 485 Herpetology (3 cr.) S
- EFB 486 Ichthyology (3 cr.) S

## E. Field Experience Elective (3 cr.)

This elective is often taken during Maymester or at [Cranberry Lake Biological Station](#), either during the post-freshman summer or subsequent summer. A secondary option is EFB 418, which can be taken during Maymester. Other options for this requirement need approval of the curriculum coordinator. No single class may be used to fulfill directed elective requirements of D and E.

## F. Recreation and Tourism Management

At least 3 credit hours must be in the subject area of recreation and tourism management. Allowable courses are listed below. The list may vary slightly from year to year.

- FOR 475 Human Behavior and Recreation Visitor Management (3 cr.) S
- FOR 476 Ecotourism and Nature Tourism (3 cr.) F
- FOR 478 Wilderness and Wildlands Management (3 cr.) F

**Total Minimum Credits For Degree: 126**

# Bachelor of Science in Forest Health

- [www.esf.edu/efb/foresthealth](http://www.esf.edu/efb/foresthealth)

Forest health is a multidisciplinary and collaborative field of study that involves the understanding, monitoring, and protection of the world's forest resources.

A solid foundation in forest health requires expertise in many disciplines including, but not limited to, plant pathology, entomology, ecology, dendrology, mycology, silviculture, and forest management. At ESF, we have provided academic training in these areas for decades, but only recently have they been merged into an academic major.

## Required Courses

Course		Codes*	Credits
APM 391	Introduction to Probability and Statistics	G	3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 103	General Biology II: Cell Biology and Genetics	G	3

EFB 104	General Biology II Laboratory	G	1
EFB 120	The Global Environment and the Evolution of Human Society	G	3
EFB 132	Orientation Seminar: Environmental and Forest Biology		1
EFB 200	Physics of Life		3
EFB 202	Ecological Monitoring and Biodiversity Assessment		3
EFB 210	Diversity of Life I		3
EFB 211	Diversity of Life II		3
EFB 303	Introductory Environmental Microbiology		4
EFB 307	Principles of Genetics		3
EFB 308	Principles of Genetics Laboratory		1
EFB 311	Principles of Evolution		3
EFB 320	General Ecology		4
EFB 336	Dendrology		3
EFB 340	Forest and Shade Tree Pathology		3
EFB 345	Forest Health		3
EFB 351	Forest Entomology		3
OR EFB 352	Entomology		3
EFB 420	Internship in Environmental and Forest Biology		1 - 5
OR EFB 498	Research Problems in Environmental and Forest Biology		1 - 5
EFB 439	Forest Health Monitoring		3
EFB 494	Senior Synthesis in Forest Health		1
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
FCH 210	Elements of Organic Chemistry		4
FOR 321	Forest Ecology and Silviculture		3
FOR 345	Introduction to Soils		3

**NOTE:** EFB 498 is a 3 credit course.

## Electives

Course	Codes*	Credits
General Education Course in two of the following categories: American History, The Arts, Western Civilization, Other World Civilizations	G	6
Directed Electives		15
Open Electives		20

## Directed Electives

To ensure that Forest Health majors obtain both strength and breadth of knowledge, 15 elective credit hours must be selected from the following list, including at least one course from **five** of the seven categories.

### A. Forest Protection and Conservation Biology

- EFB 390 Wildlife Ecology & Management (4 cr.) F
- EFB 413 Intro Conservation Biology (3 cr.) S
- EFB 502 Ecology and Management of Invasive Species (3 cr.) F

### B. Forestry/Wood Products

- FOR 322 Forest Mensuration (3 cr.) F
- FOR 334 Silviculture (4 cr.) F
- FOR 360 Principles of Management (3 cr.) F,S
- FOR 455 Forest Genetics and Tree Improvement (3 cr.) S
- FOR 465 Natural Resources and Policy (3 cr.) S
- FOR 480 Urban Forestry (3 cr.)
- CME 376 Decay of Wood Products (3 cr.) S

### C. Technology

- BTC 296 Topics in Biotechnology (3 cr.) F,S
- BTC 401 Molecular Biology Techniques (3 cr.) F
- BTC 425 Plant Biotechnology (3 cr.) S
- BTC 426 Plant Tissue Culture Methods (3 cr.) F
- ESF 300 Introduction to Geospatial Information Technologies (3 cr.) F,S
- FOR 324 Natural Resources Information Systems (3 cr.) S

### D. Ecology and Environmental Science

- EFB 312 Introduction to Personal Environmental Interpretation Methods (3 cr.) F
- EFB 415 Ecological Biogeochemistry (3 cr.) F
- EFB 428 Mycorrhizal Ecology (3 cr.) F
- EFB 445 Plant Ecology (3 cr.) S
- EFB 505 Microbial Ecology (3 cr.) S
- EFB 516 Ecosystems (3 cr.) S
- EFB 518 Systems Ecology (3 cr.) F
- FOR 338 Meteorology (3 cr.) F

### E. Biodiversity

- EFB 326 Diversity of Plants (3 cr.) S
- EFB 342 Fungal Ecology and Diversity (3 cr.) CLBS
- EFB 352 Principles of Entomology (3 cr.) F
- EFB 355 Invertebrate Zoology (4 cr.) S
- EFB 428 Mycorrhizal Ecology (3 cr.) F even years
- EFB 435 Flowering Plants: Diversity, Evolution, and Systematics (3 cr.) F
- EFB 440 Mycology (A) (3 cr.) F
- EFB 453 Parasitology (3 cr.) F
- EFB 566 Systematic Entomology (3 cr.) F

### F. Mathematics and Physical Science

- APM 105 Survey of Calculus and Application I (4 cr.) F,S
- APM 106 Calculus and its Applications II (A) (4 cr.) F,S
- APM 510 Statistical Analysis (3 cr.) F

- FOR 323 Forest Biometrics (3 cr.) S
- PHY 102 General Physics II (A) (4 cr.) S

### G. Anatomy and Physiology

- EFB 325 Cell Biology (3 cr.) S
- EFB 427 Plant Anatomy and Development (3 cr.) F
- EFB 462 Animal Physiology: Environmental & Ecological (3 cr.) F
- EFB 530 Plant Physiology (3 cr.) S
- EFB 531 Plant Physiology Lab (2 cr.) S
- EFB 570 Insect Physiology (3 cr.) S

**Total Minimum Credits For Degree: 126**

## Bachelor of Science in Wildlife Science

- [www.esf.edu/efb/wildlife](http://www.esf.edu/efb/wildlife)

Wildlife science is the application of ecological knowledge in a manner that strikes a balance between the needs of wildlife populations and the needs of people.

Research and teaching in wildlife science began at ESF in 1914, one of the first such programs in the U.S., and was quickly followed by establishment of the [Roosevelt Wild Life Station](#) in 1919. Today, our program is recognized nationally and internationally, and our graduates are employed worldwide. The focus is applied ecology, and students engage the environmental challenges associated with managing wildlife, ranging from endangered species to overabundant populations. The program recognizes and accommodates the fact that wildlife scientists increasingly must deal with all forms of wildlife, including plants and invertebrates, and the scope is becoming more international.

### Required Courses

Course		Codes*	Credits
APM 105	Survey of Calculus and Its Applications I	G	4
APM 391	Introduction to Probability and Statistics	G	3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 103	General Biology II: Cell Biology and Genetics	G	3
EFB 104	General Biology II Laboratory	G	1
EFB 120	The Global Environment and the Evolution of Human Society	G	3
EFB 132	Orientation Seminar: Environmental and Forest Biology		1
EFB 200 OR FCH 210	Physics of Life Elements of Organic Chemistry		3 4
EFB 202	Ecological Monitoring and Biodiversity Assessment		3
EFB 210	Diversity of Life I		3
EFB 211	Diversity of Life II		3
EFB 307	Principles of Genetics		3
EFB 308	Principles of Genetics Laboratory		1
EFB 311	Principles of Evolution		3

EFB 320	General Ecology		4
EFB 390	Wildlife Ecology and Management		4
EFB 491	Applied Wildlife Science		3
EFB 493	Wildlife Habitats and Populations		4
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1

## Electives

Course	Codes*	Credits
General Education Course in two of the following categories: American History, The Arts, Western Civilization, Other World Civilizations	G	6
Directed Electives		24
Open Electives		29

## Directed Electives

To ensure that Wildlife Science undergraduates obtain both strength and breadth of knowledge, and position themselves for professional certification by The Wildlife Society, 24 elective credits must be obtained in the following subject areas (A-G), through specific courses that are designed for juniors or seniors (i.e. courses numbered 300 or higher)

### A. Field experience (3 credits):

This requirement can be satisfied during any year, and is normally done via coursework at [Cranberry Lake Biological Station](#). ESF field courses offered during semester break, field courses offered by other institutions or organizations (e.g, School for Field Studies), independent research projects, or job-related internships during the summer session.

### B. Vertebrate Diversity (6 credits):

Choose at least two courses from the following:

- EFB 482 Ornithology (4 cr.) S
- EFB 483 Mammal Diversity (4 cr.) F
- EFB 485 Herpetology (3 cr.) S
- EFB 486 Ichthyology (3 cr.) S

### C. Plant Diversity and Ecology (3 credits)

Choose at least one course from the following:

- EFB 326 Diversity of Plants (3 cr.) S
- EFB 327 Adirondack Flora (3 cr.) CLBS
- EFB 336 Dendrology (3 cr.) F
- EFB 435 Flowering Plants: Diversity, Evolution and Systematics (3 cr.) F
- EFB 445 Plant Ecology and Global Change (3 cr.) S

### D. Invertebrate Diversity (3 credits)

Choose at least one course from the following:

- EFB 351 Forest Entomology (3 cr.) F, even years
- EFB 352 Elements of Entomology (3 cr.) F, odd years

- EFB 355 Invertebrate Zoology (4 cr.) S
- EFB 453 Parasitology (3 cr.) F
- EFB 554 Aquatic Entomology (3 cr.) F
- EFB 566 Systematic Entomology (3 cr.) F

#### E. Policy (3 credits)

Choose at least one course from the following:

- FOR360 Principles of Management (3 cr.) F
- FOR465 Natural Resources Policy (3 cr.) F
- FOR487 Environmental Law and Policy (3 cr.) F
- FOR488 Natural Resources Agencies and Administration (3 cr.) S
- FOR489 Natural Resources Policy and Law (3 cr.) S

#### F. Structure and Function (3 credits)

Choose at least one course from the following:

- EFB 325 Cell Biology (3 cr.) S
- EFB 385 Comparative Vertebrate Anatomy (4 cr.) S
- EFB 462 Animal Physiology: Environmental and Ecological (3 cr.) F
- EFB 480 Principles of Animal Behavior (4 cr.) S
- EFB 516 Ecosystems (3 cr.) S
- EFB 542 Freshwater Wetland Ecosystems (3 cr.) S

#### G. Technical Skills (3 credits)

Choose at least one course from the following:

- BTC 401 Molecular Biology Techniques (3 cr.) F
- ESF 300 Introduction to Geospatial Information Technologies (3 cr.) F, S
- ERE 371 Surveying For Engineers (4 cr.) F

<b>Total Minimum Credits For Degree: 126</b>
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## Graduate Program

- [www.esf.edu/efb/grad](http://www.esf.edu/efb/grad)

The graduate program in environmental and forest biology is organized in areas of study designed to provide a strong background within specific interest areas. Faculty with nationally and internationally recognized expertise define the scope of subject matter within each study area, recommend acceptance of students, and guide them through a course of study appropriate to student goals and aspirations. Most students develop a degree of depth and specialization in at least one large taxonomic group, such as plants, fungi, vertebrates, or insects.

### M.S.

- [www.esf.edu/efb/graduate/degrees.htm](http://www.esf.edu/efb/graduate/degrees.htm)

The master of science degree entails a research-based thesis (6-12 credits of thesis research) in addition to 18-24 credits of graduate coursework (including special research topics and at least three seminars) for a total of at least 30 graduate credits. Students earning a M.S. degree find a much wider range of job options that have greater responsibilities and pay compared to jobs that require only a B.S. degree. Many jobs at the M.S. level require an ability to perform research. Students interested in research-type positions in government, non-profit organizations, and academic and industry settings should pursue a M.S., rather than M.P.S. degree. Additionally, although not required by many graduate schools, a M.S. degree is often a key step toward earning a Ph.D. The M.S. student

presents a thesis proposal to the major professor and committee who will guide completion of the research and writing of the thesis. A capstone seminar and defense of thesis are required.

## M.P.S.

- [www.esf.edu/efb/graduate/degrees.htm](http://www.esf.edu/efb/graduate/degrees.htm)

The master of professional studies degree requires graduate coursework credits and graduate seminars. Depending on the area of study, students may complete the M.P.S. degree with coursework and seminars, or a combination of coursework, seminars, and professional experience (internship). The M.P.S. degree is designed to accommodate a great breadth of student goals and needs, including students desiring additional education following some experience in their field, and science teachers seeking the master's degree for permanent certification. As in all degree programs in EFB, the student will be guided through the M.P.S. by a steering committee.

**Coursework Option** for the following areas of study: chemical ecology, conservation biology, ecology, entomology, environmental interpretation, environmental physiology, fish and wildlife biology and management, forest pathology and mycology, or plant science and biotechnology: At least 30 of the 42 credits required must be taken in residence at ESF. Coursework in this option includes three seminars (EFB 797), and a maximum of six credits earned in EFB 798 or 898. Neither a comprehensive examination nor a capstone seminar is required.

**Coursework Option for the area of study in [applied ecology](#):** Coursework requirements include three credit hours each from five of the seven focus areas, two credit hours in graduate seminars (EFB 797) and additional 19 credit hours of graduate coursework for a total of 36 credit hours. Neither a comprehensive examination nor a capstone seminar is required.

**Coursework Option for the area of study in [plant biotechnology](#):** Coursework requirements consist of 19 credit hours of core coursework (including two credit hours of graduate seminars (EFB 797)), nine credit hours of directed electives and eight credit hours of open electives for a total of 36 credit hours. Neither a comprehensive examination nor a capstone seminar is required.

**Professional Experience Option** for the following areas of study: chemical ecology, conservation biology, ecology, entomology, environmental interpretation, environmental physiology, fish and wildlife biology and management, forest pathology and mycology, or plant science and biotechnology: In addition to an internship earning 6-12 credits (EFB 898), this option requires at least 30 credits of graduate coursework, of which 24 must be taken in residence at ESF. At least 36 credits must be earned between internship and coursework. Coursework for this option includes at least two seminars (EFB 797) and a maximum of three credits earned in EFB 798. A written report of the internship is required as well as an oral comprehensive exam and capstone seminar. For students completing the concurrent degree program (M.P.S./M.S.) leading to certification in biology (grades 7-12), 12 credits of student teaching and coursework will be accepted as equivalent to a professional experience.

## Ph.D.

- [www.esf.edu/efb/graduate/degrees.htm](http://www.esf.edu/efb/graduate/degrees.htm)

The doctor of philosophy degree may be pursued directly from the bachelor's level, or following a master's degree program. Doctoral study culminates in a dissertation (or its equivalent as refereed publications) based on original research. In many cases this work serves as a foundation for future studies and publications throughout the student's career. Research activity is often funded through extramural grants to the student's major professor. Abundant opportunities exist to gain teaching experience during the doctoral program. A written and oral examination is required to proceed to doctoral candidacy, at least one year prior to the capstone seminar and defense of the dissertation. Of the 60 credits required, 30-48 are awarded for coursework (including special research topics and at

least five seminars) and 12-30 credits for the dissertation.

## Graduate Areas of Study

- [www.esf.edu/efb/grad](http://www.esf.edu/efb/grad)

### Applied Ecology (M.P.S)

- [www.esf.edu/efb/appliedecology](http://www.esf.edu/efb/appliedecology)

This area of study in the M.P.S. degree is designed for students who desire to solidify their background in applied ecology and professionals who would return for “retooling”; suitable for careers in environmental oversight, policy, planning, law, and education.

This program begins with a three-day orientation in August at one or more of the ESF field facilities. Coursework requirements include three credit hours each from five of the seven focus areas: *GIS tools*, *Statistical Tools*, *Specialty Tools*, *Ecosystem Ecology*, *Organismal Ecology*, *Human Dimensions in Ecology*, and *Communications in Ecology*; two credit hours in graduate seminars (EFB 797) and additional 19 credit hours of graduate coursework for a total of 36 credit hours.

### Conservation Biology (M.S., M.P.S., Ph.D.)

- [www.esf.edu/efb/consbiograd](http://www.esf.edu/efb/consbiograd)

This area entails study and maintenance of biological diversity at the level of genes, populations, communities, ecosystems and biomes; intellectual underpinnings include evolutionary theory, systematic biology, population biology and ecosystem science. Conservation biology seeks ways to integrate biological principles with social, economic and political perspectives to achieve conservation goals.

### Ecology (M.S., M.P.S., Ph.D.)

- [www.esf.edu/efb/ecology](http://www.esf.edu/efb/ecology)

This integrative study area allows students to investigate the relationships of organisms to their environment and those factors that affect their distribution and abundance. Both the practical and theoretical applications of ecology are emphasized through courses and research.

There are four major areas in ecology: organismal ecology, population-evolutionary ecology, community ecology and systems ecology. In consultation with the student’s steering committee, courses are chosen from these areas, as well as other disciplines. Specific research may encompass any of the four major areas of ecology and entail the study of the distribution and abundance of organisms, community structure including trophic relationships, diversity, succession and ecosystem properties, such as patterns of energy transfer and biogeochemical cycling.

### Entomology (M.S., M.P.S., Ph.D.)

- [www.esf.edu/efb/ento](http://www.esf.edu/efb/ento)

Graduate study opportunities prepare students in the basic aspects of insect life and the role of insects in relation to humans and their environment.

The wide range of effects stemming from insect activity, from the beneficial to the deleterious, allows for a variety of research subjects in which insects play a major role. Thesis topics may concern insects that affect forests, shade trees and wood products, those relating to the health and well-being of humans, those playing key roles as parasites and predators of pest species, and those serving as food for many birds and vertebrate animals. Current research areas include population dynamics of forest defoliators, pheromone communications in beetles and moths, evolution

of chemical communication, effects of forest practices on stream benthic insects, natural control of insects in forest systems and biochemistry of insect detoxification mechanisms.

### **Environmental Interpretation (M.S., M.P.S., Ph.D.)**

- [www.esf.edu/efb/envint](http://www.esf.edu/efb/envint)

Environmental interpretation sharpens the cutting edge of communication among scientists and various public sectors. Graduate study enables students to explore interpretation / conservation education processes through application to specific projects in the natural sciences and science education.

Students pursue career pathways in natural resource agencies, in nature centers, museums, aquaria, botanical gardens and especially in the science classroom. The environmental interpretation program incorporates a 15,000-acre reserve in the heart of the Adirondack Park and an associated Adirondack Interpretative Center with trail system. Internships and partnerships with a variety of conservation-based programs are vital to the program. Students develop their course of study from a large palette of graduate courses in Environmental and Forest Biology.

### **Environmental Physiology (M.S., M.P.S., Ph.D.)**

- [www.esf.edu/efb/envphysiology](http://www.esf.edu/efb/envphysiology)

Environmental physiology provides students with advanced training in the nature and control of biological processes.

Current interests include mechanisms of drought tolerance in plants; plant and microbial enzymology; virology; toxicity and disposition of insecticides and environmental toxicants in vertebrates; plant defenses against phytophagous invertebrates; thermal exchange in bird eggs; plant reproductive biology; and genetic improvement of willow and poplar.

### **Fish and Wildlife Biology and Management (M.S., M.P.S., Ph.D.)**

- [www.esf.edu/efb/fishwild](http://www.esf.edu/efb/fishwild)

Study in this area provides students with advanced preparation in biological concepts of fish and wildlife populations as they relate to resource management.

Increasing concern for these wild animal resources has been matched by strong student interest in educational programs that prepare them for careers in the fish and wildlife professions; ESF graduates are employed worldwide.

### **Forest Pathology and Mycology (M.S., M.P.S., Ph.D.)**

- [www.esf.edu/efb/mycopath](http://www.esf.edu/efb/mycopath)

Forest pathology and mycology trains students to understand tree diseases and fungi from the perspective of basic biology and ecology as well as that of societal needs.

This requires global understanding of the positive and negative ecological roles of diseases in the forest environment. It requires a broad knowledge of fungi, viruses, bacteria and abiotic environmental factors affecting forest systems. It also requires sophisticated application of molecular biology, physiology and genetics to host pathogen systems. Areas of interest include environmental, fungal and viral tree diseases; mycorrhizae; wood decay; monitoring and impact assessment of disease in forest and urban tree systems; epidemiology of tree diseases and the genetics of resistance to tree diseases and pathogen variability; molecular biology and physiology of fungus infection and invasion; and taxonomy and ecology of fungi.

### **Plant Biotechnology (M.P.S.)**

- [www.esf.edu/efb/plantbio](http://www.esf.edu/efb/plantbio)

This area of study in the M.P.S. degree is designed for students who need to broaden their knowledge base and technical skills in biotechnology, for professionals returning for “retooling,” and for the recent graduate in a variety of disciplines in biology and chemistry.

Requirements consist of 19 credit hours of core coursework (including two credit hours of graduate seminars (EFB 797)), nine credit hours of directed electives and eight credit hours of open electives for a total of 36 credit hours.

### **Plant Science and Biotechnology (M.S., M.P.S., Ph.D.)**

- [www.esf.edu/efb/plantsci](http://www.esf.edu/efb/plantsci)

Plants, as the base for ecological food chains, serve as the structural and functional foundation of natural and managed systems. The study of plant science and biotechnology provides opportunity in a broad range of specialties fundamental to the understanding of plants and their interaction with other organisms and for specializing in plant biotechnology.

Emphasis is on forests and related plant systems. Current research interests include dynamics of plant communities as affected by humans and the environment; mechanisms of plant succession; epidemiology of forest and urban tree diseases; taxonomy, physiology, growth and ultrastructure of fungi; heritability of wood properties and disease resistance of trees; biochemistry and physiology of plant stress response; photosynthesis; mycorrhizae; plant reproductive biology; genetic engineering; transformation; molecular evolution; phylogenetics; taxonomy; plant-pathogen interactions, tissue culture and study of ancient DNA.

### **Chemical Ecology (M.S., M.P.S., Ph.D.)**

- [www.esf.edu/efb/chemeco](http://www.esf.edu/efb/chemeco)

As a relatively new interdisciplinary endeavor, workers in this field attempt to understand organismal interactions, both intra- and interspecific, mediated by chemical substances such as hormones, pheromones, kairomones and phytoalexins.

These interactions occur at all taxonomic levels: between uni- and multicellular organisms, microbes and plants, plants and plants, plants and animals, microbes and animals and various species of animals. Study of such interactions has accelerated in recent years through joint efforts of biologists and chemists in basic and applied research in the laboratory and field.

The area of study in chemical ecology is offered through collaboration between the Department of Environmental and Forest Biology and the Department of Chemistry. Interested students should apply to the department of major interest, which will have prime responsibility for setting requirements. Faculty from both areas contribute to the development of a plan of study enabling a student to acquire sophisticated skills in either chemistry or biology and an ample understanding of the other field to grapple with problems requiring an understanding of both.

# Department of Environmental Resources Engineering

Theodore A. Endreny, Chair

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- [www.esf.edu/ere](http://www.esf.edu/ere)

Our departmental mission is to engage in teaching, research and service to advance environmental resources engineering practices and meet the needs of the world. Faculty strengths are in ecological engineering, geospatial engineering, water resources engineering, and the broader field of environmental resources engineering. Teaching includes innovative class, lab, and field exercises in foundational and advanced engineering topics, where our flexible curriculum allows students to focus on traditional or novel engineering practices. Students receive a well-balanced education, including courses that allow students to see the social, economic, and environmental impacts of engineering practice, fundamental engineering and environmental engineering courses, and specialized courses that capture the breadth of their field of study. The ERE department is internationally recognized for coupling research and service, and many ERE courses to address community needs. The ERE department provides unparalleled mentoring to train students in engineering science and design so they can join our alumni as leaders in professional practice and research.

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## Bachelor of Science in Environmental Resources Engineering

- [www.esf.edu/ere/undergraduate/](http://www.esf.edu/ere/undergraduate/)

This degree program prepares graduates to operate with professional competence in environmental resources engineering. A broad base of study in engineering fundamentals enables graduates to enter professional practices that focus on the use and protection of soil, water, air, and other renewable and non-renewable resources. The program aims to educate professionals who will ensure sustainable development through environmentally responsible engineering solutions. **This program is accredited as an environmental engineering program by the Engineering Accreditation Commission of ABET, <http://www.abet.org>.**

### Lower Division Required Courses

Course		Codes*	Credits
APM 205	Calculus I for Science and Engineering	G	4
APM 206	Calculus for Science and Engineering II	G	4
APM 307	Multivariable Calculus		4
APM 485	Differential Equations for Engineers and Scientists		3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
ERE 132	Introduction to Environmental Resources Engineering		1

ERE 133	Introduction to Engineering Design		3
ERE 275	Ecological Engineering		3
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
GNE 271	Statics		3
GNE 273	Mechanics of Materials		3
PHY 211	General Physics I	G	3
PHY 212	General Physics II		3
PHY 221	General Physics I Laboratory		1
PHY 222	General Physics II Laboratory		1

“C-” is a requirement for students to pass each calculus course and move into the next course. This requirement is necessary to ensure engineering students have the quantitative skills to succeed in the ERE program. The admissions office uses C as a threshold for the calculus courses when students want to transfer into the ERE program.

### Lower Division Electives

Course	Codes*	Credits
Earth Science Elective: FOR 345, FCH 399, FOR 338, EAR105, EAR 111, or EAR 117	G	3
Ecology Elective: EFB 320, FOR 232, FOR 321, FOR 442, or BIO 345	G	3
General Education Courses	G	9

**Total Lower Division Credits Required: 69**

### Explanation of General Education Courses

Consistent with the SUNY General Education Requirement (GER), ERE students must earn 30 credit hours in at least 7 of the 10 SUNY GER subject areas, and demonstrate competencies in critical thinking and information management. The GER subject areas are: Basic Communication (required); Mathematics (required); American History; Other World Civilizations; Foreign Language; Social Sciences; Humanities; The Arts; Natural Sciences; and Western Civilization. The ERE B.S. Program curriculum satisfies 21 of the 30 credit hours in 4 of the 10 SUNY GER subject areas by: a) mapping 15 credit hours of Mathematics and Natural Sciences GER subject areas to required courses in calculus, biology, chemistry, and physics; b) mapping 3 credit hours of Basic Communication GER subject area to a required course EWP 190; and mapping 3 credit hours of Social Science to EWP 290. Students must complete the remaining 9 credits of SUNY GER in at least 3 of these subject areas: American History; Other World Civilizations; Foreign Language; Humanities; The Arts; and Western Civilization.

## Upper Division Required Courses

Course		Codes*	Credits
APM 395	Probability and Statistics for Engineers		3
CIE 337	Introduction to Geotechnical Engineering		4
ERE 335	Numerical and Computing Methods		3
ERE 339	Fluid Mechanics		4
ERE 340	Engineering Hydrology and Hydraulics		4
ERE 365	Principles of Remote Sensing		4
ERE 371	Surveying for Engineers		3
ERE 380	Energy Systems Engineering		3
ERE 430	Engineering Decision Analysis		3
ERE 440	Water and Wastewater Treatment		3
ERE 468	Solid and Hazardous Waste Engineering		3
ERE 480	Fate and Transport of Contaminants in Environmental Systems		3
ERE 488	Engineering Project Management		1
ERE 489	Environmental Resources Engineering Planning and Design		3

## Upper Division Electives

Course	Codes*	Credits
<p>Engineering Elective</p> <p>These courses focus on theory and application of scientific principles and quantitative skills to monitor, assess, or design in the environmental resources engineering profession.</p> <p>Pre-approved SUNY-ESF engineering elective courses are:</p> <ul style="list-style-type: none"> <li>• ERE 405 Sustainable Engineering</li> <li>• ERE 412 River Form and Process</li> <li>• ERE 425 Ecosystem Restoration Design</li> <li>• ERE 445 Hydrologic Modeling</li> <li>• ERE 448 Open Channel Hydraulics</li> <li>• ERE 465 Environmental Systems Engineering</li> <li>• ERE 475 Ecological Engineering for Water Quality Improvement</li> <li>• GNE 461 Air Pollution Engineering</li> <li>• ERE 311 Ecological Engineering in the Tropics</li> <li>• ERE 545 Environmental Soil Physics</li> <li>• ERE 496 and ERE 596 Special Topics courses must be pre-approved by the Department prior to registration</li> </ul> <p>Pre-approved Syracuse University courses that may be used to satisfy engineering electives include:</p> <ul style="list-style-type: none"> <li>• CIE 331 Analysis of Structures and Materials</li> <li>• CIE 332 Design of Concrete Structures</li> <li>• CIE 338 Foundation Engineering</li> <li>• CIE 443 Transportation Engineering</li> <li>• CIE 473 Transport Processes in Environmental Engineering</li> <li>• Special Topics courses offered through Syracuse University's L.C. Smith College of Engineering must be pre-approved</li> </ul>	E	9

by the Department prior to registration

500-599 Graduate courses designed expressly for areas of specialization in post-baccalaureate programs. Qualified undergraduate students may enroll with permission of the instructor.

- ERE 527 Stormwater Management
- ERE 545 Environmental Soil Physics
- ERE 551 GIS for Engineers

600-699 Graduate courses are designed expressly for advanced levels of specialization. Undergraduate students with a cumulative grade point average of 3.000 or better may enroll in these courses with an approved petition.

- ERE 621 Spatial Analysis
- ERE 622 Digital Image Analysis
- ERE 674 Methods in Ecological Treatment
- ERE 692 Remote Sensing of the Environment
- ERE 693 GIS-Based Modeling

Technical Elective

These courses focus on techniques, theory, and skills to advance competence in professional practice.

Any CIE class, any APM class 200 level and above; any BPE class 300 level and above; any BTC class; any CME class with the exception of CME 202; any EFB class with the exception of EFB 120, 200, 217, 220, and 312; any EHS class; any ENS class; any ERE class; any FCH class 200 level and above; any from FOR 320 and above with exception of 475 to 478; any GNE class; or any SRE class.

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**Total Minimum Credits For Degree: 128**

## Graduate Program in Environmental Resources Engineering

- [www.esf.edu/ere/graduate](http://www.esf.edu/ere/graduate)

ERE participates in graduate education leading to the master of professional studies, master of science, and doctor of philosophy degrees in environmental resources engineering. Graduate studies and research are primarily concerned with environmental and resource-related problems. ERE graduate students apply science and engineering to the conservation, restoration, holistic development, and improved utilization of the natural environment and its related resources.

Applicants to all programs of study are required to have a bachelor's degree in science or engineering and are expected to have completed at least one 3-credit course in physics, one 3-credit course in statistics, and two 3-credit courses in calculus. Students admitted without necessary background are required to take additional prerequisite courses required by the department.

### Degrees

The **Master of Professional Studies (M.P.S.)** degree requires the successful completion of a minimum of 30 credits at the graduate level, of which at least 24 must be in coursework. A comprehensive project or practicum completes the M.P.S. degree requirements.

The **Master of Science (M.S.)** degree requires the successful completion of a minimum of 30 credits at the graduate level, of which at least 18 must be in coursework and a minimum of six credits for the thesis.

The **Doctor of Philosophy (Ph.D.)** degree requires the successful completion of a minimum of 60 credits at the graduate level, of which 30-48 are for coursework and 12-30 credits are for dissertation.

All graduate degrees in ERE require completion of at least 15 credit hours of graduate coursework in engineering and applied science courses. A departmental seminar is also required. Program mastery courses may be satisfied by prior study. Plans of study are individualized by academic advisors so that students acquire needed depth and breadth in their training and courses and reach their professional goals.

## Graduate Options

- [www.esf.edu/ere/graduate](http://www.esf.edu/ere/graduate)

There are five graduate options:

### Ecological Engineering (M.P.S., M.S., Ph.D.)

- [www.esf.edu/ere/graduate/ee](http://www.esf.edu/ere/graduate/ee)

Ecological Engineering is the design of ecosystems for the mutual benefit of humans and the environment. Ideal design considers humans to be part of nature rather than apart from nature. At ESF we believe that ecological engineering education and research should meet local to global needs. We teach and research sustainable solutions and approach ecological engineering broadly, working in many areas of the world and in most major areas of ecological engineering.

#### Program Requirements

Program prerequisite or co-requisite courses beyond the departmental requirement include at least one semester of study in thermodynamics, fluid mechanics, or statics; probability and statistics; ecology; and hydrology.

Program mastery courses beyond the departmental requirement include at least one course (3+ credit hours) in each of the four areas of competence listed below (illustrative courses are listed in parenthesis).

1. Ecosystem Restoration (e.g., Ecosystem Restoration Design, Sustainable Engineering, River Form and Process, Ecological Engineering in the Tropics)
2. Pollutant Treatment (e.g., Methods in Ecological Treatment, Ecological Engineering for Water Quality, Stormwater Management)
3. Modeling (e.g., Hydrologic Modeling, Systems Engineering, Engineering Hydrology & Hydraulics)
4. Ecosystem Sciences (e.g., Microbial Ecology, Ecosystems, Systems Ecology, Tropical Ecology, Ecological Biogeochemistry, Plant Ecology and Global Change, Aquatic Ecosystem Restoration, Limnology, Environmental Chemistry)

### Environmental Management (M.P.S.)

- [www.esf.edu/ere/graduate/em](http://www.esf.edu/ere/graduate/em)

Environmental Management combines environmental engineering with environmental and business management to provide breadth and perspective for the student aspiring to managerial responsibility in public or private employment. Student coursework is designed to enhance technical and problem-solving skills to meet contemporary needs of environmental managers.

#### Program Requirements

Program prerequisite or co-requisite courses beyond the departmental requirement include at least three 3-credit undergraduate courses from at least three of the following fields: chemistry, geographic measurements, engineering mechanics, ecology, computer science, and economics.

Program mastery courses beyond the departmental requirement include at least one course (3+ credit hours) in each of the three areas of competence listed below (illustrative courses are listed in parenthesis).

- Project Management (e.g. cost engineering, principles of management, engineering economics, resource economics, engineering

management, systems engineering)

- Environmental Policy (e.g. environmental law, environmental impact analysis)
- Environmental Resources Management (e.g., solid or hazardous waste management, watershed management, sustainable design, sustainable development)

Study programs are flexible and are tailored to the interests and strengths of individuals.

## Environmental Resources Engineering (M.P.S., M.S., Ph.D.)

- [www.esf.edu/ere/graduate/ere](http://www.esf.edu/ere/graduate/ere)

Environmental Resources Engineering takes an interdisciplinary approach to solve environmental and resource-related problems. Emphasis is placed on applying science and engineering to the conservation, restoration, holistic development, and improved utilization of the natural environment and its related resources.

Student's program of study may be tailored to systems and processes at different geospatial scales, from biomolecules to planetary, and employing various tools and techniques such as biomolecular techniques, remote sensing, hydrodynamic modeling and systems analysis.

### Program Requirements

Program prerequisite or co-requisite courses beyond the departmental requirement include at least one semester of study in thermodynamics, fluid mechanics, or statics; hydrology, chemistry, or biology; and computing methods.

Program mastery courses beyond the departmental requirement are arranged to meet the objectives of the individual student program. A student's program of study in this option may combine competence areas in the other ERE options, or introduce new competence areas.

## Geospatial Information Science and Engineering (M.P.S., M.S., Ph.D.)

- [www.esf.edu/ere/graduate/gisce](http://www.esf.edu/ere/graduate/gisce)

Geospatial Information Science and Engineering is designed for specialized study in spatial information acquisition, analysis, modeling and applications.

This includes theoretical and applied projects in sensing systems and the location, measurement, analysis and description of ground features and earth resources. It also includes use of geographic information systems (GIS) to incorporate spatial data into a wide range of environmental and engineering problems.

### Program Requirements

Program prerequisite or co-requisite courses include at least one year of physics and one engineering science course in surveying, numerical methods, or computer science.

Program mastery courses include at least one course (3+ credit hours) in each of the four areas of competence listed below (illustrative courses are listed in parenthesis).

- **Remote sensing** (e.g., Principles of Remote Sensing, Remote Sensing of the Environment)
- **Geographic information systems** (e.g., Introduction to Spatial Information, GIS for Engineers, GIS-Based Modeling, Introduction to Global Positioning Systems)
- **Spatial analysis and programming** (e.g., Spatial Analysis, Digital Image Analysis, Numerical and Computing Methods, Systems Engineering, Design and Analysis of Algorithm, Introduction to Artificial Neural Networks, Introduction to Database Management Systems, Data Mining, Artificial Intelligence)
- **Statistics** (e.g., Statistical Analysis, Multivariate Statistical Methods, Nonparametric Statistics, Analysis of Variance, Regression Analysis, Map Accuracy Assessment, Sampling Methods)

Students in the MPS program will take additional coursework in at least one of these areas, MS students will take additional coursework in at least two areas, and Ph.D. students will take additional coursework in at least three of these areas.

In addition to courses from the four areas listed above, there is flexibility for students interested in supplementary courses. For example, students in the past have expanded their knowledge in geography, ecology, forestry, systems analysis, electrical/computer engineering and mathematics. These courses are identified in consultation with the Major Professor and Steering Committee.

### **Water Resources Engineering (M.P.S., M.S., Ph.D.)**

- [www.esf.edu/ere/graduate/wre](http://www.esf.edu/ere/graduate/wre)

Water Resources Engineering deals with analysis and design of water resource systems through field, laboratory, and computer methods. Emphasis is placed on coordinating engineering to reduce impacts on human and natural systems.

Students select among alternative solutions to water resource problems, in recognition of environmental, economic, legal, social and managerial constraints. Laboratory equipment includes soil columns, a river table and two tilting and sediment circulating flumes, all supported by monitoring sensors. Analytical techniques using statistics, numerical analyses, and computer applications are emphasized. Modeling efforts include computational fluid dynamics, GIS, and remote sensing applications, distributed and real-time models, and model calibration and validation.

### **Program Requirements**

Program prerequisite or co-requisite courses beyond the departmental requirement include fluid mechanics, computing methods, and engineering hydrology.

Program mastery courses beyond the departmental requirement include at least one course (3+ credit hours) in each of the four areas of competence listed below (illustrative courses are listed in parenthesis).

- Environmental Hydraulics (e.g., Engineering Hydrology and Hydraulics, Open Channel Hydraulics, Transport Processes, Environmental Sediment Transport)
- Water Resources Modeling (e.g., Hydrologic Modeling, Systems Engineering, Groundwater Modeling)
- Hydrologic Zones and Fluxes (e.g., River Form and Process, HydroMeteorology, Vadose Zone Physics, Limnology, Hydrogeology)
- Water Quality (e.g., Water Pollution Engineering, Ecological Biogeochemistry, Environmental Chemistry; Environmental Aqueous Geochemistry)

# Division of Environmental Science

**Russell D. Briggs, Division Director**

**358 Illick Hall**

**315-470-6989**

- [www.esf.edu/environmentalscience](http://www.esf.edu/environmentalscience)

Environmental science at ESF is an interdisciplinary degree program that takes full advantage of its location within an environmentally focused college. The program offers students a tremendous variety of courses and faculty members to choose from, excellent facilities for research and field study, and a level of faculty expertise that is rarely found at other colleges.

The faculty members who deliver the program perform teaching, research and public service activities to promote environmental practices that will improve the lives of people within New York state and around the world.

The program's objectives are to prepare students who:

- Will engage in environmental work while employed by government agencies and industry or in private consulting jobs that specialize in public works and the inventory, management, design, use, restoration and protection of natural and cultural resources,
- Are prepared to enter advanced academic studies involved with any of the many aspects of environmental science, and
- Will continue to develop the knowledge and skills needed to adapt to changing technological, environmental and business conditions to the benefit of society, employer and self.

## Bachelor of Science in Environmental Science

- [www.esf.edu/environmentalscience/undergraduate.htm](http://www.esf.edu/environmentalscience/undergraduate.htm)

The curriculum in the bachelor's degree program provides a strong foundation in the sciences and introduces students to the interdisciplinary breadth of environmental science through a selection of core courses dealing with the geographical, physical, social and living environments.

Students have the flexibility to satisfy their core requirements by completing courses in biology, chemistry, ecology, geography, engineering, forestry, environmental studies and other areas of study. College-wide general education requirements provide additional opportunities for students to complete courses in the arts, humanities and social sciences to develop a broader context for personal and professional growth.

## Required Courses

Course	Codes*	Credits
APM 105   Survey of Calculus and Its Applications I	G	4

## Page Contents

- [Bachelor of Science in Environmental Science](#)
- [Bachelor of Science in Environmental Health](#) (launches Fall 2014)
- [Graduate Program in Environmental Science \(GPES\)](#)
  - [Master of Science \(M.S.\)](#)
  - [Master of Professional Studies \(M.P.S.\)](#)
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    - [Biophysical and Ecological Economics \(M.S., M.P.S., Ph.D.\)](#)
    - [Coupled Natural and Human Systems \(M.S., M.P.S., Ph.D.\)](#)
    - [Ecosystem Restoration \(M.S., M.P.S., Ph.D.\)](#)
    - [Environmental Communication and Participatory Processes \(M.S., M.P.S., Ph.D.\)](#)
    - [Environmental and Community Land Planning \(M.S., M.P.S., Ph.D.\)](#)
    - [Environmental Monitoring and Modeling \(M.S., M.P.S., Ph.D.\)](#)
    - [Environmental and Natural Resources Policy \(Ph.D.\)](#)
    - [Human Dimensions of the Environment \(M.S., M.P.S., Ph.D.\)](#)
    - [Water and Wetland Studies \(M.S., M.P.S., Ph.D.\)](#)

APM 106	Survey of Calculus and Its Applications II		4
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 103	General Biology II: Cell Biology and Genetics	G	3
EFB 104	General Biology II Laboratory	G	1
EFB 120	The Global Environment and the Evolution of Human Society	G	3
ENS 132	Orientation Seminar: Environmental Science		1
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
EWP 407	Writing for Environmental & Science Professionals		3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
FOR 207	Introduction to Economics	G	3
PHY 211	General Physics I	G	3
PHY 212	General Physics II		3
PHY 221	General Physics I Laboratory		1
PHY 222	General Physics II Laboratory		1

Note that one section of this course will fulfill the EWP 407 requirement. Students should check with their advisor before registering.

## Lower Division Electives

Course	Codes*	Credits
Free electives		6
General Education Courses: American History, Western Civilization, Other World Civilizations, the arts, foreign languages	G	6

## Professional Courses

Course	Codes*	Credits
APM 391	G	3
EFB 320		4
ESF 200		1
ENS 494		1
ENS 498		1 - 5
ESF 300		3

**NOTE:** ENS 498 is taken for 3 credits

## Environmental Science Core

Students must complete **one** course from each of the following environmental science core areas.

NOTE: Courses used to complete the advanced chemistry, biology, or mathematics requirements, environmental science core requirements, or option requirements may NOT be used to satisfy more than one of these requirements.

### The Physical Environment

Course		Codes*	Credits
ERE 351	Basic Engineering Thermodynamics		3
EST 231	Environmental Geology		3
FCH 210	Elements of Organic Chemistry		4
FCH 221 AND FCH 222	Organic Chemistry I Organic Chemistry Laboratory I		3 1
FCH 360	Physical Chemistry I		3
FOR 338	Meteorology	G	3
FOR 340	Watershed Hydrology		3
FOR 345	Introduction to Soils		3
GNE 172	Statics and Dynamics		4

### The Living Environment

Course		Codes*	Credits
EFB 303	Introductory Environmental Microbiology		4
EFB 326	Plant Evolution, Diversification and Conservation		3
EFB 327	Adirondack Flora		3
EFB 336	Dendrology		3
EFB 342	Fungal Diversity and Ecology		3
EFB 345	Forest Health		3
EFB 351	Forest Entomology		3
EFB 355	Invertebrate Zoology		4
EFB 384	Field Herpetology		3
EFB 385	Comparative Vertebrate Anatomy		4
EFB 388	Ecology of Adirondack Fishes		3
EFB 440	Mycology		3
EFB 462	Animal Physiology: Environmental and Ecological		3
EFB 483	Mammal Diversity		4
EFB 485	Herpetology		3
EFB 486	Ichthyology		3

### The Social Environment

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Course		Codes*	Credits
EFB 220	Urban Ecology		3
<b>OR</b> EST 220	Urban Ecology		3
EFB 337	Field Ethnobotany		3
EST 361	History of the American Environmental Movement	G	3
EST 390	Social Processes and the Environment		3
EWP 390	Literature of Nature		3
FOR 465	Natural Resources Policy		3

### Advanced Courses in Chemistry, Biology or Mathematics

An advanced course is one that has at least one prerequisite or is numbered 300 or above. Note: Courses used to complete the advanced courses in chemistry, biology or mathematics requirement may NOT be used to complete the environmental science core or option requirements.

Course	Codes*	Credits
Advanced Courses in science or mathematics		6

### Option Area

Students must complete at least 15 credits in ONE of the following option areas of study. Courses used to complete the advanced chemistry, biology, or mathematics requirements; environmental science core requirements; or upper division electives may not be used to satisfy the option area requirements.

#### Environmental Information and Mapping (15 credits required)

Course	Codes*	Credits
ERE 365	Principles of Remote Sensing	4
ERE 371	Surveying for Engineers	3
ERE 551	GIS for Engineers	3
<b>OR</b> ENS 519	Spatial Ecology	3
GEO 381	Cartographic Design	4

#### Watershed Science (15 credits required)

Course	Codes*	Credits
FOR 340	Watershed Hydrology	3
FOR 345	Introduction to Soils	3
FOR 442	Watershed Ecology and Management	3

Choose TWO courses from the list below:

Course	Codes*	Credits
EFB 423	Marine Ecology	4
EFB 424	Limnology: Study of Inland Waters	3

EFB 486	Ichthyology		3
EFB 487	Fisheries Science and Management		3
ERE 440	Water and Wastewater Treatment		3
FOR 338	Meteorology	G	3
GEO 316	River Environments		3
CIE 657	Ecological Biochemistry		3

NOTE: CIE 657, Ecological Biogeochemistry, is an upper-division Syracuse University course. Access by petition only; confer with your academic advisor.

### Health and the Environment (17 credits required)

#### Required Courses

Course		Codes*	Credits
EHS 250	Foundations of Environmental Health		1
EFB 400	Toxic Health Hazards		3
EFB 360	Epidemiology		3

#### Elective courses

Course		Codes*	Credits
EFB 303	Introductory Environmental Microbiology		4
EFB 307	Principles of Genetics		3
EFB 308	Principles of Genetics Laboratory		1
EFB 325	Cell Biology		3
EFB 385	Comparative Vertebrate Anatomy		4
EFB 453	Parasitology		3
EFB 462	Animal Physiology: Environmental and Ecological		3
EHS 320	Disease Prevention		2
EHS 350	Environmental Health Management		3
EHS 360			
EHS 440	Occupational Health and Safety		3
EHS 480	Hazardous Waste Management		3
ENS 470	Environmental Risk Assessment		3
FST 102	Food Fights: Contemporary Food		3

### Earth and Atmospheric Systems Science (15 credits required)

Course		Codes*	Credits
FCH 399	Introduction to Atmospheric Sciences	G	3
FCH 525	Oceanography		3
FOR 338	Meteorology	G	3

Choose TWO courses from the list below:

Course		Codes*	Credits
EFB 424	Limnology: Study of Inland Waters		3
FCH 510	Environmental Chemistry I		3
FCH 511	Atmospheric Chemistry		3
CIE 657	Ecological Biochemistry		3

NOTE: CIE 657, Ecological Biogeochemistry, is an upper-division Syracuse University course. Access by petition only; confer with your academic advisor.

### Environmental Analysis (16 credits required)

Course		Codes*	Credits
EFB 303	Introductory Environmental Microbiology		4
FCH 380	Analytical Chemistry I: Gravimetric, Titrimetric and Potentiometric Analysis		3
FCH 381	Analytical Chemistry II: Spectroscopic, Chromatographic and Electroanalytical Instrumental Technique		3
FOR 338 OR FOR 340 OR FOR 345	Meteorology Watershed Hydrology Introduction to Soils	G	3 3 3
ERE 365 OR GEO 388	Principles of Remote Sensing Geographic Information and Society		4 3

### Renewable Energy (15 credits required)

Course		Codes*	Credits
SRE 441 OR CME 305	Biomass Energy Sustainable Energy Systems for Buildings		3 3
SRE 325	Energy Systems		3
SRE 335	Renewable Energy		3
SRE 479	Life Cycle Assessment		3

and a minimum of 3 credits from the following:

Course		Codes*	Credits
CME 305	Sustainable Energy Systems for Buildings		3
ERE 351	Basic Engineering Thermodynamics		3
EST 427	Environmental and Energy Auditing		3
FCH 360	Physical Chemistry I		3
PSE 361	Engineering Thermodynamics		3

PSE 370	Principles of Mass and Energy Balance		3
SRE 422	Energy Markets and Regulation		3
SRE 416	Sustainable Energy Policy		3
SRE 454	Renewable Energy Finance and Analysis		3
PHY 305	Solar Energy Science and Architectures		3

## Upper Division Electives

Course	Codes*	Credits
Electives		15

Students completing the environmental science program must complete 15 credits of upper division electives to satisfy the graduation requirements. Course taken to satisfy the advanced math/science or option areas cannot also be used to satisfy the upper division elective requirement.

Under the guidance of their academic advisor, students may design their own block of electives. Course selection should support the student's capstone research, career or advanced academic study goals. Alternatively, this requirement can also be satisfied by choosing an official college minor. A list of minors is available:

- [Minors](#)

**Total Minimum Credits For Degree: 126**

## Bachelor of Science in Environmental Health

- [www.esf.edu/environmentalscience/envhealth](http://www.esf.edu/environmentalscience/envhealth)

Environmental health focuses on the study of how people interact with their environment—the air and water around us, the plants and animals we encounter, and the workplaces and homes where we spend much of our lives. The field is broad, encompassing the direct effects of the environment on human health, and the factors that adversely affect the ecological balances essential to human health and environmental quality.

## Core Courses

Course		Codes*	Credits
APM 105	Survey of Calculus and Its Applications I	G	4
APM 106	Survey of Calculus and Its Applications II		4
APM 391	Introduction to Probability and Statistics	G	3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 103	General Biology II: Cell Biology and Genetics	G	3
EFB 104	General Biology II Laboratory	G	1
EFB 303	Introductory Environmental Microbiology		4
EFB 360	Epidemiology		3

EFB 400	Toxic Health Hazards		3
EHS 250	Foundations of Environmental Health		1
EHS 320	Disease Prevention		2
EHS 350	Environmental Health Management		3
EHS 420	Professional Internship in Environmental Health		1 - 5
EHS 440	Occupational Health and Safety		3
EHS 480	Hazardous Waste Management		3
ENS 132	Orientation Seminar: Environmental Science		1
ENS 260	Environmental Sampling Methods		3
ENS 470	Environmental Risk Assessment		3
ENS 494	Environmental Science Capstone		1
ESF 200	Information Literacy		1
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
FCH 221	Organic Chemistry I		3
FCH 222	Organic Chemistry Laboratory I		1
FCH 223	Organic Chemistry II		3
FCH 224	Organic Chemistry Laboratory II		1
FCH 399	Introduction to Atmospheric Sciences	G	3
FST 102	Food Fights: Contemporary Food		3
PHY 101	Major Concepts of Physics I		4
PHY 102	Major Concepts of Physics II		4

**NOTE: PHY 101** and **PHY 102** both include a lab.

## Electives

### General Education Electives

Students are required to take one course from three of the following areas for a total of 9 General Education Electives

Category	Codes*	Credits
Social Science	G	3
American History	G	3
Arts	G	3
Western Civilization	G	3
Other World Civilizations	G	3

Foreign Language	G	3
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## Focus Area Electives

21 credits required for breadth and depth of knowledge.

Breadth: 3 credits from each of 3 focus areas (total of nine credits)

Depth: 12 credits from a fourth focus area.

**NOTE:** Some Focus Area Elective courses may have prerequisites, effectively exceeding the 126 minimum credit requirement for the B.S.

**NOTE:** Only three credits total from the 21 can be from a 200-level course or lower.

### A. Built Environment

Course		Codes*	Credits
EST 132	Introduction to Environmental Studies		3
EST 220	Urban Ecology		3
EST 231	Environmental Geology		3
LSA 311	Natural Processes in Design and Planning		3
LSA 326	Landscape Architectural Design Studio I		5
LSA 451	Comprehensive Land Planning		3
LSA 470	Thematic Landscape Design Studio		6

### B. Geospatial Technology

Course		Codes*	Credits
ERE 365	Principles of Remote Sensing		4
ERE 371	Surveying for Engineers		3
ERE 553	Introduction to Spatial Information		1
ERE 566	Introduction to Global Positioning Systems		1
ESF 300	Introduction to Geospatial Information Technologies		3

### C. Soils

Course		Codes*	Credits
ERE 511	Ecological Engineering in the Tropics		3
FOR 332	Forest Ecology		4
FOR 345	Introduction to Soils		3
FOR 535	Advanced Forest Soils		3
FOR 635	Forest Soils and Their Analyses		3

### D. Water and Wastewater

Students interested in this focus area are encouraged to take AMP205 and AMP206 in place of AMP105 and

AMP106, as the higher level calculus is required for many of the courses; also students interested in this focus area are encouraged to take PHY211/221 and PHY212/222 in place of PHY101 and PHY102, as the higher level physics is required for many of the courses.

Course		Codes*	Credits
CIE 442	Treatment Processes in Environmental Engineering		4
EAR 401	Hydrogeology		3
EAR 420	Contaminant Hydrogeology		3
EFB 496	Topics in Environmental and Forest Biology		1 - 3
EFB 505	Microbial Ecology		2
ERE 275	Ecological Engineering		3
ERE 339	Fluid Mechanics		4
ERE 340	Engineering Hydrology and Hydraulics		4
ERE 440	Water and Wastewater Treatment		3
FCH 360	Physical Chemistry I		3
FCH 510	Environmental Chemistry I		3
FOR 487	Environmental Law and Policy		3

### E. Solid/Hazardous Materials and Waste Management

Course		Codes*	Credits
CIE 341	Introduction to Environmental Engineering		3
EFB 496	Topics in Environmental and Forest Biology		1 - 3
ERE 275	Ecological Engineering		3
ERE 340	Engineering Hydrology and Hydraulics		4
ERE 405	Sustainable Engineering		3
ERE 465	Environmental Systems Engineering		3
ERE 468	Solid and Hazardous Waste Engineering		3

### F. Hydrogeology

Course		Codes*	Credits
EAR 401	Hydrogeology		3
EAR 420	Contaminant Hydrogeology		3
FOR 340	Watershed Hydrology		3
FOR 345	Introduction to Soils		3
FOR 442	Watershed Ecology and Management		3

### G. Food Protection

Course		Codes*	Credits
FST 307	Feeding the World: Global Agri-Food Governance		3

FST 402	Feeding the City: Urban Food Systems		3
FST 421	Morality of a Meal: Food Ethic		3
NSD 114	Food Safety and Quality Assurance		2
NSD 115	Food Science I		3
NSD 225	Nutrition in Health		3
NSD 427	Public Health Nutrition		3
NSD 455	Community Nutrition		3
NSD 481	Medical Nutrition Therapy I		3
NSD 555	Food, Culture and Environment		3

## H. Pre Medical Track

Students taking this track as their depth area must also select courses from 4 other focus areas, rather than three other focus areas for their breadth. This focus area does not count as one of the three breadth areas, but courses can count as Open Electives.

Course		Codes*	Credits
BTC 498	Research Problems in Biotechnology		1 - 9
EFB 307	Principles of Genetics		3
EFB 308	Principles of Genetics Laboratory		1
EFB 320	General Ecology		4
EFB 385	Comparative Vertebrate Anatomy		4
FCH 530	Biochemistry I		3
FCH 532	Biochemistry II		3

## Open Electives

Seven (7) Credit hours. Students can take more than the 7 hours of open electives, but need to be aware that those extra credits will not substitute for required courses. Students are encouraged but not required to use some of their open electives to do research projects either on or off campus within the EHS framework. Below are listed some courses that might be of interest to EHS students.

- EST 321 Government and the Environment
- EST 361 History of the American Environmental Movement
- EST 388 Psychological Principles of Risk Communication
- EST 390 Social Processes and the Environment
- EST 393 Environmental Discourse and Communication
- EST 395 Public Communication of Science and Technology
- EST 423 Rhetorical Practices in Environmental Communication
- EST 426 Community Planning and Sustainability
- EFB 217 Peoples, Plagues, and Pests
- EFB 220 Urban Ecology
- EFB 352 Entomology
- EFB 453 Parasitology

LSA 190 Clashing Perspectives in the Built Environment

FOR 202 Introduction to Sociology

FOR 204 Natural Resources in American History

FOR 489 Natural Resources Law and Policy

**Total Minimum Credits For Degree: 126**

## Graduate Program in Environmental Science (GPES)

DYLAN PARRY, Graduate Program Coordinator

109 Illick Hall

315-470-6753

- [www.esf.edu/environmentalscience/graduate](http://www.esf.edu/environmentalscience/graduate)

The graduate program in environmental science (GPES) offers M.S., M.P.S. and Ph.D. degrees. GPES was created in the early 1970s as a unique response to the emerging institutional and analytical challenges of developing environmental problems. The program, which draws upon faculty from throughout the College, emphasizes a multidisciplinary social and natural science approach to environmental understanding and stewardship.

GPES maintains a strong academic orientation, facilitating student and faculty engagement of fundamental environmental challenges such as resource utilization and sustainability, the uses and limits of scientific prediction, risk and sustainability, the uses and limits of scientific prediction and risk analysis, and a holistic concern for the health of the environment.

### Requirements

The academic requirements of the graduate program in environmental science are designed to provide graduates with a sound preparation to meet the rapidly evolving challenges of the field as leading scholars and professionals. Programmatic requirements constitute a framework which includes a comprehensive core foundation emphasizing theory, issues and methods; extended knowledge within an area of study; and a synthesis experience.

In addition, students should have an academic background and/or work experience related to the selected area of study. Wherever possible, deficiencies should be made up prior to matriculation.

### Master of Science (M.S.)

- [www.esf.edu/environmentalscience/graduate/ms.htm](http://www.esf.edu/environmentalscience/graduate/ms.htm)

The Master's Degree is designed as a two-year experience. The minimum total credits for the degree is 30. Lists of courses that meet requirements identified in this section have been approved by each area of study (AOS) faculty group and are hyperlinked to the [AOS web page](#). These lists are not exclusive; courses not on these lists may be taken with the approval of the Major Professor and Steering Committee, as indicated on the Form 3B.

#### Required credit hours are identified in three categories:

- Core:** The broad interdepartmental focus of GPES is reflected in the core requirements - A minimum of 9 credit hours distributed in 3 areas: social science, natural or physical science, and methods/tools.
- Area of Study:** A minimum of 15 credit hours (excluding 898 and 899 courses) in AOS courses are required.
- Thesis:** A minimum of 6 credit hours of research resulting in a document that clearly demonstrates graduate level accomplishments of the student, followed by a defense examination. Students must have an approved Thesis Proposal.
  - [Guidelines for preparation of the thesis document](#) (PDF)

## Concurrent Degree

Concurrent degree students may “double count” 8 credit hours toward their M.S. degree.

## Environmental Science Seminar

There is no seminar requirement for the Master of Science.

## Advanced Standing

A maximum of 6 graduate credit hours with a grade of B or above that have not been applied to another degree may be transferred via petition. The petition must include an attached syllabus and a justification of how the courses are to be included on the student's Plan Sheet.

Petitions regarding Core requirements may be submitted following matriculation. Petitions regarding Area of Study requirements are to be submitted following the formalization of the student's steering committee (submission of Form 2A establishes the steering committee).

## Master of Professional Studies (M.P.S.)

- [www.esf.edu/environmentalscience/graduate/mps.htm](http://www.esf.edu/environmentalscience/graduate/mps.htm)

The Master of Professional Studies (MPS) degree is a 30 credit hour experience aimed at professional applications of environmental knowledge.

## Core Requirements

Required course work: A total of 9 credit hours that includes one 3-hour social science course, one 3-hour natural or physical science course, and one 3-hour methods or tools course emphasizing applications of technical knowledge.

## Area of Study Requirements

A minimum of 12-15 credit hours of course works in the chosen area of study, as determined by the major professor and study area faculty. Students in the Water and Wetland Resources program are required to take either (i) a minimum of 18\*\* credit hours of area of study coursework and 3 hours of synthesis OR (ii) 15 credit hours of coursework in the area of study combined with 6 hours of synthesis. Students select a study area at the time of application for admission into the program.

A minimum of 12 credit hours of coursework is required in the chosen area of study, as determined by the major professor and study area faculty. Students select a study area at the time of application for admission to the program.

## Synthesis Requirements

Students select either an Internship (minimum of 3 credit hours) or prepare a synthesis paper (3 credit hours). Some internships may extend to 6 credit hours, reducing electives to 0. All students must present a capstone seminar in their final semester. No terminal comprehensive examination is required. See Appendix B for internship guidance.

## Advanced Standing

- a. Course transfers. A maximum of six graduate credit hours with a grade of B or above that have not been applied to another degree may be transferred via Petition. The Petition must include an attached syllabus, and a justification of how the courses are to be included on the student's Plan Sheet. Petitions for course transfers are submitted following matriculation.
- b. Credit for prior experience. Applicants with a minimum of three (3) years of post-baccalaureate full-time professional experience directly related to the intended area of study may apply for 6 credit hours of advanced standing in the program. Partial credit for experience cannot be awarded. When awarded for prior work experience, the 6 credit hours are applied toward the Synthesis requirement.

- [All College Forms](#)

## Concurrent Degree

Concurrent degree students may "double-count" 8 credit hours toward their MPS degree.

## Environmental Science Seminar

All students are required to take two (2) semesters of ENS 797 Environmental Science Seminar **OR**, in consultation with the Major Professor, appropriate seminars in other ESF departments or Syracuse University (the latter for credit only). ENS 797 is normally completed as an Audit, but at times may be taken for credit if offered.

## Doctor of Philosophy (Ph.D.)

- [www.esf.edu/environmentalscience/graduate/phd.htm](http://www.esf.edu/environmentalscience/graduate/phd.htm)

The Ph.D. program provides a unique opportunity to develop integrative research within a strong college community of environmental analysts and to draw upon the expertise of scholars at Syracuse University. Entering students are required to complete the equivalent of the GPES master's core either from prior graduate study or coursework taken within the first year of residency.

The Ph.D. in Environmental and Natural Resources Policy (ENRP) has separate and distinct requirements (discussed below). Also, applicants are expected to have completed a master's research thesis.

## Graduate Areas of Study

### Biophysical and Ecological Economics (M.S., M.P.S., Ph.D.)

- [www.esf.edu/environmentalscience/graduate/bee.asp](http://www.esf.edu/environmentalscience/graduate/bee.asp)

Students in the Biophysical and Ecological Economics (BEE) study area develop an understanding of environmental problems and solutions through analyses of the relations between the human economy of goods and services and the biophysical economy of networks of energy and material resource flows.

Drawing on insights from social and physical sciences, BEE helps students to develop critical thinking, intellectual approaches, measurement tools and modeling skills for analyzing increasingly important topics in environment and natural resource science and policy. Specific course work in biophysical and ecological economics is supplemented by course work in ecology, resource management, environmental economics, policy analysis and others.

### Coupled Natural and Human Systems (M.S., M.P.S., Ph.D.)

- [www.esf.edu/environmentalscience/graduate/cnhs.asp](http://www.esf.edu/environmentalscience/graduate/cnhs.asp)

The Coupled Natural and Human Systems (CNHS) area of study fosters interdisciplinary research and scholarship that explicitly integrates the social and biophysical dimensions of environmental issues using a systems approach.

Our research addresses the challenges of sustaining natural and social capital during the Anthropocene—the current era in which humans shape all major Earth system processes. Drawing on diverse backgrounds, CNHS students and faculty recognize humans as integral components of ecosystems and seek to understand their interactions and dynamics of change at multiple scales. Faculty mentors form collaborative and cross-disciplinary teams to advise CNHS students based on their wide range of expertise and experiences. An emphasis is placed on research and graduate training experience with applications to emerging sustainability issues in real-world settings.

### Ecosystem Restoration (M.S., M.P.S., Ph.D.)

- [www.esf.edu/environmentalscience/graduate/er.asp](http://www.esf.edu/environmentalscience/graduate/er.asp)

The ecosystem restoration study area focuses on the technical, biogeochemical, ecological and cultural aspects of

rehabilitating and restoring degraded ecosystems, habitats and landscapes.

The program is designed for graduate students who wish to take an interdisciplinary approach to ecosystem restoration, have access to multidisciplinary expertise, and develop advanced knowledge of ecological engineering, conservation biology, restoration ecology, forest and habitat restoration, landscape ecology and eco-cultural restoration to address complex environmental problems. Current research includes urban ecology and renewal, aquatic restoration, invasive species, agroforestry, brownfields, traditional ecological knowledge and the spatial monitoring, modeling and analysis of integrated ecological processes. Field sites and study areas are located throughout the world and involve a wide variety of ecosystems, cultures and landscapes. Specific course work in ecosystem restoration is supplemented by courses offerings in science, engineering, mathematics, natural resources, and environmental and social policy.

### **Environmental Communication and Participatory Processes (Ph.D. only)**

- [www.esf.edu/environmentalscience/graduate/ecpp.asp](http://www.esf.edu/environmentalscience/graduate/ecpp.asp)

This Ph.D. study area addresses the communicative dynamics of behaviors, attitudes, values, perceptions, and ideologies. It includes decision making, public policy, public participation, campaign development, organizational effectiveness, conflict prevention and resolution, and risk communication which all hinge on the ability of participants to communicate and use information effectively, strategically, and ethically.

GPES students within this option will be prepared to enter diverse arenas of academia, industry, non-government organizations, and government structures well equipped to facilitate and/or participate in interactions among individual citizens, non-government organizations, publics, agencies, bureaucracies, scientists, and others. They will have the skills and knowledge that will allow them to choose appropriate process structures and strategies to reach objectives.

### **Environmental and Community Land Planning (M.S., M.P.S., Ph.D.)**

- [www.esf.edu/environmentalscience/graduate/eclp.asp](http://www.esf.edu/environmentalscience/graduate/eclp.asp)

The program is designed for students with social science, natural science, engineering, or design backgrounds who are interested in an interdisciplinary and integrative program. Some students have majors in interdisciplinary programs in urban studies or environmental studies. Students develop an understanding and knowledge of development processes, natural systems and governmental planning and regulation. They develop a capacity to analyze environmental and community land planning problems and to form imaginative solutions. Skills obtained include preparation of land and environmental databases, plans, policies and implementation programs.

### **Environmental Monitoring and Modeling (M.S., M.P.S., Ph.D.)**

- [www.esf.edu/environmentalscience/graduate/emm.asp](http://www.esf.edu/environmentalscience/graduate/emm.asp)

This study area focuses on multidisciplinary approaches to measuring and modeling environmental systems and processes.

Students address pressing environmental problems in an integrative manner by taking advantage of a broad range of faculty expertise, a variety of course offerings related to the environment and access to advanced field equipment, study sites and computational hardware. Current research in this area includes sustainable development, air quality, water resources, biogeography, terrestrial and aquatic ecosystems, climate and anthropogenic change, forest biometrics and energy systems. Specific course work in environmental monitoring and modeling is supplemented by courses offerings in the fields of science, engineering, mathematics, natural resources and environmental and social policy.

## **Environmental and Natural Resources Policy (Ph.D. only)**

- [www.esf.edu/environmentalscience/graduate/enrp.asp](http://www.esf.edu/environmentalscience/graduate/enrp.asp)

The ENRP doctoral program is distinguished by its approach to interdisciplinary science, bringing multiple biophysical sciences together with social science, policy, and management.

The problems we study are grounded in the biophysical world, most specifically with the human impact on biophysical systems and vice versa. Investigating these problems requires scientific understanding of the interconnections between ecosystems and social systems; the skills developed in the ENRP program help our graduates to creatively and appropriately design managerial and policy solutions, as well as conduct research studies.

## **Human Dimensions of the Environment (M.S., M.P.S., Ph.D.)**

- [www.esf.edu/environmentalscience/graduate/hde.asp](http://www.esf.edu/environmentalscience/graduate/hde.asp)

Human Dimensions of the Environment deals with people's relationships and interactions with the biophysical world. This area incorporates knowledge from both the social and biophysical sciences to examine system interactions.

Research in this area works toward (1) understanding human perceptions, behaviors, attitudes and values with respect to natural resources and the environment; and (2) applying empirical findings to the development of social and biophysical science theory as it relates to human interactions with natural and constructed environments.

## **Water and Wetland Resource Studies (M.S., M.P.S., Ph.D.)**

- [www.esf.edu/environmentalscience/graduate/wwrs.asp](http://www.esf.edu/environmentalscience/graduate/wwrs.asp)

The water and wetland resources area of study develops an understanding of technical, social and institutional aspects of water resources management, mitigation and restoration.

Individual students may emphasize scientific or social subject areas but all study in both areas. Scientific aspects include the basic physical, chemical and biological interactions occurring in water resources systems. The social aspects are concerned with planning, regulation, law and institutions and management of water and wetland resources. Water serves as a focus for graduate study in water and related land resources management and water pollution and water quality control.

Recommended coursework includes:

- physical sciences: civil engineering, geology, geomorphology, hydrology, meteorology, environmental engineering, soils, water chemistry, hydrogeology, hydrogeochemistry and geographic information systems;
- biological sciences: ecology, entomology, fisheries biology, forestry, microbiology, water quality and limnology; and
- social sciences: administration, economics, government, history, law, ethics, philosophy and policy.

# Department of Environmental Studies

**Benette Whitmore, Interim Chair**

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- [www.esf.edu/es](http://www.esf.edu/es)

The Environmental Studies program emphasizes interdisciplinary social science, humanities, and natural science approaches to environmental understanding and stewardship. The programs maintain a strong academic orientation, facilitating student and faculty engagement with fundamental environmental challenges and dynamics such as multiple and conflicting levels of environmental governance, participatory democracy, sustainable development, uses and limits of scientific prediction, discourses of environment, cultural expressions of nature, risk, and ecological sustainability.

## Bachelor of Science in Environmental Studies

- [www.esf.edu/es/undergraduate/](http://www.esf.edu/es/undergraduate/)
  - [Information on minors](#)

Students may enter the Bachelor of Science program as first-year students or as transfer students. Students who are preparing to transfer to ESF as juniors must have earned at least 60 credits of college coursework, in courses comparable to the lower-division course requirements as noted below.

In the first two years of the program, students develop a foundation in the social sciences, humanities, and natural sciences as they relate to environmental affairs. During that time, students also fulfill SUNY general education requirements and take some open elective courses.

### Option Areas

In the final two years of the program, students must select one of three specializations called Option Areas.

#### Environment, Communication and Society

- [www.esf.edu/es/undergraduate/ecs.htm](http://www.esf.edu/es/undergraduate/ecs.htm)

This option focuses on how communication and social systems influence environmental affairs and shape our perceptions of the non-human world. It addresses the subjects of rhetoric and discourse; news media; public participation; advocacy campaigns; collaboration; conflict resolution; risk communication; social processes; and representations of nature in literature and popular culture.

#### Environmental Policy, Planning and Law

- [www.esf.edu/es/undergraduate/ep.htm](http://www.esf.edu/es/undergraduate/ep.htm)

This option is concerned with how environmental policies, plans, and laws from the local to the global are created, implemented and contested. It emphasizes legislative, regulatory, and collaborative approaches to addressing environmental issues.

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  - [Ph.D. in Environmental Science \(Ph.D., link accesses the Division of Environmental Science catalog page\)](#)

## Natural Systems Applications

- [www.esf.edu/es/undergraduate/nsa.htm](http://www.esf.edu/es/undergraduate/nsa.htm)

This option is designed for students interested in the interface between biology and socio-economic issues. It provides an emphasis on natural systems and their interactions with societal issues ranging from education to habitat management.

## Lower Division Environmental Studies Core Courses

Course		Codes*	Credits
APM 104 <b>OR</b> APM 105	College Algebra and Precalculus Survey of Calculus and Its Applications I	G G	3 4
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 103 <b>AND</b> EFB 104 <b>OR</b> EST 231	General Biology II: Cell Biology and Genetics General Biology II Laboratory Environmental Geology	G G	3 1 3
EFB 120	The Global Environment and the Evolution of Human Society	G	3
ESF 200	Information Literacy		1
EST 132	Introduction to Environmental Studies		3
EST 200	Cultural Ecology	G	3
EST 201	US History Reconstruction to the Present		3
EST 221	Introduction to American Government		3
EST 245	Foundations of Environmental Communication		3
EST 255	Research Methods for Environmental Studies		3
EWP 190	Writing and the Environment	G	3
EWP 220	Public Presentation Skills		2 - 3
EWP 290	Research Writing and Humanities	G	3
FCH 110 <b>OR</b> FCH 150 <b>AND</b> FCH 151	Survey of Chemical Principles General Chemistry I General Chemistry Laboratory I	G G G	3 3 1
FOR 207	Introduction to Economics	G	3

## Lower Division Electives

Course	Codes*	Credits
General Education Course (Western Civilization)	G	3
General Education Course (The Arts)	G	3
Electives (Students pursuing Natural Systems Applications options need to complete FCH 152 and 153 as one of these electives)		6

## Upper Division Environmental Studies Core Courses

Course		Codes*	Credits
APM 391	Introduction to Probability and Statistics	G	3
EFB 320	General Ecology		4
EST 321	Government and the Environment		3
EST 361	History of the American Environmental Movement	G	3
EST 494	Senior Seminar in Environmental Studies		1
EWP 410	Writing for Environmental Professionals		3
	Senior Synthesis		3

## Upper Division Electives

Course		Codes*	Credits
EST Social Science Course Select from EST 353, EST 366, EST 426, EST 460, EST 550 or FOR 360.			3
Upper Division Computing <b>OR</b> Natural Science Course			3
Electives			9

## Environment, Communication and Society Option

Course		Codes*	Credits
EST 390	Social Processes and the Environment		3
EST 395	Public Communication of Science and Technology		3
EST 493	Environmental Communication Workshop		3
Option Courses (Including 3 credits in Methods)			15

## Environmental Policy, Planning and Law Option

Course		Codes*	Credits
EST 550	Environmental Impact Analysis		3
Policy/Planning Methods Courses			6
Law Option Courses			3
Planning Option Courses			3
Environmental Policy/Planning/Law Option Courses			12

## Natural Systems Applications Option

Course		Codes*	Credits
Field Methods	GIS (Required)		3
	Scientific breadth		3
Natural Applications Suboptions		Natural Systems	3

	Environmental Quality	3
Social Science	Policy or law courses	9
	Communication courses	6

**Total Minimum Credits For Degree: 121-124** (total credits must include a minimum of 51 credit hours at the 300 level or above)

## Graduate Programs

- [www.esf.edu/es/graduate](http://www.esf.edu/es/graduate)

The Department of Environmental Studies offers degree and certificate programs in environmental studies, science, and policy, as well as interdepartmental master's and Ph.D. options, and concurrent programs with major universities.

Programs integrate and balance the social sciences, humanities, and natural sciences in creative, interdisciplinary contexts.

### Prerequisites

Students are expected to begin the program with some academic background in Environmental Policy or Communication; Environmental Science; and Ecology, demonstrated through successful completion of at least one course in each of these three areas. Deficiencies are identified in the letter of admission. If not completed prior to matriculation, these must be taken as co-requisites during the first two semesters of residence. Undergraduate or graduate courses successfully completed for credit may be used to satisfy deficiencies. Undergraduate courses are not included in Grade Point Averages, and do not contribute to the minimum number of required graduate credit hours. Graduate courses will be included in Grade Point Averages, but may not be used to meet program requirements.

### Advanced Standing

(i) Course transfers. A maximum of six graduate credit hours with a grade of "B" or better that have not been applied to another degree may be transferred via Petition. The Petition must include an attached syllabus, and a justification of how the courses are to be included on the student's Plan Sheet. Petitions for course transfers are submitted following matriculation. (ii) Credit for prior experience (M.P.S. degree only). Applicants with a minimum of three (3) years of post-baccalaureate, full-time professional experience directly related to the intended area of study may apply for 6 credit hours of advanced standing in the M.P.S. program. Partial credit for experience cannot be awarded. When awarded for prior work experience, the 6 credit hours are applied toward the Synthesis requirement.

## Master of Science (M.S.)

- [www.esf.edu/es/graduate/esgp.htm](http://www.esf.edu/es/graduate/esgp.htm)

### M.S. Program Requirements

The Environmental Studies M.S. degree program is a 37-credit-hour experience focused on advanced academic scholarship and research related to environmental affairs and sustainability. This degree requires the completion of a Master's thesis. Details on thesis proposals and expectations are available in the Environmental Studies M.S. graduate program [handbook](#). All students must present a Capstone Seminar during their final semester. If necessary,

the distribution of required credits may be adjusted to take into account a student's prior academic work and background.

**Core (12 Credits)**

All students take:

Course		Codes*	Credits
EST 600	Foundations of Environmental Studies		3
EST 626	Concepts and Principles of Sustainable Development		3

All students also take at least two of the following:

Course		Codes*	Credits
EST 608	Environmental Advocacy Campaigns and Conflict Resolution		3
EST 612	Environmental Policy and Governance		3
EST 640	Environmental Thought and Ethics		3
EST 650	Environmental Perception and Human Behavior		3

**Research Methods (7 credits)**

All students take:

Course		Codes*	Credits
EST 797	Environmental Studies Seminar		1 - 3

**NOTE:** EST 797 students are required to take the specific section of this seminar that deals with research proposal preparation

All students also take two additional research methods course, typically from the following list and typically to support their thesis research needs:

Course		Codes*	Credits
APM 510	Statistical Analysis		3
APM 625	Sampling Methods		3
APM 630	Regression Analysis		3
APM 635	Multivariate Statistical Methods		3
EST 603	Research Methods and Design		3
EST 604	Social Survey Research Methods for Environmental Issues		3
EST 605	Qualitative Methods		3
EST 702	Environmental and Natural Resource Program Evaluation		3
LSA 640	Research Methods		3

**NOTE:** Other research methods courses may be identified in collaboration with the student's advisor.

**Generalized / Thematic Area (12 credits)**

All students take four courses--typically in a thematic area--in consultation with their major professor. The thematic area should be used to substantively prepare the student for thesis work. EST 898 and EST 899 may not be included as thematic area courses.

### Thesis Research (6 credits)

All students with an approved thesis proposal take at least six credits of:

- EST 899. Master's Thesis Research

### Typical Course Sequence

<b>Year 1: Fall</b>	
<b>COURSE TITLE</b>	<b>Credits</b>
Research Methods Course	3
EST 600 Foundations of Environmental Studies	3
Core Course	3
Area Course	3
<b>Total Semester Credits</b>	<b>12</b>
<b>Year 1: Spring</b>	
<b>COURSE TITLE</b>	<b>Credits</b>
EST 626 Concepts and Principles of Sustainable Development	3
EST 797 Environmental Studies Seminar	1
Core Course	3
Thematic Area Course	3
Research Methods Course	3
<b>Total Semester Credits</b>	<b>13</b>
<b>Year 2: Fall</b>	
<b>COURSE TITLE</b>	<b>Credits</b>
EST 798 Problems in Environmental Studies*	3*
Thematic Area Course	3
Thematic Area Course	3
<b>Total Semester Credits</b>	<b>9</b>
<b>Year 2: Spring</b>	
<b>COURSE TITLE</b>	<b>Credits</b>
EST 899 Master's Thesis Research	6
<b>Total Semester Credits</b>	<b>6</b>
<b>Total Program Credits</b>	<b>37+3*</b>

\*This is an extra course, above program requirements, taken to maintain full-time status. Often a student preparing the thesis proposal enrolls in EST 798 to complete the literature review and proposal. If the student intends to do field work as part of his or her thesis research, it is typically undertaken in the summer between Years 1 and 2. In this

case, EST 798 can be taken in the Semester of Year 1 and another Thematic course can be taken in the Fall of Year 2.

## Master of Professional Studies (M.P.S.)

- [www.esf.edu/es/graduate/esgp.htm](http://www.esf.edu/es/graduate/esgp.htm)

The Environmental Studies M.P.S. degree program is a 39-credit-hour experience focused on advanced academic scholarship and its application to environmental affairs and sustainability. This degree requires the completion of a synthesis experience which frequently, though not always, involves a professional internship. Details on internships and other synthesis options are available in the Environmental Studies M.P.S. graduate program [handbook](#). All students must present a Capstone Seminar during their final semester. If necessary, the distribution of required credits may be adjusted to take into account a student's prior academic work and background.

### M.P.S. Program Requirements

**Core** (18 credits)

**Required:**

Course		Codes*	Credits
EST 600	Foundations of Environmental Studies		3
EST 626	Concepts and Principles of Sustainable Development		3

**Required, *four of the following:***

Recommended, as the fundamental knowledge and skill set for Environmental Studies:

Course		Codes*	Credits
EST 608	Environmental Advocacy Campaigns and Conflict Resolution		3
EST 612	Environmental Policy and Governance		3
EST 640	Environmental Thought and Ethics		3
EST 650	Environmental Perception and Human Behavior		3

Alternatively, the following may also be used to meet this requirement:

Course		Codes*	Credits
EST 606	Environmental Risk Perception: Implications for Communication and Policy		3
EST 609	Collaborative Governance Processes for Environmental and Natural Resource Management		3
EST 635	Public Participation and Decision Making: Theory and Application		3
EST 645	Mass Media and Environmental Affairs		3
EST 660	Land Use Law		3
EST 708	Social Theory and the Environment		3
EST 797	Environmental Studies Seminar		1 - 3

**NOTE:** Other courses may be identified in collaboration with the student's advisor.

**Natural Sciences** (3 credits)

All students take one natural science course. Typically this would be one of the following courses, though alternatives may be considered in consultation with the major professor.

Course		Codes*	Credits
EFB 516	Ecosystems		3
EFB 518	Systems Ecology		4
EFB 523	Tropical Ecology		3
EFB 600	Toxic Health Hazards		4
EFB 611	Topics in Environmental Toxicology		3
EFB 623	Marine Ecology		5

### Research / Technical Methods (6 credits)

All students take two research or technical methods courses, typically from the following list and typically to support their learning objectives:

Course		Codes*	Credits
APM 510	Statistical Analysis		3
APM 625	Sampling Methods		3
APM 630	Regression Analysis		3
APM 635	Multivariate Statistical Methods		3
ENS 519	Spatial Ecology		3
ERE 553	Introduction to Spatial Information		1
EST 550	Environmental Impact Analysis		3
EST 603	Research Methods and Design		3
EST 604	Social Survey Research Methods for Environmental Issues		3
EST 605	Qualitative Methods		3
EST 702	Environmental and Natural Resource Program Evaluation		3
EST 705	Environmental Policy Analysis		3
FOR 557	Fundamentals of Geographic Information Systems		3
LSA 500	Digital Methods and Graphics I		3
LSA 501	Digital Methods and Graphics II		3
LSA 552	Graphic Communication		3
LSA 640	Research Methods		3

### Generalized / Thematic Area (6 credits)

All students take two courses in consultation with their major professor. The thematic area should be used to substantively prepare the student for capstone synthesis work. EST 898 and EST 899 may not be included as thematic area courses.

### Synthesis (6 credits)

All students take the equivalent of two courses of:

- EST 798. Problems in Environmental Studies
- EST 898. Professional Experience

## Typical Course Sequence

<b>Year 1: Fall</b>	
<b>COURSE TITLE</b>	<b>Credits</b>
EST 600 Foundations of Environmental Studies	3
Core Course	3
Core Course	3
Generalized/Thematic Area Course	3
<b>Total Semester Credits</b>	<b>12</b>
<b>Year 1: Spring</b>	
<b>COURSE TITLE</b>	<b>Credits</b>
EST 626 Concepts and Principles of Sustainable Development	3
Core Course	3
Core Course	3
Natural Science Course	3-5
<b>Total Semester Credits</b>	<b>12-14</b>
<b>Year 2: Fall</b>	
<b>COURSE TITLE</b>	<b>Credits</b>
General/Thematic Course	3
Research/Technical Methods Course	3
Research/Technical Methods Course	3
<b>Total Semester Credits</b>	<b>9</b>
<b>Year 2: Spring</b>	
<b>COURSE TITLE</b>	<b>Credits</b>
Synthesis	6
<b>Total Semester Credits</b>	<b>6</b>
<b>Total Program Credits</b>	<b>39-41</b>

## Certificate of Graduate Study in Environmental Decision Making

- [www.esf.edu/es/graduate/cedm.htm](http://www.esf.edu/es/graduate/cedm.htm)

The Certificate of Graduate Study in Environmental Decision Making is designed for graduate students at ESF and those enrolled in law, management, public administration, or information studies programs at Syracuse University. It provides an exposure to specialized environmental study that is relevant to students with related professional interests. The focus of this certificate is on environmental decision making, the processes by which stakeholders seek solutions to environmental problems.

## Student Eligibility

Graduate students currently matriculated and in good academic standing in their graduate degree programs at SUNY-ESF and Syracuse University are eligible to apply for entrance to the certificate program.

## Administrative Procedures

Application and admissions procedures, compliance with college requirements for successful graduate study and the awarding of certificates are all administered by ESF's Dean of Instruction and Graduate Studies, 227 Bray Hall. If enrollment limitations are established, acceptances will be made on a rolling basis, according to the date of receipt of applications.

## Certificate Program Requirements

### Core

All students take:

Course		Codes*	Credits
EST 635	Public Participation and Decision Making: Theory and Application		3

Choose 9 credits from the following two lists, at least one course from each:

### Environmental Policy and Law

Course		Codes*	Credits
EST 609	Collaborative Governance Processes for Environmental and Natural Resource Management		3
EST 612	Environmental Policy and Governance		3
EST 660	Land Use Law		3
EST 796	Advanced Topics in Environmental Studies		1 - 3
FOR 687	Environmental Law and Policy		3
FOR 689	Natural Resources Law and Policy		3
LAW 716	Environmental Law		3
LAW 865	Natural Resources Law		3
PAI 775	Energy, Environment and Resources Policy		3
PAI 777	Economics of Environmental Policy		3

### Human and Environment Interactions

Course		Codes*	Credits
EST 606	Environmental Risk Perception: Implications for Communication and Policy		3
EST 608	Environmental Advocacy Campaigns and Conflict Resolution		3
EST 625	Wetland Management Policy		3
EST 626	Concepts and Principles of Sustainable Development		3
EST 628			
EST 645	Mass Media and Environmental Affairs		3
EST 650	Environmental Perception and Human Behavior		3

LSA 650	Behavioral Factors of Community Design		3
EST 708	Social Theory and the Environment		3
PAI 730	Problems in Public Administration		3

# Department of Forest and Natural Resources Management

David H. Newman, Chair

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315-470-6534

315-470-6535 (fax)

- [www.esf.edu/fnrm](http://www.esf.edu/fnrm)

The mission of the Department of Forest and Natural Resources Management's programs is to produce and to transmit knowledge about the function and dynamics of forests and related renewable resources to all of our customers; to encourage continual learning about forest and related renewable resources and their role in making people's lives better; and to develop leaders who will manage renewable resources for people on a sustainable basis.

The department offers programs leading to bachelor's, master's and doctoral degrees at the main college campus in Syracuse, N.Y., and three programs leading to the associate in applied science (A.A.S.) degree at The Ranger School in Wanakena, N.Y. See the [Ranger School](#) for information about the associate of applied science degrees in forest technology, land surveying technology, and environmental and natural resources conservation.

## Undergraduate Programs

- [www.esf.edu/fnrm/undergrad](http://www.esf.edu/fnrm/undergrad)

The forest and natural resources management programs prepare students for work with public and private sector organizations and consultancies, and for further professional or scientific study at the graduate level.

Students develop professional skills, which employers look for in new employees:

1. Management skills including leadership, communication abilities, and teamwork;
2. Scientific knowledge and technical skills in measurements and analysis for management;
3. The ability to analyze and solve resource management problems using both social and biophysical sciences; and
4. A clear understanding of ethics and stewardship.

These skills are best developed by a broad base in the social sciences and humanities, communication, the natural sciences, and quantitative and qualitative methods. The majority of coursework taken during the first two years (lower division) is in these basics. Students are required to complete general education requirements and a professional core. Forest resources management students may concentrate some of their technical electives. Natural resources management majors have a ready opportunity to earn a minor in an area of disciplinary interest.

## Summer Program

**The Summer Program is required for all B.S. degree candidates in FES, FRM and NRM.** Students who completed an A.A.S.

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    - Monitoring, Analysis and Modeling (M.S., M.P.S., Ph.D.)
    - Sustainable Construction (M.S., M.P.S.)
    - Sustainable Energy (M.S., M.P.S., Ph.D.)

degree from the ESF Ranger School meet this requirement through transfer credits. The program is a four-week session that begins at the end of May and lasts through late June. It is taught at ESF's Wanakena Campus in the Adirondacks. The program consists of one course: FOR 304 Adirondack Field Studies. Students must complete the summer program before the junior year.

## Bachelor of Science in Construction Management

- [www.esf.edu/fnrm/cm](http://www.esf.edu/fnrm/cm)

The construction management degree prepares students for management careers in the construction industry with additional focus on sustainable construction management. Students may enter the bachelor of science program as first-year students or as transfer students.

Students who are preparing to transfer to ESF as juniors must have earned at least 65 credits of college coursework, in courses comparable to the lower-division course requirements.

As part of the bachelors degree in Construction Management, students are required to take the Associate Constructor Level I Exam for constructor certification. Students who successfully complete the exam receive the Associate Constructor (AC) designation from the American Institute of Constructors. This designation is part 1 of the process to become a Certified Professional Constructor (CPC). Students who successfully complete the course on construction safety receive the OSHA 30 Hour Construction Outreach Card.

### Lower Division Required Courses

Course		Codes*	Credits
APM 104	College Algebra and Precalculus	G	3
APM 115	Essential Calculus	G	4
CME 132	Orientation Seminar: Sustainable Construction Management and Engineering		1
CME 151	Introduction to Financial Accounting		3
CME 202	Introduction to Professional Communications		1
CME 215	Sustainable Construction		3
OR			
CME 304	Environmental Performance Measures for Buildings		3
CME 226	Statics and Mechanics of Materials		4
CME 252	Introduction to Managerial Accounting		3
CME 306	Engineering Materials for Sustainable Construction		3
CME 342	Light Construction		3
EWP 190	Writing and the Environment	G	3
EWP 222	Presentation Skills for Managers		2
EWP 290	Research Writing and Humanities	G	3
FCH 110	Survey of Chemical Principles	G	3
FCH 111	Survey of Chemical Principles Laboratory		1
FOR 207	Introduction to Economics	G	3
FOR 360	Principles of Management		3
PHY 211	General Physics I	G	3
PHY 221	General Physics I Laboratory		1

## General Education courses

Course	Codes*	Credits
General Education courses in three of the following categories: American History, Foreign Language, The Arts, Western Civilization, Other World Civilizations	G	12

## Upper Division Required Courses

Course	Codes*	Credits	
APM 391	Introduction to Probability and Statistics	G	3
CME 255	Plan Interpretation and Quantity Takeoff		3
CME 303	Sustainable Construction Management and Engineering Internship		1 - 3
CME 305	Sustainable Energy Systems for Buildings		3
CME 327	Site Investigations and Solutions		3
CME 331	Construction Safety		3
CME 335	Cost Engineering		3
CME 343	Construction Estimating		3
CME 387	Renewable Materials for Sustainable Construction		3
CME 404	Applied Structures		3
CME 405	Building Information Modeling for Construction Management		3
CME 422	Composite Materials for Sustainable Construction		3
CME 453	Construction Planning and Scheduling		3
CME 454	Construction Project Management		3
CME 455	Construction Contracts and Specifications		3
CME 497	Senior Ethics Seminar		1
ERE 371	Surveying for Engineers		3
FOR 485	Business and Managerial Law		3

## Upper Division Electives

Course	Codes*	Credits
Electives		9

**Total Minimum Credits For Degree: 124**

## Bachelor of Science in Forest Ecosystem Science

- [www.esf.edu/fnrm/fes](http://www.esf.edu/fnrm/fes)

The Forest Ecosystem Science degree is based on a vision that combines professional competency in forest management skills with an enhanced understanding of ecological sciences. Students interested in this program typically are drawn to natural settings and environments, enjoy nature, and want to understand how forested ecosystems work. Experiential field learning is combined with learning concepts and skills in the classroom and

laboratory on ESF's Syracuse campus.

The undergraduate curriculum in forest ecosystem science consists of two broad categories of courses. The first category, general education, provides students with knowledge and skills that are useful and important for all educated persons regardless of their profession as well as preparation for advanced courses leading to a specific profession. The second category, professional courses, provides students with direct preparation for a career. The first two years of college usually focus on general education and the second two on the professional studies.

The educational program in forest ecosystem science, leading to the professional bachelor of science degree in forest management, is accredited by the Society of American Foresters (SAF). SAF is recognized by the Council on Higher Education as the specialized accrediting body for forestry in the United States.

### Lower Division Required Courses

Course		Codes*	Credits
APM 105	Survey of Calculus and Its Applications I	G	4
APM 391	Introduction to Probability and Statistics	G	3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 103	General Biology II: Cell Biology and Genetics	G	3
EFB 104	General Biology II Laboratory	G	1
ESF 200	Information Literacy		1
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
FOR 132	Orientation Seminar: F&NRM		1
FOR 207	Introduction to Economics	G	3
FOR 232	Natural Resources Ecology	G	3
FOR 332	Forest Ecology		4
FOR 360	Principles of Management		3
PHY 101 OR PHY 211 AND PHY 221	Major Concepts of Physics I General Physics I General Physics I Laboratory	G	4 3 1

### Upper Division Required Courses

Course		Codes*	Credits
EFB 336	Dendrology		3
ESF 300	Introduction to Geospatial Information Technologies		3
FOR 304	Adirondack Field Studies	S	4

FOR 322	Natural Resources Measurements and Sampling	3
FOR 323	Forest Biometrics	3
FOR 334	Silviculture	4
FOR 345	Introduction to Soils	3
FOR 465	Natural Resources Policy	3
FOR 490	Integrated Resources Management	3

## Elective Courses

Course	Codes*	Credits
Directed Electives: Biology	PE	9
Directed Electives: Ecology and Ecosystems	PE	9
Directed Electives: Management and Human Dimensions	PE	9
Free Electives		15
General Education - Select at least two from the following five subject areas: American History, Western Civilization, Other World Civilizations, The Arts and Foreign Language	G	6

Students should consult with their advisors and read the Forest and Natural Resources Management Handbook for lists of courses that can be elected to meet degree requirements.

**Total Minimum Credits For Degree: 124**

## Bachelor of Science in Forest Resources Management

- [www.esf.edu/fnrm/frm](http://www.esf.edu/fnrm/frm)

Forest resources management is an integration of forest ecology and biology, forest measurements, forest policy and administration, and courses to predict and evaluate the effects of manipulation.

Timber, water, soils, recreation, wildlife, and a broad array of environmental values and services, such as biodiversity and healthy forest systems, are important results of effective management. This major prepares students to be well-rounded generalists who can practice forestry and succeed as professionals in a variety of allied natural resources management fields.

The educational program in forest resources management, leading to the professional bachelor of science degree in forest management, is accredited by the Society of American Foresters (SAF). SAF is recognized by the Council on Higher Education as the specialized accrediting body for forestry in the United States.

## Lower Division Required Courses

Course		Codes*	Credits
APM 103	Applied College Algebra and Trigonometry	G	3
<b>OR</b>			
APM 104	College Algebra and Precalculus	G	3
APM 391	Introduction to Probability and Statistics	G	3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1

EFB 336	Dendrology		3
ESF 200	Information Literacy		1
EWP 190	Writing and the Environment	G	3
EWP 220	Public Presentation Skills		2 - 3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
<b>AND</b> FCH 151	General Chemistry Laboratory I	G	1
<b>OR</b> FCH 110	Survey of Chemical Principles	G	3
<b>AND</b> FCH 111	Survey of Chemical Principles Laboratory		1
FOR 132	Orientation Seminar: F&NRM		1
FOR 203	Western Civilization and the Environment	G	3
FOR 204	Natural Resources in American History	G	3
FOR 207	Introduction to Economics	G	3
FOR 232	Natural Resources Ecology	G	3
FOR 332	Forest Ecology		4
PHY 101	Major Concepts of Physics I		4
<b>OR</b> EFB 200	Physics of Life		3

### Upper Division Required Courses

Course		Codes*	Credits
ESF 300	Introduction to Geospatial Information Technologies		3
FOR 304	Adirondack Field Studies	S	4
FOR 322	Natural Resources Measurements and Sampling		3
FOR 323	Forest Biometrics		3
FOR 333	Natural Resources Managerial Economics		3
FOR 334	Silviculture		4
FOR 345	Introduction to Soils		3
FOR 360	Principles of Management		3
FOR 370	Forest Management Decision Making and Planning		3
FOR 372	Fundamentals of Outdoor Recreation		3
FOR 373	Sustainable Harvesting Practices		3
FOR 402	Professional Forestry Mentoring Program		1
FOR 465	Natural Resources Policy		3
FOR 490	Integrated Resources Management		3

### Elective Courses

Course		Codes*	Credits

Technical Electives <i>Technical electives must include at least one course in vegetation manipulation, water resources, forest health, wildlife management, business finances, and wood technology/science. Students should consult with their advisor and the Forest and Natural Resources Management Handbook for recommended courses</i>	PE	18
Free Electives		18
General Education - Select at least two from the following five subject areas: American History, Western Civilization, Other World Civilizations, The Arts and Foreign Language	G	6

**Total Minimum Credits For Degree: 125**

## Bachelor of Science in Natural Resources Management

- [www.esf.edu/fnrm/nrm](http://www.esf.edu/fnrm/nrm)

The Natural Resources Management (NRM) program is structured to introduce students to a wide range of renewable natural resources (soils, water, vegetation, wildlife, recreation), while maintaining substantial flexibility for student-centered learning in understanding and managing natural systems. It is based on a vision that combines professional competency in management skills with a strong foundation in the social and biophysical sciences.

The educational program in natural resources management, leading to the professional bachelor of science degree in forest management, is accredited by the Society of American Foresters (SAF). SAF is recognized by the Council on Higher Education as the specialized accrediting body for forestry in the United States.

### Lower Division Required Courses

Course		Codes*	Credits
APM 103 <b>OR</b> APM 104	Applied College Algebra and Trigonometry College Algebra and Precalculus	G G	3 3
APM 391	Introduction to Probability and Statistics	G	3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
EFB 200	Physics of Life		3
EFB 320	General Ecology		4
ESF 200	Information Literacy		1
EWP 190	Writing and the Environment	G	3
EWP 220	Public Presentation Skills		2 - 3
EWP 290	Research Writing and Humanities	G	3
FCH 150 <b>AND</b> FCH 151 <b>OR</b> FCH 110 <b>AND</b> FCH 111	General Chemistry I General Chemistry Laboratory I Survey of Chemical Principles Survey of Chemical Principles Laboratory	G G G	3 1 3 1
FOR 132	Orientation Seminar: F&NRM		1
FOR 207	Introduction to Economics	G	3
FOR 232	Natural Resources Ecology	G	3

FOR 360	Principles of Management		3
FOR 372	Fundamentals of Outdoor Recreation		3
LSA 333	Plants Materials		2

### Lower Division Elective Courses

Course	Codes*	Credits
General Education Courses - Select at least two from the following five subject areas: American History, Western Civilization, Other World Civilizations, The Arts and Foreign Language	G	6
Sociology or Psychology Course One course from FOR 202, SOC 101 or PSY 205.		3

### Upper Division Required Courses

Course	Codes*	Credits
ESF 300		3
FOR 205		3
FOR 304	S	4
FOR 321		3
FOR 322		3
FOR 333		3
FOR 340		3
FOR 345		3
FOR 465		3
FOR 475		3
FOR 485		3
FOR 490		3
FOR 496		1 - 3

### Upper Division Elective Courses

Course	Codes*	Credits
Wildlife or Fisheries Course One course from EFB 390, EFB 413, or EFB 487		3-4
Specialized NRM Course One course from FOR 334, FOR 433, FOR 442, FOR 458, FOR 476, FOR 489, or a second wildlife/fisheries course.		3
Free Electives		21

**Total Minimum Credits For Degree: 122**

## Bachelor of Science in Sustainable Energy Management

- [www.esf.edu/fnrm/sem](http://www.esf.edu/fnrm/sem)

The Sustainable Energy Management (SEM) program is structured to introduce students to a wide range of energy

markets and resources (fossil fuels, electricity, renewable and sustainable energy resources) while maintaining substantial flexibility for student-centered learning in understanding and managing energy systems.

The Sustainable Energy Management program is based on a vision that combines professional competency in management skills with a strong foundation in the social and biophysical sciences. The study of responsible energy resources use, and the development of sustainable sources of energy, has become a critical national and global issue. Energy issues include concerns about the quality and quantity of the different potential resources, energy security, and potential impacts of each on the environment and human health. It is essential that our society and energy professionals gain an understanding of production and conversion of different forms of energy, their current and future supplies, the markets and policy mechanisms that regulate their supply, and the associated impacts on the environment for each fuel.

### Lower Division Required Courses

Course		Codes*	Credits
APM 103 OR APM 104 OR APM 105	Applied College Algebra and Trigonometry College Algebra and Precalculus Survey of Calculus and Its Applications I	G G G	3 3 4
APM 391	Introduction to Probability and Statistics	G	3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3
EFB 102	General Biology I Laboratory	G	1
ESF 200	Information Literacy		1
EWP 190	Writing and the Environment	G	3
EWP 220	Public Presentation Skills		2 - 3
EWP 290	Research Writing and Humanities	G	3
FCH 110 AND FCH 111 OR FCH 150 AND FCH 151	Survey of Chemical Principles Survey of Chemical Principles Laboratory General Chemistry I General Chemistry Laboratory I	G  G G	3 1 3 1
FOR 132	Orientation Seminar: F&NRM		1
FOR 207	Introduction to Economics	G	3
SRE 225 OR PHY 101	Physics of Energy Major Concepts of Physics I	G	3 4
SRE 335	Renewable Energy		3

### Lower Division Elective Courses

Course	Codes*	Credits
General Education Courses - Select at least two from the following five subject areas: American History, Western Civilization, Other World Civilizations, The Arts and Foreign Language	G	6
Natural Science Directed Elective Courses - One course from EFB 103/104, EFB 220, EFB 303, EFB 320, EST 321, FOR 232, or FOR 338		3

## Upper Division Required Courses

Course		Codes*	Credits
CME 305	Sustainable Energy Systems for Buildings		3
ESF 300	Introduction to Geospatial Information Technologies		3
FOR 205	Principles of Accounting		3
FOR 333	Natural Resources Managerial Economics		3
FOR 411	Analytical and Technical Writing for Resource Managers		3
FOR 485	Business and Managerial Law		3
SRE 325	Energy Systems		3
SRE 416	Sustainable Energy Policy		3
SRE 417	Energy Resource Assessment		2
SRE 422	Energy Markets and Regulation		3
SRE 441	Biomass Energy		3
SRE 450	Renewable Energy Capstone Planning		1
SRE 454	Renewable Energy Finance and Analysis		3
SRE 479	Life Cycle Assessment		3
SRE 491	Sustainable Energy Management Capstone		3

## Upper Division Elective Courses

Course		Codes*	Credits
Human Dimensions Course One course from EST 366, EST 390, EST 395, FOR 202, FOR 312, GEO 430, LSA 312, PSY 205, or SOC 101			3
Policy/Technical Course: One course from CME 304, EST 426, EST 427, EST 550, FOR 465, FOR 487, FOR 489, PSC 302, PHY 305, or SRE 419			3
Business Elective: One course from BUA 100, BUA 200, CME 335, ERE 430, ERE 519, EST 450, or FOR 370			3
Additional Policy/Technical or Business Course			3
Liberal Arts Electives			6
Free Electives			14

**Total Minimum Credits For Degree: 120**

## Graduate Programs

- [www.esf.edu/fnrm/graduate](http://www.esf.edu/fnrm/graduate)

The Department of Forest and Natural Resources Management offers the master of science (M.S.), the master of professional studies (M.P.S.), the master of forestry (M.F.), and doctor of philosophy (Ph.D.) degrees.

The graduate program is organized in areas of study designed to provide students with a strong background within specific interest areas.

## **Construction Management and Sustainable Construction**

Graduate options in construction management and sustainable construction allow students with technical degrees to engage specific topics of current interest.

There is an overall objective of having students look at the broad environmental implications of the construction process, to be efficient and environmentally responsible in their use of materials, and to integrate current technology to a practicum or thesis, as appropriate to the graduate degree.

## **Interdisciplinary Programs and Concurrent Degrees**

FNRM encourages interdisciplinary graduate programs. This often involves selecting steering committee members from other ESF and Syracuse University departments, or more formally, by arranging for joint study with other college departments and with Syracuse University. Concurrent degree programs that provide the student with two masters degrees, one from ESF and another from Syracuse University, are available with the following SU schools:

- Whitman School of Management
- Maxwell School of Citizenship and Public Affairs
- S.I. Newhouse School of Public Communications
- School of Education

Concurrent degree programs usually add at least an additional year to a master's program of study. To be eligible, a student must have been matriculated full time at the College for at least one semester, have a grade point average of at least 3.5, and be formally accepted into the concurrent degree program by the other school. Students who are interested in any of these programs must complete an application process through the ESF Office of Instruction and Graduate Studies within their first year of study.

## **Master of Forestry (M.F.) Forest Management and Operations**

- [www.esf.edu/fnrm/graduate](http://www.esf.edu/fnrm/graduate)

The Master of Forestry (MF) graduate degree program enables students to integrate knowledge and expertise drawn from both the natural and social sciences, and to apply their knowledge to solve practical forest management problems.

The primary focus of the program is to provide an opportunity for graduates coming from diverse academic backgrounds with non-forestry baccalaureates to gain a professional education in forestry. As such, the program is designed to be the first professional degree in forestry attained by a student. Graduates will successfully function as professional foresters on multi-disciplinary forest management teams and respond to the challenges related to the sustainable management of local, regional, and global forest resources.

The degree requires 37 graduate credits of coursework, of which at least 24 must be taken in residence at ESF. The degree meets the accreditation standards of the Society of American Foresters, recognized by the Council on Higher Education as the specialized accrediting body for forestry in the United States.

The program is open to both students with some prior background in forestry and natural resources, and for those without such background. More than four (4) semesters may be required for students from non-science backgrounds who need additional basic undergraduate coursework as part of their degree program. The MF program is designed for May admission to accommodate a 4-week summer field course.

## **Master of Professional Studies (M.P.S.)**

- [www.esf.edu/fnrm/graduate](http://www.esf.edu/fnrm/graduate)

The Master of Professional Studies (M.P.S.) graduate degree program enables students to integrate knowledge and expertise drawn from both the natural and social sciences, and to apply their knowledge to solve practical forest and natural resources management problems. The primary focus of the program is to provide an opportunity for graduates coming from related academic backgrounds with baccalaureates to gain a professional education in forestry. As such, the program is designed to be the first professional degree in forest and natural resources management. Graduates will successfully function as professional managers on multi-disciplinary forest and natural resources management teams and respond to the challenges related to the sustainable management of local, regional and global resources.

The M.P.S. degree is a coursework-based degree that enables students to increase, define, and integrate their natural science and social science knowledge and expertise in forest and natural resources management.

The degree requires at least 30 graduate credits of coursework. At least 24 of the course credits must be taken in residence at ESF. Within these credits, students must complete a core of required courses and other requirements.

The program is open to both students with some prior background in forestry and natural resources and for those without such background. Students with a degree in a related discipline (e.g., ecology, biology, wildlife, chemistry, etc.) can complete the M.P.S. degree in twelve (12) to eighteen (18) months. Students without a general science background will require eighteen (18) to twenty-four (24) months to complete the program. The curriculum is designed for fall admission, but spring semester admission is possible. More than four (4) semesters may be required for students from non-science backgrounds who need additional basic undergraduate coursework as part of their program of study.

## **Master of Science (M.S.)**

- [www.esf.edu/fnrm/graduate](http://www.esf.edu/fnrm/graduate)

The Master of Science (M.S.) graduate degree program enables students to integrate knowledge and expertise drawn from both the natural and social sciences, and to research issues and apply their knowledge to solve practical problems in forest and natural resources management situations. The primary focus of the program is to provide an opportunity for graduates coming from related academic backgrounds with baccalaureates to gain a science-based education in forest and natural resources management. Graduates will successfully function as researchers and managers on multi-disciplinary forest management teams and respond to the challenges related to the sustainable management of local, regional and global resources.

The program is open to both students with some prior background in forestry and natural resources and for those without such background. Students with a degree in a related discipline (e.g., ecology, biology, wildlife, chemistry, etc.) can complete the M.S. degree in twenty-four (24) to thirty (30) months. Students without a general science background will require more than thirty (30) months to complete the program. More than four (4) semesters of coursework may be required for students from non-science backgrounds who need additional basic undergraduate coursework as part of their program of study.

The degree requires at least 30 graduate credits, of which 24 are for coursework and six for the thesis. One-half of the 24 hours of coursework must be at the 600-level or above. At least 18 of the coursework credits must be taken in residence at ESF. All students must take one FOR 797 topical seminar and one additional graduate seminar.

## **Doctor of Philosophy (Ph.D.)**

- [www.esf.edu/fnrm/graduate](http://www.esf.edu/fnrm/graduate)

The Doctor of Philosophy (Ph.D.) graduate degree program enables students to extend knowledge and expertise from their natural and social science background in their baccalaureate and master degrees. It is normally built upon a M.S. degree, but in some instances it can be undertaken after a non-research based graduate degree (such as a

J.D., M.B.A, M.P.A, or M.P.S. degree).

The primary focus of the program is to provide an opportunity for graduates coming from diverse academic backgrounds to gain a science-based education in forest and natural resources management.

The degree provides students with an opportunity for in-depth study and to conduct a comprehensive scientifically based research program using advanced research tools. Ph.D. dissertations are expected to lead to a number of peer-reviewed articles in influential journals.

The degree is appropriate for students interested in advanced positions as forest and natural resources educators, researchers, managers, consultants and analysts on the local, regional and global levels.

The program is open to both students with some prior background in forestry and natural resources and for those without such background. Students with degrees in a related discipline (e.g., ecology, biology, wildlife, chemistry, etc.) can complete the Ph.D. degree in three (3) to five (5) years. Students with a general science background, but little or no forest or natural resources experience, will require more than five (5) years to complete the program.

The degree requires at least 60 graduate credit hours, of which 48 are for coursework and 12 for the dissertation. One-half of the 48 hours of coursework must be at the 600-level or above. At least 24 coursework credits must be taken in residence at ESF. All students must take one FOR 797 topical seminar and one additional graduate seminar.

## Areas of Study

### Construction Management (M.S., M.P.S.)

- [www.esf.edu/fnrm/graduate/scme](http://www.esf.edu/fnrm/graduate/scme)

This option is for students who plan to specialize in construction management. Studies depend upon the student's previous education, professional objectives and interests.

Recent graduates have matriculated upon completion of undergraduate degrees in architecture, mechanical engineering, construction management and civil engineering.

#### M.S. in Construction Management

Applicants for the M.S. degree in the construction management option are required to have a bachelor's degree in one of the following: science, construction management, business, management, architecture or engineering.

Topics for M.S. research may include the following areas in the management of construction projects: Construction project management, Estimating, cost engineering, building codes and zoning, Production management, Computer graphics and computer applications in construction.

For the M.S. degree in Construction Management the following courses are required (or equivalent with committee approval):

Course		<a href="#">Codes*</a>	Credits
CME 543	Construction Estimating		3
CME 653	Construction Planning and Scheduling		3
CME 654	Construction Project Management		3

#### M.P.S. in Construction Management

The M.P.S. degree is a non-thesis degree open to students with a demonstrated interest in the profession of construction management. A bachelor's degree in one of the following is strongly recommended: science,

construction management, business, management, architecture, engineering, or related field of study.

### Coursework

- Required: 12 cr hrs
- Directed Electives: 6-12 cr hrs
- Open Electives: 3-9 cr hrs
- Practicum/Synthesis Project: 3-6 cr hrs
- Total credit hours: 30 cr hrs

Required Courses: (12 credits)

Course		Codes*	Credits
CME 543	Construction Estimating		3
CME 653	Construction Planning and Scheduling		3
CME 654	Construction Project Management		3
CME 658	Construction Contracts and Specifications		3

Directed elective courses: (6 - 12 credits) Select additional courses from these or similar courses with committee approval:

Course		Codes*	Credits
CME 525	Construction Methods and Equipment		3
CME 531	Construction Safety		3
CME 535	Cost Engineering		3
CME 658	Construction Contracts and Specifications		3

Open elective courses (3-9 credits) from the following or similar courses with committee approval:

Course		Codes*	Credits
FOR 665	Natural Resources Policy		3
FOR 670	Resource and Environmental Economics		3
FOR 680	Urban Forestry		3
FOR 685	Business and Managerial Law		3
FOR 687	Environmental Law and Policy		3
FOR 689	Natural Resources Law and Policy		3
FOR 770	Ecological Economics and Policy		3
EST 550	Environmental Impact Analysis		3
EST 603	Research Methods and Design		3
EST 604	Social Survey Research Methods for Environmental Issues		3
EST 605	Qualitative Methods		3
EST 626	Concepts and Principles of Sustainable Development		3
EST 627	Environmental and Energy Auditing		3
EST 635	Public Participation and Decision Making: Theory and Application		3

EST 640	Environmental Thought and Ethics		3
EST 660	Land Use Law		3

Professional Experience/Synthesis Project (3-6 credits):

Course		Codes*	Credits
CME 898	Professional Experience/Synthesis		1 - 6

## Ecology and Ecosystems (M.P.S., M.S., Ph.D.)

- [www.esf.edu/fnrm/graduate/ee.asp](http://www.esf.edu/fnrm/graduate/ee.asp)

The Ecology and Ecosystems area of study focuses on the structure, function, dynamics, and resilience of terrestrial ecosystems, at a range of scales, from tree genetics and plant physiology to landscape ecology, modeling and remote sensing.

Because functioning and resilient ecosystems are central to human well-being, research opportunities in this area of study address a diversity of topics that help us better understand and enhance the sustainability of terrestrial ecosystems in a rapidly changing world.

## Forest Management and Operations (M.F.)

- [www.esf.edu/fnrm/graduate/fmo.htm](http://www.esf.edu/fnrm/graduate/fmo.htm)

See [Master of Forestry](#) above for a description.

## Management (M.P.S., M.S., Ph.D.)

- [www.esf.edu/fnrm/graduate/man.asp](http://www.esf.edu/fnrm/graduate/man.asp)

The Management area of study focuses on both the underlying theory and on-the-ground application of practices to achieve sustainable outcomes in natural resource systems.

Because management practices and decisions arise from the combination of ecological knowledge, economic considerations and landowner/manager objectives and/or policies, research opportunities in management are interdisciplinary by nature.

## Economics, Governance and Human Dimensions (M.P.S., M.S., Ph.D.)

- [www.esf.edu/fnrm/graduate/eghd.asp](http://www.esf.edu/fnrm/graduate/eghd.asp)

The Economics, Governance and Human Dimensions area of study emphasizes the human dimensions of resource systems involved in the processes of decision-making and action related to how coupled human-natural systems may be managed for sustainable outcomes.

This area of study also incorporates rigorous research into human behavior in recreational and natural settings, a topic that draws from multiple disciplinary perspectives in the social sciences.

## Monitoring, Analysis and Modeling (M.P.S., M.S., Ph.D.)

- [www.esf.edu/fnrm/graduate/mam.asp](http://www.esf.edu/fnrm/graduate/mam.asp)

The Monitoring, Analysis and Modeling area of study focuses on the application of statistical and operations research methods and techniques used to sample, describe and predict how individual trees, forest stands and terrestrial ecosystems change over both temporal and spatial scales.

Because trees and forests respond in varying ways to an array of human and natural disturbances, research opportunities in this area of study address a diversity of topics that help us to better understand and evaluate the dynamics of terrestrial ecosystems in a rapidly changing world.

## Sustainable Construction (M.S., M.P.S.)

- [www.esf.edu/fnrm/graduate/scme](http://www.esf.edu/fnrm/graduate/scme)

This option is for students interested in sustainable construction practices including topics such as energy use in buildings, material use in sustainable construction, life cycle analysis, environmental rating systems and environmental performance measures.

Students with a strong background in science are given greater consideration.

### M.S. in Sustainable Construction

Applicants for the M.S. degree in sustainable construction are required to have a bachelor's degree in one of the following: science, construction management, architecture or engineering. It is preferred that students have a science background and to have completed courses in physics, chemistry and calculus.

Topics for the M.S. or Ph.D. research may include the following: Energy systems in buildings, Sustainable materials, Environmental performance measures, Building codes, Renewable materials, Deconstruction and reuse, Life cycle analysis, building performance.

For the M.S. degree in Sustainable Construction, students must complete coursework in construction project management if this was not part of their undergraduate degree.

### M.P.S. in Sustainable Construction

The M.P.S. degree is open to students with a demonstrated interest in sustainable construction such as properties of construction materials, energy systems in buildings, rating systems and building performance. A bachelor's degree in one of the following is strongly recommended: science, construction management, architecture, engineering, or related degree. It is preferred that students have a science background and to have completed courses in physics, chemistry and calculus.

### Coursework

- Required: 12 cr hrs
- Directed Electives: 6-12 cr hrs
- Open Electives: 3-9 cr hrs
- Practicum/Synthesis Project: 3-6 cr hrs
- Total credit hours: 30 cr hrs

Core courses (12 credits) from the following or similar courses with committee approval:

Course		<a href="#">Codes*</a>	Credits
CIE 678	Rehabilitation of Civil Infrastructure		3
CME 504	Environmental Performance Measures for Building		3
CME 505	Sustainable Energy Systems for Buildings		3
CME 532	Mechanical and Electrical Equipment		3
CME 565	Sustainable Innovations in Residential Construction		3
CME 605	Building Information Modeling for Construction Management		3

Construction management courses (6-12 credits) from the following or similar courses with committee approval:

Course		Codes*	Credits
CME 543	Construction Estimating		3
CME 653	Construction Planning and Scheduling		3
CME 654	Construction Project Management		3

Application electives (3-9 credits):

As approved by the steering committee; may be selected from this list:

Course		Codes*	Credits
EST 550	Environmental Impact Analysis		3
EST 603	Research Methods and Design		3
EST 604	Social Survey Research Methods for Environmental Issues		3
EST 605	Qualitative Methods		3
EST 626	Concepts and Principles of Sustainable Development		3
EST 627	Environmental and Energy Auditing		3
EST 635	Public Participation and Decision Making: Theory and Application		3
EST 640	Environmental Thought and Ethics		3
EST 660	Land Use Law		3
FOR 665	Natural Resources Policy		3
FOR 670	Resource and Environmental Economics		3
FOR 680	Urban Forestry		3
FOR 685	Business and Managerial Law		3
FOR 687	Environmental Law and Policy		3
FOR 689	Natural Resources Law and Policy		3
FOR 770	Ecological Economics and Policy		3

Professional Experience/Synthesis (3-6 credits):

Course		Codes*	Credits
CME 898	Professional Experience/Synthesis		1 - 6

## Sustainable Energy (M.S., M.P.S., & Ph.D.)

- [www.esf.edu/fnrm/graduate/se](http://www.esf.edu/fnrm/graduate/se)

The Sustainable Energy area of study examines the biological, technical, economic, environmental, business, and policy feasibility and life cycle impacts of sustainable energy systems, with a particular focus on biobased sustainable energy.

The area employs an array of research methodologies from the fields of Agroforestry, Agronomy, Biology, Chemistry, Ecology, Economics, Engineering, Forestry, Law and Policy in order to fully address the multidisciplinary roles that sustainable energy systems play in the modern world.

# Department of Landscape Architecture

**Douglas Johnston, Chair**

**331 Marshall Hall**

**315-470-6544**

**315-470-6540** (fax)

- [www.esf.edu/la](http://www.esf.edu/la)

Since 1911 the Landscape Architecture program at SUNY-ESF has been educating practitioners and teachers, designers and planners, advocates and policy makers who have devoted careers to a viable, sustainable integration of natural and cultural communities.

The Department of Landscape Architecture offers three degree programs designed to educate students to contribute in varied ways to society and the wise use of land and landscape. Each provides a basis for students to establish career directions in the profession of landscape architecture and related fields. The bachelor and master of landscape architecture, and master of science degrees are offered. Qualified undergraduate students may apply for the combined B.L.A./M.S. fast-track option.

Students in the department are required to have a laptop computer with appropriate software. Guidelines are available from the [Department of Landscape Architecture](#). Many classes also have required field trips to project sites, or to study built works. Course fees attached to such classes cover transportation. Course fees also cover supplies for final plots for class assignments.

## Bachelor of Landscape Architecture

- [www.esf.edu/la/undergraduate/](http://www.esf.edu/la/undergraduate/)

The B.L.A. program is designed for those students desiring to enter the profession of landscape architecture either directly after completing the degree or after completing graduate school. This is a professional degree with an emphasis on the skills and knowledge required to qualify as a landscape architect.

**The degree is accredited by the Landscape Architectural Accreditation Board (LAAB).**

The B.L.A. degree is granted at the end of five years of study and requires the successful completion of 141 credit hours. Students are accepted into the lower-division landscape architecture program as freshmen or as sophomore transfers and into the upper-division program as junior transfers.

The quality of a student's professional development is monitored in part by a requirement that a grade of C or higher be earned to progress to the next studio.

### Lower Division Required Courses

Course		Codes*	Credits
APM 103	Applied College Algebra and Trigonometry	G	3
EFB 101	General Biology I: Organismal Biology and Ecology	G	3

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EFB 102	General Biology I Laboratory	G	1
ESF 200	Information Literacy		1
EWP 190	Writing and the Environment	G	3
EWP 220	Public Presentation Skills		2 - 3
EWP 290	Research Writing and Humanities	G	3
LSA 132	Orientation Seminar: Landscape Architecture		1
LSA 182	Drawing Studio	G	3
LSA 206	Art, Culture and Landscape II	G	3
LSA 220	Introduction to Landscape Architecture		3
LSA 226	Foundation Design Studio I		4
LSA 227	Foundation Design Studio II		4
LSA 300	Digital Methods and Graphics I		3
LSA 301	Digital Methods and Graphics II		3
LSA 305	History of Landscape Architecture I		3
LSA 311	Natural Processes in Design and Planning		3
LSA 333	Plants Materials		2

## Electives

General Education Course: American History	G	3
General Education Course: Social Sciences	G	3
General Education Course: Other World Civilization	G	3
Natural/Physical Science Elective		3

## Upper Division Required Courses

Course	Codes*	Credits
EWP 410		3
LSA 306		3
LSA 312		3
LSA 321		3
LSA 326		5
LSA 327		5
LSA 342		4
LSA 343		3
LSA 422		5
LSA 423		5
LSA 424		1
LSA 425		3
LSA 433		3

LSA 451	Comprehensive Land Planning	3
LSA 455	Professional Practice in Landscape Architecture	3
LSA 458	Off-Campus Design Thesis Studio: Faculty Advisor Visit, Weekly Reports and Field Studies	4
LSA 459	Off-Campus Design Thesis Studio: Design Journal and Project Notebook	4
LSA 460	Off-Campus Design Thesis Studio: Thesis Project	7
LSA 461	Off-Campus Final Presentation Seminar	1
LSA 470	Thematic Landscape Design Studio	6
LSA 497	Contemporary Issues in Landscape Architecture	1 - 6

**Total Minimum Credits For Degree: 141**

## B.L.A./M.S. Fast Track

- [www.esf.edu/la/undergraduate/](http://www.esf.edu/la/undergraduate/)

This option is available to outstanding fourth-year bachelor of landscape architecture students and provides the opportunity to receive both the bachelor of landscape architecture and master of science degrees during a six-year period at the College. Students who apply must have a minimum 3.000 GPA and are accepted into the program during the fall semester of the fourth year of the bachelor of landscape architecture program. The transition between the bachelor of landscape architecture and master of science curriculum requirements begins in the fall of the fifth year. The B.L.A. degree is awarded on completion of all professional requirements and a minimum of 141 credit hours. The M.S. degree is awarded after the completion of 30 graduate credits and successful completion of a research thesis. Depending on the student's needs and research interests, there are two options available for pursuing an off-campus semester or a field research component. The first option (option A) allows students to pursue the off-campus semester with their undergraduate peers. The second option (option B) links the off-campus semester to graduate field research for their theses.

### Fast-Track Option A – Summer start

#### Fourth Year, Summer option only

Course		Codes*	Credits
LSA 458	Off-Campus Design Thesis Studio: Faculty Advisor Visit, Weekly Reports and Field Studies		4
LSA 459	Off-Campus Design Thesis Studio: Design Journal and Project Notebook		4
LSA 460	Off-Campus Design Thesis Studio: Thesis Project		7

#### Fifth Year (25-28 credits)

Course		Codes*	Credits
LSA 455	Professional Practice in Landscape Architecture		3
LSA 461	Off-Campus Final Presentation Seminar		1
LSA 470	Thematic Landscape Design Studio		6
<b>OR</b> LSA 670	Thematic Landscape Design Studio		6
LSA 596	Special Topics in Landscape Architecture		1 - 3
LSA 640	Research Methods		3

LSA 697	Topics and Issues of Landscape Architecture		Audit
LSA 799	Capstone or Thesis Proposal Development		3
Directed Electives			6-9

B.L.A. program completed with a minimum of 141 credits earned

### Sixth Year (12-24 credits)

Course		Codes*	Credits
LSA 899	Master's Thesis Research		1 - 12
Directed Electives			6-12

Students may register for LSA 899 Master's Thesis Research as necessary for completion up to the time limit of the M.S. program. Minimum of 6 credits required.

B.L.A./M.S. fast-track program completed with a minimum of 171 credits hours of which a minimum of 30 credit hours must be graduate level courses.

### Fast-Track Option B – Fall start

#### Fifth Year (24-27 credits)

Course		Codes*	Credits
LSA 455	Professional Practice in Landscape Architecture		3
LSA 470	Thematic Landscape Design Studio		6
<b>OR</b> LSA 670	Thematic Landscape Design Studio		6
LSA 596	Special Topics in Landscape Architecture		1 - 3
LSA 625	Orientation for Off-Campus Experiential Studio		Audit
LSA 640	Research Methods		3
LSA 697	Topics and Issues of Landscape Architecture		Audit
Directed Electives			6-9

#### Fifth Year, Summer (6-12 credits)

Course		Codes*	Credits
LSA 760	Off-Campus Experiential Studio		12
<b>OR</b> LSA 798	Research Problem		1 - 12

6 credits of LSA 798 may be taken to fulfill this requirement. LSA 760 or LSA 798 must be linked to thesis.

B.L.A. program completed with a minimum of 141 credits

### Sixth Year (18-24 credits)

Course		Codes*	Credits
LSA 899	Master's Thesis Research		1 - 12

Students may register for LSA 899 Master's Thesis Research as necessary for completion up to the time limit of the M.S. program. Minimum of 6 credits required.

B.L.A./M.S. fast-track program completed with a minimum of 171 credits, of which a minimum of 30 credits must be graduate level courses.

## Graduate Programs

- [www.esf.edu/la/graduate](http://www.esf.edu/la/graduate)

The ESF Department of Landscape Architecture offers a range of degree options at the Masters and Ph.D. level.

### Master of Landscape Architecture (M.L.A.)

- [www.esf.edu/la/graduate/mla.htm](http://www.esf.edu/la/graduate/mla.htm)

**The degree is accredited by the Landscape Architectural Accreditation Board (LAAB).**

A three-year program for applicants who have no design or planning background leads to the fully accredited professional degree of master of landscape architecture (M.L.A.). This program is for students who intend to complete coursework full time. Applicants with a related design or planning degree may enter the three-year program with advanced standing.

The M.L.A. program, for the student seeking a first professional degree in landscape architecture, is a more tightly structured curriculum because it leads to the prerequisite work experience that qualifies the graduate for the Landscape Architecture Registration Examination (L.A.R.E.).

### M.L.A. Program Requirements

Course		Codes*	Credits
LSA 500	Digital Methods and Graphics I		3
LSA 501	Digital Methods and Graphics II		3
LSA 552	Graphic Communication		3
LSA 600	Design Studio I		4
LSA 601	Design Studio II		4
LSA 606	History of Landscape Architecture II		3
LSA 611	Natural Processes in Planning and Design		3
LSA 615	Site Construction Grading, Drainage and Road Layout		3
LSA 620	Design Studio II--Advanced Site Design		4
LSA 632	Plants and Landscapes		2
LSA 633	Planting Design and Practice		3
LSA 640	Research Methods		3
LSA 645	Construction Documentation Studio		3
LSA 650	Behavioral Factors of Community Design		3
LSA 651	Comprehensive Land Planning		3

LSA 655	Professional Practice in Landscape Architecture	3
LSA 670	Thematic Landscape Design Studio	6
LSA 697	Topics and Issues of Landscape Architecture	1
LSA 700	Design Studio V - Integrative Studio	4
LSA 799	Capstone or Thesis Proposal Development	3
LSA 800	Capstone Studio	6

### Final Integrative Experience

M.L.A. students must complete an integrative experience. Students must participate in the capstone studio and complete a 6-credit independent design project during the final semester of the program. M.L.A. students must disseminate the results of their integrative studies through capstone seminars.

**The M.L.A. program requires 70 credit hours.**

### Master of Science (M.S.)

- [www.esf.edu/la/graduate/ms.htm](http://www.esf.edu/la/graduate/ms.htm)

Because **the M.S. program serves the advanced professional**, course requirements do not address foundation professional courses in landscape architecture. However, the student, in consultation with the major professor and steering committee, has great flexibility in developing a program of study suited to career goals in the chosen area of study.

### M.S. Program Requirements

Course		Codes*	Credits
LSA 640	Research Methods		3
LSA 697	Topics and Issues of Landscape Architecture		1
LSA 799	Capstone or Thesis Proposal Development		3
LSA 899	Master's Thesis Research		1 - 12

Students may register for LSA 899 Master's Thesis Research as necessary for completion up to the time limit of the M.S. program. Minimum of 6 credits required.

### Final Integrative Experience

M.S. students must complete an integrative experience and must complete a thesis (6 credits). The thesis may be research in which new, original knowledge is generated, it may be a study that focuses on the application of existing knowledge to a new situation, or it may combine both elements. Students must disseminate the results of their integrative studies through capstone seminars.

### Areas of Study

- [www.esf.edu/la/graduate/areas.htm](http://www.esf.edu/la/graduate/areas.htm)

The landscape architecture graduate degree programs provide a well-balanced curriculum in landscape architectural design and planning, coupled with opportunities to pursue individualized advanced study in a broad range of topics.

The diversity of faculty interests and expertise offer both M.L.A. and M.S. students opportunities for in-depth

exploration in three areas of study: community design and planning, cultural landscape conservation, and landscape and urban ecology.

### **Community Design and Planning (M.L.A., M.S.)**

The purpose of this area is to address design, planning and research with regard to human settlements including discrete traditional communities such as cities, towns, hamlets, and their hinterlands; regional and rural communities connected to agriculture, watersheds and forests; and specialized communities such as institutional and corporate campuses, co-housing and new towns.

### **Cultural Landscape Studies and Conservation (M.L.A., M.S.)**

This area addresses a range of issues germane to the developmental and interpretive history of the cultural landscape. At its most fundamental level, the study area prepares students to address preservation planning and management for a range of cultural landscape types including historic sites and settlements, designed landscapes and vernacular landscapes.

There is also a growing set of interdisciplinary methods relevant to cultural landscape studies such as critical history, landscape representation, media, visual perception and reception of landscapes, interpretation, narrative and participatory design. Graduate students may explore and/or integrate these methods with design and preservation practices.

### **Landscape and Urban Ecology (M.L.A., M.S.)**

The purpose of this area of study is to address a range of theoretical and practical applications in landscape and urban ecosystems as they relate to the practice of landscape architecture and community design.

In this contemporary interdisciplinary approach, students will learn about the structure, heterogeneity and ecological processes of a broad range of natural, modified and urban landscapes. People are recognized as an integral part of the landscape and are included as a major focus of research and practice.

## **Doctoral Level Studies**

- [www.esf.edu/environmentalscience](http://www.esf.edu/environmentalscience)

Doctoral level studies in landscape architecture may be tailored in connection with the interdisciplinary Ph.D. program in the Graduate Program in Environmental Science (GPES). Please see The [Division of Environmental Science](#) section of this catalog.

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\* **Special Course Codes** (Code indicates course meets certain program or accreditation requirements. Ignore if there is no relevance to this program of study.) **G** = General Education Course (GenEd), **E** = Engineering, **ES** = Engineering Sciences, **M** = Mathematic, **NS** = Natural Sciences, **PE** = Professional Education

# Department of Paper and Bioprocess Engineering

Gary M. Scott, Chair

205 Walters Hall

315-470-6501

315-470-6945 (fax)

- [www.esf.edu/pbe](http://www.esf.edu/pbe)

The academic programs in the department of Paper and Bioprocess Engineering (PBE) emphasize fundamental engineering science and engineering skills pertaining to chemical engineering with specialization in the pulp, paper and allied industries, and the bioprocess and chemical industries. Programs include courses in traditional areas of applied chemistry, industrial bioprocessing/biotechnology, chemical engineering, and pulp and paper technology.

The department's educational programs at both the undergraduate and graduate levels are committed to preparing students for leadership roles in the paper and bioproducts industries. The department comprises nine distinguished faculty members who maintain research programs in a wide range of areas including biopulping, wood pulping and bleaching chemistry, paper physics and papermaking, chemical and process engineering, materials science, and surface and colloid science, among others.

## Bachelor of Science in Bioprocess Engineering

- [www.esf.edu/pbe/bpe](http://www.esf.edu/pbe/bpe)

The bioprocess engineering program prepares students for work in the emerging bioprocessing and biofuels industry to produce energy and related chemical products from renewable resources. Students in this program master a variety of subjects that are normally found in a chemical engineering program and supplement those studies with advanced courses specific to bioprocess engineering. The program focuses on the use of sustainable renewable biomass to replace petroleum in chemicals, pharmaceuticals, energy and industrial products in a sustainable manner.

**The bioprocess engineering program is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>.**

### Lower Division Required Courses

Course		Codes*	Credits
APM 205	Calculus I for Science and Engineering	G	4
APM 206	Calculus for Science and Engineering II	G	4
APM 307	Multivariable Calculus		4
APM 485	Differential Equations for Engineers and Scientists		3
BPE 132	Introduction to Process Engineering I		1

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  - [Advanced \(Graduate\) Certificate in Bioprocessing](#)

BPE 300	Introduction to Industrial Bioprocessing		3
EFB 103	General Biology II: Cell Biology and Genetics	G	3
EFB 104	General Biology II Laboratory	G	1
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
FCH 221	Organic Chemistry I		3
FCH 222	Organic Chemistry Laboratory I		1
FCH 223 AND FCH 224 OR PSE 223	Organic Chemistry II Organic Chemistry Laboratory II Introduction to Lignocellulosics		3 1 4
FCH 360	Physical Chemistry I		3
FOR 207	Introduction to Economics	G	3
GNE 160	Computing Methods for Engineers and Scientists		3
GNE 330	Professional Engineering Skills Seminar		0.5
GNE 330	Professional Engineering Skills Seminar		0.5
PHY 211	General Physics I	G	3
PHY 212	General Physics II		3
PHY 221	General Physics I Laboratory		1
PHY 222	General Physics II Laboratory		1
PSE 133	Introduction to Process Engineering II		1
PSE 361	Engineering Thermodynamics		3
PSE 370	Principles of Mass and Energy Balance		3

\* Only FCH 223/224 or PSE 223, not both.

### Lower Division Electives

Students are required to take two among the following four.

General Education Course: American History	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilization	G	3
General Education Course: The Arts	G	3

### Upper Division Required Courses

Course	Codes*	Credits
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APM 395	Probability and Statistics for Engineers	3
BPE 304	Summer Internship in Bioprocess Engineering	2
BPE 310	Colloid and Interface Science	3
BPE 335	Transport Phenomena	3
BPE 420	Bioseparations	3
BPE 421	Bioprocess Kinetics and Systems Engineering	3
BPE 430	Process Operations Laboratory	3
BPE 435	Unit Process Operations	3
BPE 440	Bioprocess and Systems Laboratory	3
BPE 481	Bioprocess Engineering Design	3
ESF 200	Information Literacy	1
EWP 444	Professional Writing/Paper & Bioprocess Engineering	2
GNE 330	Professional Engineering Skills Seminar	0.5
GNE 330	Professional Engineering Skills Seminar	0.5
GNE 330	Professional Engineering Skills Seminar	0.5
GNE 330	Professional Engineering Skills Seminar	0.5
PSE 371	Fluid Mechanics	3
PSE 477	Process Control	3
PSE 480	Engineering Design Economics	3

ESF 200 and EWP 405 are to be taken in the same semester *in the same time block*. Please consult your advisor if you have questions.

### Directed Electives

Nine credits out of the following.

Junior or higher Biology or Biochemistry Electives	0-9
Junior or higher Chemistry Electives	0-9
Junior or higher Engineering Electives	0-9

The list of directed elective courses is available in the student handbook and from the student's advisor. Students are encouraged to select elective courses to focus on one concentration area from among the following: biomolecular engineering, biochemical engineering, biopolymer engineering, bioenergy engineering, biomaterials, environmental engineering, industrial engineering or paper engineering.

### Internships, Co-ops, and Research Experiences

Bioprocess engineering students enjoy the advantage of hands-on learning in the bioprocess and allied industries through faculty-guided internships and cooperative education (co-op) assignments. All students are required to complete an internship, co-op or research experience in the industry or in a research setting. Internships provide students with valuable experience and financial benefits. There is a two credit course following the Bioprocess Engineering experience to summarize the experience with a report and a presentation for completion of the internship.

## Bachelor of Science in Paper Engineering

- [www.esf.edu/pbe/paperengineering](http://www.esf.edu/pbe/paperengineering)

The paper engineering program is a chemical engineering-based curriculum designed to provide greater depth in fiber and paper processing for students preparing for an engineering career in the pulp, paper and allied industries.

The pulp and paper industry is at the forefront of the renewable resources industry. It represents the first industry that uses biomass in large quantities to produce commodity and specialized products. Graduates are well prepared to move into assignments in the engineering field and advance quickly to positions of responsibility in the analysis and design of processes and equipment. **The paper engineering program is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>.**

### Lower Division Required Courses

Course		Codes*	Credits
APM 205	Calculus I for Science and Engineering	G	4
APM 206	Calculus for Science and Engineering II	G	4
APM 307	Multivariable Calculus		4
APM 485	Differential Equations for Engineers and Scientists		3
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
FCH 221	Organic Chemistry I		3
FCH 222	Organic Chemistry Laboratory I		1
FCH 223	Organic Chemistry II		3
<b>AND</b> FCH 224	Organic Chemistry Laboratory II		1
<b>OR</b> PSE 223	Introduction to Lignocellulosics		4
FCH 360	Physical Chemistry I		3
GNE 160	Computing Methods for Engineers and Scientists		3
GNE 330	Professional Engineering Skills Seminar		0.5
GNE 330	Professional Engineering Skills Seminar		0.5
PHY 211	General Physics I	G	3
PHY 212	General Physics II		3
PHY 221	General Physics I Laboratory		1
PHY 222	General Physics II Laboratory		1
PSE 132	Introduction to Process Engineering I		1

PSE 133	Introduction to Process Engineering II		1
PSE 200	Introduction to Papermaking		3
PSE 201	The Art and Early History of Papermaking	G	3
PSE 202	Pulp and Paper Laboratory Skills		1
PSE 361	Engineering Thermodynamics		3
PSE 370	Principles of Mass and Energy Balance		3

### Lower Division Electives

Students are required to take one among the following three.

General Education Course: American History	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilization	G	3

### Upper Division Required Courses

Course		Codes*	Credits
APM 395	Probability and Statistics for Engineers		3
BPE 335	Transport Phenomena		3
BPE 430	Process Operations Laboratory		3
BPE 435	Unit Process Operations		3
ESF 200	Information Literacy		1
EWP 405	Writing for Science Professionals		1 - 3
FOR 207	Introduction to Economics	G	3
GNE 330	Professional Engineering Skills Seminar		0.5
GNE 330	Professional Engineering Skills Seminar		0.5
GNE 330	Professional Engineering Skills Seminar		0.5
GNE 330	Professional Engineering Skills Seminar		0.5
PSE 304	Professional Experience/Synthesis		2
PSE 350	Fiber Processing		3
PSE 371	Fluid Mechanics		3
PSE 465	Fiber and Paper Properties		3
PSE 468	Papermaking Processes		6
PSE 477	Process Control		3
PSE 480	Engineering Design Economics		3
PSE 481	Engineering Design		3

ESF 200 and EWP 405 are to be taken in the same semester *in the same time block*. Please consult your advisor if you have questions.

### Directed Electives

The list of directed elective courses is available in the student handbook and from the student's advisor. Some courses are available in an exchange program with Germany.

**Total Minimum Credits For Degree: 128**

## Bachelor of Science in Paper Science

- [www.esf.edu/pbe/paperscience](http://www.esf.edu/pbe/paperscience)

The paper science program allows those students who are more science-focused to prepare for careers in the pulp, paper and allied industries.

Students graduating from this program are well-suited for employment in many different facets of the industry and the allied chemical industry, as well as in applications of chemistry and biology. This program prepares students for careers in the technical, managerial or technical representative areas that extend in many directions.

### Lower Division Required Courses

Course		Codes*	Credits
APM 205	Calculus I for Science and Engineering	G	4
APM 206	Calculus for Science and Engineering II	G	4
EWP 190	Writing and the Environment	G	3
EWP 290	Research Writing and Humanities	G	3
FCH 150	General Chemistry I	G	3
FCH 151	General Chemistry Laboratory I	G	1
FCH 152	General Chemistry II	G	3
FCH 153	General Chemistry Laboratory II	G	1
FCH 221	Organic Chemistry I		3
FCH 222	Organic Chemistry Laboratory I		1
FCH 223	Organic Chemistry II		3
<b>AND</b> FCH 224	Organic Chemistry Laboratory II		1
FCH 360	Physical Chemistry I		3
FCH 361	Physical Chemistry II		3
GNE 160	Computing Methods for Engineers and Scientists		3
GNE 330	Professional Engineering Skills Seminar		0.5
PHY 211	General Physics I	G	3
PHY 212	General Physics II		3
PHY 221	General Physics I Laboratory		1
PHY 222	General Physics II Laboratory		1
PSE 132	Introduction to Process Engineering I		1
PSE 133	Introduction to Process Engineering II		1

PSE 200	Introduction to Papermaking		3
PSE 201	The Art and Early History of Papermaking	G	3
PSE 202	Pulp and Paper Laboratory Skills		1
PSE 370	Principles of Mass and Energy Balance		3

### Lower Division Electives

Students are required to take two among the following three.

General Education Course: American History	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilization	G	3

### Upper Division Required Courses

Course		Codes*	Credits
ESF 200	Information Literacy		1
EWP 405	Writing for Science Professionals		1 - 3
FCH 380	Analytical Chemistry I: Gravimetric, Titrimetric and Potentiometric Analysis		3
FOR 207	Introduction to Economics	G	3
GNE 330	Professional Engineering Skills Seminar		0.5
PSE 304	Professional Experience/Synthesis		2
PSE 350	Fiber Processing		3
PSE 450	Pulping and Bleaching Processes		3
PSE 465	Fiber and Paper Properties		3
PSE 466	Paper Pigment and Barrier Coating		3
PSE 467	Papermaking Wet End Chemistry		3
PSE 468	Papermaking Processes		6

ESF 200 and EWP 405 are to be taken in the same semester *in the same time block*. Please consult your advisor if you have questions.

### Engineering Electives

Nine credits out of the following.

Course		Codes*	Credits
BPE 335	Transport Phenomena		3
ERE 440	Water and Wastewater Treatment		3
GNE 461	Air Pollution Engineering		3
PSE 361	Engineering Thermodynamics		3
PSE 371	Fluid Mechanics		3
PSE 477	Process Control		3
PSE 480	Engineering Design Economics		3

PSE 481	Engineering Design		3
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**Technical Elective Courses**

Students completing the paper science program must complete 15-18 credits of technical electives in order to satisfy the graduation requirements. Courses taken to satisfy the engineering electives above cannot also be used to satisfy the technical elective requirement. This technical elective requirement can be satisfied by completing one of the collegewide minors listed below:

- Bioprocess Science
- Computer and Information Technology
- Construction Management
- Entrepreneurship
- General Management Studies
- Marketing
- Sustainable Construction

Students not completing one of the listed minors must complete at least 15 credits of department-approved technical elective concentration coursework in the following areas:

- Biology
- Chemistry
- Pollution abatement
- Applied mathematics
- Computer modeling
- Mechanics
- Engineering design
- Materials science
- Forestry and forest management
- Biotechnology
- Wood science
- Other department-approved areas

**Free Electives**

Free Elective	3
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<b>Total Minimum Credits For Degree: 124</b>
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**Graduate Program in Paper and Bioprocess Engineering**

- [www.esf.edu/pbe/graduate](http://www.esf.edu/pbe/graduate)

The department participates in graduate education leading to the master of professional studies (M.P.S.), master of science (M.S.) and doctor of philosophy (Ph.D.) degrees in Paper and Bioprocess Engineering. Four options are available within this program:

- Paper Science and Engineering (PSE)

- Bioprocess Engineering (BPE)
- Biomaterials Engineering (BME)
- Sustainable Engineering Management (SEM)

The graduate program allows students to investigate a diverse range of topics in the area of pulp and paper design, process and product development, and manufacturing, as well as the production of chemicals, energy and other products from sustainable raw material sources using both chemical and biological methods. The overall objective of the option is to educate students at the M.P.S., M.S. and Ph.D. level in the development of new processes and products that can be produced in an ecologically sound and sustainable manner.

## Options

- [www.esf.edu/pbe/graduate](http://www.esf.edu/pbe/graduate)

### Paper Science and Engineering Option

- [www.esf.edu/pbe/graduate/pse.asp](http://www.esf.edu/pbe/graduate/pse.asp)

The PSE option in the Paper and Bioprocess Engineering program offers areas of study in:

- Pulping and Bleaching Processes (M.S., Ph.D.)
- Colloidal Chemistry and Fiber Flocculation (M.S., Ph.D.)
- Fiber and Paper Physics (M.S., Ph.D.)
- Process and Environmental Systems Engineering (M.P.S., M.S., Ph.D.)
- Pulp and Paper Technology (M.P.S.)

### Bioprocess Engineering Option

- [www.esf.edu/pbe/graduate/bpe.asp](http://www.esf.edu/pbe/graduate/bpe.asp)

Projects conducted in the department under this option develop fundamental knowledge of biorefinery processes for application in the production of a wide spectrum of industrial products and fuels from bioresources, primarily lignocellulosics.

Research is also supported by various U.S. federal and N.Y. state governmental agencies, sometimes in conjunction with private industrial partners.

The BPE option in the Paper and Bioprocess Engineering program offers areas of study in:

- Biocatalysis and Bioreaction Engineering (M.S., Ph.D.)
- Bioseparations Engineering (M.S., Ph.D.)
- Bioprocess Design, Simulation and Control (M.S., Ph.D.)
- Bioenvironmental Engineering (M.S., Ph.D.)
- Renewable Energy and Biofuels (M.S., Ph.D.)
- Biopharmaceuticals (M.S., Ph.D.)
- Industrial Biological Processes (M.S., Ph.D.)
- Bioprocess Engineering (M.P.S.)

### Biomaterials Engineering (BME) Option

- [www.esf.edu/pbe/graduate/bme.asp](http://www.esf.edu/pbe/graduate/bme.asp)

The BME option in the Paper and Bioprocess Engineering program offers areas of study in:

- Biocomposite Materials, Biopolymers (M.S., Ph.D.)
- Bioactive Materials and Biosensors (M.S., Ph.D.)
- Nanocomposites and Nanostructured Materials (M.S., Ph.D.)

### **Sustainable Engineering Management (SEM) Option**

- [www.esf.edu/pbe/graduate/bpe.asp](http://www.esf.edu/pbe/graduate/bpe.asp)

The program in Sustainable Engineering Management allows students to investigate a variety of science and engineering topics together with courses in business, management, policy, law and other fields to form a Professional Science Master's program (P.S.M.) recognized by the Council of Graduate Schools.

Students in this program must complete a total of 36 credit hours. The topical core of the program consists of 21 credit hours of courses in their technical field. An additional 12 credits of courses in business, management, policy, law and other areas constitute the "plus" courses in the degree. An integrative experience (3 credit hours) in the form of an internship or research experience is also required. The selection of the "plus" courses as well as technical electives allows students to develop study programs tailored to their individual interests and strengths.

The M.P.S. program in Sustainable Engineering Management is intended for students who:

- have a B.S. degree in an appropriate STEM field and wish to extend their technical knowledge in this area together with obtaining professional skills characterized by the "plus" courses
- have worked in the industry and wish to return for a professional degree that incorporates business skills into the program.

Students entering the M.P.S. program should have a B.S. degree in a science- or engineering-related field. In terms of coursework, students should have the necessary prerequisites to take the courses that are required for the degree or be prepared to take these courses prior to taking the required courses. In general, students should have taken as part of their undergraduate program at least two semesters of calculus, two semesters of general chemistry, a semester of physics and a semester of biology. Additional chemistry, biology, and computer science courses, while not required, would be helpful.

The SEM option in the Paper and Bioprocess Engineering program offers areas of study in:

- Bioprocess Engineering (M.P.S.)
- Paper Engineering (M.P.S.)

### **Wood Science**

- [www.esf.edu/pbe/graduate/woodscience.htm](http://www.esf.edu/pbe/graduate/woodscience.htm)

#### **Ph.D. and M.S. in Wood Science**

Applicants for the M.S. or Ph.D. degrees in the wood science option are required to have a bachelor's degree in science, engineering or related degree. Applicants must have completed at least one semester of coursework in chemistry, biology, physics and calculus.

Areas of study in Wood Science include: Wood drying, wood anatomy and ultrastructure, wood durability and decay, tropical timbers, wood preservation. Applicants must have the appropriate undergraduate degree for the area of study they pursue.

#### **M. P. S. in Wood Science**

The M.P.S. degree in Wood Science is open to students with a demonstrated interest in wood science or the wood

products industry. A bachelor's degree in science or engineering is strongly recommended. Applicants to the M.P.S. in wood science and technology should have completed at least one semester of coursework in chemistry, biology, physics, and calculus.

Two coursework options are available:

**M. P. S. Coursework**—Core courses (12-21 credits), construction management courses (3-9 credits), application electives (3-9 credits), professional experience/synthesis (3-6 credits). Courses are selected in consultation with and with approval of the steering committee.

Core courses (12-21 credits):

Course		Codes*	Credits
CME 587	Renewable Materials for Sustainable Construction		3
CME 596			
CME 682			
CME 686	Wood-Water Relationships		3
CME 770	Biodegradation of Wood		3
MCR 580	Microtechnique of Wood		3
MCR 680	Fundamentals of Microscopy		3
MCR 683 OR MCR 685	Operation of the Transmission Electron Microscope Transmission Electron Microscopy		3 5
MCR 783 OR MCR 785	Operation of the Scanning Electron Microscope Scanning Electron Microscopy		3 5

Construction Management courses: (3 to 9 credits) (or others with committee approval)

Course		Codes*	Credits
CME 543	Construction Estimating		3
CME 653	Construction Planning and Scheduling		3
CME 654	Construction Project Management		3

Application Electives: (3-9 credits) (courses selected with committee approval)

Professional Experience/Synthesis (3-6 credits):

Course		Codes*	Credits
CME 898	Professional Experience/Synthesis		1 - 6

## Advanced (Graduate) Certificate in Bioprocessing

- [www.esf.edu/pbe/graduate/certificate.htm](http://www.esf.edu/pbe/graduate/certificate.htm)

The Advanced Certificate in Bioprocessing program was developed through a collaborative and interdisciplinary effort between business and academia to take advantage of this region's unique expertise and resources. Graduates of the program will support the development and manufacture of products produced through bioprocesses, such as those

produced in the pharmaceutical and fermentation industries, and biorefineries.

The purpose of the certificate program is to provide:

- Graduate education in bioprocessing that leads to a documented level of competency for practice;
- A structured and documented course of study at the graduate level; and
- A means for students to improve their competitive position in the employment marketplace.

Applicants must hold a bachelor's degree from an accredited institution in engineering, science or a related area. The student must have the required prerequisite background in topics that are fundamental to bioprocessing guided from previous coursework or professional experience. Applicants must demonstrate competence in pre-calculus and quantitative problem solving, preferably with calculus. Students who are matriculated in ESF graduate degree programs are not eligible to earn the Advanced Certificate in Bioprocessing.

Application and admissions procedures, compliance with college requirements for successful graduate-level study, and the awarding of advanced certificates are administered by the dean of Instruction and Graduate Studies. Applicants should complete and submit the application form to the Office of Instruction and Graduate Studies. Upon completion of program credit hour requirements, students will file a certificate request form that identifies completed coursework and initiates actions to produce official transcripts, leading to the award of the certificate. The curriculum consists of five technical courses including a capstone professional experience/synthesis course that will provide participants with a variety of skills supporting the technical aspects of the program. The capstone course will challenge students to use the skills they learned throughout the program and apply those skills to relevant business settings. Students will complete 15 credits hours of specific graduate coursework with an average grade of B or better.

# The Ranger School

**Michael R. Bridgen, Director**

**Wanakena Campus**

**315-848-2566**

**315-848-3249** (fax)

- [www.esf.edu/rangerschool](http://www.esf.edu/rangerschool)

The SUNY-ESF Ranger School in Wanakena, N.Y., offers students a unique educational experience in a spectacular natural setting. The Ranger School confers the associate in applied science degree. The A.A.S. degree can open doors to forest, natural resources conservation or land surveying technology careers, or it can serve as a hands-on, experience-based step toward a bachelor of science degree.

The Ranger School curriculum educates students for outdoor careers in the areas of environmental conservation, forestry and surveying, while also providing preparation for continued education in related bachelor's degree programs. Within the curriculum there are three areas of study: forest technology, land surveying technology, and environmental and natural resources conservation.

The Ranger School's one-plus-one plan allows students to complete their first year of higher education at the college of their choice, then spend their second year at The Ranger School. Students wishing to continue on for their bachelor's degree can do so at SUNY-ESF's main campus in Syracuse, N.Y.

## Academic Programs

- [www.esf.edu/rangerschool/programs](http://www.esf.edu/rangerschool/programs)

### Associate of Applied Science (A.A.S.) Degree

- [www.esf.edu/rangerschool/programs](http://www.esf.edu/rangerschool/programs)

The Ranger School offers Associate of Applied Science (A.A.S.) degrees in three areas. The A.A.S. is typically earned with two years of study.

There are several advantages of combining a Ranger School forest technology or environmental and natural resources associate's degree with a four-year B.S. degree in professional forestry. Ranger School graduates who go on to pursue the bachelor's degree have a solid field education as well as a managerial orientation and the deeper ecological and social understanding provided by the professional curriculum.

Students wishing to transfer from the Ranger School to the B.S. programs at the Syracuse campus will be admitted as juniors. They will be given credit for the summer session in field forestry. They will still have to complete some physical sciences, social sciences and humanities requirements while in residence at Syracuse, depending on prior preparation. All other requirements as set forth in the forest resources management program option must be met.

- **NOTE:** Students contemplating subsequent transfer should concentrate their freshman year **electives in the social sciences and humanities**.
- **NOTE:** Students should also complete the first semester in **chemistry**, one semester in **physics** and a course in **calculus** prior to transferring.

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- **Academic Programs**
  - Associate of Applied Science (A.A.S.) Degree
  - Environmental and Natural Resources Conservation (A.A.S.)
  - Forest Technology (A.A.S.)
  - Land Surveying Technology (A.A.S.)

It is possible to be admitted without these courses, but subsequent progress in the program becomes more difficult.

## Dual Majors

Students who are pursuing the associate degree may pursue a dual major, combining any two of the three areas below. Program requirements must be satisfied concurrently (i.e., a student cannot graduate from ESF and return later to complete coursework for a second major). Students may petition for admission to a dual major A.A.S. degree after completing 18 credits and before 45 credits with an unambiguous GPA of 2.000 or greater (no grades of incomplete or missing grades). *The diploma will state the completion of a single A.A.S. degree.* The transcript will state the completion of two majors.

## Environmental and Natural Resources Conservation (A.A.S.)

- [www.esf.edu/rangerschool/programs/enrc.htm](http://www.esf.edu/rangerschool/programs/enrc.htm)

The environmental and natural resources conservation program provides students with the scientific theory and applied skills necessary for a technical career in the environmental and natural resources sector. This program will provide students with a solid grounding in applied ecological and sociopolitical concepts, accompanied by technical training in plant and tree identification, land surveying, natural resources measurements, geospatial applications, soil and water monitoring, wildlife techniques and forest recreation.

Students interested in a baccalaureate degree should investigate the [Department of Forest and Natural Resources Management's bachelor's degree curriculum](#). Transfer is possible upon completion of the A.A.S. degree at Wanakena. Transfer into other baccalaureate programs at ESF may be possible, but students should consult with an advisor in the Undergraduate Admissions office as soon as possible. Students who may consider transferring to a baccalaureate program after graduation from the environmental and natural resources conservation program should pay close attention to the footnotes under "freshman year."

The freshman year environmental and natural resources conservation curriculum consists of general studies courses which may be taken at any accredited four-year, community, or agricultural college, or college of technology.

### First Year Required Courses

Completed at a college of the student's choice

Course	Codes*	Credits
General Biology with lab		4
Science Course with lab (Biology, Chemistry, or Physics)		4
English with a Focus on Writing (Two 3-credit courses)		6
Trigonometry or pre-calculus (1 course)		3
Economics/Policy/Government		3
Total Maximum Transfer Credits		20

### Second Year Required Courses

Course	Codes*	Credits
FTC 200   Dendrology		3
FTC 202   Introduction to Surveying		3
FTC 204   Introduction to Natural Resources Measurements		4

FTC 206	Forest Ecology		4
FTC 207	Communications and Safety		3
FTC 208	Remote Sensing and GIS Technology		3
FTC 210	Wildlife Techniques		2
FTC 211	Silviculture		3
FTC 212	Adirondack Cultural Ecology		2
FTC 219	Introduction to Forest Recreation		1
FTC 221	Natural Resources Management		3
FTC 234	Wildlife Conservation		3
FTC 236	Interpretive Techniques in Forest Recreation		2
FTC 237	Introduction to Water and Soil Resources		3
FTC 238	Forest Insects and Disease		3
FTC 239	GIS Applications		2

**Total Minimum Credits For Degree: 64**

## Forest Technology (A.A.S.)

- [www.esf.edu/rangerschool/programs/ft.htm](http://www.esf.edu/rangerschool/programs/ft.htm)

A degree in Forest Technology provides students with knowledge of the field practice of forest management, the ability to work and communicate effectively with professional and paraprofessional personnel, and an understanding of the physical, biological and quantitative aspects that form the basis of forestry.

### First Year Required Courses

Completed at a college of the student's choice

Course	Codes*	Credits
General Biology with lab		4
Science Course with lab (Biology, Chemistry, or Physics)		4
English with a Focus on Writing (Two 3-credit courses)		6
Trigonometry or pre-calculus (1 course)		3
Economics/Policy/Government		3
Total Maximum Transfer Credits		20

### Second Year Required Courses

Course	Codes*	Credits
FTC 200	Dendrology	3
FTC 202	Introduction to Surveying	3
FTC 204	Introduction to Natural Resources Measurements	4
FTC 206	Forest Ecology	4

FTC 207	Communications and Safety		3
FTC 208	Remote Sensing and GIS Technology		3
FTC 209	Timber Harvesting		2
FTC 211	Silviculture		3
FTC 213	Forest Inventory Practicum		2
FTC 214	Leadership and Organizational Performance		2
FTC 217	Wildland Firefighting and Ecology		2
FTC 219	Introduction to Forest Recreation		1
FTC 221	Natural Resources Management		3
FTC 225	Timber Transportation and Utilization		3
FTC 234	Wildlife Conservation		3
FTC 238	Forest Insects and Disease		3

**Total Minimum Credits For Degree: 64**

## Land Surveying Technology (A.A.S.)

- [www.esf.edu/rangerschool/programs/lst.htm](http://www.esf.edu/rangerschool/programs/lst.htm)

The land surveying technology program's educational objectives are for students to obtain a sound technical background in fundamental land surveying principles, techniques and skills; become well-rounded technical specialists capable of teamwork, communication and problem solving; and develop life-long learning skills and abilities.

The program provides students with a combination of surveying and land resource knowledge and related skills which are not available elsewhere. Students will be thoroughly exposed to the field of land surveying through a carefully planned combination of classroom lectures, demonstrations and hands-on experience.

### First Year Required Courses

Completed at a college of the student's choice

Course	Codes*	Credits
General Biology with lab		4
Science Course with lab (Biology, Chemistry, or Physics)		4
English with a Focus on Writing (Two 3-credit courses)		6
Trigonometry or pre-calculus (1 course)		3
Economics/Policy/Government		3
Total Maximum Transfer Credits		20

### Second Year Required Courses

Course	Codes*	Credits
FTC 200	Dendrology	3

FTC 202	Introduction to Surveying	3
FTC 204	Introduction to Natural Resources Measurements	4
FTC 205	Computer Aided Drafting and Design 1	2
FTC 206	Forest Ecology	4
FTC 207	Communications and Safety	3
FTC 208	Remote Sensing and GIS Technology	3
FTC 214	Leadership and Organizational Performance	2
FTC 225	Timber Transportation and Utilization	3
FTC 251	Advanced Surveying Measurements and Computations	4
FTC 253	Survey Law	3
FTC 255	Boundary Surveying	3
FTC 256	Subdivision Surveys	2
FTC 257	Construction and Topographic Surveys	3
FTC 259	Computer Aided Drafting and Design II	2

**Total Minimum Credits For Degree: 64**

# Course Descriptions

The courses offered by the College are grouped by general subject areas and the number of credit hours appears after the course title. A credit hour means one recitation (or lecture) hour per week. Three laboratory hours are equivalent to one lecture hour.

The semester(s) after each course indicates when it is normally offered. The College reserves the right to alter the scheduled offering of a course when its enrollment is too small or when there is no qualified faculty member available to teach it.

Courses listed in this catalog are subject to change through normal academic channels. New courses, course deletions and changes in courses are initiated by the relevant departments and the College faculty.

- [ESF Subject Areas and Course Descriptions](#)
- [Syracuse University Subject Areas](#)  
(courses with non-ESF prefixes are taught at Syracuse University)

# Course Numbering System

**100-499:** Undergraduate courses for which no graduate credit may be given.

**500-599:** Graduate courses designed expressly for areas of specialization in post-baccalaureate programs. Qualified undergraduate students may enroll by permission of the instructor.

**600-699:** Graduate courses designed expressly for advanced levels of specialization. Undergraduate students with a cumulative grade point average of 3.000 or better may enroll in these courses with an approved petition.

**700-999:** Advanced graduate-level courses for which no undergraduate students may register. Shared resources courses, designated as 400/500 or 400/600, are designed when the topic coverage of both courses is the same. Separate course syllabuses are developed expressly differentiating the requirements and evaluative criteria between the undergraduate course and the graduate course. No type of cross listing may be offered unless approved by the ESF faculty.

# ESF Course Descriptions

## **APM 101 Fundamentals of College Algebra (3)**

Three hours of lecture/discussion per week. Algebraic operations on polynomials and rational functions as expressions, in equations, or inequalities. Graphing of linear and polynomial equations. An emphasis is placed on algebraic operations of expressions with rational exponents. Fall.

## **APM 103 Applied College Algebra and Trigonometry (3)**

Three hours of lecture per week. This course is designed to enable non-science students to solve practical problems in their specific areas of study. Topics include algebraic, exponential, logarithmic, and trigonometric functions used in measurement and modeling. Applications include percents, scaling, slopes, and contour mapping. Spring, Fall.

Prerequisite(s): Math Placement or Consent of Instructor.

## **APM 104 College Algebra and Precalculus (3)**

Three hours of lecture/discussion per week. Course meets the SUNY general education requirement for mathematics. Elements of analytic geometry.

Emphasis on the concepts of polynomial and rational functions, exponential and logarithmic functions, trigonometry and trigonometric functions and their application to design and life and management sciences. Fall and Spring.

Prerequisite: Three years of high school mathematics.

## **APM 105 Survey of Calculus and Its Applications I (4)**

Four hours of lecture per week. Introduction to calculus for students in the life and management sciences. Elements of analytic geometry, functions and their graphs, with an emphasis on the concepts of limits, and differentiation techniques for algebraic, exponential and logarithmic functions and their application to economics, and the life and management sciences. Some multivariable calculus including constrained optimization. Fall and Spring.

Prerequisite: Precalculus or 3 1/2 years of high school mathematics. Note: Credit will not be granted for APM 105 after successful completion of MAT 284, MAT 285, or MAT 295 at SU.

## **APM 106 Survey of Calculus and Its Applications II (4)**

Four hours of lecture per week. A continuation of calculus for students in the life and management sciences. Elements of analytic geometry. An introduction to integration and applications of the definite integral. Differentiation and integration of trigonometric functions. Applications of first order differential equations and partial derivatives. Spring.

Prerequisite: APM 105 or permission of the instructor. Note: Credit will not be granted for APM 106 after successful completion of MAT 286 or MAT 296 at SU.

## **APM 115 Essential Calculus (4)**

A one semester course in differential and integral calculus. An emphasis on the concepts of limits, differentiation and integration techniques for algebraic, exponential, logarithmic functions, and trigonometric functions. This course is not intended for students that plan on taking additional Calculus courses. Offered in fall and spring.

Credits will not be granted for APM 115 after successful completion of any Calculus course such as APM105, MAT

- [APM—Applied Mathematics](#)
- [BPE—Bioprocess Engineering](#)
- [BTC—Biotechnology](#)
- [CME—Construction Management Engineering](#)
- [EFB—Environmental and Forest Biology](#)
- [EHS—Environmental Health](#)
- [ENS—Environmental Science](#)
- [ERE—Environmental Resources Engineering](#)
- [ESC—Environmental Science](#)
- [ESF—College-wide](#)
- [EST—Environmental Studies](#)
- [EWP—Environmental Writing Program](#)
- [FCH—Chemistry](#)
- [FOR—Forestry \(Resources Management\)](#)
- [FTC—Forest Technology](#)
- [GNE—General Engineering](#)
- [LSA—Landscape Architecture](#)
- [MCR—Microscopy](#)
- [PSE—Paper Science and Engineering](#)
- [RMS—Renewable Materials Science](#)
- [SRE—Sustainable Renewable Energy](#)

284, or beyond. Prerequisites: APM 103 or APM 104, or equivalent.

**APM 205 Calculus I for Science and Engineering (4)**

Four hours of lecture/discussion per week. Analytic geometry, limits, derivatives of functions and equations, optimization, rates, graphs, differentials, mean-value theorem, and applications of the derivative. Fall. Prerequisite: APM 104 or permission of instructor.

**APM 206 Calculus for Science and Engineering II (4)**

Four hours of lecture/discussion per week. This course is a one semester continuation of differential calculus. Integral calculus is used to describe growth and size. Topics include: techniques of integration and their application, convergence of sequences and series, separable and first-order differential equations, and polar coordinates. Spring. Prerequisite(s): Successful completion of a differential calculus course such as APM205 or MAT295.

**APM 255 Computing Applications (3)**

Three hours of lecture per week. Introduction to computing resources: timeshared and personal computers. Introduction to basic computing concepts. Introduction to computing and computer networks. Introduction to applications computing: word processing, spreadsheets and communications (electronic mail and other Internet services). Spring.

**APM 307 Multivariable Calculus (4)**

4 hours of lecture/discussion per week. Topics include vectors three dimensions, analytic geometry of three dimensions, parametric curves, partial derivatives, the gradient, optimization in several variables, multiple integration with change of variables across different coordinate systems, line integrals, and Green's Theorem. Fall and Spring. Prerequisites: Completion of Differential and Integral Calculus with at least a C-; APM206 / MAT296, or the equivalent Note: Credit cannot be given for both APM307 and MAT397.

**APM 360 Introduction to Computer Programming (3)**

Three hours of lecture per week. The basic course in computer programming offered by the college, giving the student the skill and understanding to write computer programs to solve problems. The course will cover instruction in a commonly used programming language such as Pascal or FORTRAN; will cover basic hardware and software concepts; will make use of electronic mail and computer networks; will introduce applications software, such as spreadsheets, statistical software or other appropriate types. No prior experience with computers or programming is required. Fall.

**APM 391 Introduction to Probability and Statistics (3)**

Three hours of lecture per week. Introduction to concepts and methods of statistics as applied to problems in environmental science and forestry. Topics include inference (confidence intervals and hypothesis testing), sampling distributions, descriptive statistics, exploratory data analysis, comparison of population means and proportions, categorical data analysis, regression and correlation, and nonparametric methods. Fall or Spring.

**APM 395 Probability and Statistics for Engineers (3)**

Three hours of lecture per week. This course provides a rigorous introduction to calculus-based probability and statistical theory, with applications primarily drawn from engineering and the environmental sciences. Topics include: descriptive statistics and data presentation, probability, the theory and use of discrete and continuous probability distributions, confidence intervals, classical and distributional hypothesis testing, and regression analyses. Spring. Prerequisite(s): One year of Calculus. Note: Credit will not be granted for both APM 395 and APM 595.

**APM 485 Differential Equations for Engineers and Scientists (3)**

Three hours of lecture per week. First and second order ordinary differential equations, matrix algebra, eigen values and eigen vectors, linear systems of ordinary differential equations, numerical solution techniques and an introduction to partial differential equations. Spring.

Prerequisite: MAT 295, MAT 296, MAT 397.

### **APM 500 Introduction to Computer Programming for Graduate Students (3)**

Three hours of lecture per week. A basic course in computer usage. Provides the skill needed to utilize digital computer languages for problem solving. Includes a study of FORTRAN with a discussion of APL and Assembly Language. Other topics include representation of information, management of files, error control, operational systems and job control. Fall.

### **APM 510 Statistical Analysis (3)**

Three hours of lecture per week. Applications of descriptive and inferential statistics to natural resource problems. Basic concepts and techniques of estimation, confidence intervals, and hypothesis testing applied to one- and two-sample settings, paired designs, simple linear regression and correlation, contingency tables, and goodness of fit tests. Statistical software used to enhance data analysis skills. Fall.

Prerequisite(s): Graduate standing.

### **APM 585 Partial Differential Equations for Engineers and Scientists (3)**

Three hours of lecture per week. Analytical solutions of parabolic, hyperbolic and elliptic partial differential equations which appear in science and engineering. Numerical and approximate methods of solution. Spring.

Prerequisites: APM 485; or equivalent course.

### **APM 585 Partial Differential Equations for Engineers and Scientists (3)**

Three hours of lecture per week. Analytical solutions of parabolic, hyperbolic and elliptic partial differential equations which appear in science and engineering. Numerical and approximate methods of solution. Spring.

Prerequisites: APM 485; or equivalent course.

### **APM 595 Probability and Statistics for Engineers (3)**

Three hours of lecture per week. This course provides a rigorous introduction to calculus-based probability and statistical theory, with applications primarily drawn from engineering and the environmental sciences. Topics include: descriptive statistics and data presentation, probability, the theory and use of discrete and continuous probability distributions, confidence intervals, classical and distributional hypothesis testing, and regression analyses. Spring.

Prerequisite(s): One year of Calculus. Note: Credit will not be granted for both APM 395 and APM 595.

### **APM 620 Experimental Design and ANOVA (3)**

Three hours of lecture per week. Designing and analyzing experiments and observational studies; completely randomized, split plot, randomized complete block, and nested experiment designs; single-factor, factorial, and repeated measures treatment designs; expected mean squares and variance components; fixed, random, and mixed effects models; multiple comparison and contrast analyses; analysis of covariance; statistical computing. Spring.

Prerequisites: Graduate status and an introductory course in statistics covering material through the one-way analysis of variance.

### **APM 625 Sampling Methods (3)**

Three hours of lecture per week. Application of probability sampling methods to environmental science and forestry. Simple random, stratified, cluster, systematic, two-phase, line-intercept, point, variable radius plot, adaptive cluster, and other variable probability sampling designs; model-assisted ratio and regression estimators; inclusion probabilities; properties of estimators for design-based inference; Horvitz-Thompson estimation as a unifying theory. Fall.

### **APM 630 Regression Analysis (3)**

Three hours of lecture per week. Topics include review of basic statistical concepts and matrix algebra, classical simple and multiple linear regression models, indicator or dummy variables in regression, residual analysis, transformation and logistic regression, weighted least squares, influence diagnostics, multicollinearity, nonlinear

regression models, linear mixed models, statistical computing using SAS and interpretation of results. Fall.

Prerequisite: APM 391 or equivalent.

**APM 635 Multivariate Statistical Methods (3)**

Three hours of lecture per week. Topics include review of basic statistical concepts and matrix algebra, multivariate normal distribution, Hotelling's T<sup>2</sup>, multivariate analysis of variances, principal component analysis, factor analysis, discrimination and classification, cluster analysis, and canonical correlation analysis, statistical computing using SAS and interpretation of results. Spring.

Prerequisites: APM 391 or equivalent.

**APM 645 Nonparametric Statistics and Categorical Data Analysis (3)**

Three hours of lecture per week. Topics include: review of basic statistics, sign and ranked sign tests, median and Wilcoxon tests, binomial tests,  $\chi^2$ -test and contingency tables (with correspondence analysis), goodness-of-fit, nonparametric correlation and association analysis, nonparametric and robust regression, generalized linear models (Logistic and Poisson regression), and re-sampling methods (bootstrapping and cross-validation), statistical computing using SAS and interpretation of results. Fall.

Prerequisite: APM 391 or equivalent.

**APM 671 Map Accuracy Assessment (1)**

One hour of lecture per week. Statistical concepts and methods for quantifying the accuracy of maps. Sampling design and analysis for assessing accuracy of categorical attributes (e.g. land cover) is emphasized, with some discussion of continuous variables. Spring, even numbered years.

**APM 696 Special Topics in Quantitative Methods (1 - 3)**

Experimental and developmental courses in areas of quantitative methods not covered in regularly scheduled courses. A course syllabus will be available to students and faculty advisors prior to registration. Fall or Spring.

**APM 730 Advanced Regression Modeling Methods (3)**

Three hours of lecture per week. Topics include: review of basic regression modeling techniques, theory of generalized linear models and techniques (e.g. Logistic, Poisson and Beta regression), quantile regression, linear and nonlinear mixed models, variogram and kriging, spatial regression models (e.g., spatial lag and spatial error models), local spatial statistics and models (geographically weighted regression), statistical computing using SAS, and interpretation of results. Spring.

Prerequisite: APM 630 or equivalent

**BPE 132 Introduction to Process Engineering I (1)**

One hour lecture per week or three-hour lab/field trip per week. Introduction to process engineering as a field of study and career path. Topics covered include engineering ethics, laboratory and process safety, resumes and interviewing, and teamwork. Fall.

Note: Credit will not be granted for both BPE 132 and PSE 132.

**BPE 133 Introduction to Process Engineering II (1)**

One hour lecture per week or three-hour workshop per week. Introduction to process engineering as a field of study and career path. Topics covered include engineering calculations, basic statistics, problem solving, basic engineering design, computer tools, ethics, and professional responsibility. The internship and co-op requirements will also be covered. Credits will not be granted for BPE 133 and PSE 133. Spring.

Prerequisite(s): none

**BPE 230 China Experience (3)**

Forty five hours (equivalent) of lecture and field studies. General survey of the history of China from ancient societies through the current time, with attention to cultural, ecological and natural resource issues focused on selected

localities of China. The locality and/or hot spots will be selected from: the invention of paper; printing technology; renewable energy; anaerobic digestion of manual / plant biomass; wastewater treatment; Great Walls; Forbidden City; Three Gorges area; Canals; Chinese gardens; Sichuan; Dujiangyan Irrigation Dam/Channels; Panda preservation; Hakka culture; Tibetan culture; plants and vegetation, etc. Analysis of the evolution of the Chinese culture. Historical and contemporary influences of China. Spring, Fall or Summer.

### **BPE 296 Special Topics in Engineering (1 - 3)**

Provides experimental, interdisciplinary, or special coursework at the freshman and sophomore levels within the field of environmental resources engineering. Subject matter and course format vary from semester to semester and section to section. Fall and Spring.

### **BPE 300 Introduction to Industrial Bioprocessing (3)**

Three hours of lecture and discussions. Industrial examples of biotechnology and bioprocessing will be reviewed. Topics include applications of biotechnology and bioprocessing to the food, water and wastewater treatment, industrial biotechnology, biopharmaceutical, biochemical and biofuel industries. Through case studies of process flow sheets for different products students will develop an understanding of unit operations typically utilized in bioprocessing manufacturing operations. Fall.

Prerequisite(s): EFB 103 and EFB 104; co-requisite(s): FCH 221 and FCH 222.

### **BPE 304 Summer Internship in Bioprocess Engineering (2)**

Students implement the theory and practice of their major by working for a company, typically during the summer preceding enrolling in the course. The internship should be a minimum of twelve weeks of full-time experience. Course expectations include a written report, an oral presentation, and a supervisor evaluation. Fall and Spring.

Prerequisite: PSE 133 or BPE 133; PSE 200 or BPE 300; PSE 370; permission of instructor.

### **BPE 305 Co-op Experience in Bioprocess Engineering (2)**

One semester full-time bioprocessing experience as an engineering intern on company-assigned projects. Typically, the student works for a semester and adjacent summer also taking BPE 304. The student must submit a comprehensive report and give a presentation to fulfill this requirement. Fall and Spring.

Prerequisite: PSE 370 or equivalent.

### **BPE 310 Colloid and Interface Science (3)**

Three hours of lecture per week. This course will cover the basic principles of colloidal and interfacial science as applied to bioprocesses. It will provide a foundation and theoretical understanding that will be applied in bioseparations, transport phenomena, biochemical/bioprocess engineering and other advanced courses in the bioprocess engineering curriculum. Fall.

Prerequisites: PSE 370, PSE 361, FCH 150, FCH 152. Note: Credit will not be granted for both BPE 310 and PSE 467.

### **BPE 335 Transport Phenomena (3)**

Three hours of lecture per week. Principles of heat and mass transfer as applied to the bioprocess industries. Topics include conduction, convective heat and mass transfer, diffusion of both steady-state and transient situations, analogies for heat and mass transfer, boundary layers, porous media transport, heat and mass transfer analyses. Discussion of specific bioprocess examples. Spring.

Prerequisites: PSE 370, PSE 371. Note: Credit will not be granted for both BPE 335 and ERE 534.

### **BPE 336 Transport Phenomena Laboratory (1)**

Three hours of laboratory per week. Introduction to report writing and laboratory safety. Experiments on fluid mechanics, heat transfer, diffusion, and convective mass transfer as applied to the bioprocess industries. Data analysis and data presentation in oral and written form are required. Spring.

Prerequisites: PSE 370 and PSE 371 or equivalents. Co-requisite: BPE 335 (or prerequisite).

### **BPE 420 Bioseparations (3)**

Three hours of lecture per week. Major unit operations used for the separation, purification and recovery of products from complex mixtures. Separation processes including sedimentation, filtration, centrifugation, membrane ultra-filtration, nanofiltration, ion exchange processes, chromatographic separations. Fall.

Prerequisite: BPE 310. Note: Credit will not be granted for both BPE 420 and BPE 620.

### **BPE 421 Bioprocess Kinetics and Systems Engineering (3)**

Three hours of lecture per week. Topics in biochemical kinetics and reaction engineering are discussed including their application to microbiological systems used for bioprocessing. Batch and continuous biochemical reactor designs. The role of agitation in gas and solids delivery and heat removal for inclusion in design decisions. Impact of engineering parameters and design decisions on operability and economics. Fall.

Prerequisite: BPE 335. Co-requisite: BPE 420. Note: Credit will not be granted for both BPE 421 and BPE 621.

### **BPE 430 Process Operations Laboratory (3)**

One and half hours of lecture and four and half hours of laboratory per week. Experiments on pressure drop and flow rate measurement in pipe flow, mixing, pump operation, heat exchange, mass transfer/absorption/distillation, filtration, adsorption/chromatography, centrifugation/sedimentation, membrane filtration, extraction, drying, etc. Data acquisition and parametric analysis. Planning and execution of laboratory experiments. Report writing and seminar presentation. Fall.

Prerequisite(s): PSE 371, BPE 335.

### **BPE 435 Unit Process Operations (3)**

Two hours of lecture and three hours of laboratory and/or recitation, discussions per week. Topics include packed towers, tray columns, fluidized bed, fluid mechanic limitations, pressure drop, mass transfer coefficient, mass transfer limits, thermodynamic limits, equilibrium stage calculations, packed tower and tray column design and performance analysis. Fall.

Prerequisite(s): BPE 335/336.

### **BPE 438 Introduction to Biorefinery Processes (3)**

Three hours of lecture and discussions per week. Topics covered include chemical and physical properties of biomass feedstocks; sustainable biomass production/utilization, chemical and biological processes of converting plant biomass to chemicals, liquid fuels, and materials. Focus on green chemistry and/or environmentally benign processes, with some discussions on political and social aspects of sustainability and renewability. Fall.

Prerequisite(s): Cell biology and BPE 335 Transport Phenomena. Note: Credit will not be granted for both BPE 438 and BPE 638.

### **BPE 440 Bioprocess and Systems Laboratory (3)**

One hour of lecture and six hours of laboratory per week. Measurement and analysis of bioprocess systems, including steady-state and dynamic modeling of systems. Investigation of various bioprocesses including fermentation, enzymatic reactions, and reactive processes involving lignocellulosic materials. Spring.

Prerequisite: BPE 420 and BPE 421.

### **BPE 481 Bioprocess Engineering Design (3)**

2.5 hours of lecture and 1.5 hours of studio per week. Design project and procedure; open-ended design options; mass/energy balances; unit operations; safety considerations; and economic analysis. Process simulation and computer-aided design for process synthesis and plant layout. Formulation and solution of original design problem(s) under realistic (e.g., socioeconomic, process, environmental, safety) constraints. Spring.

Prerequisites: PSE 480, BPE 420, BPE 421, BPE 435, or equivalents. Note: Credit will not be granted for both BPE 481 and BPE 681.

### **BPE 496 Special Topics (1 - 3)**

Lectures, readings, problems and discussions. Topics in environmental or resource engineering as announced. Fall and/or Spring.

### **BPE 498 Research Problem in Bioprocess Engineering (1 - 4)**

Independent study. The student is assigned a research problem in bioprocess engineering. The student must make a systematic survey of available literature on the assigned problem. Emphasis is on application of correct research techniques rather than on discovery of results of commercial importance. The information obtained in the literature survey, along with the data developed as a result of the investigation, is to be presented as a technical report. Fall, Spring, and Summer.

### **BPE 501 Bioprocess Microbiology (3)**

Two hours of lecture and three hours of laboratory/discussion per week. Topics include general microbiology, enzymology, enzyme kinetics, biochemistry, metabolic regulation, microbial growth and product formation (with general stoichiometry), media formulation and bioprocess design including batch, fed-batch, and continuous modes, techniques for product recovery and purification, and mammalian cell lines/culture. Microbiological growth media, batching, and the operation of bench-top bioreactors and various analytical instrumentation. Fall.

Prerequisites: Permission of instructor; basic understanding of chemistry and biology; appropriate quantitative skills.

### **BPE 503 Bioprocess Plant Design (3)**

Three hours of lecture per week. Topics covered include integration of process and support systems and equipment; concepts of facility design integrating Good Manufacturing Practice (GMP), equipment and systems cleanability, people flow, product protection, capital investment, and operating costs. This course will focus towards facility design in the bioprocess industry. Spring.

Prerequisite(s): BPE 620, BPE 621

### **BPE 510 Introduction to Polymer Coatings (3)**

Fundamental science of polymerization and film formation for a wide class of organic coatings, including acrylics, latexes, polyesters, amino resins, epoxies, alkyds, and silicon derivatives as well as the integration of appropriate binders and additives affecting coating quality. Reaction chemistries and their distinguishing characteristics for several cross-linking agents. Reaction kinetics are considered with emphasis on the influence of conditions during synthesis. Various organic coatings are compared based on desired mechanical and optical properties along with specific applications. The nature of defects and the resulting effect on product lifetime of coatings are examined. Online Academic Year and/or Summer Session.

Prerequisite(s): B.S. from an accredited institution with at least one semester of organic chemistry or permission of instructor.

### **BPE 511 Radiation Curing Equipment, Instrumentation and Safety (3)**

Technologies used for commercial radiation curing for energy-efficient and environmentally-responsible curing of resins, inks, coatings and adhesives pertinent to industry chemists, engineers, technicians, and managers. Ultra violet light (UV), electron beam (EB), radio frequency (RF) and Infrared (IR) generating systems, along with ancillary equipment used to quantify energy deposition. Basic equipment functions, interaction of radiation sources with specific substrates and chemistries, benefits and drawbacks of each technology, and safety and handling considerations. Emphasis is placed on effectively selecting and justifying equipment appropriate for specific applications. Online Academic Year and/or Summer Session.

Prerequisite(s): B.S. from an accredited institution with at least one semester of organic chemistry or permission of instructor.

### **BPE 535 Transport Phenomena (3)**

Three hours of lecture per week. Principles of heat and mass transfer as applied to the bioprocess industries. Topics include conduction, convective heat and mass transfer, diffusion of both steady-state and transient situations,

analogies for heat and mass transfer, boundary layers, porous media transport, heat and mass transfer analysis.

Discussion of specific bioprocess examples. Spring.

Note: Credit will not be granted for both BPE 335 and BPE 535.

### **BPE 536 Radiation Curing of Polymer Technologies (3)**

Broad treatment of development and use of radiation curing of polymer technologies as they apply to industry-related roles such as chemists, engineers, technicians, and managers. Properties and development of free-radical and cationic systems initiated by various radiation sources. Chemical and physical underpinnings of common radiation curable materials and mechanisms. Analysis techniques that monitor the cure reaction and the properties of cured material. Emphasis on the considerations and challenges in common applications of radiation curable polymer systems and associated costs, regulatory, and safety considerations. Online Academic Year and/or Summer Session. Prerequisite(s): B.S. from an accredited institution with at least one semester of organic chemistry or permission of instructor.

### **BPE 596 Special Topics (1 - 3)**

Lectures, conferences, discussions and laboratory. Topics in environmental resources engineering not covered in established courses. Designed for the beginning graduate student or selected upper-division undergraduate. Fall and/or Spring.

### **BPE 620 Bioseparations (3)**

Three hours of lecture per week. Cell disruption, solid liquid separations, centrifugation, chromatographic techniques (gel filtration, affinity, ion exchange), and membrane processes. Extraction. Crystallization and drying. Aseptic filtration. Fall. Prerequisite: BPE 501. Note: Credit will not be granted for both BPE 620 and BPE 420.

### **BPE 621 Bioreaction Engineering (3)**

Three hours of lecture/discussion per week. Bioprocess kinetics, reaction engineering, mass and energy balances, stoichiometry, enzyme kinetics, growth and product synthesis kinetics, mass transfer effects, bioreactor analysis and design, instrumentation and control, batch processing, bioreactor scale-up, agitation, oxygen delivery, heat removal and kinetics of sterilization (clean and sterilization in place (CIP and SIP)). Spring.

Prerequisites: Mass and Heat Transfer, or Transport Phenomena. Note: Credit will not be granted for both BPE 621 and PBE 421.

### **BPE 623 Chemistry of Lignocellulosic Biomass (3)**

Three hours of lecture and discussion per week; advanced science course with discussion and literature research through the topics in chemistry of lignocellulosic biomass, including wood, grasses, and agriculture residues; major (cellulose, hemicelluloses, lignin) and minor constituents (extractives) –biosynthesis, structure, properties, physico-chemical association, use in biorefineries. Spring

Prerequisite: Organic Chemistry I Lecture and Lab plus either Organic Chemistry II Lecture and Lab or PSE223 Lecture and Lab or equivalent or by instructor's permission

### **BPE 635 Unit Process Operations (3)**

Two hours of lecture and three hours of laboratory and/or recitation, discussions. Topics include packed towers, tray columns, fluidized bed, fluid mechanic limitations, pressure drop, mass transfer coefficient, mass transfer limits, thermodynamic limits, equilibrium stage calculations, packed tower and tray column design and performance analysis. Fall.

### **BPE 638 Introduction to Biorefinery Processes (3)**

Three hours of lecture and discussions per week. Topics covered include chemical and physical properties of biomass feedstocks; sustainable biomass production/utilization, chemical and biological processes of converting plant biomass to chemicals, liquid fuels, and materials. Focus on green chemistry and/or environmentally benign

processes, with some discussions on political and social aspects of sustainability and renewability. Fall.  
Note: Credit will not be granted for both BPE 438 and BPE 638.

### **BPE 640 Bioprocess Kinetics Experiments and Data Analysis (3)**

One hour of lecture and six hours of laboratory per week. Planning and execution of laboratory exercises. Measurement and analysis of adsorption, chemical and biological transformations, including batch and/or continuous systems. Adsorption and chemical transformation or catalytic reactions may include solid catalyst(s), acid catalyst(s), base catalysts(s) or other agents. Biological transformation may include enzyme, bacteria, fungi or yeast. Bioprocess kinetics and mass transfer effects. Coaching fellow students on experimental procedures and safety requirements. Parametric analysis. Report writing and seminar presentation. Spring.  
Prerequisite(s): Consent of instructor Note: Credit will not be granted for both BPE 440 and BPE 640.

### **BPE 650 Advanced Catalysis and Surface Reactions (3)**

Three hours of lecture per week. Intended for graduate students in Bioprocess Engineering and Chemical Engineering. Topics covered in this course may include gas and/or liquid interactions with solid surfaces, adsorption, catalysis on solid surfaces, and kinetics in systems involving solid particles and/or macromolecules. Discussions will be on an advanced level especially for kinetics and reactor analysis. Spring.  
Pre-requisites: BPE 421, or permission of instructor

### **BPE 658 Advanced Biocatalysis (3)**

Three hours of lecture per week. This course is intended for graduate students in Bioprocess Engineering. Topics covered in this course may include enzyme, microbial and/or mammalian cell catalyzed molecular transformations. Biotransformations occur, at the fundamental level, due to the particular enzymes. Interactions between enzyme and ligand / substrate hold the key on how the reaction is regulated. On the cell level, enzymes work in tandem to convert one or more key substrate into one or more desired product. The mechanism and progress in the understanding of molecular transformations in microbial and mammalian systems are selectively covered. Discussions will be on an advanced level especially for kinetics and reactor analysis. Fall.  
Prerequisite: BPE 421 Bioprocess Kinetics and System Engineering, or permission of instructor.

### **BPE 681 Bioprocess Plant Design (3)**

Three hours of lecture per week. Topics covered include integration of process and support systems and equipment; concepts of facility design integrating Good Manufacturing Practice (GMP), equipment and systems cleanability, people flow, product protection, capital investment, and operating costs. This course will focus towards facility design in the biopharmaceutical industry. Spring.  
Prerequisites: BPE 620, BPE 621 or equivalents.

### **BPE 796 Advanced Topics (1 - 3)**

Lectures, conferences, discussions and laboratory. Advanced topics in forest engineering, paper science and engineering, and wood products engineering. Fall and/or Spring.  
Prerequisite: Permission of instructor.

### **BPE 797 Seminar (1 - 3)**

Discussion of assigned topics in the fields related to Bioprocess Engineering. Spring and Fall.

### **BPE 798 Research in Bioprocess Engineering (1 - 12)**

Independent research topics in Bioprocess Engineering. Fall, Spring or Summer.  
Credit hours to be arranged.

### **BPE 898 Professional Experience/Synthesis (1 - 6)**

A supervised, documented professional work experience in the Master of Professional Studies degree program. Fall, Spring, or Summer.

Pre- or co-requisite(s): Approval of proposed study plan by advisor, Faculty, and any sponsoring organization.

**BPE 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's thesis. Fall, Spring or Summer.

Credit hours to be arranged.

**BPE 999 Doctoral Thesis Research (1 - 12)**

Research and independent study for the doctoral dissertation. Fall, Spring or Summer.

Credit hours to be arranged.

**BTC 132 Orientation Seminar (1)**

One hour of lecture or discussion per week. Occasional tour of laboratories or field trips. Introduction to campus facilities, personnel, lower-division curriculum, and upper-division study options to facilitate transition of students into the program and assist them in making informed decisions on course selection and future career directions. Fall.

**BTC 298 Research Apprenticeship in Biotechnology (1 - 3)**

Full- or part-time engagement as volunteer or employee on research project having a biotechnology focus consistent with the student's educational and professional goals. Tenure at SUNY-ESF or outside institution. Faculty member in the BTC program will serve as student's sponsor. Study plan outlining the apprenticeship's educational goals completed prior to its commencement. Record of activities and performance assessment by faculty sponsor generated after apprenticeship termination. Grading satisfactory/ Unsatisfactory. Fall, Spring, Summer.

Prerequisite(s): Permission of Instructor.

**BTC 401 Molecular Biology Techniques (4)**

Two hours lecture and six hours laboratory per week. Theories behind techniques in molecular biology are introduced in lecture. Laboratory includes the extraction and quantification of genomic and plasmid DNA, agarose gel electrophoresis, restriction digestion, ligation, bacterial transformation, DNA sequencing and PCR. Additional topics in molecular biology are presented by the students. Fall.

Prerequisite(s): EFB 307, 308, 325, or equivalents. Note: Credit will not be granted for both BTC 401 and EFB 601.

**BTC 420 Internship in Biotechnology (1 - 5)**

Full- or part-time employment or volunteer work with an agency, institution, clinic, professional group, business, or individual involved in activities consistent with the student's educational and professional goals. The extent of the internship activities shall be commensurate with the credits undertaken. A resident faculty member must serve as the student's academic sponsor. A study plan outlining the internship's educational goals must be completed prior to its commencement. Grading will be based on a written report from the student and submitted to the sponsoring faculty member and on an evaluation of the student's performance written by the site supervisor to the sponsoring faculty member. Fall, Spring, Summer.

Prerequisite: Consent of a faculty sponsor.

**BTC 425 Plant Biotechnology (3)**

Two hours of lecture and three hours of laboratory per week. The use of transgenic plants to improve the human condition and remediate environmental problems is a rapidly growing field of study. Students are taught the principles of gene structure and regulation, gene cloning, transformation of plant species, and current applications. Format includes lectures, discussions, student presentations, and a laboratory project. Spring.

Note: Credit will not be granted for both BTC 425 and EFB 625.

**BTC 426 Plant Tissue Culture Methods (3)**

Two hours of lecture and discussion and three hours of laboratory per week. Introduction to plant tissue culture for biotechnology research and as a propagation method. Emphasis will be on learning laboratory instrumentation and techniques for establishing cell cultures, producing transgenic cell lines, and regenerating whole plants. Fall.

Prerequisites: One course in botany, microbiology, or genetics; or permission of instructor. Note: Credit will not be granted for BTC 426 and FOR 626/EFB 626.

### **BTC 496 Topics in Biotechnology (1 - 3)**

Experimental, interdisciplinary, or special topic coursework in biotechnology for undergraduate students. Subject matter and method of presentation varies from semester to semester. May be repeated for additional credit if topic changes. Fall or Spring.

### **BTC 497 Research Design and Professional Development (1)**

One hour of discussion or seminar each week covering the scientific method, professional ethics and responsibilities of the practicing scientist. Employment opportunities, future career choices, safety considerations, and use of the scientific literature are covered. Students will select a research topic and prepare a proposal, which may be applied to BTC 498 or BTC 420. Spring.

Pre- or co-requisite: Biotechnology major or permission of instructor.

### **BTC 498 Research Problems in Biotechnology (1 - 9)**

Laboratory research experience with research time agreed upon by student and instructor. Independent research experience covering biotechnological topics. Specific topics determined through consultation between student and appropriate faculty member. Tutorial conferences, discussions, and critiques scheduled as necessary. Grading determined by the instructor and could include, but not required, evaluation of skills learned, data obtained, and laboratory notebook record keeping. A final written report is required. Fall or Spring.

Prerequisite: Permission of instructor.

### **BTC 499 Senior Project Synthesis (1)**

One hour of discussion or seminar each week. Students will learn to synthesize results gained from their own independent research and present those data in a scientific poster at a research symposium. Topics of professional preparation will also be discussed. Spring.

### **CLL 496 (1 - 3)**

Special topics of current interest to undergraduate students in composition, literature and library. A detailed course description will be presented as the topics area is identified and developed. Fall and Spring.

### **CME 132 Orientation Seminar: Sustainable Construction Management and Engineering (1)**

One hour of lecture and discussion per week. Introduction to campus resources available to ensure academic success in the area of Sustainable Construction Management and Engineering. Fall.

### **CME 151 Introduction to Financial Accounting (3)**

Three hours of lecture/discussion per week. Financial accounting concepts that aid entrepreneurs, managers, investors, and creditors in planning, operating, and analyzing a business. Emphasis is on interpretation of financial statements. Fall.

Prerequisite(s): none.

### **CME 202 Introduction to Professional Communications (1)**

Three hours of lab per week. Introduction to intermediate-level use and understanding of software for word processing, spreadsheet analysis, and database management. Focused on developing the ability to prepare reports including preparation of documents, data analysis, and written presentations. Fall.

Pre- or co-requisite(s): none.

### **CME 215 Sustainable Construction (3)**

Three hours of lecture/discussion per week. Overview of sustainable design and construction concepts and practices. The emergence of green building, issues, and rating systems. Sources of chemicals in buildings, indoor air quality, and human comfort. Basic energy principles and energy-efficient technologies. Selection of materials. Role of the

contractor in the management and construction of green projects. Spring.

**CME 226 Statics and Mechanics of Materials (4)**

Four hours of lecture/discussion per week. Equilibrium systems of forces in two and three dimensions. Analysis of structural components for stresses and deformations. Stability and design of beams and columns made of common engineering materials. Design methods and safety considerations. Spring and Fall.

Prerequisite: Calculus I, Physics I.

**CME 252 Introduction to Managerial Accounting (3)**

Three hours of lecture/discussion per week. Introduction to the role of accounting information systems in measuring performance, influencing employee behavior, and facilitating planning decisions such as what products and services to offer, in which markets, and at what prices. Spring

Prerequisite(s): CME 151.

**CME 255 Plan Interpretation and Quantity Takeoff (3)**

Three hours of lecture/discussion per week. Introductory course in construction plan interpretation and quantity takeoff. Will address how to read and interpret construction plans and introduce basic quantity takeoff skills. Fall.

**CME 303 Sustainable Construction Management and Engineering Internship (1 - 3)**

Full or part-time employment with an organization that involves the student in an educational experience in a professional establishment. A resident faculty member must serve as the student's academic sponsor. A study plan that describes the internship's educational goals must be submitted prior to its commencement. Fall and Spring.

Prerequisite: Upper-division status.

**CME 304 Environmental Performance Measures for Buildings (3)**

An overview of how building rating systems for green construction have developed, their present application, and future directions for growth. The course will explore the process for development of individual standards, the different building certification systems that have been developed using these standards, and long-term development and code adoption of such certification systems.

**CME 305 Sustainable Energy Systems for Buildings (3)**

Three hours of lecture/discussion per week. Exploration of construction management-related issues in creating a more sustainable energy use in our building stock. Integrating sustainable energy sources in construction as well as issues related to using energy more efficiently. Fall.

**CME 306 Engineering Materials for Sustainable Construction (3)**

Two hours of lecture/discussion per week and one lab per week. Introduction to the principal structural materials used for building construction and their engineering properties and environmental impacts. The production and performance of these materials will be explored through class discussion and laboratory experiments. The application of each of the materials during sustainable construction processes will be emphasized. Spring.

**CME 322 Mechanical Processing (3)**

Two hours of lecture and three hours of laboratory per week. Primary log reduction methods and industry practices. Lumber grading. Wood cutting principles. Machining practice in secondary wood-using industries. Experience in the operation of certain primary and secondary machining equipment. Fall.

**CME 326 Fluid Treatment of Wood (3)**

Two hours of lecture, three hours of laboratory per week. Basic wood-moisture relationships, wood shrinkage and swelling, permeability, thermal conductivity, wood drying and preservation treatments, and fire retardancy. Flow of fluids, heat and water vapor are treated as analogous phenomena related to the cellular structure of wood. Laboratory studies in relative humidity measurement, wood-moisture relations, relationships between wood permeability and drying and treatability, industrial wood drying, dry kiln operation and preservation treatments, and fire retardancy.

Spring.

Prerequisite: CME 387 or permission of instructor. Note: Credit will not be granted for both CME 326 and CME 682.

### **CME 327 Site Investigations and Solutions (3)**

Three hours of lecture/discussion per week. Principles of geotechnical engineering, site investigation methods, methods for improving sites, and the role of geotechnical engineering in construction contracts. Fall.

Prerequisite(s): none

### **CME 330 Building Code of New York State (3)**

Three hours of lecture/discussion per week. Introduction to the Building Code that legally governs the design and construction of all building types within New York State. The course includes a basic understanding of the Code including history and origin, legal enforcement, basic definitions, and terminologies. Fall.

### **CME 331 Construction Safety (3)**

Occupational Safety and Health Practices in the construction industry with coverage of the U. S. Department of Labor, Occupational Safety and Health Regulations (CFR 1910 and 1926 Standards). Detailed study of Construction Safety and Hazardous Communications programs, personal protective equipment, tools, electrical power, ladders, and scaffolding, floor and wall openings, cranes and power equipment. Special problems related to concrete work, erection and demolition. OSHA 30 Hr. card earned. Fall.

Note: Credit will not be granted for both CME 331 and CME 531.

### **CME 332 Mechanical and Electrical Equipment (3)**

Three hours of lecture per week. The course introduces the basic concepts of mechanical systems design and construction for residential and commercial buildings. Simplified design and construction estimates are performed for heating, cooling, plumbing, sanitation, electrical, and lighting systems. Relevant code requirements are stressed. Fall.

### **CME 335 Cost Engineering (3)**

Three hours of lecture/discussion per week. Statistics, cost of money, rates of return, cash flow, budget development, cost tracking, productivity and progress, constructability and value engineering, change control and risk analysis. Fall.

Prerequisite: Upper division standing or permission of instructor. Note: Credit will not be granted for both CME 335 and CME 535.

### **CME 342 Light Construction (3)**

Three hours of lecture per week. An introduction to the construction process with an emphasis on the unique aspects of light construction. Introduces construction management principles related to material properties, building science, structural design, estimating, and scheduling. Fall.

### **CME 343 Construction Estimating (3)**

Three hours of lecture/discussion per week. Basic estimating/bidding theory and process. The processes for reviewing and interpreting contracts, specifications and blueprints and their role in the estimating/bidding process. How to perform a quantity takeoff, be able to create a final estimate/bid including the appropriate General Conditions and Markups. Several projects based upon the concepts are assigned on the material listed above as well as utilizing either a spreadsheet or Timberline Precision Computer Estimating. Spring.

Prerequisite(s): CME 255 Plan Interpretation and QTO or permission of instructor. Note: Credit will not be granted for both CME 343 and CME 543.

### **CME 350 Construction Methods and Equipment (3)**

Three hours of lecture/discussion per week. The study of production, methods of operation and costs of heavy construction equipment. Analysis of heavy construction operations. Economics of equipment use. The fundamentals of decision making involved in the selection of methods and equipment that will result in the most effective and efficient performance on a project. Spring.

Note: Credit will not be granted for both CME 350 and CME 525.

**CME 376 Decay of Wood Products (3)**

Three hours of lecture/laboratory/demonstration per week. Degradation of wood by fungi and other biological agents. Emphasis on the effects of decay on wood properties, methods of decay detection in wood products and decay prevention. Spring.

Prerequisite(s): CME 386 or CME 387.

**CME 387 Renewable Materials for Sustainable Construction (3)**

Three hours of discussion, lecture and demonstration per week. Properties and uses of major structural construction materials. Identification and knowledge of the major wood species and their applications in construction. Fall.

**CME 388 Wood and Fiber Identification Laboratory (2)**

Six hours of laboratory per week. Wood and papermaking fiber identification using both gross and microscopic features. Fall.

Prerequisite: CME 387 to be taken concurrently or previously.

**CME 389 Wood Identification Laboratory (1)**

Three hours of laboratory per week. Identification of principal commercial timbers of United States on gross characteristics. Spring.

Prerequisite: CME 387.

**CME 390 Fiber Identification Laboratory (1)**

Three hours of laboratory per week. Identification of woody and nonwoody papermaking fibers. Spring.

Prerequisite: CME 387.

**CME 400 Introduction to Forest Products (3)**

Three hours of lecture per week. Characteristics of the products of the forest tree and manufacture of wood products. Spring.

**CME 404 Applied Structures (3)**

Three hours of lecture/discussion/demonstration per week. Applications of statics/mechanics to common engineering structures. Analysis and design of wood, concrete and steel systems considering sustainability and life-cycle analysis. Spring.

Prerequisite(s): CME 226, Statics and Mechanics of Materials.

**CME 405 Building Information Modeling for Construction Management (3)**

Three hours of lecture per week. An introduction to the basic concepts of building information modeling as a construction approach, and an exploration of its application to construction management. Emphasis on the use of building information modeling for estimation, scheduling, clash detection, and project communication. Spring.

Prerequisite(s): CME 255 Plan Interpretation and Quantity Takeoff. Co-requisite: CME 343 Construction Estimating.

**CME 410 Computer-Aided Design and Drafting (3)**

One-half hour lecture, two-and-one-half hours lab, and a minimum of six hours additional lab is required. This course introduces the student to the fundamentals of computer-aided design and drafting. It covers the commands needed to create a two-dimensional drawing, with particular emphasis on techniques used in the design profession applications. The requirements for the course include completing self-tutorials, creating drawings, and the completion of two major projects. Spring.

Note: Credit will not be granted for both CME 410 and CME 610.

**CME 422 Composite Materials for Sustainable Construction (3)**

Two hours of lecture, three hours of laboratory per week. Properties, manufacture and design of multiphase materials. Applications and testing for service in sustainable construction systems and life-cycle analysis. Spring.

Prerequisite(s): CME 226, Statics and Mechanics of Materials and CME 387, Renewable Materials for Sustainable Construction.

### **CME 444 Materials Marketing (3)**

Three hours of lecture and discussion per week. Fundamentals of marketing forest products, building and construction industry materials, including products, markets, distribution, segmentation, pricing, promotion and sales. Specific focus is on the unique nature and issues of forest products and building materials; vertical and horizontal integration, distribution channels, market segmentation and product positioning strategies. Fall.

Prerequisite: FOR 207 Introduction to Economics or equivalent.

### **CME 453 Construction Planning and Scheduling (3)**

Three hours of lecture per week. The use of common types of schedules: Gantt, Activity on Node, Precedence Diagram, PERT and Linear. Identification of activities and performance duration analyses of these activities. Updating of schedules, resource planning and assignment, cost planning and scheduling are all covered. Schedule development is performed both manually and with industry-accepted software. Fall.

Prerequisite(s): CME 343 or permission of instructor. Note: Credit will not be granted for both CME 453 and CME 653.

### **CME 454 Construction Project Management (3)**

Three hours of lecture/discussion and three hours of laboratory per week. How to define and properly identify company organizational structures and project delivery systems. Integration of estimating, bidding, scheduling and cost control into the management process. Safety, quality control, value engineering, procurement, labor relations and insurance and bonding requirements as integral parts of a construction project. Projects based upon Expedition project management software. Spring.

Prerequisites: CME 343, CME 453, senior standing or permission of instructor. Note: Credit will not be granted for both CME 454 and CME 654.

### **CME 455 Construction Contracts and Specifications (3)**

Three hours of lecture/discussion per week. The types of contracts used in the construction industry. Analysis of the contractor, designer and owner duties and obligations as determined by the construction contract documents. Study of concepts, language, formats and procedures for project manual organization practice and the general conditions of the contract for construction. Spring.

Prerequisite(s): Upper division standing or permission of instructor. Note: Credit will not be granted for both CME 455 and CME 658.

### **CME 487 Wood Chemistry and Physics (3)**

Two hours of lecture and three hours of laboratory per week. Wood chemistry and physical properties described in relation to the practical function of wood products. The methodologies used to explore these relationships; including microscopy, mechanical testing, and chemical analysis and their interpretation. Fall.

Prerequisite: CME 387.

### **CME 488 Professional Construction Project Management Presentation Seminar (2)**

Two hours of lecture/seminar/preparation per week. A preparatory course for participation in a professional construction management proposal process including proposal development and professional presentation of the proposal. The course culminates in participation at a regional construction management competition sponsored by the Associated Schools of Construction Region 1. Fall.

Prerequisites: Junior or Senior standing and permission of the instructor.

### **CME 495 Undergraduate Experience in College Teaching (1 - 3)**

Undergraduate students gain experience as teaching assistants. They assist the instructor with the teaching and learning experience, assist students with learning course concepts, and mentor students on how to succeed in an undergraduate course. Responsibilities vary by section and instructor. Fall and Spring.

Prerequisites: Permission of instructor. The student must have previously completed, with grade of B or better, the course in which they will assist.

### **CME 497 Senior Ethics Seminar (1)**

One hour of lecture/discussion per week. Student papers/ presentations are directed toward professional issues in ethics and career preparation, Fall.

Prerequisite(s): Senior status in SCME.

### **CME 498 Research or Design Problem (1 - 3)**

Conferences, library, laboratory and/or field research on a specific problem in wood products engineering. Written report required. Fall, Spring and Summer.

Prerequisite: Permission of instructor and advisor.

### **CME 504 Environmental Performance Measures for Building (3)**

Three hours of lecture per week. Environmental Performance Measures for Buildings - Three hours of lecture/discussion per week. Overview of building rating systems for green construction, their development, present application, and future directions for growth. Explores the process for development of individual standards, different building certification systems that have been developed using these standards, and long-term development and code adoption of such certification systems. An experiment-based, analytical, or evaluative project is required. Fall

Prerequisite(s): Graduate standing, or upper-division standing with approval of instructor. Note: Credit will not be given for both CME 304 and CME 504.

### **CME 505 Sustainable Energy Systems for Buildings (3)**

Three hours of lecture/discussion per week. Exploration of construction management-related issues in creating a more sustainable energy use in our building stock. Integrating sustainable energy sources in construction as well as issues related to using energy more efficiently. An experiment-based, analytical, or evaluative project is required. Fall

Prerequisite(s): Graduate standing, or upper-division standing with approval of instructor. Note: Credit will not be given for both CME 305 and CME 505.

### **CME 525 Construction Methods and Equipment (3)**

Three hours of lecture/discussion per week. Analysis of heavy construction operations and related environmental concerns. Production calculations, means and methods selection and operating costs of heavy construction equipment are addressed. The economics of equipment use are analyzed. The use of a digitizer in earthwork quantity takeoff is explored. The outcome of the course is to select the most cost efficient and performance efficient method and equipment. A term paper is required. Spring.

Note: Credit will not be granted for both CME 525 and CME 350.

### **CME 531 Construction Safety (3)**

Three hours of lecture per week. Occupational Safety and Health practices in the construction industry. An overview of the US Department of Labor, Occupational Safety and Health Regulations, 29 CFR 1910 and 29 CFR 1926.

Comprehensive review of: general safety and health requirements, hazard communication, confined space entry, lockout/tagout programs, workplace violence, personal protective equipment, fire protection, signs and barricades, rigging, small tools – hand and power, welding and cutting, electrical, fall protection, scaffolding, cranes, mobile equipment, excavation and trenching, steel erection, stairways and ladders and permissible exposure limits. A term paper is required. Fall.

Note: Credit will not be granted for both CME 531 and CME 331.

### **CME 532 Mechanical and Electrical Equipment (3)**

Three hours of lecture per week. The course introduces the basic concepts of mechanical systems design and construction for residential and commercial buildings. Simplified design and construction estimates are performed for heating, cooling, plumbing, sanitation, electrical, and lighting systems. Relevant code requirements are stressed. An

experiment-based project is required. Fall.

Note: Credit will not be given for both CME 332 and CME 532.

### **CME 535 Cost Engineering (3)**

Three hours of lecture/discussion per week. Statistics, cost of money, rates of return, cash flow, budget development, cost tracking, productivity and progress, constructability and value engineering, change control and risk analysis.

Prerequisite: Upper division standing or permission of instructor. Note: Credit will not be granted for both CME 535 and CME 335.

### **CME 543 Construction Estimating (3)**

Three hours of lecture/discussion per week. Definition and explanation of estimating/bidding theory and process. The processes for reviewing and interpreting contracts, specifications and blueprints as well as their role in the estimating/bidding process. Perform a quantity takeoff. Create a final estimate/bid, including the appropriate General Conditions and Markups. Several projects based on the concepts listed above as well as utilizing either a spreadsheet or Timberline Precision Estimating. A term paper describing how the relevant topics of the course fit a specific industry application, and production of an additional project based on Timberline Precision estimating software or equivalent are required. Spring.

Prerequisites: CME 255 Plan Interpretation and QTO or basic estimating experience and permission of the instructor.

Note: Credit will not be granted for both CME 543 and CME 343.

### **CME 565 Sustainable Innovations in Residential Construction (3)**

Three hours of lecture per week. Principles of sustainable residential construction; the adaptation of biological, ecological, and cultural elements into building performance standards, practical building specifications, standards and systems. Spring.

### **CME 587 Renewable Materials for Sustainable Construction (3)**

Three hours of discussion, lecture and demonstration per week. Properties and uses of wood and other renewable materials as a major construction materials. Identification and knowledge of the major wood species and their applications in construction. Evaluation of current practices and materials. Fall.

### **CME 605 Building Information Modeling for Construction Management (3)**

Three hours of lecture/discussion per week. Introduction to the basic concepts of building information modeling as a construction approach, and exploration of its application to construction management. Emphasis on building information modeling for estimating, scheduling, clash detection, and project communication. An experiment-based, analytical, or evaluative project is required. Spring.

Prerequisite(s): Graduate standing Co-requisite: CME 543 Note: Credit will not be given for both CME 405 and CME 605.

### **CME 610 Computer-Aided Design and Drafting (3)**

One-half hour lecture, two-and-one-half hours lab, and a minimum of six hours additional lab is required. This course introduces the student to the fundamentals of computer-aided design and drafting. It covers the commands needed to create a two-dimensional drawing, with particular emphasis on techniques used in the design profession applications. The requirements for the course include completing self-tutorials, creating drawings, and the completion of two major projects at an advanced level. Spring.

Note: Credit will not be granted for both CME 410 and CME 610.

### **CME 622 Composite Materials for Sustainable Construction (3)**

Two hours of lecture, three hours of laboratory per week. Properties, manufacture and design of multiphase materials. Applications and testing for service in sustainable construction systems and life-cycle analysis. Evaluation of current practices and materials. Spring.

Prerequisite(s): CME 226, Statics and Mechanics of Materials, and CME 387 or CME 587, Renewable Materials for

**CME 643 Estimating for Construction in a Green Global Economy (3)**

Three hours of lecture per week. Building upon the estimating skills developed through undergraduate coursework and professional experience this course will look at how to address global estimating concerns such as monetary value between various currencies, how the purchase of commodities futures affects material pricing, the linkages between financial, real estate development and policies and their effects on the construction markets. How to price multi-year projects addressing the previous issues and how to construct an estimate that will convey the information relative to green construction costs to the client in a proper manner will also be addressed. Fall or Spring.

Prerequisites: CME 543 or equivalent or 3 to 5 years of professional estimating experience and permission of instructor.

**CME 653 Construction Planning and Scheduling (3)**

Three hours of lecture/discussion per week. The use of Gantt, Activity on Node, Precedence Diagram, PERT and Linear schedules. Identification of activities and duration analyses of these activities. Update schedules, plan and assign resources, plan cost and schedule. Schedule development is performed both manually and with industry accepted software. A term paper describing how the relevant topics of the course fit a specific industry application and an additional project utilizing the software are required. Fall.

Prerequisites: Estimating experience and/or equivalent scheduling experience. Note: Credit will not be granted for both CME 653 and CME 453.

**CME 654 Construction Project Management (3)**

Three hours of lecture/discussion per week. How to define and properly identify company organizational structures. Project delivery systems, integration of estimating, bidding, scheduling and cost control into the management process. How safety, quality control, value engineering, procurement, labor relations and insurance and bonding requirements are integral parts of a construction project. A term paper describing how the relevant topics of the course fit a specific industry application is required. Spring.

Prerequisite(s): CME 543, CME 653, or equivalent experience and permission of the instructor. Note: Credit will not be granted for both CME 654 and CME 454.

**CME 658 Construction Contracts and Specifications (3)**

Three hours of lecture/discussion per week. The types of construction contracts used in the construction industry from the Owner, Contractor, Subcontractor and Supplier viewpoints. Types of required insurance and the remedies available to contractors are presented. The process of bidding and negotiating from the legal perspective is covered along with contract administration. Specifications are introduced by type and the requirements of each type are discussed, based on current industry-accepted standards. A term paper describing how the relevant topics of the course fit a specific industry application is required. Spring.

Prerequisite: Upper division standing or permission of instructor. Note: Credit will not be granted for both CME 658 and CME 455.

**CME 663 Managing a Construction Project through Construction Planning and Scheduling (3)**

Three hours of lecture per week. Building upon planning and scheduling skills developed through undergraduate coursework and professional experience this course will examine the use of project schedules as the means to manage construction projects. The relationships between project progress, labor, materials, equipment and the project timeline will be explored. The use of the project schedule as a revenue projection, revenue measuring device will be discussed. How the schedule is used to deal with major project changes such as scope reductions, natural disaster impacts and major site accidents will also be covered. Earned value will be discussed and how the schedule can assist in its determination. Fall or Spring.

Prerequisites: CME 653 or equivalent or 3 to 5 years of professional estimating experience and permission of instructor.

**CME 664 Urban Project Management (3)**

Three hours of lecture per week. Building upon project management skills developed through undergraduate coursework and professional experience this course will look at the unique challenges of construction projects in urban settings. Topics to be addressed include but are not limited to: site logistics and their importance to a successful project, the influence of permits and codes on the project, the growing use of technology to solve urban project problems, the issues related to labor, subcontractors and suppliers in this high intensity setting. The importance of communication and project documentation will be addressed as well. Fall or Spring.

Prerequisites: CME 654 or equivalent professional experience and permission of instructor.

**CME 686 Wood-Water Relationships (3)**

Two hours of lecture and three hours of laboratory per week. Relationship between wood moisture content and the environment, electrical and thermal properties, theories of moisture sorption, hygroscopic swelling and shrinking, thermodynamics of moisture sorption, mechanism of moisture movement as it relates to activation theory. Laboratory exercises will complement the theoretical topics discussed in the lecture. Fall.

Prerequisite: Permission of instructor.

**CME 770 Biodegradation of Wood (3)**

Two hours of lecture and 1 hour of laboratory/demonstration/discussion per week. Biology of lignicolous fungi and other microorganisms concerning their effects on wood properties. Anatomical, biological and chemical aspects of the major types of wood decay. Spring.

Prerequisite: Introductory biology and permission of instructor.

**CME 797 Seminar (1 - 3)**

Discussion of assigned topics in the fields related to Sustainable Construction Management and Wood Science. Spring and Fall.

**CME 798 RESEARCH IN SUSTAINABLE CONSTRUCTION MANAGEMENT AND WOOD SCIENCE (1 - 12)**

Independent research topics in Sustainable Construction Management and Wood Science. Fall, Spring or Summer. Credit hours to be arranged.

**CME 898 Professional Experience/Synthesis (1 - 6)**

A supervised, documented professional work experience in the Master of Professional Studies degree program. Fall, Spring, or Summer.

Pre- or co-requisite(s): Approval of proposed study plan by advisor, Faculty, and any sponsoring organization.

**CME 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's thesis. Fall, Spring or Summer.

Credit hours to be arranged.

**CME 999 Doctoral Thesis Research (1 - 12)**

Research and independent study for the doctoral dissertation. Fall, Spring or Summer.

Credit hours to be arranged.

**EFB 101 General Biology I: Organismal Biology and Ecology (3)**

Three hours of lecture per week. Introductory exploration of biological principles at ecosystem, population, and organismal levels. Emphasis on form, function, diversity, ecology and evolution of living organisms. Fall.

Co-requisite: EFB 102.

**EFB 102 General Biology I Laboratory (1)**

Three hours of laboratory per week. Major concepts of organismal biology and ecology will be reinforced with hands-on laboratory exercises and required field trips exploring the form, function, diversity, ecology, and evolution of living organisms. Fall.

Co-requisite: EFB 101.

### **EFB 103 General Biology II: Cell Biology and Genetics (3)**

Three hours of lecture per week. Organization and function of living cells. Key topics include biological molecules, organelle structure and function, gene expression, cell division, metabolism, photosynthesis, cell signaling, genomics, and population genetics. Spring.

Co-requisite: EFB 104.

### **EFB 104 General Biology II Laboratory (1)**

Three hours of laboratory per week. Major concepts of cell biology and genetics will be reinforced with hands-on laboratory exercises using analytical and experimental techniques such as light microscopy, chromatography, electrophoresis, enzyme assays, aseptic culture techniques, and transformation of bacterial cells. Spring.

Co-requisite: EFB 103.

### **EFB 120 The Global Environment and the Evolution of Human Society (3)**

Three hours of lecture per week. An integrated overview of large-scale environmental issues and their relation to the development of human societies and resource-use strategies over time. Focus is on population growth and societal pressures on physical and biotic resources. Topics include energy-use issues, causes and socio-economic implications of climate change, pollution, and loss of biodiversity. Fall and Spring.

### **EFB 132 Orientation Seminar: Environmental and Forest Biology (1)**

One hour of lecture, discussion and/or exercises per week. Introduction to campus resources available to ensure academic success. Introduction to EFB as a field of inquiry. Fall.

### **EFB 200 Physics of Life (3)**

Three hours of lecture and discussion per week. Introduction to basic principles of physics from a perspective of biological function, structure and adaptation. Fall.

### **EFB 202 Ecological Monitoring and Biodiversity Assessment (3)**

Forty-five hours of lecture, laboratory and field instruction per week for three weeks. An introduction to the biodiversity of northeastern North American terrestrial, wetland, and aquatic communities with a focus on vascular plants and invertebrate and vertebrate animals, incorporating practical field exercises designed to acquaint the student with problem solving. Summer, Cranberry Lake Biological Station. Students must register for summer session, to which appropriate tuition and fees apply in addition to travel and lodging costs.

### **EFB 210 Diversity of Life I (3)**

Two hours of lecture and 3 hours of laboratory instruction per week. Introductory exploration of the diversity of life at local, regional and global scales. Hands-on laboratory exercises explore the form, function, diversity, ecology, and evolution of living organisms, focusing on viruses, fungi and plants. Fall.

Prerequisite(s): One year of introductory biology.

### **EFB 211 Diversity of Life II (3)**

Two hours of lecture and 3 hours of laboratory instruction per week. Introductory exploration of the diversity of life at local, regional and global scales. Hands-on laboratory exercises explore the form, function, diversity, ecology, and evolution of living organisms, focusing on microbes, protists and animals. Spring.

Prerequisite(s): EFB 101 and 102 or equivalent year of introductory Biology.

### **EFB 217 Peoples, Plagues, and Pests (3)**

Three hours of lecture/discussion per week. Impacts of selected diseases and pests on the development and course of human civilizations. Emphasis is on the impacts of plagues and pests on non-western civilizations. Spring.

### **EFB 220 Urban Ecology (3)**

Two hours lecture/discussion, three hours of outdoor laboratory per week. Explores the city from an ecosystems

perspective. Addresses the role and importance of science, engineering, the design professions, and community participation in creating livable communities. Environmental equity and justice are addressed. Fall.

### **EFB 296 Special Topics in Environmental and Forest Biology (1 - 3)**

Experimental, interdisciplinary or special coursework at the freshman or sophomore levels. Subject matter and course format vary from semester to semester or offering on the basis of needs and objectives of the course. Fall or Spring.

### **EFB 298 Research Apprenticeship in Environmental Biology (1 - 3)**

Full- or part-time engagement as volunteer or employee on research project having environmental biology focus consistent with the student's educational and professional goals. Tenure at SUNYESF or outside institution. EFB-based faculty member serves as student's sponsor. Study plan outlining the apprenticeship's educational goals completed prior to its commencement. Record of activities and performance assessment by faculty sponsor generated after apprenticeship termination. Grading Satisfactory/Unsatisfactory. Fall, Spring, Summer.

Prerequisite(s): Permission of Instructor

### **EFB 303 Introductory Environmental Microbiology (4)**

Three hours of lecture and three hours of laboratory per week. An introduction to the biology of microorganisms and viruses and a study of their interactions with other microbes and macroorganisms. Fall.

### **EFB 305 Indigenous Issues and the Environment (3)**

Three hours of lecture and discussion per week. Introduction to perspectives of indigenous people on environmental and natural resources management issues, including tribal forestry, fisheries, biocultural restoration, conservation strategies, climate change and treaty rights. Integrates scientific and indigenous worldviews and knowledge systems. Spring.

Note: Credit will not be granted for both EFB 305 and EFB 605.

### **EFB 307 Principles of Genetics (3)**

Three hours of lecture and discussion per week. A general course covering concepts of genetics and evolution basic to upper-division biology and biochemistry courses. Includes the inheritance and analysis of Mendelian and quantitative traits, the chemical nature of the gene and its action, genetic engineering, the genetic structure of populations and their evolution. Numerical methods for characterizing and analyzing genetic data are introduced. Fall.

### **EFB 308 Principles of Genetics Laboratory (1)**

Three hours of auto-tutorial laboratory per week. Experiments with plants and animals and computer simulation exercises demonstrate the basic principles of inheritance of Mendelian traits and changes in populations caused by major forces in evolution or by breeding procedures. Numerical methods for characterizing quantitative traits and for testing hypotheses are introduced. Fall.

Co-requisite: EFB 307.

### **EFB 311 Principles of Evolution (3)**

Three hours of lecture or discussion per week. An introduction to the fundamental processes driving evolution (genetic drift, gene flow, mutation, sexual selection, and natural selection), the evolution of life-histories, trade-offs, and phenotypic plasticity. Macroevolutionary concepts covered include speciation, extinction, co-evolution, and the reconstruction of phylogenies. Spring.

Prerequisites: EFB 307 and EFB 320, or equivalents.

### **EFB 312 Introduction to Personal Environmental Interpretation Methods (3)**

Two hours of lecture and 2 hours of recitation per week. One required Saturday field trip. Personal interpretation teaches a variety of face-to-face techniques used to connect the public with environmental science by providing an introduction to history of interpretation, popular interpretive and environmental education activities and curriculum, evaluation of programs, and lesson plans. Explores and illustrates the research and philosophy of environmental

interpretation. Credit will not be granted for both EFB 312 and EFB 512. Fall.

Prerequisite(s): EFB 320, junior or senior standing, or permission of instructor

### **EFB 320 General Ecology (4)**

Three hours of lecture and one three-hour field trip/laboratory per week. An introduction to plant and animal ecology, including concepts and techniques in population ecology, community dynamics, physiological and behavioral ecology, biogeography, ecosystem ecology, nutrient cycling and energy flow. Ecological management applications, human ecological impacts and problems are considered. Fall.

### **EFB 325 Cell Biology (3)**

Three hours of lecture per week. Morphology and physiology of cells. Emphasis on macromolecule structure and function, cell division, gene expression, cell signaling, biochemical pathways, transport, metabolism, and motility. Spring.

Prerequisite: One year of introductory biology, one semester of organic chemistry, Genetics.

### **EFB 326 Plant Evolution, Diversification and Conservation (3)**

Two hours of lecture and one three-hour laboratory per week. Evolutionary survey of the origin and diversification of land plants through geological time. Major land plants including bryophytes, lycophytes, pteridophytes, gymnosperms and angiosperms with emphasis on representative fossil and living taxa. Life histories and reproductive strategies, anatomical and morphological adaptations, species extinction and extinction events, and phylogenetic relationships within and among phyla. Highlights rare or endangered taxa in each phylum and related conservation strategies and management. Lab focused on analyses of plant structures, reproductive mechanisms, evolutionary adaptations, and identification of a variety of living and preserved specimens. Spring.

Prerequisite: EFB 210 Diversity of Life I, or instructor's permission

### **EFB 327 Adirondack Flora (3)**

Two hours of lecture, and eight hours of field work and discussion each day for two weeks. An integrated field and laboratory course in the identification of vascular plants and recognition of ecological characteristics of major plant species and communities of the Adirondack Mountain region. Satisfies elective field study requirement in Environmental and Forest Biology. Appropriate for upper and lower division undergraduate students seeking instruction in plant identification and ecology. Summer, Cranberry Lake Biological Station.

Prerequisite: General botany or general biology.

### **EFB 335 Dendrology (2)**

One hour of lecture per week and one three-hour laboratory/field trip. Field study, identification and major characteristics of important forest trees of North America. Fall.

Prerequisite: Open only to students in the forest engineering curriculum.

### **EFB 336 Dendrology (3)**

Two hours of lecture per week and one three-hour laboratory/field trip. Field study, identification, natural history and elementary silvics of important forest trees of North America. Fall.

### **EFB 337 Field Ethnobotany (3)**

Two hours of lecture per week and six to eight hours of field work and discussion each day for two weeks. A field-based introduction to the identification and traditional cultural uses of plants in the Adirondack region for food, medicine and fiber. Topics include plant identification, traditional ecological knowledge and use of ecological and ethnobotanical methods. Satisfies elective field course requirement in programs offered by Department of Environmental and Forest Biology. Cranberry Lake Biological Station. Summer. Students must register for summer session, to which appropriate tuition and fees apply in addition to travel and lodging costs.

Prerequisite: EFB 226 General Botany or equivalent.

**EFB 340 Forest and Shade Tree Pathology (3)**

Two hours of lecture per week and three hours of auto-tutorial laboratory. Major diseases of forest, shade and ornamental trees; and deterioration of forest products, with emphasis on disease identification, principles of disease development, effects of disease on the host, and practical control measures. Spring.

**EFB 342 Fungal Diversity and Ecology (3)**

Two hours of lecture, and eight hours of fieldwork and discussion each day for two weeks. An integrated field and laboratory course designed to provide an introduction to the collection, identification and ecology of fungi and fungal-like organisms. Included in the course are Oomycetes (Kingdom Straminipila) and Myxomycetes (Kingdom Protista), as well as the more familiar groups of Kingdom Fungi. Satisfies field study elective requirement in Environmental and Forest Biology. Summer, Cranberry Lake Biological Station. Students must register for summer session, to which appropriate tuition and fees apply in addition to travel and lodging costs.

Prerequisite: General biology or general botany.

**EFB 345 Forest Health (3)**

Seven and one-half hours of lecture and 45 hours of field exercises per week for two weeks. Required in the Forest Health major, but open to others. Examines the varied ecological roles and impacts of pests and pathogens in managed and unmanaged northern forests. Students learn to collect, identify, and study forest insects and pathogens using inventory, survey, analytic methods, and independent research. Summer, Cranberry Lake Biological Station. Students must register for summer session, to which appropriate tuition and fees apply in addition to travel and lodging costs.

Prerequisites: One year of general biology, and EFB 202 or equivalents.

**EFB 351 Forest Entomology (3)**

Two hours of lecture and three hours of laboratory per week. Basic insect diversity, ecology and pest management with an emphasis on insect pests of forested ecosystems. Designed for students in Environmental Biology, Forest Health and Forest Resources Management. Fall, even years.

Note: Credit will not be granted for both EFB 351 and EFB 551.

**EFB 352 Entomology (3)**

Two hours of lecture and three hours of laboratory per week. Basic insect diversity, ecology and pest management with an emphasis on common insect pests of the northeastern U.S. Designed for students in Environmental Biology and Forest Health. Fall, odd years.

Note: Credit will not be granted for both EFB 352 and EFB 552.

**EFB 355 Invertebrate Zoology (4)**

Three hours of lecture and three hours of laboratory per week. Structure, function, classification and evolution of invertebrates. Emphasis on functional biology and ecological interactions. Spring.

**EFB 360 Epidemiology (3)**

Three hours of lecture/discussion per week. Introduction to the study of disease in populations and factors influencing disease occurrence. Case studies explore population measures of disease, clinical measures and causation. Emphasizes quantitative approaches, study design, ethics, intervention and implementation. Spring.

Prerequisite(s): One year of Introductory Biology, one Statistics course or equivalent by permission.

**EFB 381 Vertebrate Museum Techniques (2)**

One hour of lecture and three hours of laboratory per week. Theory and practice of vertebrate museum methods, with emphasis on the preparation and curation of vertebrate specimens. Spring.

Prerequisites: At least junior status and permission of instructor. Limited to 10 students.

**EFB 384 Field Herpetology (3)**

Two hours of lecture, and eight hours of field work and discussion each day for two weeks. An integrated field and laboratory course in the identification, natural history, ecology, and conservation of amphibians and reptiles of the Adirondack region. Satisfies field study elective requirement in Environmental and Forest Biology. Summer, Cranberry Lake Biological Station. Students must register for summer session, to which appropriate tuition and fees apply in addition to travel and lodging costs.

Prerequisite: General biology or general zoology.

### **EFB 385 Comparative Vertebrate Anatomy (4)**

Three hours of lecture and three hours of laboratory per week. Analysis of vertebrate structure, with emphasis on comparative study of organ systems. Includes evolution of form and function, major adaptive patterns and phylogenetic relationships in vertebrates. Spring.

### **EFB 388 Ecology of Adirondack Fishes (3)**

Two hours of lecture, and eight hours of fieldwork and discussion each day for two weeks. An integrated field and laboratory course in the identification of fish and recognition of ecological characteristics of major fish species and communities of Adirondack waters. Satisfies a component of the field study elective requirement in Environmental and Forest Biology. Summer, Cranberry Lake Biological Station. Students must register for summer session, to which appropriate tuition and fees apply in addition to travel and lodging costs.

Prerequisite: General zoology or general biology.

### **EFB 390 Wildlife Ecology and Management (4)**

Three hours of lecture and one hour of recitation per week. A study of the ecological principles governing wild animal populations and their habitats, and the relationship of these principles to management programs and decisions. Directed primarily toward students majoring in wildlife science, conservation biology, and forest resources management. Fall.

Prerequisite or co-requisite: General ecology.

### **EFB 400 Toxic Health Hazards (3)**

Three hours of lecture per week. Introduction to contemporary concepts of toxicology and to scientific basis for regulations and personal decisions about toxic health hazards. For students in natural or social sciences of environmental relevance. Topics include xenobiotic load, co-evolution of plant/animal defenses, chemical interactions, animal tests and risk assessment. Fall.

Prerequisites: General biology and general chemistry. Note: Credit will not be granted for both EFB 400 and EFB 600.

### **EFB 404 Natural History Museums and Modern Science (3)**

Three hours lecture per week and one week field trip. Examination of the major roles of contemporary natural history museums as places of research and public education. Emphasis on research, exhibits, collections and programs. Organized instructional visit to natural history museums during a 1-week trip. Travel expenses apply.

Prerequisites: EFB 417, or permission of instructor

### **EFB 405 Literature of Natural History (2)**

One hour lecture and one hour discussion/seminar per week. This course examines key examples of the literature of natural history from the late 18th century to present. Major influences, perspectives and contexts associated with each selection are treated. Spring.

Prerequisites: General biology and ecology.

### **EFB 406 Great Naturalist Seminar (1)**

One hour of seminar per week. This course examines the lives and contributions of selected, significant naturalists from the late 18th century to present. Perspectives, contexts and contemporaries of the naturalists are treated in seminar format. Basic and enriched presentation skills are practiced to encourage personal understanding and enhance professionalism. Fall.

Prerequisites: General biology and ecology.

### **EFB 411 Research Methods: Understanding the Adirondack Ecosystem (3)**

Two hours of lecture/discussion and one three hour field trip per week. An introduction to biodiversity, forest and wildlife management, invasive species, climate science, and the role of humans in the context of the Adirondack Park. Biotic and abiotic drivers of the Adirondack ecosystem, field data collection methods and policy and sustainability are considered. Explores the role of science in natural resource decision-making and the uses and limitations of ecological data and planning tools. Requires concurrent registration with other Sustaining the Park courses. Fall, Newcomb Campus.

Prerequisite(s): General Biology or equivalent coursework Co-requisites: EST 401, EST 402, EST 403, EST 404

### **EFB 412 Introduction to Chemical Ecology (3)**

Three hours of lecture with discussion per week. Centers on chemical signals among organisms from microbes to man as they affect ecology, physiology and behavior; and as they can be utilized for agriculture, pest management and animal husbandry. Spring.

Prerequisite: Organic chemistry (one year). Note: Credit will not be granted for both EFB 412 and FCH 440.

### **EFB 413 Introduction to Conservation Biology (3)**

Two hours of lecture and one hour of discussion/recitation per week. As an introduction to the discipline of conservation biology, the course seeks to demonstrate how basic biological science can be integrated with social, economic and political perspectives to achieve the goals of biological conservation. Lectures will provide students with an understanding of processes that generate and erode biological diversity. Discussion/recitation exercises will provide students with hands-on experience and skill development in solving the sorts of complex problems typically encountered by conservation biologists. Spring.

Pre- or co-requisite(s): EFB 307, EFB 320.

### **EFB 414 Senior Synthesis in Conservation Biology (3)**

Three hours of discussion/seminar per week. Students research a topic in conservation biology, then practice critical thinking and discourse by presenting seminars and participating in discussions. The focus is on integrating knowledge from previous coursework in biology, management and policy for the wise use and conservation of biological diversity. Spring.

Pre- or co-requisite: EFB 413.

### **EFB 415 Ecological Biogeochemistry (3)**

Three hours of lecture and discussion per week. Investigation of the principles of biogeochemistry in ecosystems. The transformations and fluxes of elements in terrestrial and aquatic ecosystems including global cycles are emphasized. Fall.

Prerequisites: Courses in general ecology and introductory chemistry.

### **EFB 417 Non-Personal Environmental Interpretive Methods (3)**

Three hours of lecture per week. Applications of environmental interpretation theory and methods applied to nature center programming, science education, and various fields of resource management emphasizing procedures for creating non-personal interpretive media (e.g., brochures, wayside exhibits, etc.). Focus on service-learning through involvement with an outside interpretive agency. Spring.

Prerequisites: EFB 312, or permission of the instructor Note: Credit will not be granted for both EFB 417 and EFB 617.

### **EFB 418 Interpretation of Field Biology (5)**

This five-week residential course offers introductions to Adirondack flora and fauna in a regional context as subjects for various interpretive programs and products such as nature walks and trailside presentations, and slide presentations. The application of professional interpretive techniques and the inclusion of natural history in science

education are highlights. Summer.

Prerequisite: EFB 320 or permission of instructor. Note: Credit will not be granted for both EFB 418 and EFB 618.

### **EFB 419 Problem-solving in Conservation Biology (3)**

Two hours of lecture/recitation and three hours of laboratory per week. "Hands-on" experience in problem-solving, using methods and concepts related to a wide range of biodiversity conservation issues. Includes management of genetic diversity, analysis and modeling of populations, ecosystem management, and the public policy process, and of methods of information management, analysis and communication used by conservation professionals. Spring.

Prerequisite: EFB 413 or equivalent; major in Conservation Biology or permission of instructor.

### **EFB 420 Internship in Environmental and Forest Biology (1 - 5)**

Full- or part-time engagement as volunteer or employee in professional experience having environmental biology focus. Tenure at outside institution under guidance of external supervisor, but with EFB-based faculty sponsor.

Requires initial study plan outlining educational goals, plus record of activities and supervisor's assessment of student's performance upon completion. Grading satisfactory/ Unsatisfactory. Fall, Spring, Summer.

Prerequisite(s): Permission of Instructor.

### **EFB 423 Marine Ecology (4)**

Three hours of lecture per week, two hours of laboratory per week and one weekend field trip. Introduction to marine organisms and systems using the principles of population, community and ecosystem ecology. Hands-on demonstrations, discussions, presentations, lectures, and field trip allow study of major marine habitats (e.g., intertidal, pelagic, coral reefs, deep sea), and the increasing human impact on marine environments. Small fee charged for mandatory weekend field trip. Spring, even years.

Prerequisites: One year general biology and general ecology or equivalents. Note: Credit will not be granted for both EFB 423 and EFB 623.

### **EFB 424 Limnology: Study of Inland Waters (3)**

Three hours of lecture per week, with some additional hands-on activities during the semester. An introduction to the geology, physics, chemistry and biology of inland waters (lotic and lentic). The course focuses on inland waters as integrated ecosystems and explores the effects of natural and anthropogenic perturbations on these systems. Fall.

Prerequisites: Senior status, introductory courses in physics and chemistry, and EFB 320, or permission of instructor.

Note: Credit will not be granted for both EFB 424 and EFB 624.

### **EFB 427 Plant Anatomy and Development (3)**

Three hours of lecture and three hours of laboratory instruction per week. This course offers a dynamic approach to the study of plant anatomy by understanding how cells, tissues and organs are formed using concepts and tools from genetics and molecular biology. Laboratory involves hands-on activities using current techniques. Fall.

Prerequisite: one year introductory biology. Note: Credit will not be granted for both EFB 427 and EFB 627.

### **EFB 428 Mycorrhizal Ecology (3)**

Two hours of combined lecture/discussion and 3 hours of laboratory per week. Introduction to mycorrhizal symbioses, their role in plant nutrient uptake, and function in plant community dynamics. Emphasis is on important historical and current literature, and on learning methodological approaches used in mycorrhizal research. Fall, even years.

Prerequisites: General ecology or plant ecology, genetics. Note: Credit will not be granted for both EFB 428 and EFB 628.

### **EFB 434 Ecosystem Restoration Design (4)**

A summer field course followed by a weekly seminar and workshop during the Fall. Will travel in Mesoamerica. Will examine degraded and restored ecosystems. Will travel on public transportation and stay in low-cost hostels. Will use contemporary problems as source material for course projects. Continuation of restoration project designs and

analysis from the field trip will be part of the coursework after returning to Syracuse. The course will explore restoration strategies in many different ecosystems. Will consider restoration needs in less developed countries, and how that shapes design and evaluation. Course fee. Fall.

Prerequisite: Permission of instructor.

### **EFB 435 Flowering Plants: Diversity, Evolution, and Systematics (3)**

Two hours of lecture and three hours of laboratory per week. Diversity, evolution, and systematics of flowering plants with emphasis on flower structures and reproductive strategies. Flowering plant identification skills are built from examination of a broad diversity of species from major globally distributed families with particular focus on flora of the Northeastern U.S. [Fall]

Prerequisite(s): General Biology I and II or equivalent and at least junior standing.

### **EFB 437 Plant Propagation (3)**

Two hours of discussion and two hours of laboratory each week. Introduction to sexual (seed) and asexual (cuttings, budding, grafting, layering, tissue culture, etc.) techniques for reproducing plants. Laboratory and independent research projects will provide practical hands-on experiences. Spring.

Prerequisite(s): EFB 101/102 and EFB 103/104 sequence or equivalent. Note: Credit will not be granted for both EFB 437 and EFB 637.

### **EFB 439 Forest Health Monitoring (3)**

Three hours of lecture/discussion per week on theoretical and applied aspects of forest health monitoring including concepts, data acquisition, analysis, quality assurance, interpretation and reporting. Spring.

Pre- or co-requisite(s): Courses in forest resources management, ecology, pathology and entomology.

### **EFB 440 Mycology (3)**

Two hours of lecture and three hours of laboratory per week. Fundamentals of the morphology, taxonomy, life histories, ecology and symbiotic relationships of fungi. Fall.

Note: Credit will not be granted for both EFB 440 and EFB 640.

### **EFB 444 Biodiversity and Geography of Nature (3)**

Three hours of lecture per week. Earth history (plate tectonics, etc.), topography and geographic variation in environmental conditions influence species and communities. Major geographic patterns in biological diversity and strategies for conserving native species are presented. Fall, even years.

Prerequisite: EFB 320 or permission of instructor. Note: Credit will not be granted for both EFB 444 and EFB 644.

### **EFB 445 Plant Ecology and Global Change (3)**

Three hours of lecture and discussion per week. Impacts of global changes in climate, biodiversity, land-use, and biogeochemical cycles on structure and function of terrestrial plant communities and ecosystems. Examined scales range from ecophysiological processes occurring in individual leaves to global patterns of primary productivity and biodiversity. Spring.

Prerequisite: EFB 320 General Ecology or equivalent. Note: Credit will not be granted for both EFB 445 and EFB 645.

### **EFB 446 Ecology of Mosses (3)**

Two hours of lecture and one three-hour laboratory or field trip per week. A study of taxonomic diversity, ecological adaptations and the roles of bryophytes in ecosystems. Spring.

Note: Credit will not be granted for both EFB 446 and EFB 646.

### **EFB 453 Parasitology (3)**

Two hours of lecture/discussion per week, three hours laboratory per week. Diversity, ecology, and impact of parasites of ecological, medical, and veterinary importance. Emphasis on identification, life history, control, host-parasite interactions and evolution, population patterns, and parasite communities. Fall.

Prerequisite(s): One year of Introductory Biology, Ecology. Note: Credit will not be granted for both EFB 453 and EFB 653.

### **EFB 462 Animal Physiology: Environmental and Ecological (3)**

Three hours of lecture, discussion and/or exercises per week. An introduction to the physiology of adaptation to the physical and biotic environments, including animal energetics, biology of body size and physiological constraints on animal life history. Fall.

Note: Credit will not be granted for both EFB 462 and EFB 662.

### **EFB 480 Principles of Animal Behavior (4)**

Three hours of lecture and one hour of recitation per week. Basic principles of animal behavior and the scientific process. Proximate and ultimate mechanisms controlling the behavior of animals including humans, with an emphasis on evolution. Spring.

Prerequisite(s): A full year of general biology.

### **EFB 482 Ornithology (4)**

Three hours of lecture and discussion, three hours of laboratory/field trip per week and additional mandatory field trips. Students become familiar with all aspects of birds: taxonomy, structure, function, ecology, population dynamics, conservation and identification. Emphasizes identification of the birds of the eastern United States by sight, and the common species by sound. Exposure to birds worldwide. Fall.

Prerequisite: General biology and general ecology.

### **EFB 483 Mammal Diversity (4)**

Three hours of classroom instruction and three hours of laboratory per week. Describes the evolutionary development, ecology and diversity of mammals world-wide and within New York State. Laboratory exercises and discussions complement lectures, providing hands-on experience in identification, adaptive morphology, and techniques in field mammalogy. Fall.

Prerequisites: Junior standing in EFB.

### **[EFB 484 Mammalian Winter Ecology \(3\)](#)**

Ten-day field course conducted during one weekend in February and during March break in the Adirondack Mountains of New York. The course explores ecological adaptations of mammals for surviving the winter in northern latitudes. Students are in the field daily. There is a course fee. Appropriate fees apply in addition to travel and lodging costs. Spring.

Prerequisites: EFB 202, EFB 320.

### **EFB 485 Herpetology (3)**

Two hours of lecture and three hours of laboratory per week. An introduction to the structure, function, ecology, behavior, development and distribution of amphibians and reptiles as they relate to the systematics of the various groups. Fall.

### **EFB 486 Ichthyology (3)**

Two hours of lecture and three hours of laboratory per week. An introduction to the anatomy, physiology, ecology, behavior and taxonomy of fishes. Spring.

### **EFB 487 Fisheries Science and Management (3)**

Three hours of lecture per week. Introduction to biology, ecology, quantitative assessments, conservation, and management of fish species targeted in fisheries. Includes models and empirical studies of population dynamics, life history theory, bioenergetics, population sampling, growth, mortality, production, exploitation, ecological effects, and approaches to fisheries management. A practicum (EFB 488) is optional. Fall.

Prerequisite: Calculus and either Limnology or Ichthyology or permission of instructor. Note: Credit will not be granted

for both EFB 487 and EFB 687.

### **EFB 488 Fisheries Science Practicum (1)**

Three hours of laboratory per week with 2 weekend field trips. Practical experience in fisheries science, including introduction to collecting techniques, data collection, analysis, and use of models. A nominal fee is charged to defray costs on weekend trips. Designed as a complement to EFB 487. Fall, even years.

Co-requisite: EFB 487 (may be taken in a previous year).

### **EFB 491 Applied Wildlife Science (3)**

Two hours of discussion and three hours of laboratory per week, plus a field project and professional experience. Practical experience with tools used to monitor and manage wildlife populations. Designed for biology students wishing to pursue careers as wildlife biologists. Spring.

Prerequisite: EFB 390.

### **EFB 492 Senior Synthesis in Aquatic and Fisheries Science (1)**

One hour of seminar per week. Students will develop a synthesis by defining a scientific hypothesis on an aquatic topic of interest, gathering/analyzing data from the literature or elsewhere, interpreting findings, and presenting their work both orally and in a written technical report. That synthesis will relate to prior coursework and current issues in aquatic sciences. Spring.

Prerequisite: Senior standing in the Aquatic and Fisheries Science major.

### **EFB 493 Wildlife Habitats and Populations (4)**

Three hours of lecture/discussion and one three-hour laboratory per week; one Saturday field trip required. Application of ecological concepts, including succession and population biology to wildlife management planning and program assessment. Students are exposed to U.S. Fish and Wildlife Service habitat evaluation procedures and fundamentals of population modeling. Fall.

Prerequisites: EFB 491 or permission of instructor. Note: Credit will not be granted for both EFB 493 and EFB 693.

### **EFB 494 Senior Synthesis in Forest Health (1)**

One hour of discussion or seminar per week. This course integrates student internships (EFB 420) or research experiences (EFB 498) with broader issues in forest health through readings and discussions of current literature and oral presentations. Students present a 1 hr seminar that details their internship or research experiences during the previous summer, and that relates this work to prior coursework and current issues in forest health. Fall.

Prerequisite(s): EFB 420 or EFB 498

### **EFB 495 Undergraduate Experience in College Teaching (1 - 3)**

An opportunity for qualified, senior undergraduate students to gain experience in fully supervised, college-level teaching of the type they can expect to perform in graduate school. Students assist the instructor in the preparation and presentation of laboratory or recitation material in an undergraduate course. A maximum of 6 credit hours of EFB 495, and 3 credit hours relating to any single assisted course, may apply toward graduation requirements. Fall and Spring.

Prerequisites: Previous completion of the course being assisted (with a grade of B or higher), a GPA at ESF of 3.0 or higher, and permission of instructor.

### **EFB 496 Topics in Environmental and Forest Biology (1 - 3)**

Experimental, interdisciplinary or special coursework in biology for undergraduate students. Subject matter and method of presentation varies from semester to semester. May be repeated for additional credit. Fall, Spring, Maymester or Summer. For sections taught during Maymester or summer session, appropriate tuition and fees apply in addition to travel and lodging costs.

### **EFB 497 Seminar (1)**

One hour of presentations and discussion per week. A topic in environmental and forest biology will be emphasized and its importance to contemporary issues will be addressed. Fall or Spring.

### **EFB 498 Research Problems in Environmental and Forest Biology (1 - 5)**

Independent research by advanced undergraduate student in topic related to environmental biology, conducted at SUNY-ESF or outside institution. EFB-based faculty member serves as student's research sponsor; EFB-based faculty member or scientist at outside institution serves as research supervisor. Final written report to academic sponsor serves as basis for grade. Fall, Spring, Summer.

Prerequisite: Permission of instructor.

### **EFB 500 Forest Biology Field Trip (1 - 3)**

A five- to 10-day trip to: 1) agencies engaged in biological research, management and administration; or 2) regions or areas of unusual biological interest. A final report is required. Additional fees required to cover cost of travel and lodging during field portion of course. Tuition charges will apply to sections offered during Maymester and summer sessions. Fall, Spring, Maymester or Summer.

### **EFB 502 Ecology and Management of Invasive Species (3)**

Three hours of discussion/lecture per week. Explores the growing problem of invasive species as a leading threat to global biodiversity. Topics include: invasion pathways and mechanisms, community resistance, biological control, effects on ecosystems, law and policy as management tools, prediction and risk assessment, and interactions with anthropogenic environmental change. Spring.

### **EFB 504 Plant-Herbivore Interactions (3)**

Three hours of lecture/discussion per week. Introduction to major plant defensive strategies and counter-adaptation by herbivores. Costs and consequences of herbivory and evaluation of contemporary plant defense models. Direct and indirect linkage of plant-herbivore interactions with higher trophic levels, and effects on population and community dynamics. Plant-herbivore interactions and anthropogenic global change. Fall (Even years).

Prerequisite(s): Introductory courses in ecology and evolution.

### **EFB 505 Microbial Ecology (2)**

Two hours of lecture/discussion per week. An in-depth survey of contemporary topics in microbial ecology including carbon, nitrogen and sulfur cycling, microbial degradation of recalcitrant compounds, frost control, and utilization of wood-based feedstocks as carbon sources for bioconversion to bioenergy, biofuels, and biomaterials. Spring.

Prerequisite: EFB 303 or similar microbiology course is recommended.

### **EFB 512 Introduction to Personal Environmental Interpretation Methods (3)**

Two hours of lecture and 2 hours of recitation per week. One required Saturday field trip. Personal interpretation teaches a variety of face-to-face techniques used to connect the public with environmental science by providing an introduction to history of interpretation, popular interpretive and environmental education activities and curriculum, evaluation of programs, and lesson plans. Explores and illustrates the research and philosophy of environmental interpretation. Discuss interpretive research, plan and lead lectures, and mentor/evaluate undergraduates. Credit will not be granted for both EFB 312 and EFB 512. Fall.

Prerequisite(s): graduate standing or permission of instructor.

### **EFB 513 Adirondack Forest Ecology and Management (2 - 3)**

One-week, field-based examination of sustainable forest management in the Adirondacks, framed by concepts and issues associated with plant and wildlife ecology, silviculture, and forest management. Contemporary research on central Adirondack forests is featured based on work at the Huntington Wildlife Forest. Emphasis is on experiential learning via a series of trips to, and laboratories in, the forest. Fall (late summer).

Note: Credit will not be granted for both EFB 513 and FOR 513.

**EFB 516 Ecosystems (3)**

Three hours of lecture/discussion per week. Ecosystems emphasize the integration of biological, chemical and physical aspects of the environment applied in an integrative fashion to units of landscape and water. Major topics covered include a survey of ecosystem types, energy flow, nutrient cycles and the relation of ecosystem processes to plant and animal populations. Spring.

Prerequisite: EFB 320.

**EFB 518 Systems Ecology (4)**

Three hours of lecture and three hours of laboratory/field experience per week. Survey of history, literature and techniques of systems ecology, including, especially, the teaching of intellectual, basic mathematical and computer skills that allow the student to take an environmental problem of his or her choosing and simulate it on a computer. Fall.

Prerequisite: One course in ecology. It is also recommended that the student have at least some previous or concurrent experience with computers. Weekend field trip required.

**EFB 521 Principles of Interpretive Programming (3)**

Three hours of lecture and three hours of laboratory per week. This course offers principles, methods, and marketing for comprehensive interpretive programming. Creative approaches to methods for establishing effective programming featuring natural history themes are emphasized. Spring, alternate years.

Prerequisite: EFB 416/EFB 616 or EFB 417/EFB 617.

**EFB 522 Biophysical Economics (3)**

Three hours of lecture per week. Approaches economics as a biophysical rather than social science, i.e., the ecology of human-dominated ecosystems. Reviews concepts of value and economics (physiocrat, classical and neoclassical approaches), and examines an alternative model emphasizing analysis of energy and material flows and their control instead. Focus is on the developing tropics. Spring.

Prerequisite: A course in ecology and a course in economics.

**EFB 523 Tropical Ecology (3)**

One hour of lecture coupled with a period of intensive field study over spring break on a tropical island in the Caribbean. Principles of tropical ecology, resource management and island biogeography are presented. Field trips to a variety of tropical ecosystems including: rain forest, coral reefs, crater lakes and montane rain forest. Comparisons with north temperate ecosystems are made. Additional fees required to cover cost of travel and lodging during field portion of course. Requires the ability to swim. Spring. Appropriate fees apply in addition to travel and lodging costs.

Prerequisite: EFB 320.

**EFB 525 Limnology Practicum (2)**

Three hours of field work or laboratory analysis each week. Two additional field trips on weekends; time outside of class devoted to an independent project. Students will become proficient in standard field and laboratory analyses used in limnology; field trips to diverse local aquatic habitats; development of an independent project. Fall.

Prerequisites: EFB 424, 624 or equivalent must be taken concurrently or previously.

**EFB 530 Plant Physiology (3)**

Three hours of lecture per week. Internal processes and conditions in higher plants with emphasis on physiological and biochemical concepts. For students majoring in the biological sciences. Spring.

Prerequisites: EFB 325, EFB 326. Note: EFB 531 also required for plant sciences concentration students.

**EFB 531 Plant Physiology Laboratory (2)**

Two three-hour laboratory sessions per week. An introduction to methods and procedures of physiological research. Spring.

Pre- or co-requisite: EFB 530 or permission of instructor.

**EFB 542 Freshwater Wetland Ecosystems (3)**

Three hours of lecture per week. An examination of the structure and function of various freshwater wetlands. Ecologic principles that broadly apply to all wetland ecosystems are examined and contrasted with terrestrial systems. The effect of management activities on, and the management potential of, wetlands are also examined. Spring.

Prerequisite: EFB 320.

**EFB 551 Forest Entomology (3)**

Two hours of lecture and three hours of laboratory per week. Diversity, ecology and integrated management of insect pests of forested ecosystems. Additional topics include invasive species, climate change and current research topics. Intended for students in Environmental and Forest Biology and Forest Resources Management. Fall, even years.

Note: Credit will not be granted for both EFB 351 and EFB 551.

**EFB 552 Entomology (3)**

Two hours of lecture and three hours of laboratory per week. Basic insect diversity, ecology and pest management with an emphasis on common insect pests of the northeastern United States. Additional topics include invasive species, climate change and current research topics. Intended for students in Environmental Biology and Forest Health. Fall, odd years.

Note: Credit will not be granted for both EFB 352 and EFB 552.

**EFB 554 Aquatic Entomology (3)**

Two hours of lecture, three hours of laboratory/field work per week and a weekend field trip. An introduction to the identification, life histories and ecology of aquatic insects, with emphasis on genera found in the Northeastern United States. Includes a consideration of the functional role of insects in aquatic systems, and current avenues of research. Intended for seniors and graduate students pursuing interests in entomology, fisheries and wildlife, forestry, limnology and general ecology. Fall.

Prerequisite: One course in entomology or permission of instructor.

**EFB 560 Electronic Technology in Interpretation & Environmental Education (3)**

Three hours of lecture per week. Explores the research and two disciplines of electronic technologies, those used in environmental science fields and those used in interpretive fields. Demonstrates techniques used to engage the public with the cultural and natural resources. Even years. Spring.

**EFB 566 Systematic Entomology (3)**

Two hours of lecture and three hours of laboratory per week. Lectures introduce the identification and classification of the important orders and families of insects, along with the concepts and practice of systematics. In laboratories students become familiar with pertinent taxonomic literature and keys, based in part on a required collection. Fall.

Prerequisite: EFB 351 or EFB 352.

**EFB 570 Insect Physiology (3)**

Two hours of lecture and three hours of laboratory per week. Study of the life processes in insects; introduction to modern physiological instrumentation and laboratory methods. Spring.

Prerequisite: EFB 325.

**EFB 600 Toxic Health Hazards (4)**

Three hours of lecture and one hour discussion/seminar per week. Introduction to contemporary concepts of toxicology and to scientific basis for regulations and personal decisions about toxic health hazards. For students in natural or social sciences of environmental relevance. Topics include xenobiotic load, co-evolution of plant/animal defenses, chemical interactions, animal tests and risk assessment. Additional reading assignments and discussions. Fall.

Prerequisites: General biology and general chemistry. Note: Credit will not be granted for both EFB 400 and EFB 600.

### **EFB 601 Molecular Biology Techniques (4)**

Two hours lecture and six hours laboratory per week. Theories behind techniques in molecular biology are introduced in lecture. Laboratory includes the extraction and quantification of genomic and plasmid DNA, agarose gel electrophoresis, restriction digestion, ligation, bacterial transformation, DNA sequencing and PCR. Additional topics in molecular biology are presented by the students. Fall.

Prerequisites: EFB 307, EFB 308, EFB 325 or equivalents. Note: Credit will not be granted for both BTC 401 and EFB 601.

### **EFB 605 Indigenous Issues and the Environment (3)**

Three hours of lecture and discussion per week. Introduction to perspectives of indigenous people on environmental and natural resources management issues, including tribal forestry, fisheries, biocultural restoration, conservation strategies, climate change and treaty rights. Integrates scientific and indigenous worldviews and knowledge systems. Spring.

Note: Credit will not be granted for both EFB 305 and EFB 605.

### **EFB 610 Ecological Biogeochemistry (3)**

Three hours of lecture and discussion per week. Investigation of the principles of biogeochemistry in ecosystems. The transformations and fluxes of elements in terrestrial and aquatic ecosystems including global cycles are emphasized. Fall.

Prerequisites: Courses in general ecology and introductory chemistry.

### **EFB 611 Topics in Environmental Toxicology (3)**

Three hours of lecture, discussion or seminar per week. In-depth exploration of selected contemporary topics of environmental toxicology in areas such as toxic hazards of societal importance, pollutant monitoring and remediation, fate and ecological impacts of environmental pollutants, biological basis of toxic hazards, and ecological and human risk assessment and regulations. A major term paper and oral presentation required. Spring.

Prerequisite: EFB 400, EFB 600 or an introductory course in toxicology.

### **EFB 612 Introduction to Chemical Ecology (3)**

Three hours of lecture with discussion per week. Centers on chemical signals among organisms from microbes to man as they affect ecology, physiology and behavior; and as they can be utilized for agriculture, pest management and animal husbandry. Spring.

Note: Credit will not be granted for both EFB 612 and EFB 412/ FCH 440.

### **EFB 617 Non-Personal Environmental Interpretive Methods (3)**

Three hours of lecture per week. Applications of environmental interpretation theory and methods applied to nature center programming, science education, and various fields of resource management emphasizing procedures for creating non-personal interpretive media (e.g., brochures, wayside exhibits, etc.). Focus on service-learning through involvement with an outside interpretive agency. Submit an interpretive article for publication, read and hold online discussions of research on non-personal interpretation, and evaluate local interpretive media. Spring.

Prerequisites: EFB 512, or permission of the instructor Note: Credit will not be granted for both EFB 417 and EFB 617.

### **EFB 618 Interpretation of Field Biology (5)**

This five-week residential course offers introductions to Adirondack flora and fauna in a regional context as subjects for various interpretive programs and products such as nature walks and trailside presentations, and slide presentations. The course provides opportunities to select and test the application of professional interpretive techniques to activities promoting natural history and science education. Summer.

Prerequisite: EFB 320 or permission of instructor. Note: Credit will not be granted for both EFB 418 and EFB 618.

### **EFB 622 Applications of Interpretation to Science Education (3)**

Weeklong residency course with an external project. This course offers practical research strategies for science educators working with their students in local environments. The course builds on forest ecology and wildlife themes as vehicles to teach the process of science. Included within the field-oriented introductions to Adirondack birds, mammals and flora, are ideas to enhance most science curricula. Applications of nature interpretation are used to energize traditional strategies by using nature trails and walks, and trail leaflets, brochures, presentations, and exhibits. Participants must implement, test and document semester-length projects with their students. Summer.

### **EFB 623 Marine Ecology (5)**

Three hours of lecture per week, two hours of laboratory/recitation per week, one hour of graduate discussion per week and one weekend field trip. Introduction to marine organisms and systems, using the principles of population, community and ecosystem ecology. Hands-on demonstrations, discussions, presentations, lectures, and field trip allow study of major marine habitats (e.g., intertidal, pelagic, coral reefs, deep sea), and the increasing human impact on marine environments. Small fee charged for mandatory weekend field trip. Synthetic review paper and short presentation to the EFB 423 class are required. Spring, even years.

Prerequisites: One year general biology and general ecology or equivalents. Note: Credit will not be granted for both EFB 423 and EFB 623.

### **EFB 624 Limnology: Study of Inland Waters (3)**

Three hours of lecture per week, with additional hands-on activities during the semester. An introduction to the geology, physics, chemistry and biology of inland waters (lotic and lentic); effects of natural and anthropogenic perturbations are explored. Students develop a case study or exercise on a limnological issue. Fall.

Prerequisites: Introductory courses in physics, chemistry, and ecology, or permission of instructor. Note: Credit will not be granted for both EFB 424 and EFB 624.

### **EFB 625 Plant Biotechnology (3)**

Two hours of lecture and three hours of laboratory per week. Transgenic plants are currently being produced to improve agriculture, pharmaceuticals, and remediate environmental problems. Students are taught the principles of gene structure and regulation, gene cloning, transformation of plant species, and current applications. Format includes lectures, discussions, student presentations, literature review, and a detailed laboratory project. Spring.

Prerequisites: EFB 307 and EFB 325 or equivalents. Note: Credit will not be granted for both BTC 425 and EFB 625.

### **EFB 626 Plant Tissue Culture Methods (3)**

Two hours of lecture and discussion and three hours of laboratory per week. Introduction to plant tissue culture for biotechnology research and as a propagation method. Emphasis will be on learning laboratory instrumentation and techniques for establishing cell cultures, producing transgenic cell lines, and regenerating whole plants. In addition to the scheduled lab exercises, an independent micropropagation or transformation project will be required. Fall.

Prerequisite: Permission of instructor. Note: Credit will not be granted for BTC 426 and FOR/EFB 626.

### **EFB 627 Plant Anatomy and Development (3)**

Three hours of lecture and three hours of laboratory instruction per week. This course offers a dynamic approach to the study of plant structure by understanding how cells, tissues and organs are formed using concepts and tools from genetics and molecular biology. Laboratory involves hands-on activities using current techniques. Students will give oral presentation on a topic relevant to the course. Fall.

Prerequisite: one year introductory biology. Note: Credit will not be granted for both EFB 427 and EFB 627.

### **EFB 628 Mycorrhizal Ecology (3)**

Two hours of combined lecture/discussion and three hours of laboratory per week. Introduction to mycorrhizal symbioses, their role in plant nutrient uptake and function in plant community dynamics. Emphasis is on important historical and current literature, and on learning methodological approaches used in mycorrhizal research. Students will present and lead discussions on papers from the primary literature. An independent project is required. Fall, even

years.

Prerequisites: General ecology or plant ecology, genetics. Note: Credit will not be granted for both EFB 428 and EFB 628.

### **EFB 634 Ecosystem Restoration Design (4)**

A summer field course followed by a weekly seminar and workshop during the Fall. Will travel in Mesoamerica. Will examine degraded and restored ecosystems. Will travel on public transportation and stay in low-cost hostels. Will use contemporary problems as source material for course projects. Each student will work individually with the instructor to develop an approach to explore a novel research direction for ecosystem restoration. Continuation of restoration project project designs and analysis from the field trip will be part of the coursework after returning to Syracuse. The course will explore restoration strategies in many different ecosystems. Will consider restoration needs in less developed countries, and how that shapes design and evaluation. Course fee. Fall

Prerequisite: Permission of instructor.

### **EFB 635 Flowering Plants: Diversity, Evolution, and Systematics (3)**

Two hours of lecture and three hours of laboratory per week. Diversity, evolution, and systematics of flowering plants with emphasis on flower structures and reproductive strategies. Flowering plant identification skills are built from examination of a broad diversity of species from major globally-distributed families with particular focus on flora of the Northeastern U.S. Students prepare professional presentations and lead discussion on current research issues in flowering plant diversity, evolution, and systematics. [Fall]

Prerequisite(s): General Biology I and II or permission of instructor.

### **EFB 637 Plant Propagation (3)**

Two hours of discussion and two hours of laboratory each week. Two field trips. Introduction to sexual (seed) and asexual (cuttings, budding, grafting, layering, tissue culture, etc.) techniques for reproducing plants. Development, delivery and evaluation of lecture content, active-learning classroom activity, and laboratory content will introduce students to digital instructional technologies and techniques. Spring.

Prerequisite(s): Permission of the instructor. Note: Credit will not be granted for both EFB 437 and EFB 637.

### **EFB 640 Mycology (3)**

Two hours of lecture and three hours of laboratory per week. Fundamentals of the morphology, taxonomy, life histories, ecology and symbiotic relationships of fungi. Fall.

Note: Credit will not be granted for both EFB 440 and EFB 640.

### **EFB 643 Plant Virology (3)**

Two hours of lecture and three hours of laboratory per week. History of plant virology, identification and characterization of plant viruses, including transmission mechanisms, vector relationships, purification and serology. Laboratory will present techniques for the identification and characterization of plant viruses. Spring, even years.

Prerequisite: EFB 303 or permission of instructor. Note: Credit will not be granted for both EFB 443 and EFB 643.

### **EFB 644 Biogeography (4)**

Three hours of lecture per week. Earth history (plate tectonics, etc.), topography and geographic variation in environmental conditions influence species and communities. Major geographic patterns in biological diversity and strategies for conserving native species are presented. Students design and conduct independent biogeographic study utilizing information available in the literature. Fall, even years.

Prerequisite: General ecology or permission of instructor. Note: Credit will not be granted for both EFB 444 and EFB 644.

### **EFB 645 Plant Ecology and Global Change (3)**

Three hours of lecture and discussion per week. Impacts of global changes in climate, biodiversity, land-use, and biogeochemical cycles on the structure and function of terrestrial plant communities and ecosystems. Global change

impacts are examined across a wide range of spatial and temporal scales, from ecophysiological processes occurring at the scale of a leaf, to global patterns of primary productivity and biodiversity. Spring.

Prerequisite: EFB 320 General Ecology or equivalent. Note: Credit will not be granted for both EFB 445 and EFB 645.

### **EFB 646 Ecology of Mosses (3)**

Two hours of lecture per week and one three-hour laboratory or field trip. A study of taxonomic diversity, ecological adaptations and the roles of bryophytes in ecosystems. Spring.

Note: Credit will not be granted for both EFB 446 and EFB 646.

### **EFB 650 Landscape Ecology (3)**

Two hours of lecture/discussion and three hours of laboratory experience per week. Landscape Ecology focuses on spatial patterning – its development and relevance to ecological processes. Course introduces the foundations, issues, and analytical tools in Landscape Ecology through discussion of literature, GIS exercises, and an independent research project. Fall (even years).

Prerequisites: Introductory course in Geographic Information Systems, or equivalent.

### **EFB 653 Parasitology (3)**

Two hours of lecture/discussion per week, three hours laboratory per week. Diversity, ecology, and impact of parasites of ecological, medical, and veterinary importance. Emphasis on identification, life history, control, host-parasite interactions and evolution, population patterns, and parasite communities. Students write a review paper and present on a parasitic disease. Fall.

Prerequisite(s): One year of Introductory Biology, Ecology. Note: Credit will not be granted for both EFB 453 and EFB 653.

### **EFB 662 Animal Physiology: Environmental and Ecological (3)**

Three hours of lecture, discussion and exercises per week, and an independent project. An introduction to the physiology of adaptation to the physical and biotic environments, including animal energetics, biology of body size, and physiological constraints on animal life history. Fall and Spring.

Note: Credit will not be granted for both EFB 462 and EFB 662.

### **EFB 681 Aquatic Ecosystem Restoration and Enhancement (2)**

One and three-quarter hours of lecture and discussion per week and three field experiences. Guiding principles for ecological restoration of freshwater aquatic ecosystems focusing on effects of nutrient loading, sedimentation, flow alteration, and habitat loss. Factors leading to loss of aquatic resources and effectiveness of techniques to restore habitat and fauna are analyzed. Student presentation of a relevant topic and field excursions to perturbed areas and recent restoration projects are required. Fall, odd years.

Prerequisites: none. Directed toward graduate students in areas involving aquatic sciences and management.

### **[EFB 684 Mammalian Winter Ecology \(3\)](#)**

Ten-day field course conducted during one weekend in February and during March break in the Adirondack Mountains of New York. The course explores ecological adaptations of mammals for surviving the winter in northern latitudes. Students are in the field daily. There is a course fee. Spring.

### **EFB 685 Ecology of Mammals of the Adirondack Mountains (2)**

One week, field-based course with 15 hours of lecture and 45 hours of field/laboratory work. Focus on Adirondack mammals, their life histories, adaptations and habitat requirements. Emphasis on experiential learning where participants live trap, mark, and release small mammals, mist net bats, and employ radio telemetry techniques to understand the habits of mammals. Course is designed for college teachers and graduate students with teaching responsibilities. Fall (late summer).

### **EFB 687 Fisheries Science and Management (3)**

Three hours of lecture per week. Introduction to the biology, ecology, quantitative assessments, conservation, and management of fish species targeted in fisheries. Includes models and empirical studies of population dynamics, life history theory, population growth, mortality, production, exploitation, and management. Critical synthesis project required. Fall.

Prerequisites: Calculus and either Limnology or Ichthyology or permission of instructor. Note: Credit will not be granted for both EFB 487 and EFB 687.

### **EFB 692 Ecology and Management of Waterfowl (3)**

Three hours of lecture per week. A detailed examination of waterfowl ecology and management. The course is structured around the annual cycle, focusing on strategies of survival and reproduction; management aspects are treated throughout the course. Fall and Spring.

Prerequisite: EFB 483.

### **EFB 693 Wildlife Habitats and Populations (4)**

Three hours of lecture/discussion and one three-hour laboratory per week; one Saturday field trip required. Application of ecological concepts including succession and population biology to wildlife management planning and program assessment. Students are exposed to U.S. Fish and Wildlife Service habitat evaluation procedures and fundamentals of population modeling. Fall.

Note: Credit will not be granted for both EFB 493 and EFB 693.

### **EFB 696 Special Topics in Environmental and Forest Biology (1 - 4)**

Experimental, interdisciplinary or special coursework in biology for graduate students. Subject matter and method of presentation varies from semester to semester. Fall, Spring, and Summer.

### **EFB 796 Topics in Environmental and Forest Biology (1 - 3)**

Special instruction, conference, advanced study, and research in selected subject areas. A written report required. Check Schedule of Courses for details. Fall and Spring.

### **EFB 797 Seminar in Environmental and Forest Biology (1)**

Seminar discussions of subjects of interest and importance in environmental and forest biology. Seminar offerings are available in most subdisciplinary areas. Check Schedule of Courses for details. Fall and Spring.

### **EFB 798 Research Problems in Environmental and Forest Biology (1 - 12)**

Individual advanced study of selected special problems in environmental and forest biology. Offered by arrangement with individual faculty. A written report required. Fall and Spring.

### **EFB 898 Professional Experience (1 - 12)**

Professional experience which applies, enriches and/or complements formal coursework. Graded on an "S/U" basis. Fall, Spring and Summer.

### **EFB 899 Master's Thesis or Project Research (1 - 12)**

Investigation leading to the completion of a research-oriented thesis or to an application-oriented project. Graded on an "S/U" basis. Fall, Spring and Summer.

### **EFB 999 Doctoral Thesis Research (1 - 12)**

Investigation leading to the completion of the doctoral thesis. Graded on an "S/U" basis. Fall, Spring and Summer.

### **EHS 250 Foundations of Environmental Health (1)**

One hour of lecture/discussion per week. Introduction to environmental health concepts. Course will introduce students to environmental risk, epidemiology, toxicology, policy, and regulation; agents of disease and human health risks including vector-borne pathogens, toxic metals, pesticides, and radiation. Course will also cover applications of environmental health with a focus on water and air quality, food safety, waste management and occupational health.

Fall

Prerequisites: One year each of Biology with lab (EFB 101 and 102, EFB 103 and 104), General Chemistry with lab (FCH 150 and 151, FCH 152 and 153) and Calculus (APM 105 and 106).

### **EHS 320 Disease Prevention (2)**

Two 50 minute lectures per week. History of infectious diseases, control measures, new and emerging diseases, prediction and monitoring of known and infectious diseases. Examination of the intersections of public and environmental health, disease control and prevention, and historical and emerging diseases, and tracking and prediction of outbreaks. Spring.

Prerequisites: EHS 250 and EFB 303. Note: Credit will not be granted for both EHS 520 and EHS 320

### **EHS 350 Environmental Health Management (3)**

Three 50 minute lectures per week. Principles of communicable disease and contamination control, food protection, vector control, water supply safety, wastewater and solid and hazardous waste containment and remediation, air pollution control, and control of environmental hazards in specific or specialized environments. Understanding the laws and regulations governing these practices, and current protocols to maintain public and environmental safety. Spring

Prerequisites: EHS 250 and EWP 190 or the equivalent. Note: credit will not be granted for both EHS 350 and EHS 550.

### **EHS 420 Professional Internship in Environmental Health (1 - 5)**

40 hours of work with the sponsor per credit. Full or part time position as an employee or volunteer in a profession setting with an environmental health focus. Internship will be structured in collaboration between ESF faculty advisor and on-site supervisor. Requires a plan outlining learning goals and objectives, weekly record of activities, supervisors assessment and final report by student. Fall, Spring, Summer

### **EHS 440 Occupational Health and Safety (3)**

Three 50 minute lectures per week. In-depth examination of workplace environmental health issues. Topics include safety issues, ergonomics, fire protection, hazardous materials, and terrorism preparedness. Overview of legislation of these issues, as well as managing in workplace. Spring

Credit will not be granted for both EHS 640 and EHS 440. Pre or co-requisite of EHS 250 and pre or co requisite of EHS 350 or equivalent.

### **EHS 480 Hazardous Waste Management (3)**

Three 50 minute lectures per week. In-depth examination of hazardous wastes from source to disposal and chemical fate; covers medical, nuclear, industrial sources and reduction, prevention, containment, transportation, remediation. History, risk assessment, regulation and safety are included. Fall.

Credit will not be granted for both EHS 680 and EHS 480 Pre and co-requisite(s): Pre or co-requisite of EHS250 and prerequisite of one year of Organic Chemistry (FCH 221/222 and 223/224 or equivalent)

### **EHS 520 Disease Prevention (3)**

Two 50 minute lectures per week plus one hour of recitation. History of infectious diseases, control measures, new and emerging diseases, prediction and monitoring of known and infectious diseases. Examination of the intersections of public and environmental health, disease control and prevention, and historical and emerging diseases, and tracking and prediction of outbreaks. Spring.

Permission of instructor required. Credit will not be granted for both EHS 520 and EHS 320.

### **EHS 550 Environmental Health Management (4)**

Three 50 minute lectures per week plus a one hour recitation. Principles of communicable disease and contamination control, food protection, vector control, water supply safety, wastewater and solid and hazardous waste containment and remediation, air pollution control, and control of environmental hazards in specific or specialized environments. Understanding the laws and regulations governing these practices, and current protocols to maintain public and

environmental safety. Be familiar with past and ongoing issues in environmental health, and discuss the efficacy of current regulations in depth through regularly scheduled student presentations. Spring.

Permission of instructor required. Note: Credit will not be granted for both EHS 350 and EHS 550.

#### **EHS 640 Occupational Health and Safety (4)**

Three 50 minute lectures per week plus one hour recitation. In-depth examination of workplace environmental health issues. Topics include safety issues, ergonomics, fire protection, hazardous materials, and terrorism preparedness. Overview of legislation of these issues, as well as managing in workplace. Spring.

Permission of instructor required. Note: Credit will not be granted for both EHS 640 and EHS 440

#### **EHS 680 Hazardous Waste Management (4)**

Three 50 minute lectures per week plus a one hour recitation. In-depth examination of hazardous wastes from source to disposal and chemical fate; covers medical, nuclear, industrial sources and reduction, prevention, containment, transportation, remediation. History, risk assessment, regulation and safety are included. Fall

Permission of instructor required. Credit will not be granted for both EHS 680 and EHS 480

#### **ENS 132 Orientation Seminar: Environmental Science (1)**

One hour of lecture or discussion each week. Introduction to campus facilities, personnel, lower-division curriculum, and upper-division study options within the Environmental Science program. Fall.

#### **ENS 200 Climate Change Science and Sustainability (1)**

Climate Change Science and Sustainability is an introduction to climate science, the evidence of modern climate change, and an evaluation of some of the proposed solutions. The course integrates NASA and other web-based climate change media and products with outside readings. NASA's spatial and temporal climate change resources are the basis for most learning activities, which will enable students to continue their exploration of personal and societal climate change solutions.

#### **ENS 250 Foundations of Environmental Health (3)**

Three hours of lecture/discussion per week. Introduction to environmental health. Foundations in environmental risk, epidemiology, toxicology, policy, and regulation. Agents of disease include vector-borne pathogens, toxic metals, pesticides, and radiation. Applications of environmental health focus on water and air quality, food safety, waste management and occupational health. Spring. (Course description may be revised prior to registration.)

#### **ENS 260 Environmental Sampling Methods (3)**

Principles of water, soil, and air sampling to detect and quantify environmental contaminants, including sampling techniques, statistical considerations, and data analysis, interpretation, and reporting. (Course description may be revised prior to registration.)

#### **ENS 296 Special Topics in Environmental Science (1 - 3)**

One to three hours of class meetings per week. Special topics of current interest to lower division undergraduate students in environmental science. A detailed course subject description will be presented as a topic area is identified and developed. Fall and Spring.

Permission of the instructor.

#### **ENS 350 Environmental Health Management (3)**

Principles of communicable disease and contamination control, food protection, vector control, water supply safety, wastewater and solid and hazardous waste renovation, air pollution control, and controlling environmental hazards in special environments. (Course description may be revised prior to registration.)

Prerequisite: One year biology, one year chemistry, calculus I & II

#### **ENS 460 Renewable Energy Capstone (2)**

One half hour meeting per week. Students will synthesize information from courses in the Renewable Energy minor by

performing research and preparing a scientific report on topics related to renewable energy and energy. The research will consist of literature review/analysis, modeling, field work or laboratory research. Spring

Prerequisite: ENS 450

### **ENS 470 Environmental Risk Assessment (3)**

Three hours of lecture per week. Identification of environmental hazards to human and other life forms; application of statistical tools and methods required for quantifying risk and their applicability and limitations; regulatory requirements governing risk assessment reporting; and effective public communication of environmental risks. Fall.

Prerequisite: APM 106, APM 391, EFB 103, FCH 152

### **ENS 480 Hazardous Materials Management (3)**

In-depth examination of hazardous wastes from source to disposal and chemical fate; covers medical, nuclear, agricultural, industrial sources and reduction, prevention, containment, transportation, remediation. History, risk assessment, regulation and safety are included. (Course description may be revised prior to registration.)

Prerequisite: One year Biology, One year Chemistry, Calculus I & II

### **ENS 494 Environmental Science Capstone (1)**

1 hour of lecture/discussion per week. Support and instruction for completion and presentation of the senior synthesis project for Environmental Science. Topics include research skills and literature review, data analysis, scientific writing including editing, and oral presentation. Research or internship must be nearly or fully completed.

### **ENS 498 Research Problems in Environmental Science (1 - 5)**

Independent research in topics in environmental science for undergraduate students. Selection of subject area determined by the student in conjunction with an appropriate faculty member. Tutorial conferences, discussions and critiques scheduled as necessary. Final written report required for departmental record. Fall, Spring and/or Summer.

Prerequisite(s): Consent of instructor.

### **ENS 519 Spatial Ecology (3)**

Two hours of classroom instruction and three hours of laboratory, field trip, workshop, or group studio per week. Geographical modeling is the simulation of natural systems in a spatial context, interfacing the traditional tools of ecological modeling with those of Geographic Information Systems. Students in this course learn the fundamentals of ecological modeling and develop a spatial model using GIS tools to address their own research questions. Spring.

Prerequisites: EFB 518 or computer programming course; GIS course. Co-requisite: GIS course (if not already completed).

### **ENS 596 Special Topics in Environmental Science (1 - 3)**

Experimental or special coursework in Environmental Science for beginning graduate students, fifth year, and seniors with appropriate academic background. Subject matter and methods will vary. Fall or Spring.

### **ENS 601 Water Resources Management (3)**

Three hours of lecture and discussion per week. This course provides an introduction to interdisciplinary water management. It draws upon subject matters from many areas, including water policy, planning, economics, hydrology, law, engineering and water quality. Fall.

### **ENS 607 Wetland Practicum (2 - 3)**

Two hours of lecture and three hours of group learning per week. Provides students with a working knowledge of wetland management, emphasizing wetland delineation, functional assessment and mitigation with module problems with reports required for each module. Two credits for completion of two modules; three credits for completion of three modules. Fall.

### **ENS 696 Special Topics in Environmental Science and Policy (1 - 3)**

Experimental and developmental courses in new areas of interest to environmental studies faculty and graduate

students not covered in regularly scheduled courses. Fall and Spring.

**ENS 796 Advanced Topics in Environmental Science and Policy (1 - 3)**

Lectures and discussions, seminars, conferences and group research on advanced topics of special or current interest, in fields of interest to environmental studies faculty and graduate students. Fall and Spring.

**ENS 797 Environmental Science Seminar (1 - 3)**

Discussion of current topics and research related to environmental science. Fall and Spring.

**ENS 798 Problems in Environmental Science and Policy (1 - 12)**

Individualized, special study of environmental science and policy subjects and issues. Comprehensive oral or written report required for some problems. Fall, Spring and Summer.

**ENS 898 Professional Experience (1 - 12)**

Professional experience which applies, enriches and/or complements formal coursework. Graded on an "S/U" basis. Fall, Spring and Summer.

**ENS 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's degree and thesis. Fall, Spring and Summer.

**ENS 999 Doctoral Thesis Research (1 - 12)**

Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

**ERE 132 Introduction to Environmental Resources Engineering (1)**

Three hours of lab per week. Introduction to department and campus resources available to ensure academic success for ERE majors. Introduction to engineering science and design as a profession through readings, assignments, presentations, discussion, and field trips. Fall.

**ERE 133 Introduction to Engineering Design (3)**

Two hours of lecture and three hours of group instruction per week. An introduction to the engineering profession, including design, communication, ethical and professional behavior, teamwork and data analysis. Learning is reinforced through study, conduct and critique of design exercises related to environmental resources engineering. Spring.

**ERE 275 Ecological Engineering (3)**

Two hours of lecture and one hour of group instruction per week. Theory and practice of ecological engineering with strong focus on sustainability and design, monitoring, and construction of ecosystems and the built environment. Key concepts, empirical models, and case studies, including applications of water/wastewater treatment, air resources and solid waste management. Spring

Prerequisites: one semester of calculus, biology, and chemistry. ERE students only or by permission of instructor.

**ERE 311 Ecological Engineering in the Tropics (3)**

One hour of discussion per week with intensive spring break field study in a Caribbean country. Principles of ecological engineering for ecosystem restoration and pollution control. Field trips to pristine and degraded ecosystems including: humid tropical cloud forests, coastal mangrove, dry mountain forests, and coral reefs to identify target functions for nature and society, observe degradations, and develop sustainable restoration designs. Spring.

Prerequisite(s): one course in calculus, biology, and chemistry. Note: Credit will not be granted for both ERE 311 and ERE 511.

**ERE 335 Numerical and Computing Methods (3)**

Three hours of lecture/discussion per week. Introduction to numerical and computing methods for engineers. Writing computer code to analyze and solve engineering problems using state-of-the-art software packages. Fall.

Prerequisite: MAT 485.

### **ERE 339 Fluid Mechanics (4)**

Three hours of lecture per week plus one lab session. An introduction to fluid mechanics within the context of civil and environmental engineering. This includes hydrostatics, Bernoulli's Equation, control volume analysis, drag, dynamic similitude, pipe flow, and open channel flow with some brief coverage of hydraulic machines and flow in porous media. Fall.

Prerequisites: APM206 and GNE172 or equivalents

### **ERE 340 Engineering Hydrology and Hydraulics (4)**

Three hours of lecture and lab per week. Covers watershed hydrology and analysis of rainfall, evapotranspiration, infiltration, and runoff processes as well as hydraulic processes involved with pipe networks, open-channels with flow controls, and groundwater systems. Spring.

Prerequisites: ERE 335, ERE 339 Note: Credit will not be granted for both ERE 340 and ERE 540

### **ERE 351 Basic Engineering Thermodynamics (3)**

Three hours of lecture per week. Principles of energy conservation and conversion: first and second laws. Relation to PVT behavior, property functions, equilibria and heat and mass transfer, and applications to energy and power systems. Introduction to engineering problem analysis and computer methods. Spring.

Prerequisite(s): Physics, general chemistry, and calculus.

### **ERE 365 Principles of Remote Sensing (4)**

Three hours of lecture and three hours of laboratory and discussion per week. A qualitative and quantitative introduction to the fundamentals of acquiring, analyzing and utilizing remote sensing data. Introductory concepts and methods in digital image processing and photogrammetry. Spring.

Prerequisite: ERE 371 Surveying for Engineers. Note: Credit will not be granted for both ERE 365 and ERE 565.

### **ERE 371 Surveying for Engineers (3)**

Two hours of lecture and three hours of lab per week. The principles of plane surveying and position determination for engineers. Subject matter areas include introduction to the theory of measurement and errors, reference surfaces, coordinate systems and datums, horizontal and vertical measurements, traversing and computations, the analysis and treatment of systematic and random errors, foundations of global positioning systems. Laboratory fieldwork and computations culminate in a topographic map. Fall.

Prerequisite: Calculus.

### **ERE 380 Energy Systems Engineering (3)**

Three hours of lecture per week. Covers fundamentals of thermodynamics and power needed for engineering systems analysis and applies methods such as life cycle analysis, sustainability analysis, and environmental impact analysis to non-renewable and renewable energy systems. A portion of the class is spent on open-ended problem solving and engineering design. Spring.

Prerequisite: Physics II, Calculus II, ERE 275 Ecological Engineering

### **ERE 405 Sustainable Engineering (3)**

Three hours of lecture/discussion per week. Will explore and attempt to develop solutions to societal and environmental problems in a changing world that is facing climate change, premium fuel depletion, and regional water shortages. Evaluation of system sustainability using a multidisciplinary framework. Introduction to sustainability metrics, including energy evaluation and life cycle assessment. Application of energy evaluation. Spring.

### **ERE 412 River Form and Process (3)**

Three hours of lecture per week including river field sites. Field-based data collection methods for river classification. Bankfull flow estimates. Classified river form, suggested evolution sequences and governing fluvial processes.

Computational river hydraulics, sediment transport, and issues of channel stability and restoration. Fall.

Prerequisites: ERE340, ERE371, APM395. Note: Credit will not be granted for both ERE 412 and ERE 612.

### **ERE 430 Engineering Decision Analysis (3)**

Three hours of lecture per week. Classical engineering economics: time value of money, nominal and effective interest, and present worth, annual worth, rate of return, and benefit-cost ratio comparison techniques. Identification and evaluation of alternative investment and borrowing decisions, including the role of inflation, depreciation, taxes and uncertainty. Investment theory including the potential risks and rewards associated with investments options. Simulation and optimization techniques to aid in management decisions. Spring.

### **ERE 440 Water and Wastewater Treatment (3)**

Three hours of lecture per week. Two laboratory exercises and one field trip. Introduction to physical, chemical and biological parameters of water and wastewater quality as well as principles of unit operations and processes for water and wastewater treatment. Study of design parameters and design procedures for water and wastewater treatment. Spring.

Prerequisites: FCH 152 General Chemistry II; FCH 153 General Chemistry II Lab; EFB 101 General Biology I Co-requisite: APM 485 Differential Equations Note: Credit will not be granted for both ERE 440 and ERE 640.

### **ERE 444 Hydro-Meteorology (3)**

Three hours of lecture per week. Atmospheric physics, moisture dynamics, and thermodynamics emphasizing feedback loops with precipitation. Quantitative descriptions of stability and dynamics and the development of fronts, cyclones, and thunderstorms. Weather station sensors and data-logger programming. Testing of analysis products, numerical weather models, quantitative precipitation forecasts, and radar precipitation data. Spring.

Prerequisites: Physics 1, Calculus II, permission of instructor.

### **ERE 445 Hydrologic Modeling (3)**

Three hours of lecture per week. An exploration of deterministic and stochastic hydrologic models, model development, and the use of computer programming to construct, calibrate, manipulate, and interpret hydrologic models. Theoretical and analytical approaches to describing hydrologic processes, including precipitation, evapotranspiration, infiltration, surface runoff, percolation, and groundwater discharge. Stochastic techniques include frequency, trend, and regression analyses. Fall.

Prerequisite(s): Introductory computer programming, Probability and Statistics, one year of Calculus. Note: Credit will not be granted for both ERE 445 and ERE 645.

### **ERE 465 Environmental Systems Engineering (3)**

Mathematical models of environmental systems are presented and combined with optimization procedures, decision theory, uncertainty analysis, and engineering economics to develop integrated approaches to the planning, design, and sustainable management of complex environmental systems. Students will be exposed to a variety of optimization algorithms for a wide range of environmental applications. Fall.

Prerequisite(s): APM206 Corequisity(s): APM395

### **ERE 468 Solid and Hazardous Waste Engineering (3)**

Three hours of lecture and discussion. Introduction to solid and hazardous waste regulations. Analysis and design of solid and hazardous waste management systems, including generation, storage, transport, recycling, biological, physical, chemical and thermal treatment; energy recovery; land disposal; environmental protection systems and monitoring. Field trips. Fall.

Pre- or Co-requisites: ERE 340 and ERE 440. Note: Credit will not be granted for both ERE 468 and ERE 568.

### **ERE 475 Ecological Engineering for Water Quality (3)**

Three hours of lecture/seminar/discussion per week. Design and analysis of ecological treatment systems for water quality improvement. Hands-on construction, operation and/or monitoring of engineered ecosystems through group

project activities beyond class meeting times in on-campus labs and a greenhouse. Focusing on constructed wetlands, with minor topics selected by students. Fall.

Prerequisite(s): ERE 440/643 or equivalent. Note: Credit will not be granted for both ERE 675 and ERE 475.

### **ERE 480 Fate and Transport of Contaminants in Environmental Systems (3)**

Three hours of lecture per week. Content covers the movement and reactions associated with contaminants released into environmental systems. The concepts will be applied in a field trip and review of the design, construction and operation of a constructed wetland used in the tertiary treatment of municipal wastewater. Fall.

Prerequisites: General Chemistry I and II, Calculus I and II and Ecological Engineering or equivalent.

### **ERE 485 Fundamentals of Engineering Preparation (1)**

Discussion of content and administration of the Fundamentals of Engineering (FE) Exam, a comprehensive review of FE-type problems, and a targeted review of specific topics on the FE Exam. Spring.

Prerequisite(s): Senior standing or consent of instructor.

### **ERE 488 Engineering Project Management (1)**

Project management strategies for the engineering profession. Readings, exercises and discussion emphasizing professional responsibility and ethical practices; project management; technical communication and teamwork. Team-based scoping and planning of engineering design projects. Fall.

Prerequisite: Senior status ERE students only.

### **ERE 489 Environmental Resources Engineering Planning and Design (3)**

Two hours of lecture and three hours of laboratory. A capstone course to integrate engineering coursework with the engineering design process to solve interdisciplinary environmental problems. Semester-long project provides experience in problem analysis, teamwork, project management, engineering ethics, and professional communication. Spring.

Prerequisites: Senior standing in Environmental Resources Engineering, ERE 488

### **ERE 496 Special Topics (1 - 3)**

Lectures, readings, problems and discussions. Topics in environmental or resource engineering as announced. Fall and/or Spring.

### **ERE 498 Research Problem in Environmental Resources Engineering (1 - 3)**

Independent research in topics in environmental resources engineering for the highly motivated undergraduate student. Selection of subject area determined by the student in conference with appropriate faculty member. Tutorial conferences, discussions and critiques scheduled as necessary. Fall, Spring.

Prerequisite: Permission of instructor.

### **ERE 511 Ecological Engineering in the Tropics (3)**

One hour of discussion per week with intensive spring break field study in a Caribbean country. Principles of ecological engineering for ecosystem restoration and pollution control. Field trips to pristine and degraded ecosystems including: humid tropical cloud forests, coastal mangrove, dry mountain forests, and coral reefs to identify target functions for nature and society, observe degradations, and develop sustainable restoration designs. ERE 511 students will perform the additional work of writing a 15-page research paper. Spring.

Prerequisites: 1 course in calculus, biology, and chemistry. Note: Credit will not be granted for both FEG 311 and ERE 511.

### **ERE 519 Green Entrepreneurship (3)**

Three hours of lecture/discussion per week. Explore challenges and goals of creating a start-up venture in environmental science or technology. Recognize trends in the marketplace, and where commercial opportunities can be created. Analyze feasibility and potential to create a sustainable venture. Other topic areas include critical success

factors and key start-up issues unique to science and technology firms. Spring.

Pre- or Co-requisites: FOR 207 Introduction to Economics or equivalent; or permission of instructor.

### **ERE 527 Stormwater Management (3)**

Three hours of lecture per week. One Saturday field trip. Techniques for urban stormwater and erosion control and analysis of associated water quality impacts. Review of applicable regulations and design standards. Students will engage in individual and team-oriented activities such as lecture, discussion, observation, computation, reading and writing. In addition, students are required to participate in a Saturday field trip where examples of stormwater management facilities will be reviewed. Students will, in small teams, generate a design for a stormwater management alternative at a local site. Fall.

Prerequisite: FEG 340 or equivalent as determined by instructor.

### **ERE 530 Numerical and Computing Methods (3)**

Three hours of lecture/discussion per week. Programming skills and computing techniques using state-of-the-art software packages. Applications of programming and computing methods for solving geospatial, ecological, and/or water resource engineering problems. Fall.

Prerequisite(s): Differential Equations.

### **ERE 540 Engineering Hydrology and Hydraulics (3)**

Three hours of lecture per week. Covers watershed hydrology and analysis of rainfall, evapotranspiration, infiltration, and runoff processes as well as hydraulic processes involved with pipe networks, open-channels with flow controls, and groundwater systems. Problem sets, modeling exercises and a research project report are required. Spring.

Prerequisites: Fluid Mechanics, Computer Programming. Note: Credit will not be granted for both ERE 340 and ERE 540

### **ERE 545 Environmental Soil Physics (3)**

2 hours lecture, 3 hours lab per week. Soil water content and potential, steady water flow in saturated soil, heat flow in soil, transient water flow. Field methods to obtain data for analysis and modeling. Application of analytical and numerical solutions to describe heat and water fluxes in the soil-plant-atmosphere continuum, unsaturated zone hydrology, and solute transport. Fall.

Prerequisite: PHY 211, APM 485, ERE 339, or equivalent

### **ERE 551 GIS for Engineers (3)**

Two hours of lecture and three hours of laboratory per week. Introduction to fundamental concepts in geographic information systems (GISs) with a focus on engineering applications. Fundamental concepts and development of geographic information systems including models and georeferencing systems used to represent and characterize spatial data. Data processing including collection and preprocessing, data management, spatial analysis and manipulation, and data output. Necessity and utility of spatial data in engineering design analysis. Fall.

Prerequisite: Calculus. Co-requisite: ERE 371 or equivalent.

### **ERE 553 Introduction to Spatial Information (1)**

Three hours of lecture per week for the first third of the semester. An introduction to spatial terminology and methods for determining and expressing position. Examination of accuracy and precision in the context of horizontal measurements. Issues with subsequent use of measurements for producing maps and performing analysis. Fall.

### **ERE 565 Principles of Remote Sensing (4)**

Three hours of lecture and three hours of laboratory and discussion per week. A qualitative and quantitative introduction to the fundamentals of acquiring, analyzing and utilizing remote sensing data. Introductory concepts and methods in digital image processing and photogrammetry. Spring.

Prerequisite: ERE 371 Surveying for Engineers or permission of instructor. Note: Credit will not be granted for both FEG 365 and ERE 565.

**ERE 566 Introduction to Global Positioning Systems (1)**

Three hours of lecture per week for the last third of the semester. An introduction to the theory and practice of performing global positioning system (GPS) measurements. Comparison of accuracy potential for different GPS equipment and techniques. Exploration of error sources that reduce the accuracy of GPS measurements. Collection of GPS data. Fall.

**ERE 568 Solid and Hazardous Waste Engineering (3)**

Three hours of lecture and discussion. Introduction to solid and hazardous waste regulations. Analysis and design of solid and hazardous waste management systems, including generation, storage, transport, recycling, biological, physical, chemical and thermal treatment; energy recovery; land disposal; environmental protection systems and monitoring. Field trips. Fall.

Note: Credit will not be granted for both ERE 468 and ERE 568.

**ERE 570 Hydrology in a Changing Climate (3)**

Three hours of lecture/discussion per week. Drawing on a growing body of academic literature focused on better understanding the degree of uncertainty in future climate, this class provides the technical background to interpret and apply predictions of future climate changes (as primarily related to hydrology) in different locales and at different scales. Specific topics include: frequency analysis under non-stationary conditions, misconceptions in linkages between hydrology and climate, accessing and manipulating climate model files (netcdf), and strategies for decision making under uncertainty. Spring.

Prerequisite: basic programming knowledge and prior hydrology/water resources class

**ERE 605 Sustainable Engineering (3)**

Three hours of lecture/discussion per week. Introduction to sustainability metrics, such as energy evaluation and life cycle assessment. application of energy evaluation. Explore and evaluate potential solutions to societal and environmental problems in a changing world that is facing climate change, premium fuel depletion, and regional water shortages. Evaluation of system sustainability using a multidisciplinary framework. Spring.

Prerequisites: Ecological engineering or permission of instructor

**ERE 612 River Form and Process (3)**

Three hours of lecture per week including river field sites. Field-based data collection methods for river classification. Bankfull flow estimates. Classified river form, suggested evolution sequences and governing fluvial processes. Computational river hydraulics, sediment transport, and issues of channel stability and restoration. Fall.

Prerequisites: Engineering Hydrology and Hydraulics, Engineering Probability and Statistics. Note: Credit will not be granted for both FEG 412 and ERE 612.

**ERE 621 Spatial Analysis (3)**

Three hours of lecture and discussion per week. Spatial statistics and modeling as applied to various data formats: single point data, continuous data and area data. First and second order effects, complete spatial randomness, tessellation, kernel, covariograms and variograms, kriging, distance measures, correlation/correlogram. Fall.

Prerequisite(s): APM391, FEG335 or permission of instructor.

**ERE 622 Digital Image Analysis (3)**

Three hours of lecture and discussion per week. Elements of digital image processing and analysis systems: Digital image representation, visual perception, sampling and quantization, pixel connectivity, Fourier transforms, image enhancement, filtering, image segmentation, edge detection, thresholding, representation schemes, descriptors, morphology, recognition and interpretation. Spring.

Prerequisite(s): APM391, FEG335 or permission of instructor.

**ERE 640 Water and Wastewater Treatment (3)**

Three hours of lecture per week. Two laboratory exercises, one field trip and an individual or group project.

Introduction to physical, chemical and biological parameters of water and wastewater quality as well as principles of unit operations and processes for water and wastewater treatment. Study of the design parameters and design procedures for water and wastewater treatment. Spring.

Prerequisite(s): General chemistry, microbiology. Co-requisite: Differential equations. Note: Credit will not be granted for both ERE 440 and ERE 640.

### **ERE 644 Hydro-Meteorology (3)**

Three hours of lecture per week. Atmospheric physics, moisture dynamics, and thermodynamics emphasizing feedback loops with precipitation. Quantitative descriptions of stability and dynamics and the development of fronts, cyclones, and thunderstorms. Weather station sensors and data-logger programming. Testing of analysis products, numerical weather models, quantitative precipitation forecasts, and radar precipitation data. Spring. Prerequisites:

Physics, Calculus II, permission of instructor

Prerequisites: Physics, Calculus II, permission of instructor.

### **ERE 645 Hydrologic Modeling (3)**

Three hours of lecture per week. An exploration of deterministic and stochastic hydrologic models, model development, and the use of computer programming to construct, calibrate, manipulate, and interpret hydrologic models. Theoretical and analytical approaches to describing hydrologic processes, including precipitation, evapotranspiration, infiltration, surface runoff, percolation, and groundwater discharge. Stochastic techniques include frequency, trend, and regression analyses. Fall.

Prerequisite(s): Introductory computer programming, Probability and Statistics, 1 year of Calculus. Note: Credit will not be granted for both ERE 445 and ERE 645.

### **ERE 665 Environmental Systems Engineering (3)**

Mathematical models of environmental systems are presented and combined with optimization procedures, decision theory, uncertainty analysis, and engineering economics to develop integrated approaches to the planning, design, and sustainable management of complex environmental systems. Students will evaluate and present a variety of optimization algorithms for a wide range of environmental applications. Fall.

Prerequisite(s): APM206 Corequisite(s): APM395

### **ERE 674 Methods in Ecological Treatment Analysis (3)**

Two hours of lecture/seminar/discussion and three hours of lab per week. Introduction to the components and design principles of engineered ecosystems for water quality improvement. Common lab exercises for a comprehensive analysis of an engineered ecosystem, including water quality, reaction kinetics, hydraulic characteristics, vegetation, soil and gravel, and microbial community. Discussion on experimental procedures and data analysis. Spring.

### **ERE 675 Ecological Engineering for Water Quality (3)**

Three hours of lecture/seminar/discussion per week. Design and analysis of ecological treatment systems for water quality improvement. Hands-on construction, operation and/or monitoring of engineered ecosystems through group project activities beyond class meeting times in on-campus labs and a greenhouse. Focusing on constructed wetlands, with minor topics selected by students. This course is differed from ERE 475 by conducting a group project to address treatment mechanisms and synthesize experimental results and other groups' operational data. Fall.

Prerequisite(s): ERE 440/643 or equivalent. Note: Credit will not be granted for both ERE 475 and ERE 675.

### **ERE 692 Remote Sensing of the Environment (3)**

Three hours of lecture/discussion per week. Understanding of various remote sensing systems, their applications, and advanced digital image processing techniques. Analysis of satellite and airborne-acquired remote sensing data. Spring.

Prerequisite(s): FEG 365 or equivalent introduction to remote sensing.

### **ERE 693 GIS-Based Modeling (3)**

Three hours of lecture/discussion per week. Geographical, temporal, environmental modeling concepts using GIS-based modeling languages and techniques. Various modeling concepts and techniques including spatial interpolation, suitability/capability modeling, hydrologic modeling, diffusion modeling, calibration, optimization, accessibility modeling, and rainfall-runoff modeling. Fall.

Prerequisite(s): ERE 551 or equivalent.

### **ERE 797 Research Methods in Environmental Resources Engineering (1 - 3)**

One to three hours of discussion/seminar per week. Introduction to research facilities, opportunities, and responsibilities of graduate scholarship. Discussion of ERE research topics, including journal reading, proposal formulation, funding, and engineering tools. Use of scholarly resources including e-journals, web, proposal development, and presentations. Fall and Spring.

### **ERE 798 Research in Environmental Resources Engineering (1 - 12)**

Independent research topics in Environmental Resources Engineering. Fall, Spring or Summer.

Credit hours to be arranged.

### **ERE 898 Professional Experience/Synthesis (1 - 6)**

A supervised, documented professional work experience in the Master of Professional Studies degree program. Fall, Spring or Summer.

Prerequisite: Approval of proposed study plan by advisor, Department, and any sponsoring organization.

### **ERE 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's degree and thesis. Fall, Spring and Summer.

### **ERE 999 Doctoral Thesis Research (1 - 12)**

Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

### **ESC 132 Orientation Seminar (1)**

One hour of lecture or discussion each week. Introduction to campus facilities, personnel, lower-division curriculum and upper-division study options within the Environmental Science program. Fall.

### **ESC 296 Special Topics in Environmental Science (1 - 3)**

One to three hours of class meetings per week. Special topics of current interest to lower-division undergraduate students in environmental science. A detailed course subject description will be presented as a topic area is identified and developed. Fall and Spring.

Prerequisite: Permission of instructor.

### **ESF 109 Honors Seminar in Environmental Science and Forestry (1)**

One hour of lecture/discussion per week. Sequential presentations by ESF faculty and staff members. Exploration of science, engineering, design, management and social science applied to regional, national and global issues. A written report and presentation is required. Fall.

Prerequisite: Admission to the lower division Honors Program.

### **ESF 122 The Ecology of the Economic Process (3)**

An approach to economics as a natural, rather than a social science. Examination of the ecology of human-dominated ecosystems including cities, agricultural areas, and fisheries. Review of basic ideas of value, classical, neoclassical, and biophysical economics. Examines an alternative model emphasizing analysis of energy and material flows and their control. Case studies will focus on the developing economies of the tropics. Pre-Req: Enrollment in ESF in the High School.

Prerequisite(s): High School Living Environment (Biology) Co-requisite(s): High School Economics

### **ESF 200 Information Literacy (1)**

Three hours of lecture/discussion per week for five weeks. Introductory course for students of all levels and all

curricula to the basic research process for information retrieval and management. Emphasis on electronic bibliographic and Internet research tools. Fall and Spring.

**ESF 209 Honors Seminar in Environmental Science and Forestry (1)**

One hour of presentation and discussion per week. Sequential presentations by students, or faculty, or both. Exploration of science, engineering, design, management and/or social science applied to regional, national and global environmental issues. A presentation and/or a written report may be required. Fall.

Prerequisite: Admission to the lower division Honors Program.

**ESF 300 Introduction to Geospatial Information Technologies (3)**

Two hours of lecture and three hours of laboratory per week. A theoretical and practical course providing an introduction to the uses and limitations of geospatial information technologies, including geographic information systems (GIS), global positioning systems (GPS) and remote sensing, for environmental science and natural resources management applications. Fall and Spring.

**ESF 499 Honors Thesis/Project (1 - 5)**

Guided independent study in a topic related to the student's undergraduate major, resulting in a thesis/project. Students will give an honors presentation of their work. Fall and Spring.

**ESF 503 Seminar on University Outreach and Public Service (1 - 3)**

One- to three-credit seminar examines processes and strategies designed to enhance the scholarship and practice of university-based outreach and public service with an emphasis on relationships with K-12 schools and community organizations. Spring.

**ESF 797 Graduate Seminar on Information Resources (1)**

One hour of lecture/discussion per week. Searching for and evaluating information resources. Using citation management software. Preparing to write the research proposal and write and defend subsequent thesis/dissertation. Student presentations on information tools, thesis/dissertation research topics, formation of problem statement. Spring.

**EST 132 Introduction to Environmental Studies (3)**

Three hours of lecture, discussion and analytical activities per week. Gateway course for EST majors. Introduction to the study of environmental problems in the social sciences and humanities. Topics: pollution, conservation, preservation, human health, ecosystem health, limits to growth, sustainability, ecosystems, population, energy, risk and traditional knowledge. Fall.

**EST 140 Introduction to Native Peoples, Lands & Cultures (3)**

Three hours of lecture/discussion per week. Introductory survey of the history, geography, economy, and culture of Native Americans from prehistory to present, with special attention to the Great Lakes region/upstate New York and environmental topics. Draws on texts, films, guest speakers, and other resources. Spring.

**EST 200 Cultural Ecology (3)**

Three hours of lecture/discussion/oral presentations per week. Students develop skills and fluency in preparing, delivering and evaluating multicultural and traditional environmental management and decision-making. Emphasis is on situations encountered in the environmental professions. Case studies pose ethical questions, which challenge students to apply theory and analysis to each case. Topics also include interactions of culture and environment, relationship between traditional and scientific knowledge and co-management as multicultural decision making. Self-evaluation and peer evaluations are emphasized. Fall or Spring.

**EST 201 US History Reconstruction to the Present (3)**

Three hours of lecture/discussion per week. History of changes occurring in America post 1865 including land use, government, economic and international relations. Spring.

**EST 202 American History: From Discovery to Civil War (3)**

Three hours of lecture/discussion per week. A survey of American history considering the origin and development of American institutions and ideals, from the discovery of the New World through the Civil War. Students are introduced to works of major historians and to various interpretations of American history.

Prerequisite(s): none.

**EST 220 Urban Ecology (3)**

Two hours lecture/discussion, three hours of outdoor laboratory per week. Explores the city from an ecosystems perspective. Addresses the role and importance of science, engineering, the design professions, and community participation in creating livable communities. Environmental equity and justice are addressed. Fall.

**EST 221 Introduction to American Government (3)**

Three contact hours per week. Describes American political system and its roles and functions in society. Examines how political processes change over time, including the role of rhetoric and argumentation in policy development. Explores critical analysis of political phenomena. Fall.

**EST 230 China Experience (3)**

Forty five hours (equivalent) of lecture and field studies. General survey of the history of China from ancient societies through the current time, with attention to cultural, ecological and natural resource issues focused on selected localities of China. The locality and/or hot spots will be selected from: the invention of paper; printing technology; renewable energy; anaerobic digestion of manual / plant biomass; wastewater treatment; Great Walls; Forbidden City; Three Gorges area; Canals; Chinese gardens; Sichuan; Dujianyang Irrigation Dam/Channels; Panda preservation; Hakka culture; Tibetan culture; plants and vegetation, etc. Analysis of the evolution of the Chinese culture. Historical and contemporary influences of China. Spring, Fall or Summer.

**EST 231 Environmental Geology (3)**

Three hours of lecture and discussion per week. Environmental Geology is an applied field of study that uses geological information to assist in resolving human conflicts related to land use issues, environmental damage, and resource use. Topics include natural resources, energy, environmental pollution, waste disposal, geological hazards and climate change. Spring.

**EST 245 Foundations of Environmental Communication (3)**

Three hours of lecture/discussion per week. Survey of environmental communication, including nature representations in popular culture, and the role of mass media on public perceptions of environmental issues. Topics also include strategic communication, public participation in environmental decision-making, and environmental risk perception. Exposure to communication theory and social scientific and humanities-based approaches. Fall.

Prerequisite(s): none.

**EST 255 Research Methods for Environmental Studies (3)**

Three hours of lecture, discussion and analytical activities per week. An introductory methods course focused on research techniques used in environmental and natural resources social science research. This course reviews quantitative and qualitative methodologies for environmental studies research including but not limited to questionnaires, in-depth interviews, rhetorical critiques and content analyses. Spring.

Pre- or Co-requisite: EWP 290

**EST 296 Special Topics in Environmental Studies (1 - 3)**

Experimental, interdisciplinary or special coursework at the freshman or sophomore levels. Subject matter and course format vary from semester to semester or offering on the basis of needs and objectives of the course. Fall or Spring.

**EST 301 Leadership through Mentoring (1)**

Biweekly meetings with instructors and with first-year student groups. Advanced leadership training for students in

the ESF Peer Mentoring Program. Use of online resources to augment person-to-person interactions and group meetings. Fall.

Prerequisites: Upper division class standing, participation in the Peer Review Mentoring Program, and successful completion of Orientation Leader training.

### **EST 321 Government and the Environment (3)**

Three contact hours per week. Examines the relationship between government and the environment, primarily in the U.S. Introduces environmental policy, including the policy making process. Reviews legal framework and current issues in several thematic areas (e.g., air, water, hazardous waste, and endangered species protection). Spring

### **EST 353 Environmental Psychology (3)**

Three hours of lecture per week. Overview of theory, research, and methods in environmental psychology and sustainable behavior. Explores the role of human behavior as a root cause of environmental degradation and examines the contribution of individual and societal processes. The cognitive-behavioral perspective is emphasized in understanding these issues. Fall, odd years.

Prerequisites: Introductory psychology; junior status or permission of instructor.

### **EST 361 History of the American Environmental Movement (3)**

Three hours of lecture and discussion per week. The historic and cultural origins and evolution of this complex, multifaceted social phenomenon called the environmental movement and its influence on public policies, values and lifestyles. The events, personages, philosophies and historical/cultural processes that marked and continue to drive various, competing attitudes toward nature, even within the United States environmental movement. Fall.

### **EST 366 Attitudes, Values and the Environment (3)**

Three hours of lecture per week. Historical roots of environmental attitudes, values, and ethics with special emphasis on how individual attitudes impact environmental issues. Perspectives on man's relationship and responsibility to nature. Value implications of ecological principles and concepts. Examples of current environmental issues are examined in this context. Fall, even years.

Prerequisites: Junior status or permission of instructor.

### **EST 388 Psychological Principles of Risk Communication (3)**

Three hours of lecture and discussion per week. Presents socio-psychological principles and theoretical underpinnings guiding the applied social science approach to environmental risk communication issues. Three overlapping themes will be considered and linked: how communities cope with environmental hazards, how risk information is cognitively processed and evaluated and how risk communication influences perception, evaluation and behavior. Spring, even years.

Prerequisite: Upper-division status.

### **EST 390 Social Processes and the Environment (3)**

Three hours of lecture/discussion per week. Explores alternative ways of explaining the relationship between social processes and environmental conditions. Analyzes classical and modern social theories and applies their insights to questions of human-environment interaction. Introduces qualitative social science research methods and the social construction of environmental meaning. Fall or Spring.

### **EST 393 Environmental Discourse and Communication (3)**

Three hours of lecture and discussion per week. Considers the role of communication and political discourse in shaping perceptions of nature and environmental issues/problems. Explores a variety of interpersonal, group, organizational and mass communication theories and a wide range of environmental discourses using examples of written, visual, broadcast, and electronic communication. Spring.

Prerequisite: Junior standing, and either EST 245 or permission of instructor.

### **EST 395 Public Communication of Science and Technology (3)**

Three hours of lecture/discussion per week. Survey of public communication of science and technology (PCST). Considers the structure, meanings, and implications of PCST, including contexts in which it occurs. Topics also include motivations and constraints of those who produce PCST, and function of PCST in contemporary society. Exposure to communication theory and social scientific research methods and analysis. Spring.  
Prerequisite(s): EST 245 and junior standing, or permission of the instructor.

### **EST 400 Senior Paper (3)**

Individual study of an environmental topic resulting in a formal report that meets the requirements for an environmental studies synthesis experience. These requirements are identified in course meetings. Enrollment is restricted to environmental studies seniors. Fall and Spring.

### **EST 401 Environmental Ethics and Culture: Perspectives on the Adirondack Park (3)**

Introduction to the ethics of land-use conflicts in the Adirondacks, NY. This course links the philosophical history of ethics with contemporary principles of environmental ethics and advocacy. Topics include agency, ethics, value theory, morality and responsibility in the context of ongoing regional debates. Requires concurrent registration with other Sustaining the Park courses. Fall, Newcomb Campus.  
Prerequisite(s): none. Co-requisites: EFB 411, EST 402, EST 403, EST 404.

### **EST 402 Diverse Perspectives on a common landscape: Experiencing the Adirondack Park (3)**

Two hours of lecture and three hours per week of immersion in Adirondack issues including introduction to diverse stakeholders and perspectives through non-governmental, agency, and community meetings; interaction with an array of regional experts through special panel discussions; and field trips to and private tours of historic and cultural sites and institutions. Requires concurrent registration with other Sustaining the Park courses. Fall, Newcomb Campus.  
Prerequisite(s): none. Co-requisites: EFB 411, EST 401, EST 403, EST 404.

### **EST 403 Sustainable Development: An Adirondack Park Case Study (3)**

A place based study of the concepts of sustainable development and their application. Students will learn of the role of historical precedence and current context in approaching planning and policy for a sustainable future. The course will combine lecture, discussion, student led seminars and writing that illustrates both skills in analysis and synthesis. Class will meet once a week for three hours for fourteen weeks at the ESF Newcomb campus, and may require occasional field trips. Requires concurrent registration with other Sustaining the Park courses. Fall, Newcomb Campus.  
Prerequisites: none. Co-requisites: EFB 411, EST 401, EST 402, EST 404.

### **EST 404 Using Past Exp. to Inform Future Managmt: Synthesizing the Adirondack Park (3)**

Three hours of lecture/seminar/discussion per week. Synthesis of experiences, content and insights gained during the "Sustaining the Adirondack Park" residential semester, including Capstone research and production of an independent position paper and collaborative comprehensive management plan. Requires concurrent registration with other Sustaining the Park courses. Fall, Newcomb Campus.  
Prerequisite(s): none. Co-requisites: EFB 411, EST 401, EST 402, EST 403.

### **EST 412 Advanced Leadership Through Mentoring (2)**

Two hours of seminar/discussion for ten weeks. Returning mentors to the Student-to-Student Mentoring Program will help train peers while mentoring first year students. Topics include small group dynamics, diversity, time management, community service, public speaking, team-building, problem-solving, and interactive styles. Spring.  
Prerequisite(s): EST 301 Leadership Through Mentoring. Acceptance into Orientation Leader Program and Student-to-Student Mentoring Program.

### **EST 423 Rhetorical Practices in Environmental Communication (3)**

Three hours of lecture, discussion and analytical activities per week. An advanced methods course focused on the research of rhetorical appeals and practices used in environmental and natural resources discourse and decision-making. This course reviews different methodologies for communication research including rhetorical critiques, content analyses and thematic analyses. Fall.

Prerequisite(s): EWP 220 and EWP 290

### **EST 426 Community Planning and Sustainability (3)**

Three hours of lecture and demonstration per week. Presents ecological planning and development concepts and theory guiding local and global initiatives for sustainable development. Overlapping themes are considered and linked: the relationship between landscape patterns reflecting wealth, poverty and environmental quality; the role of efficiency in reducing environmental impacts; and the questions of environmental equality, and the quality of development. Fall.

### **EST 427 Environmental and Energy Auditing (3)**

Three hours of lecture, demonstration, and discussion per week. Presents environmental and energy auditing concepts and theory guiding local and regional initiatives for greenhouse gas production and energy use reduction. This course utilizes a practicum approach through use of inventory and analysis tools by student teams for project application. Spring.

Note: Credit will not be granted for both EST 427 and EST 627.

### **EST 450 Sustainable Enterprise (3)**

Three hours of classroom/presentation per week. Economic, social, and environmental dimensions of sustainability and their interdependence. Influences on organizations to adopt sustainable approaches to operations and activities. Tools to validate organizational sustainability. Transdisciplinary emphasis. Fall.

Note: This course is cross-listed at SU School of Management as LPP/SHR 450.

### **EST 460 Land Use Law (3)**

Three hours of lecture and discussion per week. This course provides an understanding of U.S., state and local laws affecting land use in New York in the context of current environmental policy debates. Students learn to recognize and analyze legal issues involving land use in varying contexts. Spring.

Prerequisites: EST 221 or permission of the instructor. Note: Credit will not be granted for both EST 460 and EST 660.

### **EST 493 Environmental Communication Workshop (3)**

Three hours of cooperative learning activities, lecture and discussion per week. A workshop format on a specified environmental program or issue introduces the theories and skills of alternative dispute resolution approaches, public participation structures and dynamics, public policy decision making and implementation, risk communication, leadership styles, and small group dynamics. Spring.

Prerequisite: Senior status or permission of instructor.

### **EST 494 Senior Seminar in Environmental Studies (1)**

Two-hour seminar every two weeks. For all seniors in Environmental Studies. Students will prepare portfolios and give capstone presentations on their senior synthesis project and develop career goals and plans. Spring.

Prerequisites: Limited to graduating seniors in the Department of Environmental Studies.

### **EST 495 Selected Readings in Environmental Studies (1 - 3)**

An in-depth and independent exploration of selected readings from the environmentally related literature. Emphasis is placed on gaining insights and understanding from the readings, rather than producing an extensive bibliography. Fall, Spring and Summer.

Prerequisite: Approval of study plan by instructor.

### **EST 496 Special Topics in Environmental Studies (1 - 3)**

Special topics of current interest to undergraduate students in environmental studies and related fields. A detailed course subject description will be presented as the topic area is identified and developed. Fall, Spring and Summer.  
Prerequisite: Permission of instructor.

### **EST 498 Introductory Research Problems (1 - 3)**

Guided individual study of an environmental topic. Emphasis is on the study procedure and the methods employed. Enrollment is possible at various times during the semester. Fall, Spring and Summer.  
Prerequisite: Approval of study plan by instructor.

### **EST 499 Environmental Studies Internship (1 - 12)**

Internships provide students with a supervised field experience to apply and extend their academic abilities in a professional working environment. Enrollment is possible at various times during the semester. Fall, Spring and Summer.  
Prerequisites: Environmental Studies senior status and written approval of an internship contract by major professor, curriculum director and field supervisor.

### **EST 550 Environmental Impact Analysis (3)**

Three hours of lecture per week. The law, administration and natural/social science basis of the environmental impact assessment process in the federal government and New York state. Spring.  
Prerequisite: Graduate matriculation or permission of instructor.

### **EST 600 Foundations of Environmental Studies (3)**

Three hours of lecture/discussion per week. Examines frameworks for understanding and solving environmental problems. Familiarizes students with the epistemological foundations of environment-society relations. Considers multiple methodological and analytical strategies. Uses a case study method to exemplify key principles. Fall.  
Prerequisites: Undergraduate courses in general ecology, environmental science and policy or communication theory.

### **EST 603 Research Methods and Design (3)**

Three hours of lecture/discussion per week. Comprehensive survey of research methods and design for Environmental Studies. Topics covered include the scientific method; research design; quantitative, qualitative, and mixed research methods; sampling; data collection techniques; data analysis and interpretation; research ethics; and research proposal development. Fall.

### **EST 604 Social Survey Research Methods for Environmental Issues (3)**

Three hours of lecture and discussion per week. Provides a critical overview of survey methods used to study human dimension of environmental problems. Explores fundamental theories, techniques, and applications of environmentally related social survey research processes. Design of original survey research and critical assessment of existing research. Spring, odd years.  
Prerequisite: Undergraduate basic statistics course.

### **EST 605 Qualitative Methods (3)**

Three hours of lecture and discussion per week. Survey of the generally recognized paradigms and methods that qualitative researchers use to better understand, evaluate, and perhaps influence complex social phenomenon. Research proposal, pilot study, final report and oral presentation required. Spring, even years.

### **EST 606 Environmental Risk Perception: Implications for Communication and Policy (3)**

Three hours of lecture and discussion per week. Concepts, problems and research related to the assessment and management of environmental hazards in our society. Current psychological, sociological and cultural theories in risk perception, communication, and policy. Emphasis on the interplay between science, politics, law, values and public opinion. Fall.  
Prerequisites: Coursework in psychology, sociology or policy recommended.

### **EST 608 Environmental Advocacy Campaigns and Conflict Resolution (3)**

Three hours of lecture and discussion per week. Addresses complex dynamics, strategies, and tactics of 1) organized campaigns by grassroots to international organizations to advocate for particular environmental policy and 2) processes that seek to resolve, manage, or prevent environmental conflicts when appropriate. Readings, simulations, projects, and case study analysis. Fall.

### **EST 609 Collaborative Governance Processes for Environmental and Natural Resource Management (3)**

Three hours of lecture and discussion per week. Introduces the evolution of innovative multistakeholder processes that characterize collaborative governance (CG). Distinguishes CG from traditional public involvement and dispute resolution approaches, and explores its challenges and opportunities. Provides knowledge and introductory tools to design and be more productive participants in collaborative processes. Spring, odd years.

### **EST 612 Environmental Policy and Governance (3)**

Three hours of lecture and discussion per week. Examination of the dynamic relationships present in the creation and implementation of environmental policies. Considers the roles of the state, the private sector, and nongovernmental organizations. Explores background and implications of recent trends in environmental management. Spring.

### **EST 625 Wetland Management Policy (3)**

Three hours of lecture and discussion per week. International, national, and local wetland management and conservation issues. Application of methods of policy research, critical evaluation and design of wetland management issues including delineation, functional evaluation, wetland banking, and property rights issues. Research paper required. Fall, odd years.

Prerequisite: EFB 542 or equivalent.

### **EST 626 Concepts and Principles of Sustainable Development (3)**

Three hours of lecture and discussion per week. Presents ecological and development concepts and theory guiding local and global initiatives for sustainable development. Four overlapping themes are considered and linked: the relationship between patterns of wealth, poverty and environmental quality; the role of efficiency in reducing environmental impacts; the theme of frugality and sufficiency in advancing development; the questions of environmental equality, and the quality of development. Fall or Spring.

### **EST 627 Environmental and Energy Auditing (3)**

Three hours of lecture, demonstration, and discussion per week. Presents environmental and energy auditing concepts and theory guiding local and regional initiatives for greenhouse gas production and energy use reduction. This course utilizes a practicum approach through use of inventory and analysis tools by student teams for project application. Spring.

Note: Credit will not be granted for both EST 427 and EST 627.

### **EST 635 Public Participation and Decision Making: Theory and Application (3)**

Three hours of discussion, presentation and exercises per week. Provides a student with fundamental theories and techniques for developing and applying citizen participation strategies and conflict resolution as they relate to environmental science and planning decision making. Spring.

### **EST 640 Environmental Thought and Ethics (3)**

Three hours of discussion per week. Critical interdisciplinary introduction to philosophical, religious, cultural and historical dimensions of environmental affairs. How ecologically significant cultural assumptions, ideologies, representations, and institutionalized practices contribute to human meanings and relationships to other-than-human-nature. Special attention to the role of language and questions of environmental ethics and ontology. Fall.

### **EST 645 Mass Media and Environmental Affairs (3)**

Three hours of discussion per week. Introduces the mass media's role in environmental affairs. Relationships between

media organizations, technology, content, and audiences frame examination of how nature and environmental issues and problems are engaged by the media and with what consequences. News and current affairs, advertising and entertainment genres are considered. Fall.

### **EST 650 Environmental Perception and Human Behavior (3)**

Three hours of lecture and discussion per week. Application of environmental perception and human behavior paradigms and theories in understanding the causes and potential solution strategies to environmental issues. Interdisciplinary approach utilizes concepts, theories and research from disciplines including environmental psychology, sociology, anthropology, and risk perception to understand the myriad influences on human behavior as it relates to environmental impacts. Spring.

### **EST 660 Land Use Law (3)**

Three hours of lecture and discussion per week. This course provides an understanding of U.S., state and local laws affecting land use in New York, in the context of current environmental policy debates. Students learn to recognize and analyze legal issues involving land use in varying contexts. Spring.

### **EST 695 Environmental Journalism (3)**

Three hours of lecture per week. This course covers a range of topics related to journalism: interviewing, writing the lead, style, writing and organizing the story, layout, editing and revising, writing features and follow-up stories, covering speeches, etc. In addition, students explore how the media covers scientific and environmental issues. Students work on writing skills--from basic editing techniques to more sophisticated areas of style. Spring.

### **EST 696 Special Topics in Environmental Studies (1 - 3)**

One to three hours of lecture and discussion per week. Experimental and developmental courses in new areas of interest to environmental studies faculty and graduate students not covered in regularly scheduled courses. Fall and Spring.

### **EST 702 Environmental and Natural Resource Program Evaluation (3)**

Three hours of lecture and discussion per week. The systematic analysis of public environmental programs with an emphasis on the evaluation of resultant environmental outcomes. Topics include evaluation contexts, objective setting, environmental monitoring, and analysis of agency organization and procedures. Spring.

### **EST 705 Environmental Policy Analysis (3)**

Three hours of lecture/discussion per week. This course covers current and classic literature in environmental policy analysis, as well as a variety of approaches to policy analysis that are relevant for working through complex environmental issues. While tools and methods for policy analysis will be treated, the overall intention of the course is to provide students with the scholarly background to think analytically, critically, and creatively across a variety of environmental policy contexts. Fall.

Prerequisite(s): A graduate-level course in environmental policy.

### **EST 708 Social Theory and the Environment (3)**

Three hours of seminar/discussion per week This course is an advanced graduate seminar that covers social theory related to the environment. Students will be exposed to foundational literature in environmental sociology in the first part of the course, after which other social science literatures will be explored that analyze the relationship between environment and society, such as Political Ecology, Environment and Citizenship, Environmental Governance, Geographies of Energy, Sustainability Indicators and Standards, Ecological Modernization, and Environmental Justice, among others. Environmental issues and scholarship from both industrialized and developing country contexts, and that represent a variety of social science disciplinary perspectives, will be discussed. Spring.

Prerequisite(s): EST 600 or consent of instructor.

### **EST 796 Advanced Topics in Environmental Studies (1 - 3)**

One to three hours of classroom instruction per week. Lectures and discussions, seminars, conferences and group research on advanced topics of special or current interest to environmental studies faculty and graduate students. Fall and Spring.

**EST 797 Environmental Studies Seminar (1 - 3)**

One to three hours of classroom instruction/discussion per week. Discussion of current topics and research related to environmental studies. Fall and Spring.

**EST 798 Problems in Environmental Studies (1 - 3)**

One to three hours of supervised individual activity per week. Individualized, special study of environmental studies subjects and issues. Comprehensive oral or written report required for some problems. Fall, Spring and Summer.

**EST 898 Professional Experience (1 - 12)**

Variable number of hours of professional experience per week. Professional experience which applies, enriches and/or complements formal coursework. Graded on an "S/U" basis. Fall, Spring, and Summer.

**EST 899 Master's Thesis Research (1 - 12)**

One to 12 hours of supervised individual activity per week. Research and independent study for the master's degree and thesis. Fall, Spring, and Summer.

**EWP 190 Writing and the Environment (3)**

Three hours of lecture, discussion, and workshops per week. Introduction to academic writing, reading, and research, reflecting college-level literacy skills of analysis, argument, and critical thinking. The course includes frequent informal writing assignments and three formal writing projects requiring revision. An oral presentation is required. Fall.

**EWP 220 Public Presentation Skills (2 - 3)**

Development of skills and fluency needed by environmental professionals in preparing, delivering and evaluating effectiveness of expository and persuasive oral presentations. Communication theory, rhetorical analysis, and visualizations of complex and technical data, self and peer evaluation, listening skills. Fall/Spring

**EWP 222 Presentation Skills for Managers (2)**

Three hours of lecture/discussion per week for 10 weeks. Development of skills needed by managers in preparing, delivering, and evaluating oral presentations for the professional workplace. Includes instruction on preparation and implementation of effective visual aids. Strategies for facilitating small group discussions and developing listening skills are emphasized. Fall.

Prerequisites: None.

**EWP 290 Research Writing and Humanities (3)**

Three hours of discussion and group work per week. Intended for students who have had an introductory writing course. Students will examine the views of nature and the environment as they are expressed by selected writers, poets, and essayists. Frequent informal and formal writing assignments, research and documentation, and an oral presentation are required. With an emphasis on critical writing, critical thinking, and critical reading, students will learn the literacy expectations of their disciplines. Spring.

Prerequisite(s): EWP 190 or equivalent.

**EWP 291 Research Writing and Humanities (Honors) (3)**

Three hours of discussion and lecture per week. Focusing on food politics, this course builds on critical reading and writing skills developed in CLL190. Students complete a 20-hour service project with a community food organization, while researching and writing about food politics and their community service experience. Spring.

Prerequisite(s): EWP 190 or equivalent.

**EWP 296 Special Topics in Writing, Literature, and Public Presentation Skills (1 - 3)**

Experimental, interdisciplinary or special course work at the freshman or sophomore levels. Subject matter and

course format vary from semester to semester or offering on the basis of needs and objectives of the course. Fall or Spring.

### **EWP 300 Survey of Environmental Writing (3)**

Three hours of classroom instruction per week. Students will explore forms of environmental writing including but not limited to journalism, poetry, memoir, field notes, historical research, natural histories and polemics. Students will analyze these writings rhetorically and create a range of texts including creative pieces, factually-based reporting, nature writing, and writing about science. Fall/Spring.

Prerequisites: EWP 190 and EWP 290.

### **EWP 311 Urban Environmental Literature (3)**

Three hours of discussion and lecture per week. Development of reading, writing, and critical thinking skills that illustrate the flora, fauna, geology, and climate that shape urban life. Evaluation and discussion of poetry and prose by contemporary authors who use urban nature as their subjects. Spring.

Prerequisite: Upper division status or permission of instructor.

### **EWP 350 Eco-Cinema: Perspectives & Practices (Honors) (3)**

Three hours of lecture/discussion and two-hour film screening each week. Environmental films are interpreted from cultural, historical, and political perspectives. The artistic process in filmmaking is emphasized. Students produce a short film or slide show with an environmental theme. Spring.

Prerequisites: EWP 190 and EWP 290 or Equivalent; Enrollment in Honors Program.

### **EWP 390 Literature of Nature (3)**

Three hours of discussion and lecture per week. Examination of views of nature and the environment as seen through works of 19th and 20th century writers, poets, and essayists. Readings, discussions, and written assignments explore aesthetics, socio-political climate, and prevailing attitudes toward the environment that formed the backdrop for readings. Fall and Spring.

### **EWP 401 Capstone Experience (3)**

Experiential learning for the Environmental Writing & Rhetoric (EWR) minor through a writing project based on a) a community-based internship b) tutoring or completing special project in the Writing Resource Center, or c) an independent creative writing project. Fall and Spring.

Prerequisites: Student must be registered for the EWR minor.

### **EWP 405 Writing for Science Professionals (1 - 3)**

Three hours of lecture, discussion, and workshops per week. Principles and practice of writing skills required of science professionals. Develop proficiency in determining the purpose of a document; analyzing audience; selecting, developing and organizing information in an appropriate design; and writing clearly, precisely and effectively. Writing assignments done weekly; rewriting is routinely required. Fall and Spring.

Prerequisite: EWP 290 and junior or senior status, or permission of instructor.

### **EWP 407 Writing for Environmental & Science Professionals (3)**

Three hours of lecture, discussion, and workshops per week. Focuses on principles and practice of writing skills required of environmental and science professionals. Emphasizes proficiency in determining purpose of a document; analyzing audience; selecting, developing and organizing information in an appropriate design; and writing clearly, precisely, and effectively. Fall and Spring.

Prerequisite: EWP 290 and junior or senior status

### **EWP 410 Writing for Environmental Professionals (3)**

Three hours of lecture, discussion, and workshops per week. Includes principles and practices of writing and communication skills relevant to environmental professionals. Emphasizes proficiency in analyzing audience and

purpose; selecting, developing and organizing information in an appropriate design; and writing clearly, precisely and effectively. Fall and Spring.

Prerequisite: EWP 290 and junior or senior status, or permission of instructor.

### **EWP 420 Public Presentation Skills (3)**

Three hours of lecture/discussion/student presentations per week. Emphasizes both theory and practice in effectively delivering, interpreting, and responding to public presentations. Social, cultural, and political dimensions of public address are examined. Issues of diversity and power are discussed. Small group communication is viewed as a site for creative problem-solving. Audience analysis, adaptation, strategic arrangement, and concept development are explored. Fall and Spring.

Prerequisite(s): EWP 220 or permission of instructor.

### **EWP 444 Professional Writing/Paper & Bioprocess Engineering (2)**

Three hours of lecture, discussion, and workshops per week for 10 Weeks. Emphasizes writing practices required of paper and bioprocess engineers, including proposals and technical reports. Develop proficiency in determining the purpose of a document; analyzing audience; selecting, developing and organizing information in an appropriate design; and writing clearly, precisely and effectively. Fall.

### **EWP 490 Contemporary Literature of Nature (3)**

Three hours of discussion and lecture per week. This writing-intensive literature course takes an ecocritical approach to nature literature, both poetry and prose, written by contemporary authors. Coverage includes ecofeminism, science literature, and native American literature. Spring.

### **EWP 494 Creative Non-fiction in the Sciences (3)**

Three hours of classroom instruction per week. Students in the course will read and write creative nonfiction, a genre that reflects a harmonious movement among subjective experience, factual research, and public interest in science and the environment. The course focuses on the writing processes and techniques used to write ideas, theories, and experiences to a lay audience. Spring.

Prerequisite: EWP 190. Note: Credit will not be granted for both EWP 494 and EWP 694.

### **EWP 495 Environmental Journalism (3)**

Three hours of lecture per week. This course covers a range of topics related to journalism: interviewing, writing the lead, style, writing and organizing the story, layout, editing and revising, writing features and follow-up stories, covering speeches, etc. In addition, students explore how the media covers scientific and environmental issues. Students work on writing skills--from basic editing techniques to more sophisticated areas of style. Spring.

### **EWP 496 Special Topics in Writing, Literature, and Public Presentation Skills (1 - 3)**

Special topics of current interest to undergraduate students in writing, literature, and public presentation skills. A detailed course description will be presented as the topics area is identified and developed. Fall and Spring.

### **EWP 498 Independent Study in Writing, Literature and Public Presentation Skills (1 - 3)**

Guided individual study of a topic in composition, literature and public presentation skills. Enrollment is possible at various times during the semester. Fall and Spring.

### **EWP 597 Graduate Scholarly Writing (3)**

Students learn advanced writing principles to produce a proposal, thesis, dissertation, or manuscript. Topics include the writing process, use of sources, and graphics. Scholarly writing style and mechanics are discussed with emphasis on organization, clarity, and conciseness. Spring.

### **EWP 620 Advanced Public Presentation Skills for Environmental Professionals (3)**

Three hours of lecture per week. Development of skills and fluency needed by environmental professionals in preparing, delivering and evaluating effectiveness of expository and persuasive oral presentations. Communication

theory, rhetorical analysis, and visualizations of complex and technical data, self and peer evaluation, listening skills. Fall/Spring.

### **EWP 694 Creative Non-fiction in the Sciences (3)**

Three hours of classroom instruction per week. Students in the course will read and write creative nonfiction, a genre that reflects a harmonious movement among subjective experience, factual research, and public interest in science and the environment. The course focuses on the writing processes and techniques used to write ideas, theories, and experiences to a lay audience. Spring.

Note: Credit will not be granted for both EWP 494 and EWP 694.

### **FCH 110 Survey of Chemical Principles (3)**

Three hours of lecture per week. An introduction to chemistry organized around physical and chemical properties of matter. Emphasizes the atomic structure of elements, bonds in chemical compounds, atomic ratios in molecules as the basis for the stoichiometry of reactions, ionic and organic compounds, chemical reactivity, kinetics and thermodynamics. Fall.

Prerequisite(s): none

### **FCH 111 Survey of Chemical Principles Laboratory (1)**

FCH 111. Survey of Chemical Principles Laboratory. (1) Three hours of laboratory per week. Basic and applied laboratory techniques will be emphasized through experiments dealing with: the density of solids and liquids, stoichiometry, calorimetry, chemical reactivity, gas laws, kinetics, acid/base chemistry, and organic chemistry. (Fall)

Prerequisite(s): none Corequisite: FCH110

### **[FCH 132 Orientation Seminar: Chemistry \(1\)](#)**

One hour of lecture and discussion per week. Introduction to campus resources available to ensure academic success. Introduction to chemistry as a field of inquiry. Introduction to laboratory safety. Fall.

### **FCH 150 General Chemistry I (3)**

Three hours of lecture per week. This first semester general chemistry course is organized around the physical and chemical properties of matter. It introduces the atomic structure of elements, the kinds of bonds in chemical compounds, how atomic ratios in molecules form the basis for the stoichiometry of reactions, begins a treatment of thermodynamics and discusses the principles of chemical reactivity. Fall.

Prerequisite(s): APM 104 (may be taken concurrently) or equivalent (ex. Precalculus).

### **FCH 151 General Chemistry Laboratory I (1)**

Three hours of laboratory per week. Basic laboratory techniques will be emphasized through experiments dealing with the density of solids and liquids, atomic ratios and mass combining ratios, atomic structure and the periodic table, calorimetry, chemical reactivity, geometric structure of molecules, formation of coordination compounds, and paper chromatography. Fall.

Corequisite: FCH 150.

### **FCH 152 General Chemistry II (3)**

Three hours of lecture. The second course in general chemistry continues the development of chemical reactivity by focusing on chemical kinetics and chemical equilibrium. Aqueous phase processes are emphasized and are applied to precipitation and solubility equilibria, acid/base dissociation phenomena, and fundamental electrochemical reactions. Spring.

Prerequisite: FCH 150 and APM 104 (or equivalent (minimum Precalculus)).

### **FCH 153 General Chemistry Laboratory II (1)**

Three hours of laboratory per week. Concepts of chemical kinetics and equilibrium processes will be reinforced through experiments in titrimetric analyses, determinations of  $K_a$  and  $K_{sp}$  values, investigation of rate constants and

reaction orders, buffer preparations, oxidation/reduction reactions and qualitative analyses. Spring.

Prerequisites: FCH 150, FCH 151. Co-requisite: FCH 152.

### **FCH 210 Elements of Organic Chemistry (4)**

Three hours of lecture and four hours of laboratory per week including pre-laboratory instruction. Nomenclature, preparation, and important reactions of functional groups and classes of organic compounds including examples relevant to biology. Isomerism and stereochemistry topics of biomolecules. Quantitative study of weak acids and weak bases. Laboratory techniques include compound manipulations, extractions, distillations, chromatography, synthesis, and calculation of yields. Spring.

Prerequisite: One year of General Chemistry.

### **FCH 221 Organic Chemistry I (3)**

Three hours of lecture per week. The structure, properties and fundamental reactivity of organic compounds will be studied with emphasis on the reaction mechanisms and stereochemistry. In combination with FCH 223, this course provides a full survey of common classes of carbon compounds. Fall.

Prerequisite: FCH 150, FCH 151, FCH 152, FCH 153.

### **FCH 222 Organic Chemistry Laboratory I (1)**

Four hours of laboratory including pre-laboratory instruction per week. Laboratory safety. Melting and boiling points, distillation, recrystallization, thin-layer and column chromatography, isolation of natural products, organic synthesis and spectroscopy. Fall.

Co-requisite: FCH 221.

### **FCH 223 Organic Chemistry II (3)**

Three hours of lecture per week. The structure, properties and fundamental reactivity of organic compounds will be studied with emphasis on the reaction mechanisms and stereochemistry. In combination with FCH 221, this course provides a full survey of common classes of carbon compounds. Spring.

Prerequisite: FCH 221.

### **FCH 224 Organic Chemistry Laboratory II (1)**

Four hours of laboratory including pre-laboratory instruction per week. Continuation of FCH 222. Simple physical and instrumental techniques applied to organic chemistry. Gas chromatography, polarimetry, spectroscopy. Introduction to classical literature synthesis. Topics from natural products chemistry including chemical ecology, biomimetic synthesis, and the synthesis of an anticancer drug from birch bark. Spring.

Prerequisite: FCH 222. Co-requisite: FCH 223.

### **FCH 232 Career Skills for Chemists (1)**

One hour of lecture per week. The objective of this course is to introduce a variety of important skills required for student success and, ultimately, career development as a practicing chemist. These skills include: Information literacy (library literature searching), communication (writing, presenting), ethics in science and academic integrity, finding employment and internships (resume and letter writing, interviewing skills). In addition, student will learn more about the B.S. Chemistry curriculum to set the stage for their choice of an "option" (Biochem, Polymer Chem, Environmental Chem. or ACS certified option) within the Chemistry Major. Fall

Prerequisite(s): none

### **FCH 290 Chemistry Teaching Assistant Experience for Undergraduates (1 - 3)**

Undergraduate students will gain experience with the management, evaluation and assessment of undergraduate courses in chemistry. Assistants will assist the instructor with course activities and mentor students on how to succeed in the respective course. Teaching Assistant responsibilities vary by section and instructor. Fall and Spring.

Prerequisite(s): Consent of Instructor.

### **FCH 296 Special Topics in Chemistry (1 - 3)**

Experimental, interdisciplinary or special course work at the freshman or sophomore levels. Subject matter and course format vary from semester to semester or offering on the basis of needs and objectives of the course. Fall and Spring.

### **FCH 325 Organic Chemistry III (4)**

Two hours of lecture, one six-hour laboratory per week. Classical and recent literature synthesis or organic compounds, employing advanced techniques. Fall.

Prerequisite: Two semesters of elementary organic chemistry.

### **FCH 360 Physical Chemistry I (3)**

Three hours of lecture per week. An introduction to the properties of gases and liquids, the laws of thermodynamics, phases, phase transitions, solutions and colligative properties, electrochemistry, and reaction equilibria. Fall.

Prerequisite(s): MAT 295 and 296, and PHY 211 and 212, or their equivalents.

### **FCH 361 Physical Chemistry II (3)**

Three hours of lecture per week. Includes discussion on principles of quantum mechanics, chemical kinetics, and basic spectroscopy. Spring.

Prerequisite: FCH 360.

### **FCH 380 Analytical Chemistry I: Gravimetric, Titrimetric and Potentiometric Analysis (3)**

Two hours of lecture and one three-hour laboratory per week. Equilibrium concepts and practical implementations of precipitation, complexation, acid-base and oxidation-reduction processes in quantitative chemical analysis. Fall.

Prerequisites: One year of General Chemistry (I, II) plus the associated lab courses

### **FCH 381 Analytical Chemistry II: Spectroscopic, Chromatographic and Electroanalytical Instrumental Technique (3)**

Two hours of lecture and one three-hour laboratory per week. Theory and practice of technology applications to UV/VIS, AAS, AES, XES, ASV, GLC and HPLC. Spring.

Prerequisites: Two years of undergraduate chemistry and FCH 380, FCH 361 taken concurrently or permission of instructor.

### **FCH 384 Spectrometric Identification of Organic Compounds (1 - 2)**

Two hours of lecture and discussion per week. The first-half semester (1 credit) will deal with common classes of organic compounds; the second-half semester (1 credit) will deal with more complex structures. The use of complementary information from mass, infrared, nuclear magnetic resonance and ultraviolet spectrometry will be applied to identification of organic natural products. Fall.

Prerequisites: One year of Organic Chemistry.

### **FCH 390 Drugs from the Wild (3)**

Three hours of lecture and discussion per week. This course is designed to give students a comprehensive understanding of the variety of medicinal agents available from natural sources. Economic and societal aspects will be explored as well as scientific ones. In addition to curative agents, discussions will include toxic substances, folk medicinal (including herbal) preparations, and the so-called "recreational drugs." Fall, odd years.

Prerequisites: Introductory courses in chemistry and biology.

### **FCH 399 Introduction to Atmospheric Sciences (3)**

Three hours of lecture and discussions per week. Atmospheric composition, mass and structure; solar radiation and the global energy budget; atmospheric moisture budget, cloud and precipitation; photolysis, gas-phase oxidation, aqueous chemistry, and gas-to-particle conversion; physical and chemical mechanisms driving environment phenomena such as acid rain, the greenhouse effect, the ozone hole, remote and urban air pollution, and haze.

Prerequisite(s): General physics I, 1 year each of general chemistry and calculus. Co-requisite(s): General physics II.

### **FCH 410 Inorganic Chemistry (3)**

Three hours of lecture and/or studio per week. This course serves as an introduction to the bonding, structure and reactivity of transition metals and main group elements. Topics will include but are not limited to covalent molecular structures, coordination chemistry, organometallic chemistry, catalysis, bioinorganic chemistry and solid state materials. The studio component focuses on the inorganic chemistry of artistic materials and traditional inorganic chemistry experiments. Fall.

Prerequisite: One year of general chemistry, one year of organic chemistry.

### **FCH 430 Biochemistry I (3)**

Three hours of lecture per week. General biochemistry with emphasis on the chemistry of amino acids, proteins, and nucleic acids. The first half of the course will cover the chemistry of amino acids, proteins, and protein structure. The second half of the course will be an introduction to nucleic acid structure and function. Credit will not be granted for both FCH 430 and FCH 530. Fall.

Prerequisites: FCH150, FCH151, FCH221, FCH223 or equivalents.

### **FCH 431 Biochemistry Laboratory (3)**

Two hours lecture and 6 hours of laboratory per week on the basic techniques used in biochemical research with an emphasis on proteins and enzymes. Techniques include spectrometry, chromatography, electrophoresis, amino acid analysis, coupled assays, and the isolation and characterization of enzymes. Credit cannot be given for both FCH 431 and FCH 531. Fall.

Prerequisites: FCH150, FCH152, FCH221, and FCH223 or equivalents. Corequisite: FCH430 or permission of instructor.

### **FCH 432 Biochemistry II (3)**

Three hours of lecture per week. Topics discussed are: Biochemistry of metabolism, sugars, polysaccharides, glycolysis, pentose phosphate pathway, glycogen formation, gluconeogenesis, glyoxylate shunt, TCA cycle, electron transport and oxidative phosphorylation, fats, fatty acid metabolism, amino acid metabolism, purine and pyrimidine metabolism, and photosynthesis. Credit will not be given for both FCH 432 and FCH 532. Spring

Prerequisites: FCH150, FCH151, FCH221, FCH223, and FCH430 or equivalents.

### **FCH 440 Introduction to Chemical Ecology (3)**

Three hours of lecture with discussion per week. Centers on chemical signals among organisms from microbes to man as they affect ecology, physiology and behavior; and as they can be utilized for agriculture, pest management and animal husbandry. Spring.

Prerequisites: Biology (one year), and organic chemistry (one year). Note: Credit will not be granted for both FCH 440 and EFB 412.

### **[FCH 495 Introduction to Professional Chemistry \(1\)](#)**

The professional chemist's relationship with industry, government and universities. Employment opportunities for the chemist, professional organizations and unions will be discussed. The selection of a senior research topic and a literature survey will be required. Fall.

Prerequisite: Senior status.

### **FCH 496 Special Problems in Chemistry (1 - 3)**

An opportunity for a special problem, technique development, independent or unstructured study in an area related to the chemical profession. The work may be technical, professional, or interdisciplinary. Advisors outside this department may be solicited. A brief proposal must be presented for approval with specific arrangements outlined including faculty advisor and objectives of the study. A written report will be expected. Fall and Spring.

Prerequisite: Upper-division status.

### **FCH 497 Undergraduate Seminar (1)**

One hour per week. Literature surveys and seminars on topics of current research interest and recent advances in chemistry. Spring.

### **FCH 498 Introduction to Research (1 - 5)**

3-4 hours per credit per week of laboratory and library research and report writing. Solution of a selected research problem using specialized techniques. A written report on data, procedures, results and conclusions. Fall and Spring. Prerequisites: None. This course is the Senior Research requirement for all FCH undergraduates, of which five (5) credits are required in total.

### **FCH 510 Environmental Chemistry I (3)**

Three hours of lecture per week. Introduction to the processes that control chemical behavior in aquatic environments, including precipitation, dissolution, gas exchange, acid-base, oxidation-reduction, complexation and adsorption reactions. Emphasis will be on explanation and prediction of chemical behavior. Examples will be from the areas of fresh and marine waters, groundwater, wastewater, and geo-chemistry. Spring.

Prerequisites: An introductory course in physical chemistry is required.

### **FCH 511 Atmospheric Chemistry (3)**

Three hours of lecture/discussion per week. Graduate-level course in atmospheric chemistry. Atmospheric structure and composition. Catalytic cycles of ozone destruction and formation. Kinetic analysis of atmospheric reactions in gas and aqueous phase. Aerosols. Global climate change. Oxidation of sulfur oxides and nitrogen oxides. Fall.

Prerequisite: One year of undergraduate chemistry or permission of instructor.

### **FCH 515 Methods of Environmental Chemical Analysis (3)**

One hour of lecture and six hours of laboratory per week. An introduction to sampling, analytical and quality control procedures necessary to obtain reliable water quality data. All analyses will be performed on a single aquatic system with the purpose of developing a final report characterizing the water quality of that system. Fall.

Prerequisite: A course in quantitative chemical analysis.

### **FCH 520 Marine Biogeochemistry (3)**

Three hours of lecture per week. Advanced level course for seniors and graduate students. Biogeochemistry of major ocean systems including coastal and pelagic environments. Chemical, biological, and geological approaches to understanding the functioning of the ocean will be covered.

Fall (Even years only) Prerequisite(s): FCH 150, 152; EFB 101, 103; APM 205, 206 or equivalent.

### **FCH 524 Topics in Natural Products Chemistry (3)**

Three hours of lecture and discussion per week. A course intended to introduce the student to various types of secondary metabolites including several of past and current interest because of their pronounced biological activities. Modes of chemical reactivity and means of structure determination and syntheses are covered. Spring.

### **FCH 525 Oceanography (3)**

Three lecture hours per week. Advanced-level course intended for seniors and entry-level graduate students. The four main oceanographic disciplines will be covered including physical, chemical, biological and geological oceanography. This course will highlight the interdisciplinary nature of oceanography and its importance in earth system dynamics such as energy and climate. Spring.

Prerequisite(s): FCH 150, 152; EFB 101, 103; PHY211, 212 or equivalent

### **FCH 530 Biochemistry I (3)**

Three hours of lecture per week. General biochemistry with emphasis on the chemistry of amino acids, proteins, and nucleic acids. The first half of the course will cover the chemistry of amino acids, proteins, and protein structure. The second half of the course will be an introduction to nucleic acid structure and function. This course requires critical

review of current topics in Biochemistry not required in FCH 430. Fall

Prerequisite: FCH150, FCH151, FCH221, FCH223 or equivalents.

### **FCH 531 Biochemistry Laboratory (3)**

Two hours lecture and 6 hours of laboratory per week on the basic techniques used in biochemical research with an emphasis on proteins and enzymes. Techniques include spectrometry, chromatography, electrophoresis, amino acid analysis, coupled assays, and the isolation and characterization of enzymes. This course requires critical review of current topics in Biochemistry not required in FCH 431. Fall.

Prerequisites: FCH150, FCH152, FCH221, and FCH223 or equivalents. Co-requisite: FCH530 or permission of instructor

### **FCH 532 Biochemistry II (3)**

Three hours of lecture per week. Topics discussed are: Biochemistry of metabolism, sugars, polysaccharides, glycolysis, pentose phosphate pathway, glycogen formation, gluconeogenesis, glyoxylate shunt, TCA cycle, electron transport and oxidative phosphorylation, fats, fatty acid metabolism, amino acid metabolism, purine and pyrimidine metabolism, and photosynthesis. This course requires critical review of current topics in Biochemistry not required in FCH 432. Spring

Prerequisites: FCH150, FCH151, FCH221, FCH223, and FCH530 or equivalents.

### **FCH 550 Polymer Science: Synthesis and Mechanisms (3)**

Three hours of lecture per week. Introduction to the synthesis of polymers and the mechanism of polymerization processes. Fundamental principles of polymer chemistry. Step-growth polymerization and network formation (theory of gelation). Chain-growth homopolymerization and copolymerization by radical-, ionic-, and coordination type catalysts. Synthesis of block and graft copolymers. Structure of polymers and their application. Polymers and the environment, polymer recycling. Fall

Prerequisites: One year of organic chemistry and one year of physical chemistry.

### **FCH 551 Polymer Techniques (3)**

Two hours of lecture/discussion and four hours of laboratory per week; laboratory reports, final exam. Twelve experiments covering the main topics of polymer synthesis (four weeks), molecular weight determination (four weeks), and characterization (four weeks) are selected from areas such as the following: free-radical solution, bulk and emulsion polymerizations; ionic and condensation polymerizations, copolymerization and reactivity ratio determination; osmometry, viscometry, light scattering, gel permeation chromatography, polarized light microscopy, X-ray diffraction, differential scanning calorimetry, thermogravimetric analysis, dynamic mechanical analysis, stress-strain analysis; nuclear magnetic resonance spectroscopy, Fourier transform infrared spectroscopy, ultraviolet/visible spectroscopy. The lecture component will include discussions of the laboratory activities as well as related topics such as the preparation of monomers, safe handling methods for monomers, polymers, solvents, catalysts, etc. Fall. Prerequisites: One year of organic and one year of physical chemistry, or permission of instructor. Co-registration in FCH 552 is recommended.

### **FCH 552 Polymer Science: Properties and Technology (3)**

Three hours of lecture per week. Introduction to physical chemistry, physics, processing and technology of synthetic polymers. Polymer solutions, including molecular weight determinations, chain statistics, and thermodynamics. Polymer solid states, including rubber elasticity, viscoelasticity, the glassy state and the crystalline state. Properties, processing, and technology of films, fibers, elastomers, and composites. Spring.

Prerequisites: One year of organic chemistry and one year of physical chemistry.

### **FCH 560 Chromatography and Related Separation Sciences (3)**

Three hours of lecture and discussion per week. A course designed to give the student a thorough understanding of analytical and isolation chemistry by modern chromatographic, distributive and molecular sieving techniques. The

chemistry of the systems discussed will be stressed as well as the important physical aspects. Spring of even years.  
Prerequisites: Two semesters each of organic and general chemistry.

### **FCH 610 Air Quality (3)**

Three hours of lecture and discussion per week. Pollution emissions; atmospheric photochemistry; dynamic/physical mechanisms; dynamic/physical-chemistry interactions; measurement campaigns; major chemical and meteorological databases; numerical modeling tools (box models, meteorological models, photochemical models); model uncertainties and evaluation; model application. Spring.

Prerequisite: FCH 511 Atmospheric Chemistry or by instructor's permission

### **FCH 620 Chemical Kinetics (3)**

Three hours of lecture/discussion per week. Graduate course in chemical kinetics. Building rate laws and analyzing experimental data. Transition state and RRKM theories. Kinetics in the aqueous phase and on surfaces. Kinetic modeling of complex reaction systems. Analysis of published papers in chemical kinetics. Spring of alternating years.

Prerequisites: 1 year undergraduate physical chemistry

### **FCH 630 Plant Biochemistry (3)**

Three hours of lecture and discussion per week. Includes the biochemistry of photosynthetic electron transport and phosphorylation, photosynthetic carbon fixation, photorespiration, nitrogen fixation, nitrate reduction, photochrome, and plant hormones. The economic, ecological and environmental aspects of plant biochemistry will also be discussed. Spring.

Prerequisites: FCH 530, FCH 532.

### **FCH 650 Statistical Physics and Chemistry of Macromolecules (3)**

Three hours of lecture per week. Topics to be discussed are chain statistics, polymer thermodynamics, scaling theory, colloidal particles, viscoelasticity and the glass transition. Spring, even years.

Prerequisites: FCH 360 and FCH 552 or equivalent; consent of instructor.

### **FCH 796 Special Topics in Chemistry (1 - 3)**

Lectures, conferences and discussion. Advanced topics in physical chemistry, organic chemistry or biochemistry. Fall and Spring.

### **FCH 797 Graduate Seminar (1)**

Presentation and discussion of a selected topic in chemistry. Topics to be selected by participating faculty each semester. Fall and Spring.

### **FCH 798 Research in Chemistry (1 - 12)**

Independent research in chemistry. One written report required. Fall, Spring and Summer.

### **FCH 898 Professional Experience/Synthesis (1 - 6)**

A supervised, documented professional work experience in the Master of Professional Studies degree program. Fall, Spring, or Summer.

Pre- or co-requisite(s): Matriculation in Department of Chemistry MPS degree program. Department chair approval required.

### **FCH 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's degree and thesis. Fall, Spring and Summer.

### **FCH 997 Seminar (1)**

Seminars scheduled weekly; an average of 20 to 30 seminars are given annually. Discussion of recent advances in chemistry. Credit is given only once to a student. Fall and Spring.

### **FCH 999 Doctoral Thesis Research (1 - 12)**

Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

**FEG 132 Orientation Seminar: Forest Engineering (1)**

One hour of lecture, discussion and/or exercises per week. Introduction to campus resources available to ensure academic success. Introduction to engineering as a design profession. Fall.

**FEG 133 Introduction to Engineering Design (3)**

Two hours of lecture and three hours of group instruction per week. An introduction to the engineering profession, including design, communication, ethical and professional behavior, teamwork and data analysis. Learning is reinforced through study, conduct and critique of design exercises related to environmental resources engineering. Spring.

**FEG 275 Ecological Engineering I (3)**

Two hours of lecture and three hours of group instruction per week. Overview of ecological engineering theory and practice. Key concepts, empirical models, and case studies of ecological engineering. Living machines, treatment wetlands, bioremediation, municipal composting, agroforestry, traditional ecological knowledge, energy analysis, and ecosystem restoration. Spring.

Prerequisites: one semester each of calculus, biology, chemistry, and ecology. Forest Engineering students only or by permission of instructor.

**FEG 300 Engineering Design (1)**

One hour of lecture or three hours of laboratory per week. A focus on application of design processes to the needs and desires of society, with emphasis on systems useful in resource manipulation and development. Concepts of planning and design are reinforced through study, conduct and critique of design exercises and projects. Fall.

**FEG 340 Engineering Hydrology and Hydraulics (4)**

Three hours of lecture and three hours of laboratory and discussion per week. Introduction to water resources engineering. Hydraulics processes include pipe flow, open-channel flow, flows within control structures, and flow through porous media. Hydrologic processes include watershed storage and flux, rainfall-runoff models, flood routing, and stormwater design. Spring.

Prerequisites: FEG 133, MAE 341, FEG 335, ERE 371. Co-requisite: APM 395. Note: Credit will not be granted for both FEG340 and ERE540.

**FEG 365 Principles of Remote Sensing (4)**

Three hours of lecture and three hours of laboratory and discussion per week. A qualitative and quantitative introduction to the fundamentals of acquiring, analyzing and utilizing remote sensing data. Introductory concepts and methods in digital image processing and photogrammetry. Spring.

Prerequisite: ERE 371 Surveying for Engineers. Note: Credit will not be granted for both FEG 365 and ERE 565.

**FEG 437 Transportation Systems (3)**

Two hours of lecture and three hours of laboratory per week. Interrelationships between natural features, transportation types, design and management objectives to provide the most effective system within a given framework. Basic engineering principles in the planning, location, design, construction and maintenance of suitable transportation systems to serve various aspects of forest resource management. Spring.

Prerequisites: ERE 371, CIE 337, FEG 340.

**FEG 448 Open Channel Hydraulics (3)**

Three hours of lecture and discussion per week. Classroom instruction and exercises introduce advanced concepts in open channel hydraulics, including the energy and momentum principles, critical flow, uniform flow, flow profiles, and unsteady flow, as appropriate. Suitable as an engineering design elective in the forest engineering curriculum. Fall.

Prerequisite: FEG 340 or equivalent, senior standing. Note: Credit will not be granted for both FEG 448 and ERE 548.

**FEG 454 Power Systems (2)**

Two hours of lecture per week. Application of alternative technologies to the matching of power needs and resource constraints. Topics include tractive power, wind power, cogeneration, alternative fuels and photovoltaics. Spring.

Prerequisites: ERE 351, FEG 420.

**FEG 489 Forest Engineering Planning and Design (3)**

Two hours of lecture and three hours of laboratory per week. A capstone course to integrate engineering coursework with the engineering design process to solve interdisciplinary environmental problems. Semester-long project provides experience in problem analysis, teamwork, project management, engineering ethics, professional communication and related aspects. Spring.

Prerequisite(s): Senior standing in Forest Engineering, FEG 340, FEG 365.

**FEG 498 Research Problem in Forest Engineering (1 - 3)**

Independent research in topics in forest engineering for the highly motivated undergraduate student. Selection of subject area determined by the student in conference with appropriate faculty member. Tutorial conferences, discussions and critiques scheduled as necessary. Final written report required for departmental record. Fall, Spring and Summer.

Prerequisite: Permission of instructor.

**FOR 106 Introduction to Green Entrepreneurship (3)**

One-week short-course. An introduction to the challenges and goals of creating a start-up venture in environmental science or technology. Recognize marketplace trends and creating commercial opportunities. Analyze feasibility and potential to create a sustainable venture. Topics include critical success factors and key start-up issues unique to science and technology. Summer.

Prerequisite(s): Completed 11th grade.

**FOR 132 Orientation Seminar: F&NRM (1)**

Thirteen hours of lecture and six hours of field time. An introduction to forest and natural resource management and related career paths. Indoor and outdoor lectures expand student awareness of ESF's educational opportunities, properties, and faculty in F&NRM. Fall.

**FOR 201 Introduction to Watershed Hydrology (2)**

One hour of online lecture per week. Introductory survey of the distribution of water throughout the atmosphere, biosphere, and the physical earth. Topics include major storages and flows of water including precipitation, evaporation, runoff, urban stormwater, and soil storage, as well as water budgets and watershed management.

Spring, fall, summer.

**FOR 202 Introduction to Sociology (3)**

Three hours of lecture per week. General introductory principles and methods of sociology including group dynamics and development, different structural arrangement of social groups, community development and adjustment processes, relationships with the natural environment. Fall and Spring.

**FOR 203 Western Civilization and the Environment (3)**

Three hours of lecture per week. General survey of the history of Western civilization from ancient societies through the seventeenth century, with attention to environmental and natural resource issues and perspectives. Analysis of the rise of the West. Historic and contemporary influences of the Western tradition. Fall and Spring.

**FOR 204 Natural Resources in American History (3)**

Three hours of lecture/discussion per week. Introductory survey of American history from colonization through the twentieth century, with attention to natural resources use, allocation, and management. Environmental history and introduction to historiography. Fall and Spring.

**FOR 205 Principles of Accounting (3)**

Three hours of lecture per week. Principles and methods used in financial and managerial accounting. Includes interpretation and effective use of financial statements through study of the accounting model, the measurement processes, data classification and terminology. Fall and Spring.

**FOR 207 Introduction to Economics (3)**

Three hours of lecture per week. Coverage of basic theory in microeconomics and macroeconomics. Application of theory and economic models to problems at the firm and national policy levels. Exploration of topics in money and banking, globalization and economic development. Fall and Spring.

**FOR 208 Introduction to Sustainable Energy Resources (2)**

Two hour of seminar/lecture/discussion per week concerning sustainable energy resources. Topics include: energy use and sources, sustainable use of energy resources, energy units and conversions, renewable energy, and financial analysis of energy projects. Fall.

**FOR 232 Natural Resources Ecology (3)**

Three hours of lecture/discussion per week for the first 12 weeks. Then 1.5 hours of lecture/discussion per week plus a 4.25-hour field trip for the last four weeks. The course provides an introduction to basic principles of ecology as they relate to terrestrial and freshwater ecosystems, and to natural resources. General topics for study include consideration of the physical environment, primary net production and energy flow through trophic levels, genetics and adaptation, ecosystem structure and function, competition and community dynamics, characteristics of freshwater ecosystems, and biogeochemical cycling and human impacts from local to global levels. Spring. Prerequisites: EFB 101/EFB 102 General Biology I w/lab, or equivalent (organismal biology).

**FOR 296 Special Topics in Resource Management/Forestry (1 - 3)**

Experimental, interdisciplinary or special coursework at the freshman or sophomore levels. Subject matter and course format vary from semester to semester. Fall or Spring.

**FOR 298 Research Internship in Forest and Natural Resources Management (1 - 3)**

Students will participate in research projects consistent with their educational and professional goals. A faculty member in the Department of Forest and Natural Resources Management will serve as the student's faculty sponsor. The student in consultation with the faculty sponsor will prepare a study plan outlining the educational goals of the apprenticeship. The faculty sponsor will generate a performance assessment and record of activities at the end of the apprenticeship. Grading Satisfactory/Unsatisfactory. Fall, Spring, Summer.

Prerequisite(s): Permission of Instructor

**FOR 304 Adirondack Field Studies (4)**

Four-week field course with five hours of lecture and 30 hours of field laboratory per week. Introduction to silvics, forest ecology and natural and cultural history as a basis for understanding forest vegetation and other natural resources. Principles and methods for the measurement of spatial and vegetative attributes of forested landscapes. Course stresses development of field ability in common plant identification, overland navigation and timber, tree, forest and habitat measurements, and synthesis of field data. Summer.

**FOR 312 Sociology of Natural Resources (3)**

Three hours of lecture per week. The concepts and principles of sociology as applied to natural resource questions. Concepts of community, forest-dependent communities, shared identity, and social structures of resource-based groups. The forest as an integrated social and biological community. Spring.

**FOR 321 Forest Ecology and Silviculture (3)**

Two hours of classroom lecture with weekly three-hour trips and labs to forests across Central New York. Survey of forest tree and stand ecology (silvics) and silviculture concepts, applications and implications for treatment of forest

stands for various values. Experiential learning emphasized through a strong field component of assessing vegetation, site quality and land use history variables, and treatment alternatives to create different forest conditions. For students outside forest resources management curriculum; not open to students taking FOR 332 and FOR 334. Fall. Prerequisite: Botany or general biology. Note: Credit will not be granted for both FOR 321 and FOR 521.

### **FOR 322 Natural Resources Measurements and Sampling (3)**

Two hours of lecture and three hours of laboratory. Principles and methods used in the measurement and quantitative analysis of natural resources, including vegetation, water, soils, recreation and wildlife. The application of sampling designs for estimating populations and inventory planning, and statistical analysis for quantifying sampling error. Fall. Prerequisite(s): FOR 304 or equivalent; APM 391 or equivalent

### **FOR 323 Forest Biometrics (3)**

Three hours lecture per week. Statistical techniques for analyzing problems in forest resource management including hypothesis testing, analysis of variance, simple and multiple linear regressions, and weighted least squares regression. Spring. Prerequisite: APM 391 or equivalent.

### **FOR 330 Studies in Silviculture (3)**

Three hours of lecture per week, with reading assignments, exams, and projects. Students gain an appreciation of silviculture and its use for influencing the character, composition, and development of forest stands, and the conceptual framework for those practices. Projects provide opportunities to explore techniques for analyzing forest stands and developing prescriptions. Fall

### **FOR 332 Forest Ecology (4)**

Three hours of lecture/discussion and three hours of laboratory per week. Structure, function and dynamics of forest ecosystems at multiple scales, from trees to landscapes, including human interactions. Topics include ecophysiology, disturbance, succession, carbon and nutrient cycling, forest management, invasive species and climate change. Field data collection and analysis. Fall. Prerequisite(s): FOR 232, or EFB 101 and 102, or equivalent by permission of instructor.

### **FOR 333 Natural Resources Managerial Economics (3)**

Three hours of lecture per week and a mandatory one-day or two-day overnight field trip. Every natural resources manager must answer the question of how to use economic information to make better business and management decisions daily. Solutions require identifying alternative means of achieving given objective(s), then selecting the alternative that accomplishes this in the most resource efficient manner. Spring. Required for Forest Resources Management, Natural Resources Management, and Sustainable Energy Management degree programs. This is a shared resource course with FOR533. Note: Credit will not be granted for both FOR333 and FOR533. Prerequisite: FOR 207 Introduction to Economics (or equivalent) and FOR 205 Principles of Accounting (pre- or co-requisite; or equivalent); or permission of instructor

### **FOR 334 Silviculture (4)**

Three hours of lecture and three hours of lab per week. The practice of silviculture in managing stands to serve various landowner interests. Field trips and exercises provide opportunities to see examples of silvicultural methods under different management scenarios, and to learn and practice techniques for analyzing forest stands and developing prescriptions for their treatment. Fall. Note: Credit will not be granted for both FOR 334 and FOR 534.

### **FOR 338 Meteorology (3)**

Three hours of lecture/discussion per week. This is a shared resource course with FOR 538. An introduction to the atmospheric physical processes important to understanding weather and weather forecasting at the surface of the earth and macro-, synoptic-, meso-, and micro-climates. The emphasis is on synoptic and microscale phenomena.

Students will learn how to access weather data on the Internet and use the data to forecast weather. At the microscale, emphasis is on describing conditions and projecting change. Fall.

Note: Credit will not be granted for both FOR 338 and FOR 538.

### **FOR 340 Watershed Hydrology (3)**

Three hours of lecture per week. Principles of physical hydrology, including the basic principles of watershed hydrology, from the relationship between watershed hydrology and the global water cycle, to the specifics of groundwater flow, stream flow generation, and water quality management at the watershed scale. Spring.

Prerequisites: FOR345 - Introduction to Soils Note: Credit will not be granted for both FOR 340 and FOR 540.

### **FOR 345 Introduction to Soils (3)**

Two hours of lecture and three hours of lab per week. Introduction to the fundamentals of soil science in the context of soil as an ecosystem component. Fall.

Prerequisite or Co-requisite: 1 semester of Introductory Chemistry. Note: Credit will not be granted for both FOR 345 and FOR 545.

### **FOR 360 Principles of Management (3)**

Three hours of lecture per week. This course focuses on the basic theories, concepts, principles and functions of modern management and administration, with an emphasis on the four functions of management: leading, planning, organizing, controlling. The four functions of management are applied to the public and private sectors, as well as for profit and not-for-profit organizations. Environmental management systems, corporate ethics and social responsibility and systematic problem solving are among the principal topics emphasized. Fall.

Note: Credit will not be granted for both FOR 360 and FOR 560.

### **FOR 370 Forest Management Decision Making and Planning (3)**

Two hours of lecture/discussion and three hours of laboratory per week. Introduction to the components of forest management decision making and planning. The topics include forest regulation, growth and yield, and harvest scheduling given that a landowner's goals may include more than just commercial timber production. Spring.

Prerequisites: FOR 322 and FOR 334. Note: Credit will not be granted for both FOR 370 and FOR 570.

### **FOR 372 Fundamentals of Outdoor Recreation (3)**

Three hours of lecture/discussion per week. Introduction to the programs and practices of federal, state and local agencies and private organizations involved in planning, administration and management of outdoor recreation areas. Emphasis is placed on common resource and social problems faced by area managers, and how they integrate solutions into their plans. Spring.

### **FOR 373 Sustainable Harvesting Practices (3)**

Two hours of lecture and three hours of lab per week. Overview of forest roads and timber harvesting; planning, construction, and maintenance of forest roads; economic and environmental characteristics of harvesting systems; safety and health; wood procurement systems; and the role of forest operations in the broader context of forest management. Fall.

Prerequisite: FOR 322 or FOR 334 or permission of instructor.

### **FOR 402 Professional Forestry Mentoring Program (1)**

One-hour session per week supplemented by a one-day internship with a professional forester. Sessions will focus on contemporary issues in forestry including a historical perspective of the forestry profession, what it means to be a forester today, the role of certification and licensing, and professional ethics. It will serve to increase the professionalism of the forestry students. Fall.

Prerequisites: Junior status or permission of instructor.

### **FOR 403 Humans and the Environment: New Zealand (4)**

Three and one-half week study-abroad program examines the natural and cultural history and resource management of New Zealand's South Island. Through class lecture/discussion and field excursions, students obtain an understanding of integrated resource management and sustainability in protected areas. Spring.

**FOR 404 Ecotourism Abroad (3)**

Five 1-hour lectures plus 9- to 10-day field trip. This service learning course introduces students to the field of ecotourism through a short-term study abroad program held during spring break. Students will travel to several ecotourism destinations within a selected country, meet with destination managers, and complete a service learning project related to ecotourism. Additional fees required to cover cost of travel and lodging during field portion of course. Spring

**FOR 411 Analytical and Technical Writing for Resource Managers (3)**

Three hours of lecture per week. Research, summary, and evaluation of scholarly and grey literature. Application of decision making process and written recommendation. Introduction to argument. Composition of a technical report related to management major. Proposal writing and development of brochures, posters, and/or presentations for defined audiences. Fall and Spring.

Prerequisites: EWP 290 or equivalent, and junior or senior status in FNRM

**FOR 433 Silviculture Workshop (3)**

Three hours of classroom or six hours field instruction, and three hours independent study per week. Advanced study of silviculture in managing stands to serve a variety of landowner objectives. Enhanced problem-solving skills related to stand analysis and prescription making. Field exercises provide practical experience in implementing silvicultural prescriptions. Spring.

Prerequisite: One prior course in silviculture.

**FOR 442 Watershed Ecology and Management (3)**

Three hours of lecture and discussion per week. Introduction to watershed ecology and stream ecosystems. Interactions and linkages among upland, riparian and stream processes. Management and restoration associated with multiple uses of forest and rangelands. Explore influences of spatial and temporal scale, watershed and network position, disturbance regimes, and global change. Fall.

Note: Credit will not be granted for both FOR 442 and FOR 642.

**FOR 458 Advanced Topics in GIS (3)**

Two hours of lectures and three hours of labs per week. Lecture, demonstration, discussion, and lab exercises. Apply advanced geoprocessing techniques in resource analysis and modeling. Students complete a capstone project. Fall.

Prerequisite(s): ESF300 or equivalent.

**FOR 465 Natural Resources Policy (3)**

Three hours of lecture/discussion per week. Examination of US and NYS government roles in natural resource policy, and how government policies influence the management of public and private lands. Analysis of institutions, participants, and drivers of public lands, forest, water, wetlands, wildlife, fisheries, and fire policies. Fall.

**FOR 475 Recreation Behavior and Management (3)**

Three hours of lecture per week and a one-day field trip. Applies sociological and psychological concepts to: 1) individual preferences for recreation activities and settings, 2) description of recreation visitor behavior, 3) sources of management problems, 4) developing direct and indirect visitor management strategies, and 5) recreation planning decisions necessary to manage recreation settings and experiences. Students have the opportunity to apply concepts to personal recreation experiences. A one-day field trip is required. Fall.

Prerequisite: FOR 372 or equivalent, enrollment in the Natural Resource Management major or Recreation Resources and Protected Area Management minor, or permission of instructor.

**FOR 476 Ecotourism and Nature Tourism (3)**

Three hours of instruction per week. Overview of ecotourism and nature tourism programs and efforts around the world. Community, business, and organizational structures necessary for managing ecotourism and nature tourism programs are discussed, as are related environmental, social, and economic impacts. One-day field trip. Fall.

Prerequisite: FOR 372. Note: Credit will not be granted for both FOR 476 and FOR 676.

**FOR 478 Wilderness and Wildlands Management (3)**

Three hours of lecture per week. One, two-day, overnight field trip. Review of the state and federal legislation and agency policies that frame the planning and management of public lands designated as wilderness or wildlands. Emphasizes stewardship and management for protection of natural resources and human values. Concepts include carrying capacity, preservation of ecological conditions and processes, visitor management, dispersed recreation management, human values and benefits, and planning frameworks. Fall.

Prerequisite: FOR 372 or equivalent. Note: Credit will not be granted for both FOR 478 and FOR 678.

**FOR 480 Urban Forestry (3)**

Three hours of lecture per week. Evaluation and management of urban greenspace resources, with emphasis on urban trees, in the context of other values and management processes in urban areas. Class practice in evaluating urban greenspace and tree resources. Fall.

Prerequisite: Junior or senior status in any Forest and Natural Resources Management programs or permission of instructor for juniors and seniors in other programs. Note: Credit will not be granted for both FOR 480 and FOR 680.

**FOR 481 Introduction to Arboriculture (3)**

Two hours of lecture and one three-hour laboratory per week. Overview of the practice of arboriculture. Emphasis will be on site evaluation for species selection, planting, pruning, fertilization and removal of trees in an urban environment. Spring.

Prerequisite: Botany or Ecology.

**FOR 485 Business and Managerial Law (3)**

Three hours lecture/discussion per week. An introduction to the law governing business and management. Examination of sources of law, court systems and trials, constitutional foundations, criminal law, contracts, employer and employee law, business organization law, torts, personal property and motor vehicle law, landlord and tenant law, home ownership law, and wills and estates. Spring.

Prerequisite(s): Enrollment in the Construction Management, Natural Resources Management, or Sustainable Energy Management majors, or permission of instructor.

**FOR 487 Environmental Law and Policy (3)**

Three hours of lecture/discussion per week. Introduction to the approaches used in US environmental law. Analysis of common law and statutory designs and strategies used to address environmental problems. Examination of common law environmental remedies, Clean Air Act, Clean Water Act, Endangered Species Act, hazardous waste, and other environmental laws. Fall.

Prerequisite: Junior or Senior standing. Note: Credit will not be granted for both FOR 487 and FOR 687.

**FOR 489 Natural Resources Law and Policy (3)**

Three hours of lecture/discussion per week. An introduction to the law governing the management of natural resources. Examination of the history and constitutional basis of natural resources law, wildlife and biodiversity law, protected lands law, water law, marine fisheries law, rangelands law, minerals law, and forest law. Spring.

Prerequisites: Junior or senior standing. Note: Credit will not be granted for both FOR 489 and FOR 689.

**FOR 490 Integrated Resources Management (3)**

One hour of lecture, three hours of laboratory, and three hours of supervised work per week. This capstone course emphasizes the assimilation, integration, and interpretation of the biophysical and socioeconomic sciences. It

provides students with the opportunity to integrate skills and knowledge accumulated from professional and supporting coursework. A written comprehensive management plan, also presented orally in the field and classroom, provides the central vehicle by which students demonstrate their abilities as future natural resource managers. Spring.  
Prerequisite: Senior status in Forest and Natural Resources Management.

**FOR 495 Undergraduate Teaching Assistance (1 - 3)**

Undergraduate students gain experience as teaching assistants. They assist the instructor with the teaching and learning experience, assist students with learning course concepts, and mentor students on how to succeed in an undergraduate course. Responsibilities vary by section and instructor. Fall and Spring.

Prerequisite: Permission of instructor. Prior completion of course to be assisted with grade of B or better.

**FOR 496 Special Topics in Resource Management/Forestry (1 - 3)**

Experimental and developmental courses in new areas of resource management/forestry or areas not covered in regularly scheduled courses. Topics may include but are not limited to the biological, physical, and social dimensions and the many and varied resources of forest lands and forestry. Specific detailed course descriptions for each course taught under the FOR 496 designation are available for student perusal. Fall, Spring and Summer.

**FOR 498 Independent Study in Forest Resources Management (1 - 6)**

Independent research or study in resource management/forestry for selected undergraduate students. Selection of subject area, nature of the research or study, and number of credit hours determined by student in conference with appropriate faculty member; initiative in taking FOR 498 rests with the student. Final written report is required for record. Fall, Spring and Summer.

Prerequisite: Cumulative GPA of at least 2.50 and approval of the adviser and instructor.

**FOR 499 Internship in Forest and Natural Resources Management (1 - 12)**

Full- or part-time engagement as volunteer or employee working for off-campus resource management/forestry/renewable energy organization under guidance of external supervisor. Record of activities and final written report is required for record. Junior or senior status, cumulative GPA of at least 2.5, and written approval of a study plan by faculty advisor and field supervisor must be submitted prior to its commencement. Fall, Spring and Summer.

Prerequisite: Junior or Senior status. Must have a cumulative GPA of at least 2.5.

**FOR 501 Introduction to Environmental Resources Management (2)**

Two-week, field-based examination of forest, water, wildlife, recreation, and mineral resources and their management in New York State and surrounding states, framed by public administration, political science, economic, human dimension, and biophysical concepts. Emphasis is on experiential learning via a series of field trips. Fall (mid-August).

Prerequisite(s): Enrollment in the ERM MPS degree program.

**FOR 513 Adirondack Forest Ecology and Management (2 - 3)**

One-week, field-based examination of sustainable forest management in the Adirondacks, framed by concepts and issues associated with plant and wildlife ecology, silviculture, and forest management. Contemporary research on central Adirondack forests is featured based on work at the Huntington Wildlife Forest. Emphasis is on experiential learning via a series of trips to, and laboratories in, the forest. Fall (late summer).

Note: Credit will not be granted for both EFB 513 and FOR 513.

**FOR 519 Green Entrepreneurship (3)**

Three hours of lecture/discussion per week. Explore challenges and goals of creating a start-up venture in environmental science or technology. Recognize trends in the marketplace, and where commercial opportunities can be created. Analyze feasibility and potential to create a sustainable venture. Other topic areas include critical success factors and key start-up issues unique to environmental science and technology firms. Spring.

Prerequisite(s): FOR 207 Introduction to Economics or equivalent; or permission of instructor.

**FOR 521 Forest Ecology and Silviculture (3)**

Two hours of classroom lecture with weekly three-hour trips and labs to forests across Central New York. Study of the conceptual underpinnings and application of forest ecology via explorations of the environmental complex and silvicultural systems. Experiential learning is emphasized through a strong field component of assessing vegetation, site and land use history variables, and treatment alternatives to create different forest conditions. Provides a study of trees as individuals and communities, and how we can manipulate them both using planned methods and techniques to affect sustained production of a wide variety of forest ecosystem benefits, services, and values. Fall.

Prerequisite(s): Botany or general biology. Note: Credit will not be granted for both FOR 321 and FOR 521. Note: Not open to students taking FOR 534.

**FOR 522 Forest Mensuration (3)**

Two hours of lecture and three hours of laboratory per week. Principles and methods used in the measurement of standing trees, forest stands, forest products and growth. The application of sampling designs and analysis for forest valuation and inventory planning. Graduate students will be required to complete two additional term projects in addition to those required of undergraduate students. Fall.

Prerequisites: FOR 304 or equivalent. Co-requisites: APM 391 or equivalent. Note: Credit will not be granted for both FOR 322 and FOR 522.

**FOR 523 Tropical Ecology (3)**

Preparatory lectures(1.5 hr/wk) coupled with intensive spring break field study on a tropical island in the Caribbean. Principles of tropical ecology, resource management, and island biogeography are presented. Field trips to a variety of tropical ecosystems including rain forest, coral reefs, crater lakes, montane rain forest with comparison to north temperate ecosystems. Additional fee covers costs of travel, lodging. Spring. Prerequisite(s): General Ecology  
Prerequisite: General Ecology.

**FOR 524 Forest Biometrics (3)**

Three hours of lecture per week. Statistical methods and techniques including hypothesis testing, analysis of variance, simple and multiple linear regressions used for analyzing forest resource management problems and developing forest growth and yield models. Graduate students will be required to write a research paper in addition to those required of undergraduate students. Spring.

Prerequisite: APM 391 or equivalent. Note: Credit will not be granted for both FOR 323 and FOR 524.

**FOR 530 Studies in Silviculture (3)**

Three hours of lecture per week, with reading assignments, exams, and projects. Students gain an appreciation of silviculture and its use for influencing the character, composition, and development of forest stands, and the conceptual framework for those practices. Projects provide opportunities to explore techniques for analyzing forest stands and developing prescriptions. Fall

**FOR 532 Forest Ecology (4)**

Four hours of lecture/discussion and three hours of laboratory per week. Structure, function and dynamics of forest ecosystems at multiple scales, from trees to landscapes, including human interactions. Topics include ecophysiology, disturbance, succession, carbon and nutrient cycling, forest management, invasive species and climate change. Field data collection and analysis. Fall.

Prerequisite(s): Undergraduate coursework in biology/ecology; or by permission of instructor

**FOR 533 Natural Resources Managerial Economics (3)**

Three hours of lecture per week and a mandatory one-day or two-day overnight field trip. Every natural resources manager must answer the question of how to use economic information to make better business and management decisions daily. Solutions require systematically analyzing economic tools and models to identify alternative means of achieving given objective(s), then selecting the alternative that accomplishes this in the most resource efficient

manner. Spring.

Required in the Master of Forestry degree program. This is a shared resource course with FOR333. Note: Credit will not be granted for both FOR333 and FOR533. Prerequisite(s): Microeconomics (e.g., FOR207 Introduction to Economics or equivalent); Calculus (e.g., APM105 Survey of Calculus and Its Applications I or equivalent); Principles of Accounting (pre- or co-requisite; e.g., FOR205 Principles of Accounting or equivalent); or permission of instructor

### **FOR 534 Silvicultural Practice (4)**

Three hours of lecture and three hours of laboratory per week. The practice of silviculture in managing stands to serve various landowner interests, and explore the conceptual framework for those practices. Field trips and exercises provide opportunities to see examples of silvicultural methods under different management scenarios and to learn and practice techniques for analyzing forest stands and developing prescriptions for their treatment. Laboratory projects include reports that explore the conceptual and technical rationale for silvicultural decisions. Fall.

Note: Credit will not be granted for both FOR 334 and FOR 534.

### **FOR 535 Advanced Forest Soils (3)**

Three hours of lecture/discussion per week concerning the current state-of-the-art in forest soils. Effect of intensive forest management on soil, soil-site-species relationships, forest fertilization tree nutrition. Application of forest soils information to silviculture. Spring.

Prerequisite: FOR 332 or beginning courses in soils and silviculture.

### **FOR 538 Meteorology (3)**

Three hours of lecture/discussion per week. An introduction to the atmospheric physical processes important to understanding weather and weather forecasting at the surface of the earth and macro-, synoptic-, meso-, and micro-climates. The emphasis is on synoptic and micro-scale phenomena. Students will learn how to access weather data on the Internet and use that data to forecast weather. At the micro-scale, emphasis is on describing conditions and projecting change. Fall.

Note: Credit will not be granted for both FOR 338 and FOR 538.

### **FOR 540 Watershed Hydrology (3)**

Three hours of lecture per week. This course provides students with a detailed understanding of watershed hydrology, water quality and water management at the watershed scale, and offer the students the opportunity to gain in depth knowledge on one topic of particular interest to them through completion of a term project, and the development of a teaching/research presentation and interactive discussion with students in the class. Spring.

Prerequisites: FOR345 - Introduction to Soils Note: Credit will not be granted for both FOR 340 and FOR 540.

### **FOR 545 Introduction to Soils (3)**

Two hours of lecture and three hours of laboratory per week. Introduction to the fundamentals of soil science in the context of soil as an ecosystem component. Fall.

Prerequisite or Co-requisite: one semester of Introductory Chemistry or permission of instructor. Note: Credit will not be granted for both FOR 345 and FOR 545.

### **FOR 546 Forest Soil Genesis, Classification, and Mapping (3)**

Three hours of lecture per week during the first two-thirds of the semester. The last third of the semester is devoted to fieldwork and production of a soil map. Models of soil genesis, application of the U.S. system of soil taxonomy, and soil mapping. Spring.

Prerequisite: Introductory course in soil science.

### **FOR 557 Fundamentals of Geographic Information Systems (3)**

Three hours of lecture/discussion/recitation per week. Fundamental concepts of Geographic Information Systems (GIS); raster and vector data models and geodatabase design; common raster and vector data analysis tools used in the fields of forest and natural resources management, environmental science, conservation biology, ecology, and

landscape architecture; cartographic model construction; and map design. Completion of an independent project is required. Fall

Prerequisite(s): none

### **FOR 560 Principles of Management for Environmental Professionals (3)**

Three hours of lecture per week. This course focuses on the basic theories, concepts, principles and functions of modern management and administration, with an emphasis on the four functions of management: leading, planning, organizing, controlling. The four functions of management are applied to the public and private sectors, as well as for profit and not-for-profit organizations. Environmental management systems, corporate ethics and social responsibility and systematic problem solving are among the principal topics emphasized. Fall.

Prerequisite(s): none.

### **FOR 570 Forest Management Decision Making and Planning (3)**

Two hours of lecture/discussion and three hours of laboratory per week. Introduction to the components of forest management decision making and planning. The topics include forest regulation, growth and yield, and harvest scheduling given that a landowner's goals may include more than just commercial timber production. Sensitivity analysis of parameters used in forest management planning. Spring.

Prerequisites: FOR 322/522 and FOR 334/534 or permission of the instructor. Note: Credit will not be granted for both FOR 370 and FOR 570.

### **FOR 573 Sustainable Harvesting Practices (3)**

Two hours lecture and three hours of laboratory per week. Overview of forest roads and timber harvesting; planning, construction, and maintenance of forest roads; economic and environmental characteristics of harvesting systems; safety and health; wood procurement systems; and the role of forest operations in the broader context of forest management. Emphasis on application of knowledge, requiring a written report with a problem-solving focus. Fall.

Prerequisite: FOR 322 and FOR 334 or permission of instructor. Note: Credit will not be granted for both FOR 373 and FOR 573.

### **FOR 601 Environmental Resources Management Workshop (2)**

Three-week examination of a current topic in environmental resources management. Synthesis course that applies environmental resources management knowledge and techniques through a group consulting assignment for a government or non-government environmental resource organization. Spring (late Spring).

Prerequisite(s): 501: Introduction to Environmental Resources Management and completion of majority of ERM MPS coursework.

### **FOR 607 Restoration Ecology (3)**

Three hours of lecture per week. Students investigate and apply major ecological concepts to ecosystem restoration, including abiotic and biotic resource limitation, ecophysiology, trophic webs, disturbance, climate change, and alternative ecosystem states. Diverse readings and interactive class discussions have broad relevance to restoration practitioners, conservation biologists, and environmental engineers. Fall.

Prerequisite(s): an ecology course or permission of instructor.

### **FOR 610 Environmental Resources Business (3)**

Three hours of lecture per week. This course introduces the student to the fundamentals of business accounting and finance and their application to environmental management. The course is small enterprise oriented with emphasis on practical applications and problem solving techniques. The primary objective is to provide the student with the tools to understand and solve the basic accounting and financial problems confronting businesses and organizations in the environmental management field. Topics covered include basic accounting techniques, financial analysis, time value of money, valuation of assets, capital budgeting techniques, capital structure theory. Spring.

### **FOR 620 Silvicultural Concepts and Applications (3)**

Three hours of lecture or six hours of field studies and three hours of independent study per week. Advanced study of silviculture, including the conceptual basis for designing prescriptions to serve a variety of landowner objectives. Concurrent independent work on assigned projects enhances problem-solving skills related to stand analysis and prescription making. Reports articulate the conceptual basis for recommendations, and discuss likely outcomes based upon findings from research and computer simulations. Field exercises provide practical experience in implementing silvicultural prescriptions. Spring.

Prerequisite: previous studies in silviculture at the baccalaureate or higher level.

### **FOR 626 Plant Tissue Culture Methods (3)**

Two hours of lecture and discussion and three hours of laboratory per week. Introduction to plant tissue culture for biotechnology research and as a propagation method. Emphasis will be on learning laboratory instrumentation and techniques for establishing cell cultures, producing transgenic cell lines, and regenerating whole plants. In addition to the scheduled lab exercises, an independent micropropagation or transformation project will be required. Fall.

Prerequisite: Permission of instructor. Note: Credit will not be granted for both BTC 426 and FOR/EFB 626.

### **FOR 635 Forest Soils and Their Analyses (3)**

One hour of lecture, one hour of recitation, four hours of field and laboratory study of forest soils, emphasizing plant-soil relationships per week. Stress on quantification of plant-soil diagnostic techniques and their interpretation. Spring (odd years).

Prerequisite: FOR 446. Note: Background in physical and biological sciences recommended.

### **FOR 642 Watershed Ecology and Management (3)**

Three hours of lecture and discussion per week. Introduction to watershed ecology and stream ecosystems. Interactions and linkages among upland, riparian and stream processes. Management and restoration associated with multiple uses of forest and rangelands. Explore influences of spatial and temporal scale, watershed and network position, disturbance regimes, and global change. Students will apply course concepts to an independent research project. Fall.

Note: Credit will not be granted for both FOR 442 and FOR 642.

### **FOR 658 Advanced GIS (3)**

Five hours of class meeting per week. Lecture, demonstration, discussion, and lab exercises. Students learn to apply and evaluate advanced geoprocessing techniques in resource analysis and modeling. Students complete and present a capstone project. Spring.

Prerequisite(s): FOR557 or equivalent. This is a shared resource course and credit will not be granted for both FOR 458 and FOR 658.

### **FOR 659 Advanced GIS (3)**

Two hours of lectures and three hours of labs week. Lecture, demonstration, discussion, and lab exercises. Students learn to apply and evaluate advanced geoprocessing techniques in resource analysis and modeling. Students complete and present a capstone project. Spring.

Prerequisite(s): FOR557 or equivalent

### **FOR 665 Natural Resources Policy (3)**

Three hours of lecture per week. Analysis and application of political, policy formation, and policy administration theories to natural resources. Examination of drivers of U.S. natural resources policies. Analysis of private lands, public lands, forest, wildlife, endangered species, water, fire, and certification policies. Focus is on U.S. natural resources policies. Spring.

Prerequisite: graduate standing.

### **FOR 670 Resource and Environmental Economics (3)**

Three hours of lecture per week. An introductory course in resource and environmental economics. Apply economic

theories and models to analyze decisions concerning the use of forest, marine, and water resources and to analyze policy tools for mitigating pollution created as a result of production and consumption. Fall.

Prerequisite: A course in economics.

### **FOR 676 Ecotourism and Nature Tourism (3)**

Three hours of instruction per week. Overview of ecotourism and nature tourism programs and efforts around the world. Community, business, and organizational structures necessary for managing ecotourism and nature tourism programs. Environmental, social, and economic impacts. One-day field trip. Graduate level readings, assignments, and exams. Fall.

Prerequisite: FOR 372. Note: Credit will not be granted for both FOR 476 and FOR 676.

### **FOR 678 Wilderness and Wildlands Management (3)**

Three hours of lecture per week and one, two-day, overnight field trip. Reviews the state and federal legislation and agency policies that frame the planning and management of public lands designated as wilderness or wildlands. Emphasizes the use of wilderness research information for adaptive management approaches to stewardship of and planning for protection of natural resources and human values. Fall.

Prerequisite: FOR 372 or equivalent. Note: Credit will not be granted for both FOR 478 and FOR 678.

### **FOR 680 Urban Forestry (3)**

Three hours of lecture per week. Evaluation and management of urban greenspace resources, with emphasis on urban trees, in the context of other values and management processes in urban areas. Class practice in evaluating urban greenspace and tree resources, development of a research paper on urban forestry. Fall.

Prerequisite: Permission of instructor. Note: Credit will not be granted for both FOR 480 and FOR 680.

### **FOR 685 Business and Managerial Law (3)**

Three hours lecture/discussion per week. An introduction to the law governing business and management. Examination of sources of law, constitutional foundations, ethics, court systems and trials, contracts, agency, consumer law, security interests, bankruptcy, entrepreneurship law, corporations, torts, criminal law, personal property, real property, and wills and estates. Spring.

### **FOR 687 Environmental Law and Policy (3)**

Three hours of lecture/discussion per week. Introduction to the approaches used in US environmental law. Analysis of common law and statutory designs and strategies used to address environmental problems. Examination of common law environmental remedies, Clean Air Act, Clean Water Act, Endangered Species Act, hazardous waste, and other environmental laws. Analysis and application of primary and secondary legal sources to business and management problems. Fall.

Note: Credit will not be granted for both FOR 487 and FOR 687.

### **FOR 689 Natural Resources Law and Policy (3)**

Three hours of lecture/discussion per week. An introduction to the law governing the management of natural resources. Examination of the history and constitutional basis of natural resources law, wildlife and biodiversity law, protected lands law, water law, marine fisheries law, rangelands law, minerals law, and forest law. Analysis and application of natural resources law research and commentary. Spring.

Note: Credit will not be granted for both FOR 489 and FOR 689.

### **FOR 690 Integrated Resources Management (3)**

One hour of lecture, three hours of laboratory and three hours of supervised work per week. This capstone course emphasizes the assimilation, integration and interpretation of the biophysical and socioeconomic sciences. It provides students with the opportunity to integrate skills and knowledge accumulated from professional and supporting coursework. The final deliverable is a written management plan. Spring.

**FOR 692 Capstone in Forest and Natural Resources Management (3)**

Three hours of seminar discussions and presentations per week. Students will integrate and apply their knowledge of forest natural resources management to practical problems of their own design in their areas of interest, in consultation with clients whom they identify to be in need of their professional services. Class sessions include opportunities to develop advanced knowledge and professional skills, such as research, analysis, management, and communication. The final project outcomes are delivered through written reports and oral presentations. Fall.

**FOR 694 Writing for Scientific Publication (3)**

Three hours of lecture and discussion per week. Students will improve their skills in technical reporting by preparing a manuscript suitable for submission to a scientific journal. Topics include selection of an appropriate journal, design of effective figures and tables, sequential preparation of sections of the manuscript, writing tips, peer review and ethical issues. Spring.

**FOR 770 Ecological Economics and Policy (3)**

Three hours of seminar per week. A transdisciplinary approach to understand the interface of human and ecological systems, includes concepts and methods of ecologists, economists, and social scientists. Focus is on historical, conceptual and epistemological foundations. Draws on contemporary economic and policy thought, evolutionary biology, ecology, systems theory, social psychology, and environmental ethics. Spring.

Prerequisite: Graduate coursework in ecology or economics; doctoral student standing, or permission of instructor.

**FOR 796 Special Topics in Forest Resources Management (1 - 3)**

Lectures, seminars, and discussion. Advanced topics in resource management and policy. Check schedule of classes for details of subject matter. Fall and/or Spring.

**FOR 797 Seminar (1)**

Individual presentation and group discussion concerning current topics of concern to natural resources or their management. Fall and Spring.

**FOR 798 Research Problems in Forest and Natural Resources Management (1 - 12)**

Special investigation and analysis of forest and natural resources management topics. A study plan and a final written report are required. Fall and Spring.

**FOR 898 Professional Experience/Internship (1 - 6)**

Professional experience/internship which applies, enriches, or complements formal coursework. All professional experiences/internships must have a signed experience/internship agreement on record with the advisor. Graded on an "S/U" basis. Fall, Spring, and Summer.

**FOR 899 Master's Thesis Research (1 - 12)**

Investigation leading to the completion of a Master's thesis. Graded on an "S/U" basis. Fall, Spring, and Summer.

**FOR 999 Doctoral Thesis Research (1 - 12)**

Investigation leading to the completion of the doctoral thesis. Graded on an "S/U" basis. Fall, Spring and Summer.

**FTC 101 Trigonometry for Natural Resource Technicians (3)**

Forty hours of lecture and sixteen hours of recitation conducted over a four-week period. A review of selected geometry and algebra topics, and an introduction to trigonometry and its applications. Emphasis on pythagorean theorem, quadratic equations, rectangular coordinate systems, right triangle trigonometry, oblique triangle trigonometry, the Law of Sines, the Law of Cosines and the graphing of trigonometric functions. Graphic calculator required. Summer.

**FTC 105 Tree and Forest Biology (4)**

A four-week summer program having 45 hours of lecture and 45 hours of lab. An introduction to the biology of trees and the diversity of animal life commonly found in forests. Field labs concentrate on biological relationships in

Adirondack forests. Summer.

Pre- or co-requisite(s): Four credits in biology.

### **FTC 200 Dendrology (3)**

Thirty eight hours of lecture, and forty hours of field laboratory. Characteristics, distribution, and uses of tree species in North America. Identifying plant species using common and scientific names, from leaf, twig, fruit, or bark samples. Habitats, species associates, and succession of plants, including some invasive species. Fall.

### **FTC 202 Introduction to Surveying (3)**

Twenty eight hours of lecture and 72 hours of laboratory and field exercises. The course is an introduction to the theory and practice of plane surveying. Emphasis is on developing individual skills and techniques through small crew projects where it is necessary to handle typical surveying equipment in actual field situations. Lecture topics include the theory of measurements and errors, field record keeping procedures, mathematics for plane surveying, introduction to field problems, introduction to map use and preparation, concepts of land tenure systems and basic computer aided drafting. Students tour the various offices found at the County courthouse and participate in a research exercise. Field projects include traversing using common forester's and surveyor's tools and instruments, mapping including field and office procedure, and proficiency projects in handling various surveying instruments. Fall.

### **FTC 204 Introduction to Natural Resources Measurements (4)**

Forty-five hours of lecture and sixty hours of field/laboratory. A study of the tools and techniques used to measure primary forest products and inventory and/or measure natural resources, such as timber, water, biomass, carbon stocks, wildlife habitat, recreation use and impact, and plant diversity. Professional presentation of forest inventory data in the form of technical reports. Basic forest sampling methods are used and compared, and associated statistical methods are learned and applied. Fall.

Prerequisite(s): none.

### **FTC 205 Computer Aided Drafting and Design 1 (2)**

Eighteen hours of lecture and 36 hours of laboratory time. An introductory course in computer aided drafting. Emphasis is on developing individual skills and techniques for making professional quality drawings and maps. Topics include the drawing, editing, layer management, dimensioning, survey computations, data reduction, contouring and Geographic Information Systems. Fall.

Prerequisite(s): FTC 202 - Introduction to Surveying

### **FTC 206 Forest Ecology (4)**

Fifty-one hours of lecture and fifty-six hours of laboratory and field. Study of interactions between forest vegetation and the environment. Considers how sunlight, moisture, soils and climate impact species presence, composition and growth. Human dimension of forest ecology, including critical thinking and evaluation of environmental issues. Fall.

### **FTC 207 Communications and Safety (3)**

Twenty six hours lecture and fifty eight hours laboratory provides students with technical competence. Students develop study skills, handwriting skills, computer skills and communication skills including how to use library services. A resume and cover letter will be prepared for use in the job search process. Students receive training on the proper use and maintenance of forest hand tools and chainsaws. Students receive advanced training in the use and maintenance of chainsaws, and skidding equipment. First Aid and CPR/AED are covered as well as wilderness first aid. Prepares students for living in remote areas. Fall

Prerequisite(s): none.

### **FTC 208 Remote Sensing and GIS Technology (3)**

Thirty hours of lecture and forty-five hours of laboratory. This course is an introduction to the use of remote sensing and geographic information systems in the field of natural resources. Students practice interpretation of aerial photographs and digital imagery to measure horizontal distances and azimuths and calculate ground area.

Acquisition, creation and basic analysis of spatial data are also emphasized. Fall.

Prerequisite(s): None.

### **FTC 209 Timber Harvesting (2)**

Eighteen hours of lecture and thirty six hours of laboratory or field instruction. Student learns basic harvesting methods with northeastern United States emphasis and its relationship to other forest uses. Student understand the role of best management practices in timber harvesting. A technical competence in timber sale contract administration and basic timber appraisal is gained. Fall.

Co-requisite(s): FTC 204, FTC 207.

### **FTC 210 Wildlife Techniques (2)**

Eighteen hours of lecture and thirty-six hours field and laboratory time. Standard methods and techniques for measuring, monitoring, controlling and evaluating wildlife populations are discussed, demonstrated and/or practiced. Further practice in measuring and evaluating wildlife habitat. Identification of common birds, amphibians, reptiles and mammals by sight and sound. Fall.

Prerequisites: FTC 200, FTC 202, and FTC 204.

### **FTC 211 Silviculture (3)**

Thirty hours lecture and seventy five hours field lab. Regeneration and tending of forest stands. Physical and chemical treatments used for growing forests in the northeastern states. Introduction to silviculture in the southern and western states. Methods for quantifying and predicting forest growth. Marking timber stands for harvesting. Establishing new stands. Spring.

Prerequisites: FTC 200, FTC 204, and FTC 206.

### **FTC 212 Adirondack Cultural Ecology (2)**

Twenty two hours of lecture and twenty eight hours of field laboratory. Development of the Adirondack Park as influenced by the exploitation and eventual conservation of the region's natural resources. An historical review and contemporary assessment of the political, economic, and sociologic issues that define and influence Adirondack culture. Guest speakers, public meeting attendance, and field trips within the Park reinforce cultural history and emphasize the role of individuals, organizations, and agencies in managing the unique blend of public and private lands that comprise the Park. Spring.

Prerequisite(s): none

### **FTC 213 Forest Inventory Practicum (2)**

Six hours of lecture and sixty four hours of field/laboratory. A practical field problem requiring students to use professional methods of collecting, analyzing, and presenting forest inventory data. Inventory of the timber/biomass resource and the development of a forest type map are emphasized. Spring.

Prerequisites: FTC 200, FTC 202, FTC 204, and FTC 208.

### **FTC 214 Leadership and Organizational Performance (2)**

Twenty-two hours of lecture and twenty-four hours of laboratory time. Provides students with technical competence and decision-making abilities. Students learn about company and agency organization; the selection, placement, training, and evaluation of workers; managing crews and the techniques of foremanship; and human relations in the workplace, with emphasis on the special personnel problems of the forest and surveying industries. Spring.

Prerequisite(s): FTC 207 Communications and Safety

### **FTC 217 Wildland Firefighting and Ecology (2)**

Twenty-five hours of lecture and sixteen hours of laboratory and field. An introduction to fire science. Learn basic principles of fire ecology, behavior, danger rating and control. Practical experience conducting a prescribed burn. Spring.

Prerequisite(s): FTC 200, FTC 204, FTC 206, FTC 210.

**FTC 219 Introduction to Forest Recreation (1)**

Fourteen hours of lecture and twenty hours field and laboratory time. A study of forest-recreation resources, their importance to humans, and of the basic history, laws and principles underlying forest-recreation management in the United States. The technical aspects of recreation management are emphasized, as is the study of public-land management, including wilderness. Spring.

Pre-requisites: FTC 207.

**FTC 221 Natural Resources Management (3)**

Thirty-five hours of lecture and thirty hours of laboratory and field. Addresses common issues in organizing a forest property to meet stakeholder goals. Techniques of growth and resource measurement, monitoring, and evaluation are emphasized. Examples and case studies of forest management and production activities are presented. A final project involves the application of knowledge accumulated at the ESF Ranger School in a management plan for an assigned forest property. Spring.

Prerequisites: FTC 204, FTC 206 and FTC 208.

**FTC 224 Field Applications (1)**

Forty hours field laboratory visiting various facilities, including private, state, industrial, nongovernmental organizations and other groups. Students will learn how these agencies address financial, political, and environmental concerns within their professional fields. Spring

Prerequisite(s): none

**FTC 225 Timber Transportation and Utilization (3)**

Forty three lecture hours and forty three laboratory hours. Students gain knowledge of graveled forest road administration, location, design, construction, and maintenance. Differences in wood structure, and their effects on wood products of various species are studied. Spring.

Prerequisites: FTC 208, and FTC 210. Co-requisite: 259.

**FTC 234 Wildlife Conservation (3)**

Thirty-eight hours of lecture and twenty hours field and laboratory time. An introduction to the history and evolution of wildlife-related policies and laws, and to the biological, ecological, economical and sociological principles underlying wildlife management and conservation efforts in the United States. Terrestrial vertebrate animals serve as the basis of discussions and case studies. Students improve their communication skills by presenting papers and speeches on wildlife-related topics. Spring.

Prerequisite: FTC 206.

**FTC 236 Interpretive Techniques in Forest Recreation (2)**

Twenty-eight hours of lecture and twenty-four hours field and laboratory time. Students complete NAI's Certified Interpretive Guide course, and more closely study the relationship between interpretation and recreation management. Students improve their communication skills by presenting papers, speeches and interpretive posters. Spring.

Pre-requisites: FTC 200, FTC 202, FTC 204, and FTC 208.

**FTC 237 Introduction to Water and Soil Resources (3)**

Thirty-seven hours of lecture and twenty-four hours of laboratory and field. Introduction to watershed ecology and soil science. Interactions among upland, riparian, stream and wetland systems, including the hydrologic cycle. Study and measurement of soil physical, chemical and biological characteristics and processes. Recognize soil and water resource management and protection issues associated with multiple uses of forest lands. Spring.

Prerequisites: FTC 202, FTC 206, and FTC 208.

**FTC 238 Forest Insects and Disease (3)**

Thirty-five hours of lecture and twenty-six hours of laboratory and field. An introduction to forest insects and diseases.

Explore ecological roles and identify selected insects and pathogens based on morphology, signs and symptoms. Discuss integrated pest management and other control measures. Spring.

Prerequisites: FTC 200, and FTC 206.

### **FTC 239 GIS Applications (2)**

Fifteen hours of lecture and forty-five hours of laboratory. Introduction to acquisition, manipulation, and creation of geospatial data using geographic information systems. Build geodatabases, use geoprocessing tools, work with attribute data in both Excel and ArcGIS. Plan and conduct a simple geospatial analysis project. Spring.

Prerequisites: FTC 202, and FTC 208.

### **FTC 251 Advanced Surveying Measurements and Computations (4)**

Thirty hours of lecture and eighty-five hours of field and laboratory time. Advanced survey measurements and computational techniques including traverse calculations, rectangular coordinates, statistical analysis of surveying data, state plane coordinates, meridian determination, partition of land, trigonometric leveling and horizontal control are explored. Students will make the necessary surveying measurements in the field and be expected to complete various surveying measurements using a calculator and computer. Spring.

Prerequisite: FTC 202. Co-requisite: FTC 257.

### **FTC 253 Survey Law (3)**

Thirty five hours of lecture and 30 hours of laboratory time. The course is a study of courthouse real property research, property boundary determination by various methods, case and statute law as it relates to real property and land surveying, legal research and the liability and professionalism of the practicing land surveyor. Spring.

Prerequisite: FTC 202.

### **FTC 255 Boundary Surveying (3)**

Thirty hours of lecture and forty-five hours of field and laboratory time. A study of the procedures necessary to conduct a retracement survey including preliminary office procedures, field practices, and preparation of final survey documents. Students will complete a retracement survey and use the compiled data in a mock trial. Spring.

Prerequisite: FTC 202. Co-requisite: FTC 253.

### **FTC 256 Subdivision Surveys (2)**

Twenty hours of lecture and 30 hours of laboratory time. An introduction to the preparation of a multi-lot subdivision of a parcel of real estate. Development of a subdivision in relation to topography, zoning requirements, utility services, existing and proposed roads or streets and client requests. Students learn to design minor storm drain facilities in relation to the subdivisions. The student will incorporate all of the above while using survey software. Spring.

Prerequisite: FTC 202. Co-requisite: FTC 259.

### **FTC 257 Construction and Topographic Surveys (3)**

Twenty-five hours lecture and sixty hours field and laboratory. A study of the various methods and techniques used to perform construction and topographic surveys and develop topographic maps. Theory, mathematics, and layout of circular, spiral and vertical curves. Layout of various construction projects including buildings, roads, pipelines and bridges will be discussed. Earthwork, staking and cross-section calculations will also be covered. Students complete a topographic mapping project and develop maps using appropriate surveying and mapping software. Spring.

Co-requisites: FTC 252 and FTC 259.

### **FTC 259 Computer Aided Drafting and Design II (2)**

Eighteen hours of lecture and seventy hours of laboratory time. An additional course in computer aided drafting and design. Emphasis is on developing individual skills and techniques for making professional quality drawings, maps and plats. Topics include the drawing, editing, layer management, dimensioning, survey computations, data reduction, surface modelling and GIS. Spring.

Prerequisite(s): FTC 202 - Introduction to Surveying, FTC 205 Computer aided Drafting and Design I.

**FTC 298 Independent Study in Forest Technology (1 - 6)**

Independent study in forest technology to apply, enhance or supplement forest technology or related natural resource education. Objectives and scope of the project are negotiated in a learning contract between the student and instructor(s), with course admission based on permission of the instructor(s). Limited to those who have attended the complete regular SFT program, or those who have graduated from another forest technology program or a related natural resource program, or to students enrolled in any ESF program other than SFT. A maximum of six credit hours may be taken by any student in total. Semesters as arranged. Fall, Spring or Summer.

**GNE 160 Computing Methods for Engineers and Scientists (3)**

Two hours lecture and three hours laboratory per week. Introduction to algorithm design, programming structures, and data structures. Engineering calculation software including programming languages, spreadsheets, and simulation software. Application of computing methods to engineering problems and data analysis. Spring.

**GNE 171 Engineering Mechanics Dynamics (2)**

Two hours of lecture per week. Kinematics and kinetics of particles and rigid bodies; rectangular, normal and tangential, radial and transverse components; translation and rotation; force and acceleration; impulse; momentum; work and energy; impact. Spring.

Prerequisites: Statics and Calculus II.

**GNE 172 Statics and Dynamics (4)**

Four hours of lecture per week. This course provides fundamental principles, methods and applications of engineering mechanics. Development and discussion of analytic models for rigid-body mechanics are used to apply theories. Rigid bodies of a practical nature and at rest or in motion are covered. Fall.

Prerequisites: Algebra, derivative and integral calculus.

**GNE 271 Statics (3)**

Three hours of lecture per week. Covers fundamentals of analysis of static systems including equilibrium of rigid bodies, distributed loads, and trusses. A portion of the class is spent on open-ended problem solving and engineering design. Fall.

Prerequisite: Physics I (Mechanics) and Calculus II

**GNE 273 Mechanics of Materials (3)**

Three hours of lecture per week. Theories of stress, deformation and stability of common structural materials subjected to various force systems. Spring.

Prerequisites: Integral calculus and statics.

**GNE 330 Professional Engineering Skills Seminar (0.5)**

Two hour seminar approximately every other week. Professional skills needed by engineers to be successful in their profession including teamwork, ethics, communications, impact of engineering solutions, life-long learning, and contemporary issues. Seminar topics include industry outlook, professional organizations, networking, finance, management, personnel issues, among other topics. Topics will typically be covered on a three-year cycle. Fall and Spring.

**GNE 410 Structures (4)**

Three hours of lecture, three hours of computation laboratory and discussion per week. Engineering principles in the analysis, planning design and construction of components and framed structures under various types of loadings. The proportioning of wood, steel and composite members and the design of statically determinate structural systems. Emphasis is placed on the relationship between theoretical stress analysis and codes and specifications for appropriate materials and structural design practices. Fall.

Prerequisite(s): GNE 273 and scientific computing.

**GNE 461 Air Pollution Engineering (3)**

Three hours of lecture and discussion per week. Study of physical, chemical, legislative, and meteorological aspects of air pollution and its control. Air quality and emission standards. Local and global effects of air pollution and atmospheric dispersion modeling. Design principles of air pollution control devices. Fall.

Prerequisites: 1 year of college-level physics, chemistry and calculus. Note: Credit will not be granted for both GNE 461 and GNE 661.

**GNE 530 Professional Engineering Skills Seminar (0.5)**

Two hour seminar approximately every other week. Professional skills needed by engineers to be successful in their profession including teamwork, ethics, communications, impact of engineering solutions, life-long learning, and contemporary issues. Seminar topics include industry outlook, professional organizations, networking, finance, management, personnel issues, among other topics. Topics will typically be covered on a three-year cycle. A project is required. Fall and Spring.

**GNE 661 Air Pollution Engineering (3)**

Three hours of lecture and discussion per week. Study of physical, chemical, legislative, and meteorological aspects of air pollution and its control. Air quality and emission standards. Local and global effects of air pollution and atmospheric dispersion modeling. Design principles of air pollution control devices. Fall.

Prerequisites: 1 year of college-level physics, chemistry and calculus. Note: Credit will not be granted for both GNE 461 and GNE 661.

**LSA 132 Orientation Seminar: Landscape Architecture (1)**

One hour of lecture, discussion and/or exercises per week. Occasional field trips. Orientation to campus resources available to ensure academic success. Introduction to the professional culture and some topics of interest to landscape architects. Fall.

**LSA 182 Drawing Studio (3)**

Six hours of studio and one hour of lecture per week. This drawing course introduces the students to materials, techniques and components of drawing, architectural elements and figure drawing. Fall and Spring.

Prerequisite: Landscape architecture students or permission of instructor.

**LSA 190 Clashing Perspectives in the Built Environment\* (3)**

Three hours of lecture/discussion per week. Can obesity, depression, and other public health issues be linked to the design of cities and suburbs? Examine how past and present social behavior, societal needs and cultural values shape the environment. Explore the complex array of public and private decisions--and their unintended consequences--on our physical communities. Spring and Fall.

\*This course description was added to the on-line catalog on October 21, 2009.

**LSA 205 Art, Culture and Landscape I (3)**

Three hours of lecture per week. The course will examine the evolution of cultural expression in the arts and allied design professions. Lectures will emphasize the interrelationships between the arts and their cultural contexts from prehistory to the Renaissance. Fall.

**LSA 206 Art, Culture and Landscape II (3)**

Three hours of lecture per week. The course will examine the evolution of cultural expression in the arts and allied design professions. Lectures will emphasize the interrelationships between the arts and their relation to cultural contexts from the Renaissance to the present day. Spring.

**LSA 220 Introduction to Landscape Architecture (3)**

Three hours of lecture per week. LSA 220 presents an overview and introduction to the profession of landscape architecture. It presents a survey of the development of the profession in the United States and how the profession

responds to societal needs in providing services to various public and private clients. Emphasis is placed on understanding the significance of environmental, socio/cultural, physical/visual, and aesthetic factors in developing intervention strategies and designs. Contemporary landscape architectural issues, practitioners and work are presented. Fall.

### **LSA 226 Foundation Design Studio I (4)**

Five hours of studio and one hour of lecture per week. Studio time devoted to demonstrations, exercises and projects. Content focuses on skills and knowledge necessary to visualize and communicate 2-D and 3-D design ideas using appropriate traditional or digital graphic tools, techniques and technology. An emphasis is placed on the development of a working graphic and spatial design vocabulary and an introduction and application of fundamental design principles and the design process. Fall.

Prerequisite: LSA 182 or permission of instructor.

### **LSA 227 Foundation Design Studio II (4)**

Five hours of studio and one hour of lecture per week. Studio time is devoted to demonstrations, exercises and projects. Content focuses on the expansion of skills and knowledge necessary to visualize and communicate 2-D and 3-D design ideas. An emphasis is placed on the development of a working understanding of the design process and its application toward the synthesis of design form in the landscape. Spring.

Prerequisite: LSA 226 or permission of instructor.

### **LSA 300 Digital Methods and Graphics I (3)**

Three hours of lecture per week. Through active participation, students learn to produce 2D digital graphics and documents (posters, reports, presentations and e-docs). Content includes image processing and vector drawing; document assembly for print, viewing and electronic distribution; and general concepts of digital workflow management. Credit will not be given for both LSA 300 and LSA 500. Fall.

Prerequisite: Undergraduate standing in Landscape Architecture, Natural History and Interpretation or permission.

### **LSA 301 Digital Methods and Graphics II (3)**

Three hours of lecture per week. Through active participation, students learn to produce 2D digital technical drawings and 3D digital models, to assemble graphics derived from diverse applications and produce composite digital documents suitable for printing, display and digital distribution. Credit will not be given for both LSA 301 and LSA 501. Spring.

Prerequisite: BLA standing in Landscape Architecture or permission of the instructor. LSA 300 recommended.

### **LSA 305 History of Landscape Architecture I (3)**

Three hours of lecture per week. This course offers a survey of landscape architecture and urban design in the context of the cultural history of the western world. Prior to taking this class, students should have passed at least one semester of college-level art (LSA 206) or architectural history.

### **LSA 306 History of Landscape Architecture II (3)**

Three hours of lecture per week. Survey of landscape design in the modern era, emphasizing the 20th century through the emergence of contemporary practice. Lectures and readings on significant movements, works and designers in the cultural, social and environmental context of the period. Fall.

Prerequisites: LSA 305, or permission of instructor.

### **LSA 311 Natural Processes in Design and Planning (3)**

Three hours of lecture per week. An overview of basic principles and processes of physical and biological landscape systems with respect to their roles in landscape design and planning. Emphasizes landform, soil, slope, hydrology, climate, energy and general ecological issues as common elements influencing landscape design and the land use decision-making process. Sources and uses of environmental data are discussed. Fall.

Note: Credit will not be granted for both EST 311 and LSA 311.

**LSA 312 Place/Culture/Design (3)**

Three hours of lecture/discussion per week. Introduction to the interpretation of common places (streets, plazas, shopping malls, neighborhoods, parks, etc.) as expressions of culture. The course uses an interdisciplinary cultural studies approach to analyze the cultural processes and practices that shape places and applies these understandings in the context of design professions. Course requirements include readings, discussions, projects, reports and examinations. Field trips may be scheduled. Fall.

**LSA 321 Ecological Applications in Planning and Design (3)**

Three hours of lecture per week. Introduction to concepts of ecology and landscape ecology related to sustainable land planning and design. Emphasis on using theory to guide planning and design decision making, with a goal of greater integration of ecological concepts into professional work. Fall.

Prerequisite(s): Junior standing in the Bachelor of Landscape Architecture program or permission of the instructor.

**LSA 326 Landscape Architectural Design Studio I (5)**

Seven hours of studio and one hour of lecture per week. This course will instruct those enrolled in the processes of measuring various physical qualities of a site or landscape, and then how to apply knowledge of ecology, natural processes, and human behavior and culture to assess the viability of potential design uses and forms. The material addressed will include land measurement and measurement systems, physiography and landform, soils, hydrology, climate, and plant, animal and human ecology. A variety of manual and computer techniques for data collection, analysis and synthesis of natural and cultural systems information will be explored. The course will concentrate on the comparison of synthesis techniques and their use in land use and site design decision-making. Occasional local field trips will be utilized. Fall.

Prerequisites: LSA 182, LSA 226, LSA 227 and LSA 311 (or their equivalent) with grades of "C" or better, or permission of instructor.

**LSA 327 Landscape Architectural Design Studio II (5)**

Seven hours of studio and one hour of lecture per week. This course addresses intermediate to advanced level site design, including skill development, theory and strategies as they relate to design issues and process. Emphasis is placed on in-depth investigation of concept and form expression in small-scale site design. Focus is on the form implications of applying specific materials, plantings and structural systems through design development and detailing. Occasional field trips to illustrate various design solutions. (Student field trip and materials expenses \$300-\$400).

Prerequisite: LSA 326 with a minimum grade of "C" or better, or permission of instructor. Co-requisite: LSA 342.

**LSA 333 Plants Materials (2)**

One hour of lecture followed by three hours of field identification lab per week. Course provides an introduction to the identification, site requirements, natural and cultural history, community ecology, and landscape value of native and exotic woody and herbaceous plant materials typical of landscape architectural practice. Field identification labs include on-campus site walks and trips to local gardens, arboreta and natural areas to demonstrate the use of plants in designed and ecological settings. Fall.

**LSA 342 Landscape Architectural Construction Technology (4)**

Three hours of lecture and three hours of studio/laboratory per week. Lectures, project, and assigned readings. This course provides an introduction to important site construction basics, including landscape grading and landform manipulation. Topics addressed will include appropriate slopes for various site uses, surface and subsurface drainage, principles of cut/fill analysis, pedestrian and vehicular circulation design, horizontal and vertical road alignment, storm water management, and soil erosion control. Appropriate methods and technologies will be demonstrated through studio projects and exercises. Spring.

Prerequisite: College math (with algebra and trigonometry), LSA 326, or permission of instructor.

**LSA 343 Landscape Materials and Structures (3)**

Three hours of lecture and discussion per week. This course introduces the properties of various "hardscape" design materials used in landscape architectural construction, as well as the appropriate structural systems and design detailing typical for design elements. Occasional local field trips. Spring.

**LSA 422 Landscape Architectural Design Studio III (5)**

Seven hours of studio and one hour of lecture per week. This course introduces and applies concepts urban and regional planning, environmental planning, and landscape ecology, in the context of large-scale landscape architectural, community, and urban design. Emphasis will be placed upon the application of appropriate technologies and strategies to foster environmentally and economically sustainable community forms, as well as greater environmental and social equity. Occasional field trips to illustrate various design solutions. (Student field trip and materials expenses \$300-\$400). Spring.

Prerequisites: LSA 327 with a minimum grade of "C" or better, or permission of instructor.

**LSA 423 Landscape Architectural Design Studio IV (5)**

Seven hours of studio and one hour of lecture per week. LSA 423 addresses the final refining stages of small-scale site design, design detailing, precise layout and grading, selection of individual plant specimens and other materials, and the production of "working drawings" or contract documentation. Projects will include development of a complete set of working "contract documents," including layout plans, grading plans, planting plans and design details and specification. Occasional field trips to illustrate various design solutions. (Student field trip and materials expenses \$300-\$400). Spring.

Prerequisite: LSA 422 with a minimum grade of "C" or better, or permission of instructor.

**LSA 424 Preparation for Off-Campus Design Thesis Studio (1)**

One hour of lecture and discussion per week. The initial orientation and exploration of suitable landscape architecture or environmental studies topics for study during LSA 460. Students will tentatively select topics, form off-campus groups and be assigned a faculty advisor. Fall.

Prerequisite: Senior BLA standing, or permission of instructor.

**LSA 425 Orientation for Off-Campus Design Thesis Studio (3)**

Three hours of lecture and/or discussion per week. The initial orientation and exploration of suitable landscape architecture or environmental studies topics for study during LSA 460. Students undertake a detailed literature review, identify and refine research/study methods and prepare a detailed study proposal, including logistical details for LSA 460 (Off-Campus Design Thesis Studio). Spring.

Prerequisite: LSA 424 and senior BLA standing, or permission of Off-Campus Program Director.

**LSA 433 Planting Design and Practice (3)**

Two hours of lecture and three hours of lab/studio exercises per week. This course concentrates on the ecological, aesthetic and technical considerations of woody and herbaceous plant use in landscape architectural design. Concepts covered include ecological relationships among plants, cultural requirements of plants, nursery production, planting design and composition, planting plans and specifications, and plant establishment and maintenance. Course utilizes field trips to gardens, arboreta and natural areas to demonstrate planting design concepts. Fall.

Prerequisite: LSA 333 or permission of instructor. Note: Credit will not be granted for both LSA 433 and LSA 633.

**LSA 451 Comprehensive Land Planning (3)**

Three hours of lecture per week. Introduction to the planning process including survey and analysis techniques, the comprehensive plan, political context, and land use controls. Selected functional planning areas such as land use, environmental, growth management, regional planning, and economic development planning. Legal and historical basis. Spring.

Prerequisite: LSA 311 or permission of instructor. Note: Credit will not be granted for both LSA 451 and LSA 651.

**LSA 455 Professional Practice in Landscape Architecture (3)**

Three hours of lecture per week. This course examines the historic and contemporary modes of landscape architectural practice including practice types, ethics, operations, and client systems. Particular emphasis is given to the projected trends of professional practice and with impact on future roles for the landscape architect. Professional development is reviewed as it relates to internship, licensing, and continuing education. Spring.

Prerequisites: Upper division standing in landscape architecture or permission of the instructor. Note: Credit will not be granted for both LSA 455 and LSA 655.

**LSA 458 Off-Campus Design Thesis Studio: Faculty Advisor Visit, Weekly Reports and Field Studies (4)**

Twelve hours of individual field study per week conducted in an international or domestic location. Short field studies executed through on-site observation, sketching and analysis exercises. Study progress is communicated through weekly reports to an advisor and presented during the advisor's visit, the fifth week of the Off-Campus semester. Summer or Fall.

Prerequisites: LSA 423 and LSA 425 with a minimum grade of "C". Co-requisites: LSA 459, LSA 460.

**LSA 459 Off-Campus Design Thesis Studio: Design Journal and Project Notebook (4)**

Twelve hours of individual field study per week conducted in an international or domestic location. Field observations and travel experiences documented through daily graphic and narrative entries in a design journal/sketchbook. Thesis project studies and research documented through daily entries in a project notebook. Summer or Fall.

Prerequisites: LSA 423 and LSA 425 with a minimum grade of "C". Co-requisites: LSA 458, LSA 460.

**LSA 460 Off-Campus Design Thesis Studio: Thesis Project (7)**

Twenty-one hours of individual field research and studio per week conducted in an international or domestic location. The completion of a thesis project as delineated in a proposal prepared by the student and approved by the Off-Campus faculty advisor in LSA 425. Summer or Fall.

Prerequisites: LSA 423 and LSA 425 with a minimum grade of "C". Co-requisites: LSA 458 and LSA 459.

**LSA 461 Off-Campus Final Presentation Seminar (1)**

One hour of seminar per week. Seminar time devoted to individual presentations and critique. Content focuses on individual projects undertaken as a component of LSA 460. Spring.

Prerequisite: LSA 460.

**LSA 470 Thematic Landscape Design Studio (6)**

Eight and one-half hours of studio and one hour of lecture per week. Studio time devoted to demonstrations, exercises and projects. Content focuses on different themes, topics, and scales each year, traditionally addressing sub-disciplines in landscape architecture such as urban design, community design and planning, ecological design and restoration and cultural landscape preservation. Spring.

Prerequisite: LSA 423 or permission of the instructor. Note: Credit will not be granted for both LSA 470 and LSA 670.

**LSA 480 Seminar in Urban Design (3)**

Three hours of seminar per week. This course is an exploration of literature and case studies that address the history, theories, principles and practice of 19th and 20th century North American and European urban design. The format includes readings, discussion and presentations, papers, and a three-day field trip. Fall.

Prerequisite: Permission of instructor. Note: Credit will not be granted for both LSA 480 and LSA 680.

**LSA 481 Cultural Landscape Preservation (3)**

Two hours of presentation and one hour of discussion per week. The course provides an overview and introduction to cultural landscape preservation and the general preservation movement in the United States. Philosophy, history, and legislation of the preservation movement will be presented. The focus will be on preservation terminology and application, standards, guidelines and procedures. Research, identification, evaluation of significance, and integrity and treatment of cultural resources will be explored. Limited enrollment. Spring.

Prerequisite: Permission of instructor. Note: Credit will not be granted for both LSA 481 and LSA 681.

### **LSA 495 Undergraduate Experience in College Teaching (1 - 3)**

Undergraduate Experience in College Teaching. An opportunity for 4th year senior or 5th year students to gain experience in fully supervised, college-level teaching similar to what they can expect to perform as a graduate teaching assistant. Students assist the course instructor in the preparation and presentation of studio or lecture material in an undergraduate course. A maximum of 6 credit hours of LSA 495 and 3 credit hours relating to any single assisted course. Fall, Spring, Summer. Prerequisite(s): 4th year senior or 5th year standing, a grade of B or higher in course being assisted, consent of instructor and minimum cumulative GPA of 3.0.

Prerequisite(s): 4th year senior or 5th year standing, a grade of B or higher in course being assisted, consent of instructor and minimum cumulative GPA of 3.0.

### **LSA 496 Special Topics in Landscape Architecture (1 - 6)**

One to three hours of class meetings per week. Special topics of current interest to undergraduate students in landscape architecture and related fields. A detailed course subject description will be presented as a topic area is identified and developed. Fall and Spring.

Prerequisite: Permission of instructor. Note: Credit will not be granted for the same topic in LSA 496 and LSA 696.

### **LSA 497 Contemporary Issues in Landscape Architecture (1 - 6)**

Three hours of lecture/discussion per week. This seminar covers contemporary issues related to landscape architecture. Through in-class discussion and out-of-class work, the course seeks to deepen the student's understanding of the dynamics of the built environment and the challenges and opportunities stemming from changes in environmental and social contexts. Topics will vary with each offering and may include ecological design, design for community resilience, urban redevelopment strategies and issues, among others. Fall, Spring.

Prerequisite(s): Junior or Senior standing

### **LSA 498 Introductory Research Problem (1 - 3)**

Guided study of a selection of problems relating to landscape architecture and environmental design. Emphasis on study procedure and methods employed. Enrollment at periodic intervals throughout the semester. Fall, Spring and Summer.

Prerequisite: Permission of instructor.

### **LSA 499 Undergraduate Landscape Architecture Internship (1 - 12)**

LSA 499. Undergraduate Landscape Architecture Internship. Supervised office or field experience in a professional working environment. Fall, Spring and Summer. Prerequisites: BLA students only with an approved internship proposal.

### **LSA 500 Digital Methods and Graphics I (3)**

Three hours of lecture per week. Through active participation, students learn to produce 2D digital graphics and documents (posters, reports, presentations and e-docs). Content includes image processing and vector drawing; document assembly for print, viewing and electronic distribution; and coordination of workflow in team-based production settings. Credit will not be given for both LSA 300 and LSA 500. Fall.

Prerequisite: Graduate standing in Landscape Architecture, Environmental Interpretation or permission.

### **LSA 501 Digital Methods and Graphics II (3)**

Three hours of lecture per week. Through active participation, students learn to produce 2D digital technical drawings and 3D digital models, to assemble graphics derived from diverse applications and produce composite digital documents suitable for printing, display and digital distribution; and to coordinate workflow in team-based production settings. Credit will not be given for both LSA 301 and LSA 501. Spring.

Prerequisite: Graduate standing in Landscape Architecture or permission of the instructor. LSA 500 recommended.

### **LSA 552 Graphic Communication (3)**

Two three-hour studios and one one-hour lecture per week. Studio time devoted to demonstrations, exercises, and projects focusing on sketching, drafting, drawing construction and rendering techniques used in the landscape architecture field. Introduction to drawing reproduction and technologies. Emphasis on skill development, use of graphics in the design process. Drawings, examinations and a final project constitute basis for grades. Fall. Prerequisite: Graduate status in landscape architecture or permission of instructor.

### **LSA 596 Special Topics in Landscape Architecture (1 - 3)**

Experimental or special coursework in landscape architecture for graduate and undergraduate students. Subject matter and method of presentation vary from semester to semester. Fall and Spring. Prerequisite: Permission of instructor.

### **LSA 600 Design Studio I (4)**

Nine hours of studio and one hour of lecture/discussion per week. The first in a sequence of studios focusing on the concepts, skills and methods of design. This course introduces students to the basic vocabulary of theoretical design principles, to the application and operation of these in the physical environment, and to the development of three-dimensional spatial concepts in community scale patterns. The requirements for the course include readings, examinations, field trips, design exercises and projects. Fall. Prerequisite: Graduate status in landscape architecture or permission of instructor.

### **LSA 601 Design Studio II (4)**

Five hours of studio and one hour of lecture per week. The second in a sequence of studios applying the concepts, skills and methods of design in a critical analysis of various natural and human systems in community scale environments. Concentration is on the evaluation of options concerning a variety of land use activities, with special emphasis on landscape analysis and the functional and spatial quality of built environments. The requirements for this course include readings, examinations, field trips, design exercises and projects. Spring. Prerequisites: Graduate status in landscape architecture and LSA 600, LSA 552, or permission of instructor.

### **LSA 605 History of Landscape Architecture (3)**

Three hours of lecture per week. Historical study and style analysis of Western culture on environmental design, and changing attitudes and relationships to the environment. Non-Western influences on Western culture. Study of historical personalities as well as periods that are of environmental concern up to the modern period. Additional readings and a supplementary research/writing component. Spring. Note: Credit will not be granted for both LSA 405 and LSA 605.

### **LSA 606 History of Landscape Architecture II (3)**

Three hours of lecture per week. Survey of landscape design in the modern era, emphasizing the 20th century. Lectures and readings on significant movements, works and designers in the cultural, social and environmental context of the period. Additional seminar, reading and writing component. Fall. Prerequisites: MLA status or permission of instructor Note: Credit will not be given for both LSA 406 and LSA 606.

### **LSA 611 Natural Processes in Planning and Design (3)**

Two hours and 40 minutes of lecture and one hour of discussion per week. This course addresses basic principles and processes of physical landscape systems with respect to their roles in landscape design and planning. Sources and uses of environmental data are discussed and illustrated. An emphasis is placed on landform, soil, slope, hydrology, climate and general ecological issues as common elements influencing landscape design and the land use decision making process. Fall. Prerequisite: Graduate status in landscape architecture or permission of instructor.

### **LSA 615 Site Construction Grading, Drainage and Road Layout (3)**

One hour of lecture and six hours of studio per week. This course provides an introduction to important site

construction basics, including landscape grading and landform manipulation to achieve appropriate slopes for use and positive surface drainage, principles of cut/fill analysis and subsurface drainage, horizontal and vertical alignment for road design, storm water management, and soil erosion control. Appropriate analysis methods and technologies will be employed through studio projects and exercises. Spring.

Prerequisite: Graduate status in landscape architecture, concurrent enrollment in LSA 601 or permission of instructor.

#### **LSA 620 Design Studio II--Advanced Site Design (4)**

One hour of lecture and nine hours of studio per week. This course is the third in a sequence of landscape architectural design studios. It focuses on advanced issues in site design and on the integration of project programming and design development into the design process. Concentrations include detailed designing for site layout, grading, storm water management, interior and exterior planting, site furnishing, and site lighting. Design exploration and project communication techniques are pursued such as CAD, reprographics, and computer-based visual simulation. Course requirements include readings, field trips, exercises, and design projects. Fall.

Prerequisites: Graduate status in landscape architecture, LSA 601, LSA 611, LSA 615, or permission of instructor.

#### **LSA 621 Design Studio IV--Community Design and Planning (4)**

Nine hours of studio and one hour of lecture and discussion per week. Design studio problems addressing principles and practice of community design, the structure and language of human settlements, community design process, natural systems and community design, and an introduction to the history, traditions and literature of the field. Spring.

Prerequisite: LSA 620 or permission of instructor.

#### **LSA 625 Orientation for Off-Campus Experiential Studio (2)**

This course includes two hours of lecture and discussion per week. It is an exploration of cultural, logistical and academic issues relevant to a research, internship or self-directed study experience abroad. The format also includes research and readings. Open to MLA and MS candidates. Spring.

#### **LSA 632 Plants and Landscapes (2)**

Five hours of instruction per week for eight weeks. This course provides an introduction to the identification and use of native and exotic plants typical of landscape architectural practice. It also introduces students to a range of landscape contexts ranging from natural areas to urban settings and establishes a foundation for the discussion of the social, historical and ecological themes and issues of each. Field trips required. Fall.

Prerequisite: Entering MLA status or permission of the instructor.

#### **LSA 633 Planting Design and Practice (3)**

Two hours of lecture and three hours of lab/studio exercises per week. This course concentrates on the ecological, aesthetic and technical considerations of woody and herbaceous plant use in landscape architectural design. Concepts covered include ecological relationships among plants, cultural requirements of plants, nursery production, planting design and composition, planting plans and specifications, and plant establishment and maintenance. Course utilizes field trips to gardens, arboreta and natural areas to demonstrate planting design concepts. Students complete a final research project that explores current and emerging trends in the use of plant materials in landscape architectural design. Fall.

Prerequisite: LSA 632 or permission of instructor. Note: Credit will not be granted for both LSA 433 and LSA 633.

#### **LSA 640 Research Methods (3)**

Three hours of seminar per week. Students learn skills for: (1) performing scholarly activities associated with learning what is known about topics, (2) using accepted methods for producing new knowledge which possesses qualities of validity and reliability, and (3) preparing documents which meet expectations for academic rigor. Parallels between scholarship, research and design are emphasized. Spring.

Prerequisite(s): Graduate standing in DLA graduate programs in Landscape Architecture or permission of the instructor.

**LSA 645 Construction Documentation Studio (3)**

Six hours of studio and one hour of lecture per week. This course covers the production of traditional contract documents for bidding and construction of landscape architectural projects. Taught as a shared resource with LSA 445, students enrolled in LSA 645 participate in a separate studio section. Spring.

Note: Credit will not be granted for both LSA 445 and LSA 645.

**LSA 650 Behavioral Factors of Community Design (3)**

Three hours of lecture and discussion per week. An introduction to the contribution of the behavioral sciences to community design and planning is provided. Readings and discussions concern both theoretical and methodological aspects. Case studies are used to illustrate a variety of current behavioral science applications. Course assignments familiarize the student with basic behavioral science methods including questionnaires, observations and interviews. A final project provides an opportunity to synthesize course materials. Fall or Spring.

Prerequisite: Graduate status in landscape architecture or permission of instructor.

**LSA 651 Comprehensive Land Planning (3)**

Three hours of lecture per week. Survey of urban planning and design and environmental management in terms of contemporary challenges; legal, technological, administrative and political processes; human and ecological processes; the role of design; case studies, and current and projected best practices. Lectures, readings, discussions and presentations. Required field trip. Spring.

Note: Credit will not be granted for both LSA 451 and LSA 651.

**LSA 652 Community Development and Planning Process (3)**

Three hours of lecture per week. This course introduces planning and community development as connected, interdependent processes. Community dynamics, the participants in the planning and development processes, theories, principles and practices, and the role of design will be explored. Lectures, seminars, guest speakers, research projects, readings and discussion will be used to engage the course material. Fall.

**LSA 655 Professional Practice in Landscape Architecture (3)**

Three hours of lecture per week. This course examines the historic and contemporary modes of landscape architectural practice including practice types, ethics, operations and client systems. Particular emphasis is given to the projected trends of professional practice and with impact on future roles for the landscape architect. Professional development is reviewed as it relates to internship, licensing and continuing education. Students enrolled in LSA 655 will also produce a graduate project portfolio. Spring.

Prerequisite: Graduate status in landscape architecture or permission of instructor. Note: Credit will not be granted for both LSA 455 and LSA 655.

**LSA 670 Thematic Landscape Design Studio (6)**

Eight and one-half hours of studio and one hour of lecture per week. Studio time devoted to demonstrations, exercises and projects. Content focuses on different themes, topics, and scales each year, traditionally addressing sub-disciplines in landscape architecture such as urban design, community design and planning, ecological design and restoration and cultural landscape preservation. Additional readings and a supplementary research/writing component. Spring.

Prerequisite: LSA 423 or permission of instructor. Note: Credit will not be granted for both LSA 470 and LSA 670.

**LSA 680 Seminar in Urban Design (3)**

Three hours of seminar per week. This course is an exploration of literature and case studies that address the history, theories, principles and practice of 19th and 20th century North American and European urban design. The format includes readings, discussion, oral presentations, papers and a three-day field trip. This course fulfills the seminar requirement for students in the Community Design and Planning area of study. Fall.

Prerequisite: Permission of instructor. Note: Credit will not be granted for both LSA 480 and LSA 680.

### **LSA 681 Cultural Landscape Preservation (3)**

Two hours of presentation and one hour of discussion per week. This course provides an overview and introduction to cultural landscape preservation and the general preservation movement in the United States. The philosophy, history and legislation of the preservation movement will be presented. The focus will be on preservation terminology and application, standards, guidelines and procedures. Research, identification, evaluation of significance and integrity, and treatment of cultural resources will be explored. A major research project and presentation are required. Spring. Prerequisite: Permission of instructor. Note: Credit will not be granted for both LSA 481 and LSA 681.

### **LSA 696 Special Topics in Landscape Architecture (1 - 6)**

One to three hours of class meetings per week. Special topics of current interest to graduate students in landscape architecture and related fields. A detailed course subject description will be presented as a topic area is identified and developed. Additional readings, supplementary research and writing assignments. Fall and Spring.

Prerequisite: Permission of instructor. Note: Credit will not be granted for the same topic in LSA 496 and LSA 696.

### **LSA 697 Topics and Issues of Landscape Architecture (1)**

Two hours of lecture and discussion every other week. Topics for discussion are selected to acquaint the entering graduate student with a generalized view and current issues facing landscape architects. Fall.

Pre- or co-requisite: Audit LSA 220 and graduate status in landscape architecture or permission of instructor.

### **LSA 699 Landscape Architecture Internship (1 - 12)**

Internships provide students with a supervised field experience to apply and extend their academic abilities in a professional working environment. Enrollment is possible at various times during the semester. Fall, Spring and Summer.

Prerequisites: Fast Track BLA/MS status and written approval of an internship contract by major professor, curriculum director and field supervisor.

### **LSA 700 Design Studio V - Integrative Studio (4)**

One hour of lecture and nine hours of studio per week. This studio requires the integration of design/planning processes, research methods and information, and technical skills through focus on large-scale, community-based or multicomunity-based projects. Studio work will require individual and teamwork, as well as consideration of multidisciplinary contributions and interdisciplinary work. This studio is the final studio for all MLA students. Fall.

Prerequisite: LSA 621 or permission of instructor.

### **LSA 760 Off-Campus Experiential Studio (12)**

This course involves research, internship or self-directed study abroad with faculty guidance. Activities include field analysis, research, documentation, or directed fieldwork based on faculty-approved student proposals. Immersion in the host culture is a required aspect of this course. A final report is required. The course is open to MLA and MS candidates. Summer and Fall.

Prerequisites: LSA 625 and LSA 799 with a grade of B or better. Note: Credit will not be granted for both LSA 460 and LSA 760.

### **LSA 796 Special Topics in Landscape Architecture (1 - 3)**

One to three hours of lecture per week. Special topics of current interest to graduate students in landscape architecture and related fields. A detailed course subject description will be presented as a topic area is identified and developed.

Prerequisite: Permission of instructor.

### **LSA 798 Research Problem (1 - 12)**

Special study of assigned problems relating to landscape architecture or planning, with emphasis on critical thinking. Fall, Spring and Summer.

Prerequisite: Permission of instructor.

**LSA 799 Capstone or Thesis Proposal Development (3)**

One hour of lecture/seminar and two hours of tutorial per week. Students develop and defend a proposal for their MLA capstone projects or MS thesis. Fall or Spring.

Prerequisite: LSA 640 or permission of instructor.

**LSA 800 Capstone Studio (6)**

One hour of lecture/seminar and 15 hours of studio per week. Students complete an academic landscape architecture investigation or professional-level project. Public presentations and comprehensive project documentation are required. Grades on an "S/U" basis. This is the final MLA studio prior to graduation. Fall or Spring.

Prerequisite: LSA 799.

**LSA 898 Professional Experience (1 - 12)**

A supervised external professional work experience that satisfies Option 2 of the master's study integration requirement. Graded on an "S/U" basis. Fall, Spring and Summer. Prerequisites: Formation of committee, approval of proposed experience by committee, and the sponsor of the professional experience.

**LSA 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's degree and thesis. Graded on an "S/U" basis. Fall, Spring and Summer.

**MCR 480 Fundamentals of Microscopy (3)**

Three hours of lecture/demonstration per week. Introduction to light microscopy, electron microscopy, atomic force, confocal, Raman, Near Field Optical, Correlative and other microscopic methods and their newest applications. Light microscopic techniques include brightfield, phase contrast, polarized light, Nomarski, Kohler illumination. Imaging and recording methods. Fall.

Credit will not be granted for both CME 480 and CME 680

**MCR 484 Scanning Electron Microscopy (3)**

Two hours of lecture/three hours of laboratory/ demonstration per week. Theory and operation of the scanning electron microscope, awareness of specimen preparation techniques, digital imaging, and interpretation of micrographs. Fall.

**MCR 485 Transmission Electron Microscopy (3)**

Two hours of lecture/ three hours of laboratory/ demonstration per week. Theory and operation of the transmission electron microscope including specimen preparation, photographic technique and interpretation of micrographs. Spring.

**MCR 570 Medical and Industrial Applications of Electron Microscopy (3)**

Three hours of lecture/demonstration per week. Scanning and transmission electron microscopy applications in the medical, petroleum, polymer, solar, forensic, glass, pulp and paper and other industries. Sample preparation; image collection, interpretation and analysis. Safety, calibration, and quality control techniques. Spring.

**MCR 580 Microtechnique of Wood (3)**

Three hours of laboratory per week. Instruction on the use of the sliding microtome to slice thin sections of wood for light microscopy and for sample surface preparation of wood for scanning electron microscopy. Care of the microtome blade, staining of wood sections and preparation of microscope slides. Fall or Spring

Prerequisite: Permission of instructor

**MCR 585 Light Microscopy for Research Applications (3)**

Two hours of lecture/three hours of laboratory per week. Principles of light microscopy and photomicrographic digital imagery using Spot camera and Image Pro 7.0 software. Extensive laboratory component. Spring

Prerequisite: Permission of instructor

**MCR 680 Fundamentals of Microscopy (3)**

Three hours of lecture/demonstration per week. Introduction to light microscopy, electron microscopy, atomic force, confocal, Raman, Near Field Optical, Correlative and other microscopic methods and their newest applications. Light microscopic techniques include brightfield, phase contrast, polarized light, Nomarski, Kohler illumination. Imaging and recording methods. Fall.

**MCR 682 Transmission Electron Microscopy for Nanoparticle Research (2)**

Two hours of lecture/laboratory/demonstration plus two hours of individual laboratory per week. Theory and operation of the transmission electron microscope, specimen preparation for nanoparticle imaging, photographic technique and interpretation of micrographs. Fall or Spring.

**MCR 683 Operation of the Transmission Electron Microscope (3)**

Two hours of lecture/ 3 hours of demonstration/laboratory per week. Theory and operation of the transmission electron microscope, including specimen preparation, digital imaging, and interpretation of micrographs.

**MCR 685 Transmission Electron Microscopy (5)**

Two hours of lecture/two hours of laboratory/ demonstration/four to six hours of individual laboratory per week. The theory and operation of the transmission electron microscope including specimen preparation, photographic technique and interpretation of micrographs. Preparation of a portfolio of biological and non-biological specimens demonstrating a variety of techniques. Spring.

**MCR 783 Operation of the Scanning Electron Microscope (3)**

Two hours of lecture/three hours of demonstration/ laboratory per week. Theory and operation of the scanning electron microscope, including specimen preparation, digital imaging, and interpretation of micrographs. Fall.

**MCR 785 Scanning Electron Microscopy (5)**

Two hours of lecture/two hours demonstration/laboratory per week. Ten hours of independent laboratory experience per week. Theory and operation of the scanning electron microscope, including specimen preparation, digital imaging, and interpretation of micrographs. Preparation of a portfolio of biological and non-biological specimens demonstrating a variety of techniques. Fall.

Prerequisite: Permission of instructor

**PSE 132 Introduction to Process Engineering I (1)**

One hour lecture per week or three-hour lab/field trip per week. Introduction to process engineering as a field of study and career path. Topics covered include engineering ethics, laboratory and process safety, resumes and interviewing, and teamwork. Fall.

Note: Credit will not be granted for both BPE 132 and PSE 132.

**PSE 133 Introduction to Process Engineering II (1)**

One hour lecture per week or three-hour workshop per week. Introduction to process engineering as a field of study and career path. Topics covered include engineering calculations, basic statistics, problem solving, basic engineering design, computer tools, ethics, and professional responsibility. The internship and co-op requirements will also be covered. Credits will not be granted for BPE 133 and PSE 133. Spring.

Prerequisite(s): none

**PSE 200 Introduction to Papermaking (3)**

Three hours of lecture per week. Historical and commercial consideration of the paper industry. Topics include wood handling, pulping, stock furnish, stock preparation and paper machine operation. Introductory discussions of papermaking technology, materials and paper making processes including environmental aspects. Fall.

**PSE 201 The Art and Early History of Papermaking (3)**

Two hours lecture per week and three hours of studio. This papermaking course provides a historical (Asia – far east)

and artistic perspective in both lecture and studio formats. History lectures will include the influence of paper in non-western cultures as a practical medium for human communication and as a versatile medium for expression of various paper art forms. Studio sessions will vary but generally will focus on historical papermaking by hand using non-western techniques and those paper art forms of far eastern origin. More modern techniques in the creation of paper art forms will also be explored in studio sessions. Spring

### **PSE 202 Pulp and Paper Laboratory Skills (1)**

Three hours of laboratory per week provide a working knowledge of fundamental papermaking concepts. "Survival" skills learned enable students to perform well in subsequent PSE courses as well as summer employment. Operations and skills include: pulp preparation and analysis, papermaking, paper testing, report writing and team work. Spring. Pre- or co-requisite: PSE 200 (concurrent registration).

### **PSE 223 Introduction to Lignocellulosics (4)**

Three hours of lecture and three hours of laboratory per week. Topics included: structure and chemistry of lignocellulosic materials such as wood, including bark, agriculture residues, and grasses; major (cellulose, hemicelluloses, lignin) and minor constituents (extractives, proteins, ash); biosynthesis, distribution, structure, properties, conversion into energy, chemicals, and other products. Spring. Pre-requisite: One semester of organic chemistry.

### **PSE 296 Special Topics in Engineering (1 - 3)**

Provides experimental, interdisciplinary, or special coursework at the freshman and sophomore levels within the field of environmental resources engineering. Subject matter and course format vary from semester to semester and section to section. Fall and Spring.

### **PSE 304 Professional Experience/Synthesis (2)**

Students implement the theory and practice of their major by working for a company, typically during the summer preceding enrolling in the course. The internship should be a minimum of twelve weeks of full-time experience. Course expectations include a written report, an oral presentation, and a supervisor evaluation. Fall and Spring. Pre- or co-requisites: PSE 133 or BPE 133; PSE 200 or BPE 300; PSE 370; permission of instructor.

### **PSE 305 Co-op Experience (2)**

One semester full-time pulp or paper mill experience. Work experience as an engineering intern on company-assigned projects. Traditionally, the student works for a semester and adjacent summer also taking PSE 304. The student must submit a comprehensive report and give a presentation to fulfill this requirement. Fall and Spring. Pre- or co-requisites: PSE 300, PSE 302.

### **PSE 350 Fiber Processing (3)**

Two hours of lecture, three hours of laboratory per week. Discussion of the principles of operation and the basic chemistry used in pulping, bleaching, and deinking processes. Transport and physical operations involved in fiber procurement, preparation, pulping, dispersion, washing, screening and refining are presented. Principles of operation of pulp mill equipment are reviewed and demonstrated in the laboratory. Spring. Prerequisites: PSE 200, PSE 223 or FCH 223. Note: Credit will not be granted for both PSE 350 and PSE 550.

### **PSE 351 Pulping and Bleaching Laboratory Skills (3)**

One hour of lecture per week provides background and information necessary for the three hours of laboratory per week. Students learn basic principles of chemical pulping and bleaching in a practical research format. Relative success in laboratory pulping and bleaching is determined by comparing results using over twenty standard test methods. Spring. Pre- or co-requisites: FCH 223, FCH 360, FCH 380 with PSE 350 (concurrent registration).

### **PSE 361 Engineering Thermodynamics (3)**

Three hours of lecture per week. Principles of classical thermodynamics applied to engineering practice. First and second laws; heat effects; property functions and their correlation; physical and chemical equilibrium; solutions and mixtures; power and refrigeration cycles. Thermodynamic analysis of processes and systems via case studies and computer simulation. Spring.

Prerequisites: MAT 296, FCH 152, PHY 211. Note: Credit will not be granted for both PSE 361 and ERE 561.

### **PSE 370 Principles of Mass and Energy Balance (3)**

Three hours of lecture per week. Conservation of mass and energy applied to steady-state and dynamic process units and systems. Problem analysis and solution; computational techniques. Thermodynamic data and their use; real vs. perfect gases; steam properties; psychrometry. Fall.

Pre- or co-requisite(s): PHY 211, MAT 296 (or concurrent), FCH 152.

### **PSE 371 Fluid Mechanics (3)**

Three hours of lecture per week. Fluid statics. Principles of mass, energy and momentum balance. Bernoulli's equation. Application to pipe flows, flow measurement and porous media. Movement of particles in fluid media. Rheology of fluids and suspensions typical in the pulp and paper industry (pulp, black liquor, etc.). Filtration and sedimentation of fibrous and particulate suspensions. Characteristics of pumps. Flow systems with economic considerations. Fall.

Prerequisites: PHY 211, FCH 152, MAT 296 or APM296. Note: Credit will not be granted for both PSE 371 and PSE 571.

### **PSE 436 Pulp and Paper Unit Operations (3)**

Two hours of lecture and three hours of laboratory per week. Applications of momentum, heat, and mass transfer to operations in the pulp and paper industry. Topics include pulp flow, heater and heat exchanger design, black liquor evaporation, humidification, steam systems, paper and pulp drying, gas absorption, pulp washing, leaching, and extraction. Laboratory exercises include paper drying, pulp washing and cleaning, heat exchanger operations, and gas absorption for liquor preparation. Spring.

Prerequisites: PSE 361, PSE 370, PSE 371, BPE 335.

### **PSE 437 Equipment Troubleshooting and Maintenance (3)**

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Provides students with fundamental knowledge in troubleshooting and maintenance of industrial machines, processes and systems used in pulp and paper, bioprocess, and chemical engineering field. Spring and/or Fall.

Note: Credit will not be granted for both PSE 437 and PSE 637.

### **PSE 438 Biorenewable fibrous and nonfibrous products (3)**

Three hours of lecture per week. Three credit-hour advanced science course through the topics in the production and properties of lignocellulosic products. Topics cover fibrous products including different paper grades, nanocellulose and cellulose derivatives, and nonfibrous products including products of enzymatic and/or chemical conversion of biomass constituents. Spring and/or Fall.

Prerequisite(s): PSE 465 Fiber and Paper Properties and/or PSE 223 Introduction to Lignocellulosics or consent of instructor. Note: Credit will not be granted for both PSE 438 and PSE 638.

### **PSE 450 Pulping and Bleaching Processes (3)**

Two hours of lecture, three hours of laboratory per week plus a critical review of recent literature on assigned topics including a technical write-up and presentation. Discussion of principle and fundamental chemistry in pulping and bleaching processes. Conducted experiments in pulping, bleaching and pulp evaluation. Spring.

Prerequisites: PSE 350. Note: Credit will not be granted for both PSE 450 and PSE 650.

### **PSE 456 Management in Industry (3)**

Three hours of lecture per week. Discussion of published approaches to managerial excellence are supplemented with current reports from periodicals, newspapers, and business and human resource oriented websites to prompt discussion of underlying principles of good management. Examples of good and bad results from published examples are used to prompt discussion of current issues in management around the world. Current and retired business managers are invited to guest lecture and share their experience with the students. The correlation between excellent business results and excellence in management of people is included and discussed. Spring.

Note: Credit will not be granted for both PSE 456 and PSE 656.

### **PSE 465 Fiber and Paper Properties (3)**

Two hours of lecture and three hours of laboratory per week. Evaluation, study, and discussion of the physical, optical, and chemical properties of fibers, non-fibrous paper additives, and paper. The interrelationships between papermaking fibers, nonfibrous additives, and manufacturing methods, and their effects on the final quality of paper are discussed in correlation with different test methods. Fall or Spring.

Prerequisite: PSE202 Introduction to Papermaking

### **PSE 466 Paper Pigment and Barrier Coating (3)**

Two hours of lecture per week. Discussion and study of surface sizing, various pigment coating formulations, and introduction to polymers used in barrier coating. Study of equipment used in coating operations, fundamental principles, and parameters which control their use and the effects on final paper properties. Spring or Fall.

Prerequisite: PSE465 Fiber and Paper Properties

### **PSE 467 Papermaking Wet End Chemistry (3)**

Three hours of lecture per week. Provides the student with the fundamental principles of colloid and surface chemistry as they relate to the interaction of papermaking materials and chemical additives in the wet end of a papermachine system. The topics of retention of fine solids and dewatering are addressed in detail. Application of the various topics presented during the course are made during a pilot papermachine trial. Spring.

Note: Credit will not be granted for both: PSE 467 and BPE 310.

### **PSE 468 Papermaking Processes (6)**

One hour of lecture, fifteen hours of laboratory per week. Laboratory study of the papermaking process, with emphasis on operation of the semi-commercial Fourdrinier paper machine. Emphasis is on the fundamentals of pulping, stock preparation, paper machine operation, evaluation of the finished product, and the collection and analysis of data to develop material and energy balances. Results of each paper machine run are evaluated in seminar-type discussions. Spring.

Prerequisites: PSE 300, PSE 370, PSE 465. Note: Credit will not be granted for both PSE 468 and PSE 668.

### **PSE 469 Functional and Nano Additives (3)**

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Provides the student with fundamental knowledge of structure, occurrence and preparation of mineral materials, the concepts of mineralogy -with an emphasis on carbonates, silicates (clay, talcum), titanium dioxide, sulphates, aluminum compounds, as well as pigments. The use of mineral materials in paper making applications. Consideration of ecological and economic aspects in relation to the mineral applications. Spring and/or Fall.

Pre- or co-requisites: PSE 465. Note: Credit will not be granted for both PSE 469 and PSE 669.

### **PSE 477 Process Control (3)**

Three hours of lecture per week. Presents an introduction to the principles of process control. Linear analysis, Laplace transforms, and nonlinear simulation are presented and applied to feedback, and feedforward control. Examples of process simulation, accuracy and stability of control are drawn from paper industry processes. Fall.

Prerequisite: APM 485 or equivalent. Note: Credit will not be granted for both PSE 477 and PSE 677.

### **PSE 480 Engineering Design Economics (3)**

Three hours of lecture per week. Steps of process design, engineering economic analysis, estimation of capital investment, operating costs, profitability measures, evaluation of alternatives, inflation. Modeling and computer simulation of process units and systems; use of software. Design exercises and case studies. Spring.

Prerequisites: PSE 370, MAT 296.

### **PSE 481 Engineering Design (3)**

Three hours of lecture per week. Design-project procedure; data sources and development. Application of simulation and computer-aided design to process synthesis and plant layout. Formulation and solution of original design problems. Fall.

Prerequisites: PSE 371, PSE 372, PSE 480. Pre- or co-requisite: BPE 335.

### **PSE 492 Research Practice (3)**

One hour of lecture per week and six hours of laboratory and/or recitation discussions, plus literature study of assigned topics, with emphasis on managing and executing a research project in the pulp and paper, bioprocess, chemical and environmental sector. Provides the student with in-depth knowledge of literature and patent search, correct research techniques, research planning, data gathering techniques and reporting. Fall.

Note: Credit will not be granted for both PSE 492 and PSE 792. Student needs to register for PSE 498 in Spring for research project execution.

### **PSE 496 Special Topics (1 - 3)**

Lectures, conferences and discussions. Specialized topics in chemistry, chemical engineering and physics as well as topics pertaining to management as related to the pulp, paper, paperboard and allied industries. Fall and Spring.

### **PSE 498 Research Problem (1 - 4)**

The student is assigned a research problem in pulping, bleaching, refining, additives, quality control of paper or paper products, or chemical engineering. The student must make a systematic survey of available literature on the assigned problem. Emphasis is on application of correct research technique rather than on the results of commercial importance. The information obtained from the literature survey, along with the data developed as a result of the investigation, is to be presented as a technical report. Fall, Spring and Summer.

### **PSE 550 Fiber Processing (3)**

Two hours of lecture, three hours of laboratory per week. Discussion of the principles of operation and the basic chemistry used in pulping, bleaching, and deinking processes. Transport and physical operations involved in fiber procurement, preparation, pulping, dispersion, washing, screening and refining are presented. Principles of operation of pulp mill equipment are reviewed and demonstrated in the laboratory. Each student will conduct independent study of at least one facet modern pulping processes and equipment and present results during a lecture or laboratory session. Spring.

Prerequisites: PSE 200, PSE 223 or FCH 223. Note: Credit will not be granted for both PSE 350 and PSE 550.

### **PSE 552 Fiber Materials Recycling and Processing (3)**

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Topics include advanced process operation and calculations for deinking, dispersion, washing, cleaning and bleaching of recycled fiber raw materials including related chemistry used in the paper processing industry. Spring and or Fall.

### **PSE 561 Engineering Thermodynamics (3)**

Three hours of lecture per week. Principles of classical thermodynamics applied to engineering practice. First and second laws; heat effects; property functions and their correlation; physical and chemical equilibrium; solutions and mixtures; equations of state. Compressible flow. Electrolyte solutions. Thermodynamic analysis of processes and systems via case studies and computer simulation. Compressible flow and /or thermodynamics of electrolyte

solutions. Fall.

Credit will not be granted for both PSE 361 and PSE 561 Prerequisites: Physics and Calculus

### **PSE 570 Principles of Mass and Energy Balances (3)**

Three hours of lecture per week. Conservation of mass and energy applied to steady-state and dynamic process units and systems. Problem analysis and solution; computational techniques. Thermodynamic data and their use; real vs. perfect gases; steam properties; psychrometry. Computer simulation of steady and non-steady state process systems. Fall.

Prerequisites: Physics, Calculus, and General Chemistry. Note: Credit will not be granted for both PSE 370 and PSE 570.

### **PSE 571 Fluid Mechanics (3)**

Three hours of lecture per week. Fluid statics. Principles of mass, energy and momentum balance. Bernoulli's equation. Application to pipe flows, flow measurement and porous media. Movement of particles in fluid media. Rheology of fluids and suspensions typical in the pulp and paper industry (pulp, black liquor, etc.) Filtration and sedimentation of fibrous and particulate suspensions. Characteristics of pumps. Flow systems with economic considerations. Analysis of some papermaking operations such as drainage, dewatering, vacuum dewatering and wet pressing. Fall.

Prerequisites: Physics, Chemistry, Calculus. Note: Credit will not be granted for both PSE 371 and PSE 571.

### **PSE 596 Special Topics (1 - 3)**

Lectures, conferences, discussions and laboratory. Topics in environmental resources engineering not covered in established courses. Designed for the beginning graduate student or selected upper-division undergraduate. Fall and/or Spring.

### **PSE 637 Equipment Troubleshooting and Maintenance (3)**

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Provides students with fundamental knowledge in troubleshooting and maintenance of industrial machines, processes and systems used in pulp and paper, bioprocess, and chemical engineering field. Spring and/or Fall.

Note: Credit will not be granted for both PSE 437 and PSE 637.

### **PSE 638 Biorenewable Fibrous and Nonfibrous Products (3)**

Three hours of lecture per week. Three credit-hour advanced science course through the topics in the production and properties of biorenewable products for graduate students. Topics include fibrous products such as different paper grades; printing and writing paper, paper board, tissue, and specialty papers, and nanocellulose and cellulose derivatives and nonfibrous products such as hemicelluloses, lignin, pectins, extractives and products of enzymatic and chemical conversion of carbohydrates. Independent academic research component required. Spring and/or Fall. Prerequisite(s): PSE 465 Fiber and paper Properties and/or, PSE 223 Introduction to Lignocellulosics or consent of instructor. Note: Credit will not be granted for both PSE 438 and PSE 638.

### **PSE 650 Pulping and Bleaching Processes (3)**

Two hours of lecture, three hours of laboratory per week plus a critical review of recent literature on assigned topics including a technical write-up and presentation. Discussion of principle and fundamental chemistry in pulping and bleaching processes. Conducted experiments in pulping, bleaching and pulp evaluation. Spring.

Prerequisite(s): Organic, physical and analytic chemistry. Note: Credit will not be granted for both PSE 450 and PSE 650.

### **PSE 656 Management in Industry (3)**

Three hours of lecture per week. Discussion of published approaches to managerial excellence are supplemented with current reports from periodicals, newspapers, and business and human resource oriented websites to prompt

discussion of underlying principles of good management. Examples of good and bad results from published examples are used to prompt discussion of current issues in management around the world. Current and retired business managers are invited to guest lecture and share their experience with the students. The correlation between excellent business results and excellence in management of people is included and discussed. Students will critically review selected literature and present their findings. Spring.

Note: Credit will not be granted for both PSE 456 and PSE 656.

### **PSE 665 Fiber and Paper Properties (3)**

Two hours of lecture and three hours of laboratory per week. Advanced science course in evaluation, study, and discussion of the physical, optical, and chemical properties of fibers, non-fibrous paper additives, and paper. The interrelationships between fibers and nonfibrous paper additives, and manufacturing methods, and their effects on the final paper quality of paper are discussed. Independent academic research required. Spring and/or Fall.

Prerequisite: PSE 202 Introduction to Papermaking. Note: Credit will not be granted for both PSE 465 and PSE 665.

### **PSE 666 Paper Pigment and Barrier Coating (3)**

Two hours of lecture per week. Advanced course in materials and processes used in surface sizing, pigment coating, and barrier coating for graduate students. Study of equipment used in coating operations, fundamentals and parameters, which control their use and effects on final paper properties. Independent literature research with report and presentation on a selected topic. Spring and/or Fall.

Prerequisite: PSE 465 Fiber and Paper Properties. Note: Credit will not be granted for both PSE 466 and PSE 666.

### **PSE 667 Colloidal and Interface Science Applications in Papermaking (3)**

Three hours of lecture per week. Provides the student with the fundamental principles of Colloidal and Interface Science as it relates to the interaction of papermaking materials and chemical additives in the wet end of a paper machine system. The topics of retention of fine solids and dewatering are addressed in detail. Spring.

Pre- or co-requisite: Physical chemistry.

### **PSE 668 Papermaking Processes (6)**

One hour of lecture and fifteen hours of laboratory per week. Study of the papermaking process from theoretical and practical standpoints featuring the operation of the pilot paper machines. Emphasis is on the fundamentals of stock preparation and paper machine operations, papermaking process and product design, evaluation of the finished product, and the collection and analysis of process data. An independent project is required in conjunction with the undergraduate paper machine runs. Spring.

Pre- or co-requisite(s): PSE 300, PSE 370, PSE 665. Note: Credit will not be granted for both PSE 468 and PSE 668.

### **PSE 669 Functional and Nano Additives (3)**

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Provides the student with fundamental knowledge of structure, occurrence and preparation of mineral materials, the concepts of mineralogy -with an emphasis on carbonates, silicates (clay, talcum), titanium dioxide, sulphates, aluminum compounds, as well as pigments. The use of mineral materials in paper making applications. Consideration of ecological and economic aspects in relation to the mineral applications. Spring and/or Fall.

Pre- or co-requisites: PSE465 Note: Credit will not be granted for both PSE 469 and PSE 669.

### **PSE 677 Process Control (3)**

Three hours of lecture per week. Presents an introduction to the principles of process control. Linear analysis, Laplace transforms, and nonlinear simulation are presented and applied to feedback, and feedforward control. Examples of process simulation, accuracy and stability of control are drawn from paper industry processes. Process identification using numerical techniques and MATLAB. Fall.

Prerequisite: Differential Equations. Note: Credit will not be granted for both PSE 477 and PSE 677.

**PSE 792 Research Practice (3)**

One hour of lecture per week and six hours of laboratory and/or recitation discussions, plus literature study of assigned topics. with emphasis on managing and executing a research project in the pulp and paper, bioprocess, chemical and environmental sector. Provides the student with in depth knowledge of literature and patent search, correct research techniques, research planning, data gathering techniques and reporting. Fall.

Note: Credit will not be granted for both PSE 492 and PSE 792. Student needs to register for PSE 798 in Spring for research project execution.

**PSE 796 Advanced Topics (1 - 3)**

Lectures, conferences, discussions and laboratory. Advanced topics in forest engineering, paper science and engineering, and wood products engineering. Fall and/or Spring.

Prerequisite: Permission of instructor.

**PSE 797 Seminar (1 - 3)**

Discussion of assigned topics in the fields related to Paper Science Engineering. Spring and Fall.

**PSE 798 Research in Paper Science Engineering (1 - 12)**

Independent research topics in Paper Science Engineering. Fall, Spring or Summer.

Credit hours to be arranged.

**PSE 898 Professional Experience/Synthesis (1 - 6)**

A supervised, documented professional work experience in the Master of Professional Studies degree program. Fall, Spring, or Summer.

Pre- or co-requisite(s): Approval of proposed study plan by advisor, Faculty, and any sponsoring organization.

**PSE 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's thesis. Fall, Spring or Summer.

Credit hours to be arranged.

**PSE 999 Doctoral Thesis Research (1 - 12)**

Research and independent study for the doctoral dissertation. Fall, Spring or Summer.

Credit hours to be arranged.

**RMS 200 Renewable Materials and Composites from Lignocellulosics (3)**

Two hours of lecture and three hours of laboratory per week; this is an introductory modular course in renewable materials; structure and composition of lignocellulosics/wood; production, properties and use of wood products and wood composites; pulp, paper, packaging, and lignin products; polymers: natural and synthetic. Fall

Prerequisites: Two semesters of General Chemistry Lecture and Lab, Calculus I and II, Two semesters of General Physics and Lab Co-requisite: Organic Chemistry I Lecture and Lab

**RMS 465 Renewable Materials and Surfaces (3)**

Three hours of lecture and discussion per week; Bulk and Surface Properties of renewable materials: Multiphase (Porous) Materials. Structure & Morphology; Mechanical and Optical; Transport – Thermal and Moisture Equilibrium and Dynamics; Surfaces & Tribological Properties; Applications to Wood products and wood composites, Pulp/paper/packaging products; Polymers: Natural and Synthetic. Fall.

Pre-requisites: RMS200 or by instructor's permission

**SRE 225 Physics of Energy (3)**

Three hours of lecture per week. Introduction to the principles of physics and their application in conventional and sustainable energy systems. This course covers the fundamentals of mechanical, chemical, electrical, thermal, and nuclear energy, including efficiency of energy conversions. Fall.

Prerequisite: APM 103 or equivalent and enrollment in the Sustainable Energy Management major, or permission of

instructor

### **SRE 325 Energy Systems (3)**

Three hours of lecture per week. The Energy Systems course provides an interdisciplinary overview of human-dominated energy systems. A variety of topics will be covered to introduce students to fossil fuel-based, renewable, and other energy systems, including: energy supply and consumption, extractive approaches, resource demands, environmental impacts and energy security, and quantitative methods related to energy metrics. Students will use systems thinking to evaluate existing and emerging energy systems. The course involves occasional field trips. Fall. Prerequisites: SRE 225 or equivalent introductory physics course, and FCH 110 and FCH 111 or equivalent one semester of introductory chemistry with lab. Credits will not be granted for SRE 325 and SRE 525 (both undergraduate and graduate versions of the same course).

### **SRE 335 Renewable Energy (3)**

Three hours of lecture/discussion per week providing an overview of the role of renewable energy in the context of energy generation and supply. Sustainable sources of heat, power and fuels will be covered and compared in terms of technological, economic and environmental impacts. Spring. Prerequisites: PHY 211, EFB 200, SRE 225 or equivalent one semester of introductory physics. FCH 110 and FCH 111, or equivalent one semester of introductory chemistry with lab. SRE 325 or instructor permission. Note- Credits will not be granted for SRE 335 and 535 (both undergraduate and graduate versions of the same course)

### **SRE 416 Sustainable Energy Policy (3)**

Three hours of lecture per week. Evaluation of the sustainable energy field as it relates to policy. Primary emphasis on the following topics: policy concerns that motivated the development and expansion of sustainable energy, a history of the policy interactions between sustainable energy pathways, and controversies that have arisen from these interactions and their effects. Prerequisites: SRE 325, SRE 335. Corequisite: SRE 422

### **SRE 417 Energy Resource Assessment (2)**

One hour of lecture per week. One week of field visits to utility-scale energy facilities during the week following the end of finals. Evaluation of energy pathways employed in the Northeast U.S. Primary emphasis on the following topics: the economic, environmental, and technical tradeoffs of utility-scale energy pathway; assessments of the economic viability of utility-scale energy pathways. Spring semester. Prerequisites: SEM major or permission of instructor, SRE 325, SRE335

### **SRE 419 Energy Policy Assessment Methodologies (3)**

Three hours of lecture per week. This course covers the primary methodologies employed to conduct assessments of energy policies and policy proposals, including techno-economic assessment, deterministic analysis, and stochastic analysis. Students will learn how to select the methodology that is most appropriate for an analytical scenario, conduct assessments using the available methodologies, and select the policies or policy proposals that are most effective at achieving a desired energy policy outcome. Spring. Prerequisites: SRE 335, SRE 416, or FOR333

### **SRE 422 Energy Markets and Regulation (3)**

Three hours of lecture/discussion concerning markets and regulation of energy. Topics include: the economics of energy markets, industry restructuring, and the development of markets for energy efficiency and renewable power. The role and impacts of energy regulation on markets will also be examined. Fall. Prerequisites: SRE 325 Energy Systems Note: Credits will not be granted for SRE 422 and SRE 622 (both undergraduate and graduate versions of the same course).

### **SRE 441 Biomass Energy (3)**

Three hours of lecture per week. Production and use of biomass as a source of renewable energy for the production

of bioenergy, biofuels and bioproducts. Characteristics of biomass sources, their conversion to different forms of energy and end products, and an assessments of sustainability. Field trips to regional biomass facilities. Spring  
Prerequisites: SRE 325, SRE 335 or consent of instructor

### **SRE 450 Renewable Energy Capstone Planning (1)**

One hour group meeting every two weeks. This course will afford the student an opportunity to select a topic, in conjunction with the instructor, for detail investigation in Capstone II. Each student will work individually with the instructor to arrive at a feasible project. Fall

Prerequisites: SRE 325, SRE 335 Corequisite: SRE 422

### **SRE 454 Renewable Energy Finance and Analysis (3)**

Three hours of lecture/discussion per week concerning renewable energy finance and analysis. Topics include: the adoption and financing of renewable energy project within the context of overall economics of energy markets, financial analysis of renewable energy projects, the role of tax and subsidies in promoting the adoption of renewable sources of energy. Spring.

Prerequisite(s): FOR205 Principles of Accounting (or equivalent) and FOR333 Natural Resources Managerial Economics (or equivalent) or permission of the instructor

### **SRE 479 Life Cycle Assessment (3)**

Three hours of lecture per week. Life cycle assessment (LCA) is a tool used across fields to determine the cradle-to-grave environmental impacts of products and systems. The course will cover how to perform an LCA and how to evaluate LCA results. Students will conduct in groups a full life cycle assessment with a literature review, sensitivity analysis, and uncertainty analysis using available data and impact assessment methods. Spring.

Prerequisites: A college-level statistics course, junior or senior standing, or instructor permission

### **SRE 491 Sustainable Energy Management Capstone (3)**

Three hours of lecture/discussion per week. This capstone course emphasizes the assimilation, integration, and interpretation of the physical and socioeconomic sciences. It provides students with the opportunity to integrate skills and knowledge accumulated from professional and supporting coursework. A written comprehensive energy resource plan, also presented orally, provides the central vehicle by which students demonstrate their abilities as future energy resource managers. Spring.

Prerequisites: SRE 325, SRE 335, SRE 422, and FOR 333, or Permission of Instructor

### **SRE 525 Energy Systems (3)**

Three hours of lecture per week. The Energy Systems course provides an interdisciplinary overview of human-dominated energy systems. A variety of topics will be covered to introduce students to fossil fuel-based, renewable, and other energy systems, including: energy supply and consumption, extractive approaches, resource demands, environmental impacts and energy security, and quantitative methods related to energy metrics. Students will use systems thinking to evaluate existing and emerging energy systems. The course involves occasional field trips. Students taking SRE 525 will be required to complete additional work and held to higher expectations than those taking SRE 325. Fall.

Prerequisites: Undergraduate courses in introductory physics and introductory chemistry. Note: Credits will not be granted for SRE 325 and SRE 525 (both undergraduate and graduate versions of the same course).

### **SRE 535 Renewable Energy (3)**

Three hours of lecture/discussion per week providing an overview of the role of renewable energy in the context of energy generation and supply. Sustainable sources of heat, power and fuels will be covered and compared in terms of technological, economic and environmental impacts. Students taking SRE 535 will be required to complete additional work and held to higher standards than those taking SRE 335. Spring

Prerequisites: Graduate standing or instructor permission. Note: Credits will not be granted for SRE 335 and 535

(both undergraduate and graduate versions of the same course)

### **SRE 619 Energy Policy Assessment Methodologies (3)**

Three hours of lecture per week. This course covers the primary methodologies employed to conduct assessments of energy policies and policy proposals, including techno-economic assessment, deterministic analysis, and stochastic analysis. Students will learn how to select the methodology that is most appropriate for an analytical scenario, conduct assessments using the available methodologies, and select the policies or policy proposals that are most effective at achieving a desired energy policy outcome. Graduate students will be expected to further compare and contrast the different methodologies available, identify the appropriate methodology for a policy question and justify its use, and quantify the effectiveness of the solution to the policy question in a separate term paper. Spring

Prerequisite: Graduate standing

### **SRE 622 Energy Markets and Regulation (3)**

Three hours of lecture/discussion concerning markets and regulation of energy. Topics include: the economics of energy markets, industry restructuring, and the development of markets for energy efficiency and renewable power. The role and impacts of energy regulation on markets will also be examined. Fall.

Prerequisites: SRE 325 Energy Systems or equivalent or permission of instructor Note: Credits will not be granted for SRE 422 and SRE 622 (both undergraduate and graduate versions of the same course).

### **SRE 641 Biomass Energy (3)**

Three hours of lecture per week. Production and use of biomass as a source of renewable energy for the production of bioenergy, biofuels and bioproducts. Characteristics of biomass sources, their conversion to different forms of energy and end products, and an assessment of source sustainability. Field trips to regional biomass facilities. Spring

Note: Credit will not be granted for SRE 441 and SRE 641 (both undergraduate and graduate versions of the same course)

### **SRE 679 Life Cycle Assessment (3)**

Three hours of lecture per week. Life cycle assessment (LCA) is a tool used across fields to determine the cradle-to-grave environmental impacts of products and systems. The course will cover how to mathematically define the life cycles of products and systems, perform an LCA, and interpret LCA results and evaluate them within the context of the scientific literature. Students will individually conduct a full life cycle assessment with a literature review, sensitivity analysis, and uncertainty analysis using available data and impact assessment methods. Spring.

Prerequisites: A college-based statistics course or instructor permission.

# ESF Faculty and Professional Staff

**NASRI ABDEL-AZIZ** (2001) *Director, Math Program and Instructor*, Forest and Natural Resources Management; BA, Syracuse University, 1998; MS, Syracuse University, 2001

**LAWRENCE P. ABRAHAMSON** (1977) *Senior Research Associate*, Research Programs; BS, Michigan Technological University, 1964; MS, University of Wisconsin, 1967; PHD, University of Wisconsin, 1969

**NEAL M. ABRAMS** (2007) *Associate Professor*, Chemistry; BS, Ithaca College, 2000; PHD, Pennsylvania State University, 2005

**KIM B. ADAMS** (1993) *Director, Tree Pest Information Service*, Environmental and Forest Biology; BS, SUNY College of Environmental Science and Forestry, 1991; MS, SUNY College of Environmental Science and Forestry, 1994

**JULIA ALLIS** (2013) *Digital Media Associate*, Communications; BA, Pennsylvania State University, 2001; MS, Syracuse University, 2012

**THOMAS E. AMIDON** (2000) *Professor*, Paper and Bioprocess Engineering; BS, SUNY College of Environmental Science and Forestry, 1968; MS, SUNY College of Environmental Science and Forestry, 1972; PHD, SUNY College of Environmental Science and Forestry, 1975

**SUSAN E. ANAGNOST** (1991) *Director, NC Brown Center for Ultra Studies, Professor and Chair*, Paper and Bioprocess Engineering; BA, Gettysburg College, 1977; MS, SUNY College of Environmental Science and Forestry, 1982; PHD, SUNY College of Environmental Science and Forestry, 1990

**MARK J. APPLEBY** (2008) *Forest Property Manager II*, Forest Properties - Tully; BA, SUNY College of Environmental Science and Forestry, 1997

**RAYMOND J. APPLEBY** (1982) *Manager, Pilot Operations*, Paper and Bioprocess Engineering

**JOSHUA L. ARNOLD** (2015) *Energy Manager*, Physical Plant & Facilities; BA, Columbia University, 2012

**DONALD E. ARTZ** (1987) *Administrative Staff Assistant IV*, Provost/Academic Affairs

**RYAN ASH** (2010) *Forest Property Technician I*, Forest Properties - Tully

**EDWARD T. AUGUSTINE** (2014) *Admissions Advisor*, Undergraduate Admissions; MA, Long Island University-C W Post Campus, 1988

**JOHN E. AUWAERTER** (2000) *Research Scientist and Co-Director of the Center for Cultural Landscape Preservation*, Landscape Architecture

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