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State University of New York College of Environmental Science and Forestry

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SUNY-ESF
Improve Your World

2006-2007
Catalog

About This Catalog

Additional information is available upon request from any of the addresses found on the inside front cover.

The calendar, courses, tuition, and fees described in this catalog are subject to change at any time by official action either of the State University of New York Board of Trustees or of the SUNY College of Environmental Science and Forestry.

Accreditation

The State University of New York College of Environmental Science and Forestry is accredited by the Middle States Association of Colleges and Schools.

The B.S. degree program in resources management with an option in forestry is accredited by the Society of American Foresters.

The A.A.S. degree program in forest technology is recognized by the Society of American Foresters.

The B.L.A. and M.L.A. degree programs in landscape architecture are accredited by the American Society of Landscape Architects.

The B.S. degree program in forest engineering is accredited by the Accreditation Board for Engineering and Technology.

The B.S. degree in wood products engineering with an option in wood products is accredited by the Society of Wood Science and Technology.

Equal Opportunity and Affirmative Action

The State University of New York College of Environmental Science and Forestry values diversity. We welcome and appreciate all people in order to become a community of equality and diversity.

SUNY-ESF will provide equal opportunity and will not discriminate because of race, color, religion, sex, national origin, age, disability, marital status, sexual orientation, or status as a special disabled veteran, Vietnam Era veteran, or other disabled veteran.

Coordinator for 503-504 Programs and the Americans With Disabilities Act is Connie S. Webb, Vice President for Administration, 208 Bray Hall.

Crime Statistics

A copy of the State University of New York College of Environmental Science and Forestry campus crime statistics as reported annually to the U.S. Department of Education will be provided upon request to University Police at 315-470-6666. Information can also be obtained from the U.S. Department of Education website at <http://ope.ed.gov/security>.

Collegewide Smoking Policy

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.

SUNY-ESF


1 Forestry Drive
Syracuse, New York 13210
315-470-6500

www.esf.edu

**State University of New York
College of Environmental Science and Forestry**

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Academic Calendar

www.esf.edu/registrar

Syracuse Campus Fall 2006

Residence Halls Open
New Student Orientation Program
Registration for New Students
Classes Begin
Labor Day (no classes)
Last Day to Add a Class
Yom Kippur (no classes)
Eid Ul-Fitr (no classes or exams)
Last Day to Drop a Class
Advising
Registration for Spring 2007
Thanksgiving Recess
ESF Convocation
Last Day of Classes
Reading Days

Exam Period

Wednesday, August 23
Wednesday-Sunday, August 23-27
Saturday-Sunday, August 26-27
Monday, August 28
Monday, September 4
Tuesday, September 5
Monday, October 2
Tuesday, October 24
Wednesday, October 25
Monday-Friday, October 30-November 3; Monday-Tuesday, November 6-7
Wednesday-Friday, November 8-10; Monday-Friday, November 13-17
Wednesday-Sunday, November 22-26
Friday, December 8
Friday, December 8
Saturday-Sunday, December 9-10; Tuesday morning, December 12; Thursday morning, December 14
Monday, December 11; Tuesday afternoon, December 12; Wednesday, December 13; Thursday afternoon, December 14; Friday, December 15

Spring 2007

Orientation, Advising, and
Registration for New Students
Martin Luther King Day (no classes)
Classes Begin
Last Day to Add a Class
Spring Recess
Last Day to Drop a Class
Advising Week
Easter Break (no classes)
Registration for Fall 2007
Last Day of Classes
Reading Days
Exam Period
ESF Convocation
Commencement

Sunday, January 14
Monday, January 15
Tuesday, January 16
Tuesday, January 23
Sunday-Sunday, March 11-18
Tuesday, March 20
Monday-Thursday, April 2-5
Friday, April 6
Monday-Friday, April 9-13; Monday-Tuesday, April 16-17
Tuesday, May 1
Wednesday, May 2; Saturday-Sunday, May 5-6
Thursday-Friday, May 3-4; Monday-Wednesday, May 7-9
Saturday, May 12
Sunday, May 13

Wanakena Campus Fall 2006

Campus Opens
Orientation/Registration
Classes Begin
Labor Day (no classes)
Columbus Day (no classes)
Thanksgiving Recess
Semester Ends

Sunday, August 20
Sunday-Tuesday, August 20-22
Wednesday, August 23
Monday, September 4
Monday, October 9
Wednesday-Sunday, November 22-26
Saturday, December 23

Spring 2007

Martin Luther King Day (no classes)
Classes Begin
Spring Recess
Camp Alleghany (Forestry students only)
Surveying Students (classes at Ranger School)
Graduation

Monday, January 15
Tuesday, January 16
Saturday-Sunday, March 24-April 1
Monday-Friday, April 2-6
Tuesday-Friday, April 3-6
Saturday, May 19

State University of New York

SUNY Board of Trustees

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Chancellor of the University: John R. Ryan

About the State University of New York

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.

- SUNY's 64 campuses are divided into four categories, based on educational mission, the kinds of academic opportunities available, and degrees offered. These are university centers/doctoral granting institutions, university colleges, technology colleges, and community colleges. Together they offer the widest selection of higher education opportunities in the U.S.
- State University offers students a wide diversity of educational options: short-term vocational/technical courses, certificate programs, associate degrees, baccalaureate degrees, graduate degrees and post-doctoral studies. The University offers access to almost every field of academic or professional study somewhere within the system — some 7,669 degree and certificate programs overall.
- SUNY curricula range from those in the more conventional career fields, such as business, engineering, medicine, teaching, performing arts, social work, finance and forestry, to those concerned with tomorrow's developing and societal needs in the

areas of environmental science, urban studies, immunology, information systems, biotechnology, telecommunications, microbiology, and health services management.

- SUNY has a total enrollment of 414,000. Students pursue traditional study in classrooms and laboratories or are working at home, at their own pace, through such innovative institutions as the SUNY Learning Network and Empire State College.
- State University's students are predominantly New York State residents, representing every one of the state's 62 counties. SUNY students also come from every other state in the United States, the District of Columbia, from four U.S. territories, and 168 foreign countries.
- State University enrolls 40 percent of all New York State high school graduates, and its total enrollment (full-time and part-time) is approximately 37 percent of the state's entire higher education student population.
- SUNY students represent the society that surrounds them. In fall 2005, 19.3 percent of all students were minorities and full-time minority faculty members made up more than 12.5 percent of all full-time SUNY faculty.
- As of fall 2005, the University had more than 2.3 million graduates on its rolls. The majority of the University's alumni reside and pursue careers in communities across New York, contributing to the economic and social vitality of the state's people.
- SUNY is committed to bringing its students the very best and brightest scholars, scientists, artists and professionals. State University campuses boast nationally and internationally recognized faculty in all the major disciplines. Their efforts are regularly recognized in numerous prestigious awards and honors.
- SUNY's 28,000 faculty have won awards including the Nobel Prize, Pulitzer Prize, Fields Medal, Dirac Medal, National Medal of Science, and Grammy, Emmy and Tony awards.
- State University research contributions are helping to solve some of today's most urgent problems. At the same time, contracts and grants received by University faculty directly benefit the economic development of the regions in which they are located. State University researchers pioneered nuclear magnetic resonance imaging and the supermarket bar code scanner, introduced time-lapse photography of forestry subjects, isolated the bacteria that causes Lyme disease, and developed the first implantable heart pacemaker. Other University researchers continue important studies in such wide-ranging areas as breast cancer, immunology, marine biology, sickle-cell anemia, and robotics, and make hundreds of other contributions, inventions and innovations that benefit society.

Introducing ESF

Vision

A better world through environmental discovery.

Mission

The mission of the College of Environmental Science and Forestry is to advance knowledge and skills and to promote the leadership necessary for the stewardship of both the natural and designed environments.

The State University of New York College of Environmental Science and Forestry (ESF) is recognized and emulated all over the world.

The college was founded in 1911 through the efforts of Syracuse University Chancellor James R. Day and respected state leaders, such as Louis Marshall, who were attuned to a growing national sentiment in favor of forest conservation and sensed the need for a professional school of forestry.

Under the leadership of its first dean, Hugh P. Baker, ESF looked to serve the broad needs of environmental professionalism. As other forestry schools became more specialized, ESF expanded its scope to include such essentials of environmental science as design, engineering, life sciences and resource management.

The college is a doctoral-granting institution, one of only 13 in the 64-campus SUNY system, with highly focused research and service programs that reach across the globe in the search for new knowledge and a mission to improve the quality of life. Students share in the vast array and excitement of these opportunities through direct contact with distinguished faculty and researchers and plenty of hands-on experience in conducting scientific research and applying the results of their work. Quality instruction and learning opportunities for students top ESF's priorities.

About 2,000 students are enrolled at the college, all but 60 of them on its campus in Syracuse, N.Y. For the latter group, ESF's Ranger School in Wanakena, N.Y., in the Central Adirondack Mountains, provides a rigorous introduction to their career objectives in an environment famed for its beauty and recreational opportunities.

Students are divided almost equally between men and women. About one-third of the total student body is comprised of graduate students. Most students who attend ESF are residents of New York, but the campus draws students from throughout the U.S. and from more than 30 different foreign countries. The ethnic diversity of ESF undergraduates has risen steadily over the last 15 years.

The size of the student population means students receive a lot of individual attention from faculty and personal assistance from staff. The student-faculty ratio is 12-to-1 at the Syracuse campus and 7-to-1 at the Ranger School. Students get to know one another and form long-lasting friendships.

But the close nature of the college community is not inhibiting. The Syracuse campus is located adjacent to Syracuse University, a major private university with big-time sports and more than 300 student and professional clubs and organizations. ESF students have the advantage of being considered students at both institutions.

ESF and SU have a dynamic and long-standing partnership that goes back to the founding of the college. From the beginning, the college has contracted with SU to provide accessory instruction, athletic programs, health and counseling services, library facilities and other services for students. In a very real sense, ESF students have the best of both worlds — the intimacy and intellectual

atmosphere of a small dynamic college and the exciting atmosphere of one of the nation's leading university centers.

SU enrolls a total of about 18,000 students at its main and branch campuses, including 12,000 undergraduates. Students select from more than 200 majors available within the University's nine colleges, which include the prestigious Maxwell School of Citizenship and Public Affairs and the S.I. Newhouse School of Public Communications.

ESF and SU together are located on one of several hills that overlook downtown Syracuse and nearby Onondaga Lake. The greater metropolitan area is home to about 750,000 people and offers a variety of cultural, educational and recreational opportunities.

The city has several fine museums, including the renowned Everson Museum of Art, and several excellent theater companies. The Syracuse Symphony Orchestra is one of the nation's finest, and the downtown OnCenter and Landmark Theater feature performing artists from around the world. The area is home to several colleges and universities. The State University of New York Upstate Medical University, Le Moyne College, and Onondaga Community College join ESF and Syracuse University in the city, while Cazenovia College is nestled in a nearby suburb. There are many other institutions of higher education within a short drive, including Colgate University, Cornell University, Hamilton College, Ithaca College, SUNY Cortland, SUNY Institute of Technology, SUNY Morrisville, SUNY Oswego and Utica College.

There are more than 50 state, county and city parks in the area and several nature centers. The Adirondacks, Lake Ontario, the Finger Lakes, downhill and cross-country skiing facilities, and golf courses are also within easy driving distance, and make Central New York a haven for recreation and nature lovers.

Syracuse is called the Crossroads of New York State, because it is situated at the intersection of two major highways: the 500-mile east-west New York State Thruway (Interstate 90) and the north-south Penn-Can Highway (Interstate 81). The highways cut the driving time to New York City, Boston, Philadelphia, Toronto or Montreal to approximately five hours, while Buffalo and Albany are less than three hours away.

The city is also served by Hancock International Airport, Amtrak, and major bus lines, which make it a convenient home for students and faculty alike.

Students come to ESF because they care about the environment and want to make the world a better place to live. But ESF students aren't naïve. They're smart and hardworking, and ready to apply what they've learned to real situations.

As society becomes increasingly concerned about the environment, ESF graduates find their services in demand. Those who have broad foresight and a balance of judgment in applying scientific, technical, and sociological knowledge to guide environmental and human forces may determine the future of the world. Modern civilization with its compelling demands from industry and government needs people who think objectively and constructively, and act creatively and responsibly.

From its start in 1911, the college has served the state, nation and world in meeting the needs of its citizens through education, research and public service. Faculty and students at ESF are committed to resolving immediate environmental hazards, learning how to avoid future problems, and offering policy alternatives that will both protect the environment and meet the needs of a global society.

Academic Programs

Degree Programs and Areas of Study

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. Enrollment in programs that are not registered or otherwise approved may jeopardize a student's eligibility for certain financial aid programs. Program descriptions and coursework requirements of the individual academic programs may be found on the page numbers listed with the program title.

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

Forest Technology (HEGIS Code 5403)
The Ranger School, page 103 and www.rangerschool.esf.edu

Land Surveying Technology (HEGIS code 5309)
The Ranger School, page 103 and www.rangerschool.esf.edu

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

Landscape Architecture (HEGIS Code 0204)
Faculty of Landscape Architecture, page 90 and fla.esf.edu

Bachelor of Science (B.S.)

Aquatic and Fisheries Science (HEGIS Code 0115)
Faculty of Environmental and Forest Biology, page 63 and www.esf.edu/efb

Bioprocess Engineering (HEGIS Code 0905)
Faculty of Paper Science and Engineering, page 97 and www.esf.edu/pse

Biotechnology (HEGIS Code 0499)
Faculty of Environmental and Forest Biology, page 63 and www.esf.edu/efb

Chemistry (HEGIS Code 1905) with options in biochemistry and organic chemistry of natural products, environmental chemistry, or natural and synthetic polymer chemistry.
Faculty of Chemistry, page 56 and www.esf.edu/chemistry

Conservation Biology (HEGIS Code 0420)
Faculty of Environmental and Forest Biology, page 63 and www.esf.edu/efb

Construction Management (HEGIS Code 0599)
Faculty of Construction Management and Wood Products Engineering, page 59 and www.esf.edu/wpe

Dual Option in Forest Ecosystems Science (HEGIS Codes 0499 and 0115)
Faculty of Forest and Natural Resources Management, page 81 and www.esf.edu/for

Environmental Biology (HEGIS Code 0499)
Faculty of Environmental and Forest Biology, page 63 and www.esf.edu/efb

Environmental Science (HEGIS Code 0420) with options in environmental information and mapping, watershed science, health and the environment, earth and atmospheric systems science,

environmental analysis, or environmental engineering science.
Division of Environmental Science, page 50

Environmental Studies (HEGIS Code 0420) with options in biological science applications, environmental policy, or environmental communication and culture.
Faculty of Environmental Studies, page 75 and www.esf.edu/es

Forest Engineering (HEGIS Code 0999)
Faculty of Environmental Resources and Forest Engineering, page 73 and www.esf.edu/erfeg

Forest Health (HEGIS Code 0114)
Faculty of Environmental and Forest Biology, page 63 and www.esf.edu/efb

Forest Resources Management (HEGIS Code 0114)
Faculty of Forest and Natural Resources Management, page 81 and www.esf.edu/for

Natural History and Interpretation (HEGIS Code 0499)
Faculty of Environmental and Forest Biology, page 63 and www.esf.edu/efb

Natural Resources Management (HEGIS Code 0115) with options in recreation resources management, or watershed management.
Faculty of Forest and Natural Resources Management, page 81 and www.esf.edu/for

Paper Engineering (HEGIS Code 0999) with a minor in management.
Faculty of Paper Science and Engineering, page 97 and www.esf.edu/pse

Paper Science (HEGIS Code 0999) with a minor in management.
Faculty of Paper Science and Engineering, page 97 and www.esf.edu/pse

Wildlife Science (HEGIS Code 0107)
Faculty of Environmental and Forest Biology, page 63 and www.esf.edu/efb

Wood Products Engineering (HEGIS Code 0999) with elective concentrations in marketing and sales, production and manufacturing, building construction and renovation, or wood science.
Faculty of Construction Management and Wood Products Engineering, page 59 and www.esf.edu/wpe

Bachelor of Landscape Architecture / Master of Science

B.L.A./M.S. Fast Track (HEGIS Code 0204)
Faculty of Landscape Architecture, page 90 and fla.esf.edu

Advanced (Graduate) Certificates

Advanced Engineering Tools (HEGIS Code 0999)
Division of Engineering, Faculty of Environmental Resources and Forest Engineering, page 44 and www.esf.edu/erfeg

Bioprocessing (HEGIS Code 0199)
Division of Engineering, Faculty of Paper Science and Engineering, page 44 and www.esf.edu/pse

Environmental Decision Making (HEGIS Code 0420)
Division of Environmental Science, page 50

Master of Forestry (M.F.)

Forest Management and Operations (HEGIS Code 0115)
Faculty of Forest and Natural Resources Management, page 81 and www.esf.edu/for

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

Landscape Architecture (HEGIS Code 0204) with areas of study in community design and planning, cultural landscape studies and conservation, or landscape and urban ecology.
Faculty of Landscape Architecture, page 90 and fla.esf.edu

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

Environmental and Forest Biology (HEGIS Code 0499) with areas of study in 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.
Faculty of Environmental and Forest Biology, page 63 and www.esf.edu/efb

Environmental and Resource Engineering (HEGIS Code 0999) with an option in **construction management and wood products engineering** and areas of study in construction and construction management or wood science and technology.
Division of Engineering, Faculty of Construction Management and Wood Products Engineering, page 44 and www.esf.edu/wpe

Environmental and Resource Engineering (HEGIS Code 0999) with an option in **forest engineering** and areas of study in environmental management, or mapping sciences.
Division of Engineering, Faculty of Environmental Resources and Forest Engineering, page 44 and www.esf.edu/erfeg

Environmental and Resource Engineering (HEGIS Code 0999) with an option in **paper science and engineering** and areas of study in process and environmental systems engineering or pulp and paper technology.
Division of Engineering, Faculty of Paper Science and Engineering, page 44 and www.esf.edu/pse

Environmental Science (HEGIS Code 0420) with areas of study in environmental and community land planning, environmental communication and participatory processes, environmental policy and democratic processes, environmental systems and risk management, or water and wetland resource studies.
Division of Environmental Science, page 50

Forest Resources Management (HEGIS Code 0115) with areas of study in environmental and natural resources policy, forest ecosystem science and applications, natural resources management, quantitative methods in forest science and management, recreation and resources management, or watershed management and forest hydrology.
Faculty of Forest and Natural Resources Management, page 81 and www.esf.edu/for

Master of Science (M.S.)

Environmental and Forest Biology (HEGIS Code 0499) with areas of study in 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.
Faculty of Environmental and Forest Biology, page 63 and www.esf.edu/efb

Environmental and Forest Chemistry (HEGIS Code 1905) with areas of study in biochemistry, environmental chemistry, organic chemistry of natural products, or polymer chemistry.
Faculty of Chemistry, page 56 and www.esf.edu/chemistry

Environmental and Resource Engineering (HEGIS Code 0999) with an option in **construction management and wood products engineering** and areas of study in construction and construction management, engineered wood products and structures (timber structure design), tropical timbers, wood science and technology, wood anatomy and ultrastructure, or wood treatments.
Division of Engineering, Faculty of Construction Management and Wood Products Engineering, page 44 and www.esf.edu/wpe

Environmental and Resource Engineering (HEGIS Code 0999) with an option in **forest engineering** and areas of study in geo-spatial information systems or water resources engineering.
Division of Engineering, Faculty of Environmental Resources and Forest Engineering, page 44 and www.esf.edu/erfeg

Environmental and Resource Engineering (HEGIS Code 0999) with an option in **paper science and engineering** and areas of study in chemistry of pulping and bleaching, colloid chemistry and fiber flocculation, fiber and paper mechanics, process and environmental systems engineering, pulp and paper technology, or renewable energy and bioprocess engineering.
Division of Engineering, Faculty of Paper Science and Engineering, page 44 and www.esf.edu/pse

Environmental Science (HEGIS Code 0420) with areas of study in environmental and community land planning, environmental communication and participatory processes, environmental policy and democratic processes, environmental systems and risk management, or water and wetland resource studies.
Division of Environmental Science, page 50

Forest Resources Management (HEGIS Code 0115) with areas of study in environmental and natural resources policy, forest ecosystem science and applications, natural resources management, quantitative methods in forest science and management, recreation and resources management, or watershed management and forest hydrology.
Faculty of Forest and Natural Resources Management, page 81 and www.esf.edu/for

Landscape Architecture (HEGIS Code 0204) with areas of study in community design and planning, cultural landscape studies and conservation, or landscape and urban ecology.
Faculty of Landscape Architecture, page 90 and fla.esf.edu

Doctor of Philosophy (Ph.D.)

Environmental and Natural Resources Policy (HEGIS Codes 0420 and 0115)
• Division of Environmental Science, page 50, and the Faculty of Forest and Natural Resources Management, page 81, and www.esf.edu/enrp

Environmental and Forest Biology (HEGIS Code 0499) with areas of study in 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.
Faculty of Environmental and Forest Biology, page 63 and www.esf.edu/efb

Environmental and Forest Chemistry (HEGIS Code 1905) with areas of study in biochemistry, environmental chemistry, organic chemistry of natural products, or polymer chemistry.
Faculty of Chemistry, page 56 and www.esf.edu/chemistry

Environmental and Resource Engineering (HEGIS Code 0999) with an option in **construction management and wood products engineering** and areas of study in construction and construction management, engineered wood products and structures (timber structure design), tropical timbers, wood science and technology, wood anatomy and ultrastructure, or wood treatments. Division of Engineering, Faculty of Construction Management and Wood Products Engineering, page 44 and www.esf.edu/wpe

Environmental and Resource Engineering (HEGIS Code 0999) with an option in **forest engineering** and areas of study in geo-spatial information systems or water resources engineering. Division of Engineering, Faculty of Environmental Resources and Forest Engineering, page 44, and www.esf.edu/erfeg

Environmental and Resource Engineering (HEGIS Code 0999) with an option in **paper science and engineering** and areas of study in chemistry of pulping and bleaching, colloid chemistry and fiber flocculation, fiber and paper mechanics, process and environmental systems engineering, pulp and paper technology, or renewable energy and bioprocess engineering. Division of Engineering, Faculty of Paper Science and Engineering, page 44, and www.esf.edu/pse

Environmental Science (HEGIS Code 0420) with areas of study in environmental and community land planning, environmental communication and participatory processes, environmental systems and risk management, or water and wetland resource studies. Division of Environmental Science, page 50

Forest Resources Management (HEGIS Code 0115) with areas of study in forest ecosystem science and applications, natural resources management, quantitative methods in forest science and management, recreation and resources management, or watershed management and forest hydrology. Faculty of Forest and Natural Resources Management, page 81 and www.esf.edu/for

Graduation Rate

Of the freshman students who began their studies in the fall of 1998 at ESF, 69 percent received their degree or continued in a five-year program, after 10 semesters of study. For those who began in the fall of 1999, approximately 66 percent received their degree or continued in a five-year program after eight semesters of study.

Of the transfer students who began their studies in the fall of 1999 at ESF, 66 percent received their degree or continued in a five-year program, after eight semesters of study. For those who began in the fall of 2000, approximately 68 percent received their degree or are continuing in a five-year program, after six semesters of study. Further information on student retention is available from the director of Information Technology and Institutional Planning.

Undergraduate Education

General Education

The State University of New York requires graduates of bachelor degree (B.S.) programs to successfully complete 27 credit hours of coursework distributed among nine knowledge and skill areas, collectively referred to as general education. The core of the curricula for all ESF undergraduate degree programs satisfy the natural science, basic communications, mathematics, humanities, and other world civilizations general education knowledge and skill areas. For the remaining general education knowledge and skill areas requirements, students must complete one course chosen from the course selections in the knowledge and skill areas designated for their degree programs.

Mathematics

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 I	4
APM	391	Introduction to Probability and Statistics	3
MAT	111	Basic Algebra	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	3
MAT	122	Probability and Statistics for the Liberal Arts II	3
MAT	194	Precalculus	3
MAT	295	Calculus I	4
MAT	296	Calculus II	4

Natural Sciences

EFB	120	Global Environment	3
EFB	226	General Botany	4
EFB	285	Principles of Zoology	4
EFB	320	General Ecology	4
EFB	321	Fundamentals of Ecology for Designers and Planners	3
FCH	150	General Chemistry I	3
FCH	151	General Chemistry I Laboratory	1
FCH	152	General Chemistry II	3
FCH	153	General Chemistry II Laboratory	1
FCH	210	Elements of Organic Chemistry	3
FCH	221	Organic Chemistry I	3
FCH	222	Organic Chemistry I Laboratory	1
FCH	223	Organic Chemistry II	3
FCH	224	Organic Chemistry II Laboratory	1
GOL	101	Dynamic Earth	4
PHY	211	General Physics I	3
PHY	221	General Physics I Laboratory	1
PHY	212	General Physics II	3
PHY	222	General Physics II Laboratory	1

Social Sciences

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:

EST	201	American History: Reconstruction to Present	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:

EST 361 History of the American Environmental Movement 3

Western Civilization

ETS 211 Early European Literary History 3

FIA 105 Arts and Ideas I 3

FIA 106 Arts and Ideas II 3

FOR 203 Western Civilization and the Environment 3

HST 111 Early Modern Europe, 1350-1815 3

HST 210 The Ancient World 3

HST 211 Medieval and Reformation Europe 3

LIT 203 Greek and Roman Epic in English Translation 3

LIT 211 Greek and Roman Drama in Translation 3

LSA 206 Art, Culture and Landscape I 3

LSA 205 Art, Culture and Landscape II 3

LSA 405 History of Landscape Architecture 3

PSC 125 Political Theory 3

REL/JSP 114 The Bible 3

REL 205 Ancient Greek Religion 3

REL 206 Greco-Roman Religion 3

REL/JSP 215 Hebrew Bible 3

Other World Civilizations

AAS 241 African Religions: An Introduction 3

ANT 121 Peoples and Cultures of the World 3

ANT 185 Global Encounters: Comparing World Views and Values Cross-Culturally 3

ANT/SAS /WSP 324 Modern South Asian Cultures 3

ANT 326 Africa Through the Novel 3

EST 200 Cultural Ecology 3

GEO 272 World Cultures 3

HST 320 Traditional China 3

HST 321 Modern China 3

REL 101 Religions of the World 3

REL/SAS 185 Hinduism 3

REL/SAS 186 Buddhism 3

Humanities

AAS 231 African American Literature to 1900: An Introduction 3

AAS 235 African American Drama 3

CLL 290 Perspectives on the Environment 3

EST 245 Nature and Popular Culture 3

ETS 107 Living Writers 3

ETS 141 Readings and Interpretation I: From Language to Discourse 3

ETS 151 Interpretation of Poetry 3

ETS 153 Interpretation of Fiction 3

ETS 192 Gender and Literary Texts 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 217 New Testament 3

REL 231 Judaic Literature 3

REL 235 Judaism 3

REL 248 American Religious Thought 3

REL 252 Religious Ethics and Social Issues 3

REL 256 Christianity 3

The Arts

APH 241 Art Photography, Introduction 3

EFB 215 Interpreting Science through Art 3

ETS 215 Sophomore Poetry Workshop 3

ETS 217 Sophomore Fiction Workshop 3

FIA 105 Arts and Ideas I 3

FIA 106 Arts and Ideas II 3

FIA 115 The Visual Arts in North America 3

FIA 125 Introduction to Music Theory 3

FIA 165 Understanding Music I 3

FIA 166 Understanding Music II 3

FIA 301 Masterpieces of Art 3

FIA 317 Nineteenth-Century American Art 3

LSA 182 Drawing Studio 3

LSA 205 Art, Culture and Landscape I 3

LSA 206 Art, Culture and Landscape II 3

Basic Communication

CLL 190 Writing and The Environment 3

Undergraduate Minors

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.

Management Minors

In collaboration with the Syracuse University School of Management, undergraduate minors in entrepreneurship, general management studies, and marketing are available for ESF students. To be eligible for any of these minors, students must have a cumulative grade point average of 2.750 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. Normally, students are allowed to take only one management course per semester, with one semester of two management courses, so careful planning is required. It is preferable students begin the minor during their sophomore year.

Entrepreneurship Minor: The following 18 credits of courses are required: ACC 201 Introduction to Accounting for Non-Management Students (3); FIN 301 Finance for Non-Management Students (3); EEE 370 Introduction to Entrepreneurship and Emerging Enterprises (3). Three additional courses chosen from among the following: EEE 375 Entrepreneurial and Family Business Management (3); EEE 400 Special Topics (3); EEE 442 Emerging Enterprise Law (3); EEE 443 Consulting in Entrepreneurial Practice (3); EEE 451 Finance for Emerging Enterprises (3); FOR 360 Principles of Management (3); or PSE 456 Management in the Paper Industry (3).

General Management Studies Minor: The following 18 credits of courses are required: ACC 201 Financial Accounting for Non-Management Students (3); EEE 370 Introduction to Entrepreneurship and Emerging Enterprises (3); FIN 301 Finance for Non-Management Students (3); LPP 225 Introduction to the Legal System (3) or FOR 488 Natural Resources Administration Law (3); MAR 255 Principles of Marketing (3); SHR 355 Strategic Human Resource Management (3). The following courses may be substituted for SHR 355, EEE 370, or MAR 255: FOR 360 Principles of Management (3); PSE 456 Management in the Paper Industry (3).

Marketing Minor: The following 18 credits of courses are required: ACC 201 Financial Accounting for Non-Management Students (3); EEE 370 Introduction to Entrepreneurship and

Emerging Enterprises (3); FIN 301 Finance for Non-Management Students (3); MAR 255 Principles of Marketing (3). Two additional courses chosen from among the following: MAR 356 Marketing Research (3); MAR 400 Special Topics (3); MAR 455 Marketing Communications (3); MAR 456 Global Marketing Strategy (3); FOR 360 Principles of Management (3); PSE 456 Management in the Paper Industry (3).

Bioprocess Science Minor

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 2.8, 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 faculty, 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 faculty 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 in Bioprocess Engineering (3); BPE 320 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.

Computer and Information Technology Minor

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 of 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 2.800 or better by the end of the sophomore year. Students will elect the minor by submitting an application form with courses listed to their faculty advisor and the undergraduate coordinator of their home Faculty. This signed application will then be sent to the dean of Instruction and Graduate Studies for final approval.

Eighteen credit hours (6 courses) in computer science and information technology courses will be required to satisfy the minor. Required courses: APM 153 Computing Methods for Engineers and Physical Scientists (3) or APM 360 Introduction to Computer Programming (3); ESF 200 Information Literacy (1); CIS 252 Introduction to Computer Science (4); CIS 351 Data Structures (4). Elective courses: At least two courses (6 credits) chosen from among courses available from both ESF and Syracuse University including Applied Mathematics (APM), Environmental Resource Engineering, Forestry, Wood Products Engineering, Computer and Information Science, Computer Engineering, and Computational Science. The complete list is available from faculty advisors.

Construction Management Minor

The construction management minor is available to all ESF undergraduates (except students in construction management or wood products engineering programs) and prepares students for management careers in the construction industry. The basic objective of the minor is to provide a fundamental understanding of the various methods used to take a design into the field and build a quality structure in the most efficient and effective manner with minimal environmental impacts. 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 five courses given below. A cumulative grade point average of 2.0 or higher is required for the construction management courses.

Admission to the minor requires sophomore status, a cumulative grade point average of 2.5 or higher, and permission of the construction management and wood products engineering faculty chair. Interested students must submit a petition and application form, with courses listed, to their academic advisor and the chair of Construction Management and Wood Products Engineering, with final approval from the dean of Instruction and Graduate Studies. Successful completion of the minor will be noted on the student's transcript.

Eighteen credit hours of courses are required. Specified courses: WPE 342 Light Construction (3); WPE 343 Construction Estimating (3); WPE 453 Construction Planning and Scheduling; WPE 454 Construction Project Management; and two additional courses chosen from the following: WPE 330 Building Codes and Zoning Practices (3); WPE 331 Construction Safety (3); WPE 335 Cost Engineering (3); WPE 350 Construction Methods and Equipment (3); WPE 455 Construction Contracts and Specifications (3).

Paper Science Minor

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 2.8 and who desire to develop greater knowledge of paper science and its related fields. Students will elect the minor by submitting an application form with courses listed to their faculty advisor and the undergraduate coordinator of their home Faculty. The petition and application will then be sent to the dean of Instruction and Graduate Studies for final approval. A student should declare the minor by the end of the sophomore year, but may petition to his/her own faculty 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) in paper science courses will be required to satisfy the minor. Specified courses: PSE 370 Principles of Mass and Energy Balance (3); PSE 300 Introduction to Papermaking (3); PSE 302 Pulp and Paper Laboratory Skills (1); and directed elective courses (at least 11 credits): PSE 350 Pulping and Bleaching Processes (3); PSE 351 Pulping and Bleaching Laboratory (2); PSE 465 Paper Properties (4); PSE 466 Paper Coating and Converting (2); PSE 467 Papermaking Wet End Chemistry (3); PSE 468 Papermaking Processes (3).

Urban Environmental Science Minor

While many people often associate the environment with wild lands and linked rural areas, many of the most important environmental and quality-of-life issues of the coming decades will be related to the urban environment. ESF, under its Urban Initiative, offers a campus-wide minor in urban environmental science. All students, but perhaps especially those with an intimate knowledge of the challenges facing city inhabitants, will find this program stimulating and provocative—and will find professors interested in working with them to learn about and develop improved urban environments. Graduates of the program can make important professional contributions on issues ranging from urban forestry and urban wildlife, to urban air and water quality, population growth and urban sprawl, and environmental justice and equity. Successful completion of the minor will be noted on the student's transcript.

Twelve credit hours (4 courses) of urban concentration courses are required to satisfy the minor. Required courses: EST/EFB 220 Urban Ecology (3) and a Capstone Experience (3). A student enrolled in the minor, will present to the advisory committee in the 6th 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 courses: At least two courses (6 credits) of urban environmental science minor advisory committee-approved courses other than courses in, or required by, the student's major. The complete list of approved elective courses is available from faculty advisory committee representatives.

Honors Program

The Honors Program provides opportunities for students to complete intensive research and creative projects under the guidance of research and design experts. The ESF Honors Program emphasizes and encourages holistic and multidisciplinary awareness to the problems and opportunities of the environment.

ESF students enrolled in the Faculties of Chemistry, Construction Management and Wood Products Engineering, Environmental and Forest Biology, Environmental Resources and Forest Engineering, Environmental Studies, Forest and Natural Resources Management, and Landscape Architecture are eligible to be invited to participate in the ESF Honors Program. Students must be at the beginning of their junior year, between the first and second semester of their junior year, or (in unusual circumstances) in the beginning of their senior year.

To be invited for admission, students must meet the minimum grade point requirement of at least a 3.500 cumulative grade point average at the end of 60 credits of lower-division preparation. This includes any courses taken while matriculated at ESF and any transfer courses accepted toward the ESF degree. Students who are invited to apply for admission must also submit a personal statement.

Students in the program must complete degree requirements with a cumulative grade point average of at least 3.400 for all upper-division courses and complete the following coursework:

Thesis Exploration Seminar (ESF 309, 1 credit)

Two courses that contribute directly to the honors thesis/project.

These courses must be either a) In the student's major or a related area at the 400-, 500-, or 600-level and must not be a requirement for all students in that major (Students admitted to the ESF Honors Program are automatically eligible to enroll in appropriate courses numbered 500 to 699.); or b) An enhanced or graduate-level version of a required upper-division course.

A total of at least four credits of Honors Thesis/Project (ESF 499, 1-5 credits) with a grade of B or better. Students must supplement their work with an honors essay and presentation to an honors review committee.

The Honors Program receives oversight from the Honors Faculty Council. The director of the Honors Program recruits, admits, and counsels honors students in matters pertaining to the program requirements.

Coordinated Programs with SUNY Upstate Medical University

Transfer Articulation Agreement

Students seeking admittance to the upper-division bachelor of science programs offered by the College of Health Professions at SUNY Upstate Medical University (UMU) in Syracuse may prepare for curricula in cardiovascular perfusion, cytotechnology, medical imaging sciences, medical technology, physical therapy, or respiratory care by taking lower-division coursework at SUNY-ESF. Prospective students must apply to both ESF and UMU. For further details, contact the dean of Instruction and Graduate Studies.

Entry Level Doctor of Physical Therapy Program (DPT 3+3)

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 Faculty of Environmental and Forest Biology are eligible for admission.

Students apply for admission to ESF and UMU simultaneously, with the first three years of the program completed at ESF and the final three years completed at UMU. Admission to the DPT 3+3 program is based on academic achievement and personal qualifications that are considered essential for the successful practice of physical therapy.

Prior to matriculation at UMU, students must submit GRE scores, demonstrate familiarity in the demands of physical therapy via volunteer or work experience, and complete 53 credits of prerequisite coursework (completed with grades of C- or better) as follows:

Courses	Credits
Anatomy and Physiology I and II (or one semester each of Anatomy and Physiology)	8
General Biology I and II	8
General Chemistry I and II	8
General Physics I and II	8
English (including Composition)	6
Mathematics (College Trigonometry, Precalculus or Calculus)	3
Statistics	3
Psychology (including Child or Developmental Psychology)	9

Additional information about the DPT 3+3 Program is available from the Office of Undergraduate Admissions or the dean of Instruction and Graduate Studies.

Pre-Professional Advising

Pre-health advising

ESF students interested in medicine, dentistry, and veterinary medicine are encouraged to participate in the Health Professions Advisory Program (HPAP) offered through Syracuse University. Students should begin the program as early in their academic programs as possible, attend seminars and participate in the preparatory workshops to ensure their success in the professional school admissions process.

Most health professions schools require at least one year in each of the following subjects: English, general biology (botany and

zoology), general physics, general chemistry and organic chemistry; calculus is recommended. In addition to the general science background, colleges of veterinary medicine require coursework in bacteriology or microbiology, and at least one summer of practical experience in the management of poultry, pigs, cattle or horses. Regardless of the specific prerequisites of a school of medicine, dentistry or veterinary medicine, coursework available at ESF has proven to be valuable to applicants to those professional programs.

All students applying to medical school are required to provide letters of recommendation from a health advisory committee, evidence of public service, and evidence of previous experience (volunteer or paid) working in an area of health professions. The Health Professions Advisory Program assists students in making decisions about health careers and matches students with appropriate professional schools. The Health Professions Advisory Program is located in 312 Hall of Languages, College of Arts & Sciences, Syracuse University, Syracuse, N.Y. 13244 and may be contacted at 315-443-2321 or <http://hpa.p.syr.edu>.

Pre-law advising

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. ESF's programs provide students with such an education.

ESF's pre-law advisor, Dr. Robert Malmsheimer, counsels students regarding selection of elective courses, the Law School Admission Test (LSAT), law school application procedures, and other matters of importance. Brochures and application forms for the LSAT and the Law School Data Assembly Service are available from the college's pre-law advisor. Each year, Syracuse University and the college's pre-law programs offer a variety of workshops and seminars to introduce students to law school and legal topics. Students considering law school are encouraged to meet with ESF's pre-law advisor as early in their academic careers as possible to take advantage of these services.

Coordinated Programs with Syracuse University

Joint Program in Science Teacher Certification

ESF and the School of Education at Syracuse University offer qualified undergraduate students an opportunity to prepare for initial New York state teacher certification in biology or chemistry, and general science. This opportunity is available through the following ESF bachelor of science (B.S.) degree programs: chemistry (leading to initial certification in chemistry in grades 7-12 and general science in grades 7-9); and environmental biology (leading to initial certification in biology in grades 7-12 and general science in grades 7-9). Students who earned at least a 3.000 grade point average during their first semester at ESF and transfer students who maintained a 3.000 or greater cumulative grade point average at their previous college are eligible for admission to the program. Students who are interested in pursuing this opportunity should contact the assistant dean of Instruction and Graduate Studies at ESF for application materials.

Academic Requirements

Students must complete all requirements for their academic program as listed in this catalog that include the following: To meet the standards for general education, students must complete at least 30 semester hours (credits) in the general education core. Students who transfer into an English writing course that is substantially different in purpose from CLL 290 must complete WRT

428 to meet the education literacy requirement. Included in this standard is a foreign-language requirement: One year of college-level foreign language study, or its equivalent established through appropriate high school study (passing Level II exams) and/or testing.

To meet the standards in content teaching, students complete at least 30 semester hours in the content core. For biology certification, content courses include cell biology, biochemistry, anatomy and physiology, comparative anatomy, genetics and evolution, biological diversity, human biology, botany, and zoology. Courses in nutrition are acceptable if the topics are cell nutrition, organic and inorganic chemistry, or physical chemistry. For chemistry certification, content courses include matter and atomic structure, energy, chemical bonds and molecular structure, chemical reactions, and quantitative relationships.

To meet the standards for certification to teach general science, students must complete at least 24 credits of science in the primary certification area (as noted above), at least 15 credits in a second science area, and at least six credits in each of the two remaining science areas: biology, chemistry, earth science, and physics.

Students must also complete:

SED 340 Participation in the Professional Development School (0-1)—also known as "The Academy"—each semester.

The non-credit workshop offered by the School of Education, which examines six areas of concern to teachers: identifying and reporting child abuse; violence prevention/intervention; alcohol/tobacco/drug abuse prevention; child abduction prevention; fire and arson prevention; and highway safety/traffic regulations/safety patrols.

Students are required to complete the following professional education (pedagogy) core courses at Syracuse University in preparation for the candidacy semester:

EDU 204 Principles of Learning in Inclusive Classrooms (4)

EDU 304 Study of Teaching (4) Prerequisite: EDU 204 or equivalent

RED 326 Literacy Across the Curriculum (4)

EDU 310 The American School (3)

CANDIDACY SEMESTER (Spring only): prerequisites include a minimum 2.8 cumulative average and a minimum 2.8 average in both required education and science courses; completion of EDU 204, EDU 304, RED 326, and a significant number of science credits; successful review of the professional portfolio by The Academy; and satisfactorily meeting the assessment standards of the School of Education. The following courses are co-requisites for the candidacy semester:

SED 409 Adapting Instruction for Diverse Student Needs (3)

SCE 413 Methods and Curriculum in Teaching (3)

EDU 508 Student Teaching/Secondary Candidacy (3)

STANDARD STUDENT TEACHING SEMESTER (in the student's final fall semester prior to the degree conferral): prerequisites include a minimum 2.8 cumulative average and a minimum 2.8 average in both required education and science courses; successful completion of the candidacy semester and approval by The Academy; completion of a majority of the required credits on the science content area; and satisfactorily meeting the assessment standards of the School of Education. The following 12 credits are taken as co-requisites for the standard student teaching semester:

EDU 508 Student Teaching/Science (9)

SED 415 Teacher Development/Science (3)

Initial Certification and Professional Certification

The School of Education evaluates and recommends eligible candidates as having met the requirements for the certificate. Students must pay fees for certification and exam processing. Candidates for initial certification must apply for certification within two years of the completion of the degree program and they must successfully complete (a) the Liberal Arts and Sciences Test (LAST); (b) the Written Assessment of Teaching Skills (ATS-W); and (c) the Content Specialty Test (CST).

Requirements for professional certification must be met within five years of the date of the initial certification. To achieve

professional certification, applicants must earn a master's degree that meets one of the following criteria: (a) a graduate-level teacher education program that is registered with the Department of Education; (b) a master's-level or higher program in the content core of the initial certificate or in a related content area; or (c) a master's-level or higher program in any field, provided that it includes at least 12 semester hours of graduate study in the content core of the initial certificate or in a related content area. A one-year extension may be granted by the state if a student has completed at least 24 credits of the master's degree. Application for professional certification also requires three years of teaching experience. If the teaching experience is in New York State, the first year must be mentored by the school district. Teachers with professional certification must complete 175 hours of professional development every five years.

For additional information about certification requirements and the process, visit the New York State Education Department Web site at www.highered.nysed.gov/tcert/certificate/req-spec.htm.

Service Learning Program

www.esf.edu/students/csl

Public service is a vital component of ESF's mission, reflecting our commitment to making the world a better place. Through the college's service learning program, students can participate in this mission of service, contributing to the larger community while gaining invaluable experience and earning course credit.

Students enrolled in any of ESF's service learning courses spend time working in the community on service projects related to their field of study. Through these courses, the traditional classroom is extended beyond the bounds of our campus, offering energizing, "real-world" learning experiences. The community benefits from student help and knowledge, even as students gain inspiration and a richer understanding of the value of their work.

Students are also welcome to participate outside of class in an ESF community service project. Numerous community service opportunities are available on campus and in the greater Syracuse community. For additional information on these activities, visit the service learning Web site.

Service learning activities help students develop a number of academic, personal and social attributes and may aid students in career development choices. For a list of courses that have incorporated service learning in the past, please refer to the service-learning website at www.esf.edu/students/csl.

International Study Abroad

ESF students who have completed 30 or more credits toward their bachelor's degree with a cumulative grade point average of 3.000 or greater are eligible to apply for study in a foreign country through the Division of International Programs Abroad at Syracuse University (DIPA), or through overseas study programs offered at other institutions within the SUNY system. Although some international study programs require specific language skills or may be conducted in the language of the host country, others offer study in part or entirely in English. Students who seek additional information about the requirements for study abroad should contact ESF's Office of Instruction and Graduate Studies or search the SUNY Study Abroad Web site at www.suny.edu/Student/Common/studyAbroad.cfm.

Graduate Education

Graduate degree programs at ESF enable students to:

- think critically and independently;
- comprehend the processes of science and effectively apply scientific principles and professional procedures;
- attain proficiency in the current knowledge in their respective fields;

- develop competence in the technical skills and tools required in their disciplines;
- demonstrate high standards of performance as scientists, educators and professionals; and
- exercise ethical conduct in their relationships with colleagues, other professionals and the public.

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 Faculties 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 Faculty 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.

Degrees

Four master's degrees are offered at ESF, the 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 Science Degree

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

Master of Forestry Degree

The master of forestry (M.F.) degree is intended to be a terminal degree and is offered in the Faculty of Forest and Natural Resources Management. It is designed primarily for students whose undergraduate degree was not in a professional program in forestry. This degree requires the successful completion of a minimum of 30 credits at the graduate level, of which at least 27 must be in coursework. The student's study plan (Form 3B) must be approved by the major professor and faculty chair.

In addition, this program requires an integrative experience such as an internship or team project. If an examination is required, it is

developed and managed by the Faculty of Forest and Natural Resources Management.

Master of Landscape Architecture Degree

At the graduate level, the master of landscape architecture (M.L.A.) degree is the first professional degree in landscape architecture. This degree requires successful completion of a minimum of 66 credit hours of which at least 42 must be graduate coursework. The student's study plan (Form 3B) must be approved by the major professor and faculty chair. All steering committee members should sign the 3B form before the end of the last year of the student's program.

Master of Professional Studies Degree

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: environmental and forest biology, forest resources management, environmental and resource engineering, and environmental science.

This degree requires the successful completion of a minimum of 30 credits at the graduate level, of which at least 24 must be in coursework. The student's study plan (Form 3B) must be approved by the major professor and faculty chair. 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.

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 Faculty responsible for the program.

Doctor of Philosophy Degree

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 and resource 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 Faculties 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.

Tool Requirements

Doctoral students must demonstrate competence in at least one research tool as a requirement for graduation. Such tools include statistics, computer science, or the ability to translate technical articles in a language, other than English, commonly used in science. Tool requirements and standards for each doctorate program will be determined by the corresponding program Faculty.

Student Advising and Study Plan (Form 3B)

Major Professor: Appointment and Responsibilities

The student's major professor is appointed by the dean of Instruction and Graduate Studies upon the recommendation of the faculty chair. A major professor should be appointed upon the student's matriculation into a graduate program. For the graduate student accepted into a graduate program but lacking a major

professor, a temporary advisor will be appointed by the faculty chair. However, every effort should be made to expedite appointment of a major professor.

The major professor shall be a member of the ESF faculty, except those with visiting appointments. The major professor, or at least one of the co-major professors, must hold a degree equal to or higher than the degree sought by the student. It is the duty of the major professor to fulfill a primary role as the student's mentor. Aided by other members of the steering committee, the major professor guides the student in the development and implementation of the student's study plan (Form 3B), including course selection, research planning, choice of the professional experience, and facilitation of the examination schedule. The major professor also guides the student in reviews of thesis or dissertation drafts, including a complete review of the thesis or dissertation before the final copy is presented for defense. It is the responsibility of the major professor to assure that the document presented at defense is the final version, subject only to minor grammatical changes.

Steering Committee: Appointment and Duties

The steering committee for master of science and doctoral students is composed of the major professor and at least two faculty members or other qualified persons. The steering committee for master of forestry, master of professional studies and master of landscape architecture students is composed of the major professor and at least one other faculty member or other qualified person. Other qualified people include faculty at other institutions or other recognized professionals.

The student's steering committee is appointed by the dean of Instruction and Graduate Studies upon the recommendation of the faculty chair. The steering committee should be appointed within the first semester. For all students, the steering committee must be established and must have met by the end of the third semester of graduate study.

The steering committee assists the student in the development of the student's study plan (Form 3B), including the development of the student's research or professional experience. All steering committee members should sign the 3B form before the end of the last year of the student's program. The steering committee guides the development of the thesis or dissertation, including a review of the thesis or dissertation before the final copy is presented for defense.

Student's Study Plan

The student's study plan (Form 3B) includes an individualized sequence of courses and a plan for research or professional experience. The student and all steering committee members should sign the 3B form, submit it to the faculty chair for approval and then forward it to the dean of Instruction and Graduate Studies by the end of the third semester for the M.S., M.L.A., or Ph.D. degree; it must be submitted by the end of the first semester for the M.F. or M.P.S. degree. For all graduate degrees, the program of study must be submitted by no later than the end of the last year of the student's program. The study plan can be changed during the course of a student's program. Changes must be approved by the major professor and faculty chair with notification to the dean of Instruction and Graduate Studies.

Part-Time Study

Upon completion of 12 credit hours as a matriculated student, the part-time student will request assignment of a steering committee that consists of the major professor and one other person. The steering committee will meet and agree upon a program of study (Form 3B) and specify the delimitation date according to the needs of the part-time student.

Communication Skills

All students entering graduate programs at ESF are expected to be proficient in communication skills, including technical writing and

library skills. Students 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. Credit for such courses taken during the graduate program are not counted towards degree requirements. Alternatively, graduate students can meet the requirement by demonstrating the equivalent in experience in writing and library skills, as determined by the steering committee.

Seminars

Participation in seminars, including the preparation and presentation of technical material, is vital to the student's graduate education. All graduate students at ESF are required to participate in graduate seminars as follows:

Topic Seminar: Each graduate student is expected to participate in topic seminars, including presentations, as determined by the individual Faculty. This requirement can be fulfilled, with appropriate approval, by seminars offered at Syracuse University or SUNY Upstate Medical University.

Capstone Seminar: Students completing the master of science degree or the Ph.D. degree, are required to present a capstone seminar on their thesis or dissertation research. Other master's students may be required to present a capstone seminar on a topic chosen in consultation with the major professor and steering committee. The purpose of the capstone seminar is to provide an opportunity for the graduate student to present technical information to a critical body of professionals and peers. This seminar will be presented prior to the thesis or dissertation defense and should be attended by the student's steering committee. Each seminar is open to the college community and will be announced college-wide to encourage attendance by students and faculty.

Examinations

Students who wish to complete the doctoral candidacy examination, defense of thesis or dissertation should request formation of their examining committee guided by the schedule provided by the Office of Instruction and Graduate Studies.

To ensure the integrity of the examination process, oral examinations will generally take place during the academic year and all members of the examination committee appointed by the dean of Instruction and Graduate Studies will be present at the oral examination. Students must complete the oral examination within six months from the appointment of the examination committee or the student will be required to request the assignment of a new examination committee. Exceptions may be granted by the dean of Instruction and Graduate Studies.

Doctoral Preliminary Examination

The requirement for this examination is determined by individual Faculties. The purpose of this examination is to assess the entering student's basic knowledge in the chosen field of study. The results of this examination may be used to determine the student's suitability for the doctoral program and as a guide in selecting coursework and developing a program of study.

Doctoral Candidacy Examination

The objectives of this examination are to determine the breadth and depth of knowledge in the chosen field of study and assess the student's understanding of the scientific process. The doctoral candidacy examination is taken when the majority of coursework is completed and no more than three years from the first date of matriculation has elapsed or the student may be dismissed from the doctoral program. This examination must be taken at least one year prior to the dissertation defense.

Upon the recommendation of the appropriate faculty chair, the dean of Instruction and Graduate Studies appoints the doctoral candidacy examination committee consisting of the student's major professor, the student's steering committee and an additional faculty

member from an appropriate area. Additionally, the dean of Instruction and Graduate Studies appoints a committee chair who is not from the Faculty of the student's degree program. The examination must have both written and oral components.

The role of the examination committee chair is to manage the examination, ensure its integrity, and represent the interests of the faculty and student. Any member of the faculty may be an observer. The student examinee may invite a silent student observer to attend the oral examination with notification of the chair of the student's exam committee.

Written Examination: The examining committee shall convene at a planning meeting with the student. During the first part of the planning meeting, the committee determines the schedule for the process and establishes the date for the oral component. The student is then excused from the meeting and the committee develops and discusses the exam content.

There are three alternative forms for the written component, as follows:

FORM 1: The members of the committee submit questions or problems addressing the objectives of the exam. The questions are discussed and agreed upon at the planning meeting.

The major professor administers the written examination. Usually, one-half day is allocated to questions submitted by each examiner. Upon completion by the student, the examination questions are reviewed and graded by the committee members who prepared them. The committee then reviews the entire examination.

FORM 2: The student prepares a written report on a topic or problem assigned by the examining committee. The topic or problem must meet the objectives of this examination and its content cannot be directly related to the student's thesis research. The student has approximately one month to develop a thorough understanding of the assigned topic and prepare a written report. The report is reviewed by the committee members and committee chair.

FORM 3: The student prepares and defends a written proposal of future research likely to be carried out during their Ph.D. project. This research prospectus must be presented to the examining committee two weeks prior to the candidacy exam and should include preliminary studies supporting the feasibility of the proposed research. The exam will test the candidate's understanding of concepts directly related to his or her immediate area of research, knowledge of prior related research that has been conducted by others, their ability to design and interpret experiments in this area, and capacity to think and write independently and to present work plans orally in a clear and rational manner. The report is reviewed by the committee members and committee chair. **This option is available only to doctoral students in the Faculty of Chemistry.**

Oral Examination: Following the written examination under Form 1, completion of the report under Form 2, or completion of proposal under Form 3, the committee meets with the student for an oral examination usually lasting two hours. However, the duration can be longer if required. The questions may address the report or other areas appropriate to the objectives of the examination, including subject matter in allied fields. At the conclusion of the examination period, the student examinee and observers are excused from the room and the examination committee determines whether the student has passed the examination. Unanimous agreement is required to pass the student. If less than unanimous agreement is reached, the student is considered to have failed the first doctoral candidacy examination. The student can request a second examination which must take place no more than one year from the date of the first examination. A student is considered to have passed the second examination if there is not more than one negative vote. A student who has failed the second examination is terminated from the graduate program.

Thesis or Dissertation Defense Examination

At the conclusion of the study and research program, each master of science and doctoral candidate must successfully defend the

thesis or dissertation. The objectives of the defense examination are (1) to probe the validity and significance of the data and information presented; (2) to assess the student as a critical thinker and data analyst; (3) to evaluate the student's scientific creativity, including the student's ability to relate research results to scientific theory within the chosen field; and (4) to present the results effectively in writing.

Upon the recommendation of the appropriate faculty chair, the dean of Instruction and Graduate Studies appoints the defense examination committee. It consists of members of the steering committee and at least one additional faculty member for the master's degree examination and two additional faculty members or other qualified persons for the doctoral degree examination. Additionally, the dean of Instruction and Graduate Studies appoints a committee chair who is not from the student's degree program.

This oral examination principally covers the material in the thesis or dissertation, as well as literature and information relating to it. At least 14 days prior to the date of the oral examination, the student is required to submit a final document to all members of the examination committee. College-wide standards for final format are specified in a document available in the Office of Instruction and Graduate Studies. Within five days of the oral exam, the major professor confirms with the chair of the examining committee that the oral examination should proceed as scheduled. If the major professor determines that the written document does not meet the standards established for the thesis or dissertation exam, the exam may be postponed by the dean of Instruction and Graduate Studies at the recommendation of the chair of the student's exam committee.

The role of the examination committee chair is to manage the defense, ensure its integrity, and represent the interests of the faculty and student. Any member of the faculty may be an observer. The student examinee may invite a silent student observer to attend the examination. The defense examination usually lasts two hours, although this time period may be extended as required. At the completion of the examination, the candidate and observers are excused from the room and the examination committee determines whether the candidate has successfully defended the thesis or dissertation. The committee chair has the option to vote. Unanimous agreement is required to pass the student. If less than unanimous agreement is reached, the student is considered to have failed the first defense examination. A student who fails the first defense may request a second defense which must take place no more than one year from the date of the first examination. At the second defense, the student has passed the defense if there is not more than one negative vote. A student who has failed the second defense is terminated from the graduate program.

Standards for Theses, Dissertations and Professional Experience Reports

College-wide standards for theses and dissertations are developed and specified by the Moon Library faculty in consultation with the various Faculties and are available in the Office of Instruction and Graduate Studies.

Concurrent Graduate Degrees with Syracuse University

ESF and Syracuse University provide opportunities for graduate students to complete degrees concurrently at ESF and SU. Concurrent degrees are offered in the master of public administration program in the Maxwell School of Citizenship and Public Affairs, the master of arts or master of science programs in the S.I. Newhouse School of Public Communications, the master of science degree program in the School of Education, and the master of business administration program in the School of Management. Other concurrent degree programs may be developed with approval by the assistant dean of Instruction and Graduate Studies.

To be eligible for admission to concurrent degree programs, matriculated students must complete at least one full-time semester of graduate-level coursework or the equivalent, and earn a 3.500 grade point average or better at ESF. 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.

Students at the Syracuse University College of Law may apply for admission to a concurrent degree program at ESF during their first year of law school. Graduate students at Syracuse University should also consider the certificate of graduate studies in environmental decision-making offered through the Faculty of Environmental Studies.

Cooperative Programs at Cornell University and SUNY Upstate Medical University

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.

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 on-line at www.esf.edu/students/handbook/

College-wide Policies

Requirements and Policies

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.

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.

Dropping or Adding Courses

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.

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 for more detailed information.

Incomplete and missing grades

A temporary grade of I may be assigned by an instructor only when the student is passing and has nearly completed the course but because of circumstances beyond the student's control the work is not completed. A temporary grade of NR may be assigned by the college registrar when the course grade is not received from the course instructor by the grade deadline. Grades of I or NR must be resolved prior to the end of the semester following that in which the grade was received. At the request of the instructor and under extraordinary conditions, an I grade may be extended for one additional semester. If the incomplete is not resolved by the appropriate deadline, it will be changed to a grade of I/F or I/U. If the NR grade is not resolved by the appropriate deadline, it will be changed to a grade of NR/F or NR/U. No degree will be conferred until all the grades of I or NR have been resolved.

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 faculty 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 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 drop deadline for a 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 withdraw from ESF and in the future wish to return must apply for readmission. Prior to withdrawal from ESF, students must schedule an interview in the Office of Student Affairs and Educational Services.

Statement of Good Academic Standing

The term "in good academic standing" means that a student is eligible or has been allowed to register for and undertake academic coursework at the college for the semester in question. In some instances the college may define a student as being "on academic probation." The mechanism of academic probation, including any accompanying constraints upon a student's activities, is intended as an educational device designed to encourage greater effort on the part of students who are having difficulty in meeting certain academic standards. **Students who are on academic probation may register for no more than 15 credits per semester.** Placement on academic probation may precede denial of the right to register for

academic coursework if certain conditions are not met, but a student on academic probation is considered to be in good academic standing. Any question concerning whether or not an individual student is in good academic standing will be determined by the dean of Instruction and Graduate Studies.

Syracuse University Courses

Courses offered at ESF should be taken at Syracuse University only under extraordinary conditions authorized by the faculty 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 faculty 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.

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.sysadm.suny.edu/provost/generaleducation/Courses/ESF-courses.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.

Repeating Courses

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

For all courses passed with a grade of D or better, credit hours carried and grade points earned will be included in the semester and cumulative grade point averages each time the course is completed. However, the credit hours for the course repeated may be counted only once toward meeting graduation requirements.

Courses in which a grade of F was assigned may be repeated. Upon successful completion of the repeated course, the grade earned will be included in the semester and cumulative grade point averages, but the original grade of F and any subsequent grades of F in that course will revert to a grade of R (failed course that was repeated) on the transcript and will not be included in the grade point average.

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 2.000.

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 Faculties also assists the student by clarifying program and course requirements and providing additional advising and career-planning information.

Academic Honors

President's High Honors List

Students who carried 12 or more credits of coursework graded on a scale of A-F and earned a minimum grade point average of 3.750 with no grades of I or F will be placed on the President's High Honors List for that semester.

President's Honors List

Students who carried 12 or more credits of coursework graded on a scale of A-F and earned a minimum grade point average of 3.000 with no grades of I or F will be placed on the President's Honors List for that semester.

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 when their cumulative grade point average falls below the minimum values in the following index:

Total Hours applied Toward Degree [1]	Minimum Cumulative Grade Point Average [2]
0-18	1.0
19-30	1.4
31-45	1.5
46-60	1.6
61-75	1.7
76-90	1.8
91-120	1.9
>120	2.0

[1] Includes credit hours accepted for transfer to ESF degree program and courses taken while matriculated at ESF.

[2] Credit earned while matriculated at ESF, including SU courses.

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 Career and Counseling Services.

Students suspended a second time for unsatisfactory academic performance without successful appeal will be dismissed from the college and may not be considered again for readmission.

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 thirty 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 in the summer if they will complete all requirements during that time. There is no full-time credit-hour load to meet academic requirements.

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.

Master's students who have met all academic requirements except for their thesis defense or an examination, and all doctoral candidates (i.e., those who have successfully completed their

doctoral candidacy examination) will be considered full time if registered for at least one credit of thesis/dissertation research, professional experience or independent study, and have their major professor verify in writing they are working full time on the completion of degree requirements.

For the summer, graduate students will be considered full time if registered for at least one credit of thesis/dissertation research, professional experience, or independent study and have their major professor verify in writing they are working full time on the completion of degree requirements.

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, which is at least 12 credits hours. 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

Students may formally audit courses with permission of their major professors and the course instructors. Audited courses may not be used to satisfy any academic or graduation requirements. Formally audited courses will appear on the students' transcripts 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	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 and master of science

degree within three years, and the master of landscape architecture 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. Doctoral candidates must complete all degree requirements within three years of passing the doctoral candidacy examination, or they will be required to retake the candidacy examination.

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, faculty 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 students who wish to be reinstated must apply for readmission through the Office of Career and Counseling Services.

Students suspended a second time for unsatisfactory academic performance may not be considered for readmission.

Admissions

Undergraduate Admissions

www.esf.edu/admissions/

The college is well known for the high quality of its undergraduate instruction and unique teaching facilities, and admits well-qualified students at the freshman, sophomore and junior levels. Several factors are considered before students are accepted for admission at any level. These factors include their academic preparation, personal motivation, and reasons for wanting to study at ESF.

Campus Visits

FOR HIGH SCHOOL STUDENTS:

www.esf.edu/admissions/undergrad/interview.htm

FOR TRANSFER STUDENTS:

www.esf.edu/admissions/undergrad/transfer/visit.htm

The college welcomes visitors to its campuses. High school students should contact the Office of Undergraduate Admissions to schedule participation in a college information session, which includes a campus tour. Prospective transfer students who wish to visit the Syracuse campus to meet with a member of the admissions staff and take a campus tour are asked to make an appointment through Undergraduate Admissions. Transfer applicants will find the interview more useful if they bring college transcripts with them. Admissions staff are available for appointments Monday through Friday between 9 a.m. and 3 p.m. Campus tours, conducted by ESF student ambassadors, are also provided. Students interested in visiting the Ranger School should make arrangements directly with that campus by calling 315-848-2566. Please consult the Office of Undergraduate Admissions or our Web site for the calendar of open houses and special visitation events.

Applying for Admission

www.esf.edu/admissions/undergrad/apply.htm

Students seeking admission to undergraduate degree programs must file their application under one of the following processes. High school students may apply under the following programs:

- Early action freshman admission
- Regular freshman admission
- Guaranteed transfer admission

Students who have already attended another college may apply under regular transfer admission.

Each entrance category requires the applicant to have a specific academic background, and to have maintained satisfactory academic progress at their previous educational institution.

Students are encouraged to apply online at the ESF Web site. Paper application forms for admission to ESF are available through all New York high schools, the SUNY Application Services Center, and other SUNY admissions offices. An application package may also be obtained directly from the Office of Undergraduate Admissions.

Application Filing Dates

HIGH SCHOOL STUDENTS:

Enrollment Option	Filing Deadlines
Fall enrollment, early action (freshmen only)	November 15
Fall enrollment, regular admission	March 1*

TRANSFER STUDENTS:

Enrollment Option	Filing Deadlines
Fall enrollment	May 1*
Spring enrollment	December 1*

*NOTE: Applications received after these dates will be considered on a space-available basis.

All applicants for freshman or transfer entry are required to submit 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. Failure to submit this documentation by the stated deadlines may result in the withdrawal of the application or denial of admission.

Prospective students are strongly urged to submit their applications earlier than the recommended date to reduce the possibility they will be placed on an admissions waiting list.

Medical Examination

Each new student on the Syracuse campus is required to submit a medical history and physical examination report on a form that will be sent to the student after the initial acceptance notice.

Information for High School Students

www.esf.edu/admissions/undergrad/freshman/

Early Action Freshman Admission

Outstanding high school seniors who have selected SUNY-ESF as a top choice may apply for early action, a non-binding early application/early notification program for fall entry freshmen. Early action allows students to apply to as many institutions as they wish and, if admitted, make their final college choice no later than May 1. Early action candidates must have a completed application on file by November 15. This must include the SUNY Application (which should be received at the SUNY Application Processing Center by November 1), official high school transcripts, official results of either the SAT I or ACT and the ESF Supplemental Application with essay question response.

All early action candidates will be notified of the admission committee's decision by January 1. Please refer to the next section, "Regular Freshman Admission," for additional information on the application process.

Regular Freshman Admission

Students who choose to attend ESF following high school graduation apply for admission to the college under regular freshman admission. This freshman enrollment option is available for students who meet the admissions standards for all baccalaureate programs and for a limited number of students applying to the A.A.S. degree programs at The Ranger School. Most applicants to The Ranger School will apply under the guaranteed transfer admission process. Please refer to the next section, which explains this process.

Successful freshman applicants should present strong academic credentials from high school. A minimum of three units each of college preparatory mathematics and science are required for all majors. An official high school transcript must be submitted as part of the student's application credentials. Applicants are required to forward the official results of either the SAT I or ACT examination. The Admissions Committee will review either 'old' or 'new' SAT I results, but the essay portion is not required for admission. 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 write an essay. The essay question is included on the ESF Supplemental Application, published in the ESF Application booklet or available on the ESF Web site.

Guaranteed Transfer Admission

The college recognizes that some students have made arrangements to spend some portion of their first two years of college at other institutions, and will transfer to ESF in either their sophomore or junior year. To facilitate this process and reduce difficulties associated with transferring, ESF has established a guaranteed transfer admission (GTA) option.

Under this option, admitted students are guaranteed admission to ESF for either their sophomore or junior year. These students benefit from long-term academic advising to ensure they meet all academic requirements for transferring to the college. Guaranteed transfer applicants must submit the same credentials as outlined under "Regular Freshman Admission." 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 2.000 (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.

Information for College Students

www.esf.edu/admissions/undergrad/transfer/

Regular Transfer Admission

Approximately half of the students who enroll at the college each year transfer to ESF after completing at least one semester at another college following high school graduation. ESF recognizes the unique interests and needs of transfer students.

Transfer students' admissibility is based primarily on the quality and distribution of previous college-level coursework. Consideration involves how much of their previous coursework applies to the requirements of their intended program of study 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. Students who have completed less than 30 semester hours at their previous college may be 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. Students attending one of our pre-ESF cooperative transfer colleges (see below) will find information on course equivalencies for all of our programs of study on our Web page. Printed copies of this information may be obtained from the Office of Undergraduate Admissions. To be considered for admission to ESF, a transfer student must have a minimum cumulative grade point average of 2.000 (A=4.000) at the last institution where the student was enrolled full time. Only coursework with grades of C or higher will transfer to meet ESF degree requirements.

Cooperative Transfer Option

The college has developed pre-environmental science and forestry transfer options with other colleges both in and out of New York state. These programs offer students a wide selection of colleges from which they can obtain the necessary courses, and appropriate advice on how to prepare for transfer to ESF. Information on ESF cooperative transfer colleges may be found on our Web page.

Students who attend these colleges and follow the academic program prescribed by ESF will share a common academic background with other students who transfer to the college.

The cooperative colleges are:

NEW YORK STATE COLLEGES

Adirondack Community College, Glens Falls
Alfred State College, Alfred

Broome County Community College, Binghamton
Cayuga County Community College, Auburn
Columbia-Greene Community College, Hudson
Corning Community College, Corning
Dutchess County Community College, Poughkeepsie
Erie County Community College, Buffalo
Finger Lakes Community College, Canandaigua
Fulton-Montgomery Community College, Johnstown
Genesee Community College, Batavia
Herkimer County Community College, Herkimer
Hudson Valley Community College, Troy
Jamestown Community College, Jamestown
Jefferson County Community College, Watertown
Kingsborough Community College, Brooklyn
Mohawk Valley Community College, Utica
Monroe County Community College, Rochester
Morrisville State College, Morrisville
Nassau County Community College, Garden City
Niagara County Community College, Sanborn
North Country Community College, Saranac Lake
Onondaga County Community College, Syracuse
Orange County Community College, Middletown
Rockland County Community College, Suffern
Schenectady Community College, Schenectady
Suffolk County Community College, Selden
Sullivan County Community College, Loch Sheldrake
SUNY College of Agriculture and Technology at Cobleskill
SUNY College of Technology at Canton
SUNY College of Technology at Delhi
Syracuse University
Tompkins-Cortland Community College, Dryden
Ulster County Community College, Stone Ridge
Westchester County Community College, Valhalla

OUT-OF-STATE COLLEGES

Berkshire Community College, Pittsfield, MA
Bucks County Community College, Newtown, PA
Holyoke Community College, Holyoke, MA
Housatonic Community College, Bridgeport, CT
Northampton Community College, Bethlehem, PA

Transfer Credit

Credit hours 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 Schools¹; 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.

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). The following guidelines are intended to assist students and advisers.

¹ *Middle States Commission on Higher Education, 3624 Market Street, Philadelphia, Pa., 19104; 215-662-5606.*

- Scores of 3, 4, or 5 on AP exams may be accepted for credit for all exams except those defined below as fundamentals of math and science.
- Scores of 4 or 5 on AP exams are needed for credit in areas defined as the fundamentals of math and science. The AP exams indicative of knowledge areas in fundamentals of math and science are given in the following table:

AP Examination	Credits	Courses
Biology	8	EFB 226/ EFB 285
Chemistry	8	FCH150/151/152/153
Calculus AB	4	APM 105 or MAT 295
Calculus BC	8	APM 105/106 or MAT 295/296
Physics B	8	PHY 101/102
Physics C: Mechanics	4	PHY 211/221
Physics C: Electricity and Magnetism	4	PHY 212/222

- Scores of 3 or higher on the language/composition (credit awarded for CLL 190) and literature/composition (credit awarded for CLL 290) AP exams are acceptable for writing course credit.

Ranger School Admission

www.esf.edu/rangerschool

The Ranger School, located in Wanakena in the central Adirondack Mountains, offers A.A.S. degrees in forest technology and in land surveying technology, but does not enroll freshmen. Students complete their freshman year requirements at ESF's Syracuse campus or at another college of their choice. They complete their sophomore year of the A.A.S. programs in residence at The Ranger School campus. Candidates may apply for acceptance into either the forest technology or land surveying technology program either under the guaranteed transfer admission option or as a regular transfer admission student.

High school students who wish to enroll in this program 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 program of the A.A.S. and eventual completion of the bachelor degree, usually in a program of study in the Faculty 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 Web site or refer to the Ranger School section of this catalog on page 103.

Educational Opportunity Program

www.esf.edu/admissions/undergrad/special.htm

The State University of New York's Educational Opportunity Program (EOP) provides academic support and financial aid to students who show promise for mastering college-level work, but who may otherwise not be accepted. Offered only to full-time students who are New York state residents, EOP accepts both freshmen and transfer students who qualify, academically and financially, for the program. Students cannot apply for both EOP and early action programs.

The basic goal of the EOP program at ESF is to provide qualified students with a college education and the opportunity for personal growth and professional development in career fields related to the college's mission. Counseling, financial assistance and tutoring are provided on an individual basis.

High school seniors who wish to apply for freshman enrollment and EOP status at the college must file a SUNY application form with their high school guidance counselor, 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 an 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 admission 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 complete applications for undergraduate admission and financial aid as described in these two sections of this catalog. For further information, contact the director of the Educational Opportunity Program, Office of Financial Aid, 315-470-6670.

Deferred Admissions

www.esf.edu/admissions/undergrad/special.htm

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.

International Students

The college enrolls international students as undergraduates if they satisfy the admission requirements outlined throughout this section of the catalog.

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

- Proficiency in the English language through acceptable performance on the Test of English as a Foreign Language (TOEFL), or by completing at least two years of college at an institution where the courses were taught in English.
- 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. A list of *approved* agencies is available through the Office of Undergraduate Admissions.
- 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. A list of *approved* agencies is available through the Office of Undergraduate Admissions.
- Ability to meet all of the financial obligations, which will be incurred while attending the college, must also be demonstrated. If accepted for enrollment, health and accident insurance supplied by the State University of New York must be obtained before the student will be allowed to register at the college. Further details about this policy are available from Syracuse University's Slutzker Center for International Services, 310 Walnut Place, 315-443-2457, or from the ESF Office of Student Life, 315-470-6660.

Graduate Admissions

www.esf.edu/graduate/

Admission to graduate studies is conditional upon review and acceptance of the applicant's credentials by appropriate faculty members and upon the recommendation of the appropriate Faculty chair to the dean of Instruction and Graduate Studies. 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 be in a matriculated status at the college.

Required for admission are, at minimum, a bachelor's degree from a recognized institution, and generally an academic record showing at least a B average for junior and senior years of the baccalaureate program or for the master's program.

Also required are Graduate Record Examination (GRE) scores and for some degree programs, subject (advanced) test scores; supporting letters of recommendation; and a statement of educational and professional goals.

The Graduate Record Examination may be waived by a faculty chair or graduate coordinator on an individual basis. This waiver can only be granted by the graduate coordinator and/or faculty chair.

A nonrefundable \$60 application fee is charged.

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.

On-line applications are preferred and are accessible at www.esf.edu/graduate/admission.htm.

Application forms may be printed from the Internet or requested in paper form from the Office of Instruction and Graduate Studies, 227 Bray Hall, SUNY-ESF, Syracuse, N.Y. 13210.

Application Deadlines:

Semester	Deadline
Fall	February 1
Spring	November 1

Applications completed by these dates will normally receive decisions by early April for fall matriculation and by early December for spring matriculation. Applications completed after these deadlines will be processed in a timely manner.

Graduate Record Exam Subject Tests

Subject tests are required by the following programs:

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

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 thirty 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 other SUNY-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 Admissions

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.

International Students

The college enrolls international students on the graduate level if they satisfy the admission requirements outlined throughout this section of the Catalog.

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

- Proficiency in the English language through acceptable performance on the Test of English as a Foreign Language (TOEFL) or the College Entrance Board Achievement Test in English. On paper-based exams, scores of 550 or higher are required. Scores of 213 or higher demonstrate proficiency for the computer-based TOEFL, or by completing at least two years of college at an institution where the courses were taught in English. The Test of English as a Foreign Language (TOEFL) examinations are offered several times each year in major cities of the world. For information on the examinations, write to the Educational Testing Service, Princeton, N.J. 08540. In submitting test scores to the college (**institutional number R2530**), request they be sent to the Office of Instruction and Graduate Studies.
- Ability to meet all of the financial obligations that will be incurred while attending the college.
- International students must also file the State University of New York Foreign Student Admission forms. No fee is required for processing these forms.

If accepted for enrollment, health and accident insurance supplied by the State University of New Ycrk must be obtained before the student will be allowed to register at the college. Further details about this policy are available from ESF's Office of Business Affairs, 102 Bray Hall, 315-470-6630.

International students who are currently enrolled at American colleges or universities may apply for admission to ESF. In addition to the entrance requirements for other international students, they must obtain permission to transfer to ESF from the U.S. Bureau for Citizenship and Immigration Services (BCIS) district office having jurisdiction over the college in which they are currently enrolled.

International students will be considered for assistantships and fellowships, but are not eligible for need-based student financial assistance.

Expenses

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

The tuition schedule *per semester* and the fees listed below are subject to change.

	NYS Resident Students	Out-of-State Students
Undergraduate Matriculated		
Full-time	\$2,175	\$5,305
Part-time	\$181/credit hour	\$442/credit hour
Graduate Matriculated		
Full-time	\$3,450	\$5,460
Part-time	\$288/credit hour	\$455/credit hour
Continuing Education Non-degree Students without a Baccalaureate Degree		
Course Nos. 0-599	\$181/credit hour	\$442/credit hour
Course Nos. 600-999	\$288/credit hour	\$455/credit hour
Students with a Baccalaureate Degree		
Course Nos. 0-499	\$181/credit hour	\$442/credit hour
Course Nos. 500-999	\$288/credit hour	\$455/credit hour
Maximum Total Tuition for 12 Credit Hours or More		
Undergraduate	\$2,175	\$5,305
Graduate	\$3,450	\$5,460

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.

Fees

Application

Students who apply for admission to an undergraduate program at any State University of New York campus are charged a nonrefundable application fee of \$40. For more information about the fee, and guidelines for exemptions, obtain the *Application Guidebook* for the State University of New York through any SUNY admissions office or any New York high school.

Students who apply for admission to a graduate program at ESF are charged a nonrefundable application fee of \$60.

College

The college fee is \$12.50 per semester for full-time students and 85 cents per credit hour for part-time students. For tuition purposes, students are considered full-time when they are enrolled in 12 credit hours or more.

Student Activities

Each full-time undergraduate student is charged \$90 per year to cover the cost of student activities at the college and part-time matriculated students are charged \$3.75 per credit hour.

Full-time graduate students are charged an activity fee of \$40 in the fall only. Part-time matriculated graduate students are charged \$7.50 per semester. Full-time graduate students who enter ESF in the spring semester are charged a \$7.50 student activities fee.

Students also pay an annual fee to Syracuse University to cover university-sponsored activities and services that are available to ESF students, but not duplicated at the college. These fees are \$36 for full-time undergraduate students and \$15 for full-time graduate students, and are charged in the fall only.

Part-time matriculated undergraduate students are charged \$19.10 per year and part-time matriculated graduate students are charged \$10 per year at fall registration only.

Syracuse University does not charge an activities fee for nonmatriculated undergraduate or graduate students.

Orientation Program

New undergraduate students will be charged a \$50 fee to cover the cost of a college orientation program. This is a voluntary activity and students who choose not to attend may request a refund.

Student Support Services

All full-time students are charged \$165 per semester to partially offset the cost of academic and other support services provided by Syracuse University, while part-time students are charged \$13.75 per credit hour.

Final Year

Undergraduate students pay a commencement fee of \$60 that is required at the beginning of the semester in which a student is expected to obtain a degree.

All undergraduates are also charged \$30 for a school yearbook in the fall semester, and a \$10 senior gift charge the semester they are expected to graduate.

Graduate students incur additional costs for the binding and archiving of theses and dissertations. Fees for these services are determined in the semester of degree completion. In Fall 2006, all graduate students will be charged a one-time \$35 commencement activity fee. Students who matriculate after Fall 2006 will be charged the commencement fee upon matriculation only.

Field Trip Fees

A transportation fee of \$25 is charged for each course that has a field trip component to cover costs of transporting students to off-campus sites.

Drop/Add Fee

A fee of \$20 is assessed for each drop and each add transaction after the drop or add deadlines. See the "Academic Calendar" on page 3 for the dates.

International Student Health Insurance

All international students attending the college must participate in the State University of New York International Health Insurance Program. The cost is estimated to be \$650 per calendar year. Coverage for dependents is available from the insurance carrier.

Technology Fee

A fee of \$11 per credit hour up to a maximum of \$132 per semester is assessed to maintain and enhance the college's computer infrastructure and online services provided to students.

Official Transcript Fee

All students, including matriculated, non-matriculated, full time and part time, are assessed a fee of \$5 per semester. This guarantees students access to unlimited lifetime transcripts.

Terms of Payment

Undergraduate Deposit

All undergraduate students pay an advance payment deposit of up to \$100 after they are admitted to the college. Information on when the deposit is due, as well as refund guidelines, is sent to students at the time they are offered admission. The deposit is credited to the student's first semester tuition. There is no advance payment deposit required for students accepted for graduate study.

Billing

Six weeks prior to the start of each semester, the college sends students who have registered for the upcoming semester a detailed invoice indicating the total expected charges. This invoice includes only ESF charges. (See below for room and board costs at Syracuse University.) New students will be billed upon arrival and payment will be due in 15 days. Instructions are included with the invoice.

The college provides a monthly payment plan, the purpose of which is to allow students or parents to make tuition payments in installments.

Late Payment Fee

A late payment fee ranging from \$30 to \$50 will be charged each time a monthly statement is issued. The maximum will not exceed four late payment fees.

Insufficient Funds

Individuals will be assessed a charge of \$20 for checks returned unpaid due to insufficient funds.

Refunds

A student who is given permission to cancel registration is liable for payment of tuition in accordance with the following schedule:

Liability During Semester

- 1st week: 0%
- 2nd week: 30%
- 3rd week: 50%
- 4th week: 70%
- 5th week: 100%

In order to receive a refund of amounts paid over the liability, individuals must apply within one year after the end of the semester for which the tuition was paid. The first day that classes are offered, as scheduled by the college, shall be considered the first day of the semester, and the first week of classes for purposes of refunds shall be deemed to have ended when seven calendar days, including the first day of scheduled classes, have elapsed.

There is no tuition or fee liability for a student who withdraws to enter military service prior to the end of a semester for those courses for which the student does not receive academic credit.

A student who is dismissed for academic or disciplinary reasons prior to the end of a semester is liable for all tuition and fees due for that semester.

A student who cancels registration at a unit of the State University of New York, and within the same semester registers at another unit of the state system is entitled to full credit for tuition and fees paid for that semester.

In situations where a student must withdraw from the college under circumstances in which the denial of a refund would create serious hardship, the college president or the vice president for administration can waive the normal refund schedule. Such action can be taken if the student has completed no more than one-half of the semester and will not receive academic credit for the semester. A written request for relief from the provisions of the refund schedule, including the reasons for the student's withdrawal, must be submitted to the college president or the vice president for administration.

Other Costs

Room and Board Costs

The college does not operate student residence or dining halls, but facilities are available at Syracuse University.

In general, housing costs at Syracuse University range from \$2,350 to \$3,980 per semester, reflecting the diversity of single- and multiple-room accommodations for graduate, undergraduate, single and married students.

A variety of meal plan options are also available to all students, whether or not they reside in university residence halls. The costs of these plans range from \$625 to \$2,825 per semester. Payment for housing and meal plans is made directly to Syracuse University.

For more information about housing and meal options, refer to the "Student Life" section of this catalog, and/or contact the Office of Housing, Meal Plan and I.D. Card Services, 202 Steele Hall, Syracuse University, Syracuse, N.Y. 13244, 315-443-2721.

Program Expenses

The cost of books and supplies is approximately \$800 per year. Additional costs for personal expenses, clothing and transportation vary greatly from student to student, but are estimated to range from \$900 to \$1,600 per year.

Several programs at ESF include additional costs. Students majoring in forest resources management attend a seven-week Summer Session in Field Forestry at the Wanakena campus between the sophomore and junior years. Environmental and forest biology majors attend the summer field experience at the Cranberry Lake Biological Station at the end of their junior year.

The Summer Session in Field Forestry costs approximately \$1,375, while the program at Cranberry Lake costs \$425 a week, plus travel and personal expenses.

Field trips for landscape architecture students range between \$300 and \$400. In addition, students enrolled in landscape architecture are required to spend one semester off campus. This is a self-designed and student-budgeted program. Costs do not necessarily exceed those of a semester on campus, but additional costs are often incurred depending upon the location chosen. These additional costs are the responsibility of the student, and are not covered by financial aid.

Additional course fees for labs provided by Syracuse University will be billed separately by SU. They are typically \$20/semester for chemistry labs and \$40/semester for physics labs.

The Ranger School Expenses

Please see page 103 for detailed expenses for the Ranger School at the Wanakena campus.

Financial Aid

www.esf.edu/finanaid

The college offers these basic forms of student financial assistance: scholarships or grants; part-time employment; long-term 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 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 Guide*, which is a separate publication that is mailed to all applicants and is available through the Office of Financial Aid.

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 not awarded based upon financial need.

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.

Financial aid advisors are aware of the many problems of financing higher education and meeting day-to-day 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

How to Apply

Students interested in receiving financial assistance, with the exception of graduate assistantships, tuition scholarships and fellowships, must complete an application process each year.

After January 1, students must complete the Free Application for Federal Student Aid (FAFSA), and submit it to the Federal Student Aid Processor. There is a paper version of the FAFSA or you can file electronically at www.fafsa.ed.gov

The deadline for first consideration is March 1.

Applications will be accepted after March 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 decision is rendered.

All students and parents are encouraged to visit our Financial Aid home page on the Internet. While visiting, please check out the following:

- Electronic filing for financial assistance
- Free scholarship search for students/parents
- Latest links to other Financial Aid sites.

The FAFSA forms are available in the Office of Financial Aid, high school guidance offices, and college financial aid offices.

Students are invited to discuss with the Financial Aid staff any problems they may have in financing their education. Applicants are also urged to contact the office for the latest information and requirements pertaining to financial assistance because financial aid systems and forms frequently change.

Selection of Recipients

The primary consideration in determining which students will receive awards is comparative financial need. However, scholastic standing, citizenship and potential contribution to the college community are also considered in making certain award decisions.

Verification of Information

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

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.

Appeal, Probation, Reinstatement

Students who fall below the minimum standards may appeal to the dean of Instruction and Graduate Studies to retain their academic eligibility to receive Title IV Federal Student Assistance (See Academic Performance, undergraduates page 19, graduate students page 21).

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 dean of Instruction and Graduate Studies places a student on "academic probation," the student remains eligible for Title IV aid as defined by the Statement of Good Academic Standing (See page 17).

The Office of Financial Aid will notify students via certified mail if they are in danger of losing financial assistance because they have fallen below academic standards.

New York State Awards

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 stated minimums on 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.
 - Associate in applied science degree students must complete 75 percent of the full-time credit load. Therefore, they must receive at least nine credits per semester ($.75 \times 12 = 9$).
 - 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) average to retain their New York State TAP Award.

Waivers for New York Awards

Students who fall below the credit or grade point average requirements listed on the following charts may apply for a waiver. 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 for waivers are made through the Director of Financial Aid.

Waivers for the C 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 the C waiver are also requested through the director of Financial Aid.

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

The charts below 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	3	.500
#3	9	.750
#4	18	1.300
#5	30	1.500
#6	45	1.700
#7	60	2.000
#8	75	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	3	.500
#3	9	.750
#4	18	1.200
#5	30	2.000
#6	45	2.000
#7	60	2.000
#8	75	2.000
#9	90	2.000
#10	105	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

Federal Awards

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 Perkins Student Loans, Federal Stafford 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 toward a degree.

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 the 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.

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

Degree	Credit Hours Required	Maximum Hours Allowed
Associate in Applied Science		
Forest Technology	78	117
Land Surveying Technology	78	117
Bachelor of Science		
Aquatic and Fisheries Science	126	189
Bioprocess Engineering	132	198
Biotechnology	123	184
Chemistry	121	181
Conservation Biology	126	189
Construction Management	127	190
Dual Option in Forest Ecosystems Science	132	198
Environmental Biology	126	189
Environmental Science	125	187
Environmental Studies	122-125	187
Forest Engineering	130	195
Forest Health	126	189
Forest Resources Management	129	193
Natural History and Interpretation	126	189
Natural Resources Management	122	183
Paper Engineering	140	210
Paper Science	133	199
Wildlife Science	126	189
Wood Products Engineering	127	190

Bachelor of Landscape Architecture	150	225
Bachelor of Landscape Architecture / Master of Science	150/30	225
Master of Forestry	30	45
Master of Landscape Architecture	66	99
Master of Professional Studies (unless otherwise noted)	30	45
Environmental and Forest Biology	42	63
Master of Science	30	45
Doctor of Philosophy	60	90

Types of Available Awards

Scholarship, Fellowship, and Grant Programs

Federal Supplemental Educational Opportunity Grants

The college receives Federal Supplemental Educational Opportunity Grants (FSEOG) authorized under Title IV-A of the Higher Education Act of 1965. These funds enable the college to award grants to undergraduate students who have financial need. Grants range from \$100 to \$2,000 per year.

Educational Opportunity Program

Students accepted into the college's Educational Opportunity Program (EOP) may receive, in addition to other financial assistance, a special award to pay for education-related costs. Students must come from a socioeconomically and academically disadvantaged background to be eligible.

Prospective EOP students must apply for financial aid when submitting their admissions applications.

Federal Pell Grants

The Federal Pell Program was authorized in the Educational Amendments of 1972. Grants are available to eligible full-time and part-time undergraduate students, and can vary from \$400 to \$4,050.

Eligibility for a Pell Grant is determined by filing the FAFSA (Free Application for Federal Student Aid).

Tuition Assistance Program and Regents Programs

Tuition Assistance Program (TAP) awards are available to New York residents enrolled in full-time degree programs. The awards are based on income, and range from \$100 to 95 percent of full tuition.

Regents Grants or Children of Deceased or Disabled Veterans Grants are awarded to children of parents who served during specific periods of war or national emergency, and who died as a result of such service or suffered a disability of at least 50 percent. The awards entitle state residents who qualify to \$450 per year.

Additional information and applications for these programs are available from the Office of Financial Aid, or from New York State Higher Education Services Corporation, Tower Building, Empire State Plaza, Albany, N.Y. 12255.

Vocational and Educational Services Grants

Financial assistance and program counseling are provided by New York for students with disabling conditions. Information is available from any New York Office of Vocational and Educational Services.

Veterans' Benefits

The Veterans' Readjustment Benefits Act of 1966, as amended, enables veterans and children of deceased or disabled veterans to obtain financial aid for their college education.

Application forms and additional information and counseling are available from the ESF Veterans' Affairs Counselor in the Office of the Registrar, local veterans' administration offices, and the State Regional Office, 111 West Huron Street, Buffalo, N.Y. 14202.

Diversity and Underrepresented Student Scholarships and Fellowships

Undergraduate students who are New York residents and Black/Non-Hispanic, Hispanic, Native American or Alaskan Native are eligible for scholarships comprised of funds from both the college and SUNY. Eligible students should contact the Office of Financial Aid. Awards are based on need, and funds are limited.

Graduate students who are Black/Non-Hispanic, Hispanic, Native American or Alaskan Native and are also U.S. citizens or permanent residents are eligible for SUNY Underrepresented Graduate Fellowships. Eligible students should contact the director of Multicultural Affairs.

Assistance for Native American Students

Native American students with financial need may be eligible for scholarship and grant assistance through programs sponsored by the federal Bureau of Indian Affairs and the New York State Education Department. For more information, students should contact the Bureau of Indian Affairs, 1951 Constitution Avenue NW, Washington, D.C., or the Native American Education Unit, State Education Department, Education Building Annex, Albany, N.Y. 12234.

Private Fellowships, Scholarships and Grants

The college administers more than 130 private fellowships, scholarships and grants established by individuals, companies, organizations and foundations. These funds have varying eligibility requirements, which are described in more detail in the *ESF Financial Aid Guide*.

A list of the private funds administered by the ESF College Foundation may be found at www.esf.edu/development/scholarships.htm.

Syracuse Pulp and Paper Foundation Scholarships

Scholarships from the Syracuse Pulp and Paper Foundation, Inc. are awarded to undergraduate students in paper science and engineering who are United States citizens or permanent residents. SPPF scholarships and awards vary based on a student's cumulative grade point average. Entering freshman students will be reviewed for scholarships based on their high school academic record. Entering freshman and transfer students and ESF continuing students in PSE, who have a 2.5 cumulative grade point average or higher, will be considered for scholarship assistance. Awards are renewed each semester subject to scholarship committee approval. Students entering the program should contact the Office of Financial Aid or the Syracuse Pulp and Paper Foundation for further information.

State University Supplemental Tuition Assistance

The college annually awards small grants to a limited number of students with financial need as part of the State University Supplemental Tuition Assistance program.

Employment Opportunities

Federal College Work-Study Program

The college participates in the Federal College Work-Study Program, which provides part-time jobs during the academic year and full-time positions during the summer to students who need financial assistance to attend the college. Wages for these positions begin at the minimum wage and increase as duties and responsibilities increase. The current wages are \$6 per hour during the academic year and \$7 per hour during the summer.

Job Locator Service

The college coordinates and maintains an active program of part-time and summer employment opportunities. Interested students should contact the student employment coordinator in the Office of Financial Aid for additional information. The program is open to all ESF students seeking employment.

Loans

Federal Perkins Student Loans

Federal Perkins Student Loans, formerly known as National Direct Student Loans, are available to students with financial need who are enrolled at least half time. A total of \$4,000 can be borrowed each year for four years, up to a maximum of \$20,000. A repayment plan, including 5 percent interest, begins nine months after the student leaves college. Deferment and cancellation benefits are available in certain situations. The average loan per student totaled \$2,000 in 2005-2006.

Federal Stafford Student Loans

The Federal Stafford Student Loan program, formerly Guaranteed Student Loans, is administered by the college through outside lenders and agencies for ESF students.

These loans are available from a bank or other lending agent to students who are registered at least half time. Undergraduate students can borrow as follows: \$2,625 in the first year; \$3,500 in the second year; \$5,500 in the third, fourth and fifth years up to a total of \$23,000. Graduate students can borrow \$8,500 a year up to a total of \$65,500.

Stafford loans may be subsidized or unsubsidized or a combination. A subsidized loan is 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.

A repayment plan, with a variable or fixed percent interest, begins six months after the student leaves college. An additional 1 percent interest is charged at the time the loan is received. Applications are available at local banks. The average subsidized Stafford Student Loan was \$5,500 in 2005-2006. The average unsubsidized Stafford Student Loan was \$4,000 in 2005-2006.

Federal Parent Loan for Undergraduate Students

Parents of undergraduate students may borrow from local lending institutions up to the cost of attendance at ESF annually at an interest rate of 8.5 percent with a Federal Parent Loan for Undergraduate Students (PLUS). A repayment plan begins 60 days after receipt of the loan. Applications for PLUS loans are available at local lending institutions.

Emergency Loans

The college provides some matriculated students interest-free, short-term loans. These 30-day loans are available through the support of the Alumni Association Short-term Loan Fund, the David B. Schorer Memorial Fund and the Edward Vail Emergency Fund. For more information, contact the Office of Financial Aid.

Graduate Assistantships and Tuition Scholarships

Assistantships are awarded to students who have demonstrated scholarship and academic promise, and whose education and experience enable them to assist in laboratory instruction and research. The amounts of the assistantships range from \$10,500 per academic year to as high as \$18,000 for a calendar year. In addition, a tuition scholarship may be awarded. Students who hold an assistantship must be enrolled for full-time study as defined by graduate policies, and be making satisfactory progress toward completing their degree.

Beginning graduate students may apply for assistantships on their application for admission. Continuing graduate students should request a position description from their Faculty office.

Student Life

Student Services

Student Services at ESF

Career and Counseling Services

The Office of Career and Counseling Services is available to students who seek the advice of an experienced counselor, and should be contacted whenever personal questions or problems arise.

The career and counseling services staff helps students adjust to life at ESF, successfully graduate from the college, and make the transition into the work force. Through various presentations, counseling sessions, group activities and workshops, students can develop their decision-making, studying, and time-management skills. Other programs explore the adjustments students must make when entering college or transferring between institutions.

The office also provides career counseling to meet the individual needs of students at various stages of their education and employment search through a variety of materials and presentations. The career services offered include skill development workshops, job lists, on-campus recruiting visits, career Web sites, and reference information.

The office also conducts an annual survey to monitor the activities of ESF graduates six-to-nine months after graduation. The survey results are available at the Office of Career and Counseling Services.

Syracuse University provides additional assistance for a broad range of concerns or difficulties including the Office of Student Assistance, the Counseling Center, the Goldberg Marriage and Family Therapy Center, the Hendricks Chapel staff and denominational chaplains, the Psychological Services Center, the Office of International Services and the Campus Mediation Center.

Academic Support

Academic support services for learning-disabled students, as well as students requiring tutorial and remedial assistance, are available. Students should contact the ESF Office of Student Life so that appropriate services can be provided.

Tutoring Services

The ESF Peer Tutoring Program is one of the many support programs in place to help develop students' academic abilities. Through the Peer Tutoring Program, the service of a qualified undergraduate or graduate student tutor may be available to any ESF student who feels a need for academic support in meeting the demands of ESF courses. The focus for the peer tutoring program is on lower-division undergraduate courses. Requests for tutoring in more specialized classes will be dealt with on a case-by-case basis. Students should contact the Office of Student Life for more information.

Services for Students with Disabilities

Students who experience temporary disabilities or incapacitating injuries that require special transportation or classroom assistance should contact the Office of Student Life.

The office staff provides specialized support services and helps more permanently disabled students obtain maximum academic, social and cultural benefits within the college community. The college is also prepared to respond to disabled students' needs for personal and career counseling, and job placement assistance. For further information contact the Office of Student Life, or the college's 504 Coordinator in the Office of the Vice President for Administration.

The Gebbie Speech and Hearing Clinics at Syracuse University provide free remedial assistance to all regularly enrolled students who may have hearing, speech and/or voice disabilities. Syracuse

University's Office of Disabilities Services may be reached at 804 University Avenue Room, 309, 315-443-4498. There is a Telecommunication Device for the Deaf (TDD) at 315-443-1371.

The college maintains liaison relationships with local and state rehabilitation agencies, including the Office of Vocational and Educational Services for Individuals with Disabilities (VESID). Students should contact the proper agency for specific information about eligibility.

Internships

ESF students can explore interests and career opportunities through a variety of internships on campus, in the local community, and around the country. Internship opportunities exist for students in all majors. Students should contact the Office of Student Life for more information.

University Police

ESF's University Police department consists of a staff of 13, including 10 uniformed sworn police officers. The department is responsible for personal safety, criminal investigations, campus access, building security, parking, and enforcement of all New York vehicle and traffic laws on campus roadways 24 hours per day, seven days a week.

The Blue Light Help Phone System is a direct voice link with University Police offices. Blue help lights are located throughout the ESF campus and may be used any time assistance is needed.

University Police is located in the basement of Bray Hall, room 19, and can be reached by calling 315-470-6667.

Student Services at Syracuse University

Housing

College students may seek housing with Syracuse University, or one of the many off-campus options. The College of Environmental Science and Forestry does not operate its own residence facilities or food service.

Unless they commute from home, freshmen are expected to live in Syracuse University residence halls.

Syracuse University housing is within walking distance of the ESF campus, but students may ride free shuttle buses or city buses between campus and their residence. Students have a choice of living centers, which includes large residence halls, apartment houses, fraternity and sorority houses, or cooperative units. Student resident advisors live on each floor or in each unit of residences, and are available for counseling, advisement and referral services. Contracts for room and board made with Syracuse University cover a full academic year (both fall and spring semesters) and are not normally renegotiable during that time period.

Syracuse University also has housing for married students and their families available in the South Campus area.

For more information about costs and availability, contact the Office of Housing, Meal Plans, and ID Card Services, 202 Steele Hall, Syracuse University, Syracuse, N.Y. 13244, 315-443-2721.

Food Services

Syracuse University offers different meal plans to help meet the various needs and interests of individual students. Students living in residence halls without full kitchen facilities are required to subscribe to a meal plan, while students living in university apartments, co-ops, fraternities and sororities, or off campus, may purchase a meal plan if they so desire.

The college does not provide food services. However, The Gallery, located in the basement of Marshall Hall, offers snacks and light meals weekdays during the academic year.

Health and Medical Facilities

Students may consult a physician for medical care or health advice at Syracuse University's Health Services, 111 Waverly Avenue, 315-443-2666. Full-time students are entitled to unlimited visits to the outpatient clinic and 10 days of ordinary medical care and confinement in the infirmary per college year. Infirmary stays totaling more than 10 days will be charged at prevailing infirmary rates. There are separate charges for all X-rays, medications and all laboratory tests.

Student accident or health insurance plans not only supplement the usual infirmary privileges, but also can provide health protection during the summer months when students are not under the care of Health Services. Married students with dependents who are not covered by Health Services privileges are strongly urged to purchase health insurance made available to students through SU Health Services, 315-443-2668.

All international students, as well as faculty and students planning to study abroad, are *required* to carry health and accident insurance supplied by the State University of New York. Further details about this policy are available from SU's Office of International Services, 310 Walnut Place, 315-443-2457, or from the ESF Business Office, 102 Bray Hall.

Co-curricular Activities

Students at the college can choose from co-curricular activities at both ESF and Syracuse University.

Activities at ESF

Your ESF education will be characterized by stimulating and challenging academics. The experience you gain in the classroom will prepare you technically for your chosen career. However, an equally important element of your college education is how you spend your out of class time. The Office of Student Activities offers a variety of programs that promote students' education beyond the classroom. ESF students have access to over 200 student groups. These professional, recreational, service and social affiliations can help to facilitate a well-rounded education. On the ESF campus there are approximately 25 organizations, and more than 200 at Syracuse University.

The Undergraduate Student Association (USA) and the Graduate Student Association (GSA) are the official representative bodies on campus governing student organizations. Both undergraduate and graduate students elect representatives from each Faculty to the associations, which manage the affairs and respond to the concerns of their constituents.

The two organizations sponsor a variety of events funded by student activity fees. The annual events include the All-College Welcome Back Picnic held the first weekend of the fall semester; the Annual Alumni and Family Fall BBQ; the December Soirée, a formal dinner dance; and the Spring Awards Banquet, where students, faculty and staff are recognized for their contributions to the college community. The associations also host several graduate and all-campus "TGIFs" each semester.

The GSA produces the *Graduate Student Handbook* to assist new graduate colleagues in becoming acclimated to the college. The organization also sponsors an annual professional lecture series and several social events enjoyed by students, staff and faculty.

Several other campus organizations offer students opportunities to broaden their knowledge, gain experience and leadership skills, and meet other students with similar interests. Descriptions are on the college Web site at www.esf.edu/students/activity/clubs and

additional information can be obtained from the student activities office in 110 Bray Hall.

Activities at Syracuse University

Students at the college enjoy the same privileges as Syracuse University students. They may participate in student government or join any of the scores of Syracuse University student groups, which include a wide variety of clubs, the International Student Association, religious and military organizations, and professional and honor societies.

College students may also perform with the Sour Citrus Society "pep" band, Hendricks Chapel Chorus, Black Celestial Chorale Ensemble, SU Marching Band and other performance/arts organizations.

The Archbold and Flanagan gymnasiums are the center of athletics and physical education at Syracuse University, and are adjacent to the ESF campus. Additional indoor facilities are available at Manley Field House and the Carrier Dome, which is the site of Syracuse University's home football, basketball and lacrosse games. The Women's Building offers instructional, social and recreational facilities. Facilities on South Campus include a lodge, 22 tennis courts, and a Nautilus exercise room in the Goldstein Student Center. There is also an ice rink at South Campus.

Although students at the college can take part in Syracuse University club and intramural sports, the university does not allow ESF students to participate on its Division I intercollegiate teams due to National Collegiate Athletic Association guidelines.

Alumni Association

The Office of Alumni Affairs serves as a liaison among the college, the Alumni Association Board of Directors, and ESF's more than 17,000 alumni. The association supports educational programs through scholarships, publishes a newsletter and alumni directory, and represents concerns of ESF graduates. The association also hosts numerous events in Syracuse and throughout the United States.

ROTC Opportunities

Many students attending the college are eligible to participate in the Army or Air Force Reserve Officer Training Corps (ROTC) programs at Syracuse University.

The ROTC programs consist of both two- and four-year programs. Students attending the college for two years can gain admission to either the Army or Air Force program through participation in summer training. Both four- and six-week camps and on-campus programs are available to suit the individual needs of students. The ROTC programs offer academic instruction, both active and reserve career opportunities, leadership experience and financial aid.

For more information contact Air Force ROTC at 303 Archbold Gymnasium, 315-443-2461, and Army ROTC at 308 Archbold Gymnasium, 315-443-1752.

Student Rules and Regulations

The complete guidelines for academic and social conduct for all students attending the college are found in the *ESF Code of Student Conduct* and the *Student Handbook*. These documents are available on the college website at www.esf.edu/students/handbook or in hard copy in 110 Bray Hall. The guidelines pertain to all students, and it is each student's responsibility to be familiar with the regulations and to abide by them.

All students receive copies of informational materials related to prevention of sexual harassment, campus security and crime statistics, and drug-free campus programs.

The Campuses

The college is a multiple campus system of about 1 million square feet of facilities in 186 buildings on 25,000 acres of land.

The Syracuse Campus

ESF's Syracuse campus lies on 12 acres adjacent to Syracuse University in an area traditionally known as "The Hill." The principal instructional programs at the bachelor's, master's, and doctoral levels are on the Syracuse campus. In addition, the Syracuse campus houses a wide variety of important research organizations. Programs are housed in the seven academic buildings: Baker Laboratory, Jahn Laboratory; Walters, Bray, Marshall, and Illick halls; and Moon Library.

Moon Library

www.esf.edu/moonlib

The F. Franklin Moon Library contains more than 135,000 cataloged items and receives approximately 800 print journals and hundreds more electronically. The collection constitutes a specialized information source for the academic programs of the college. The collection has concentrations in such areas as botany and plant pathology, biochemistry, chemical ecology, forest chemistry, polymer chemistry, economics, entomology, environmental studies, landscape architecture, environmental design, management, paper science, photogrammetry, silviculture, soil science, water resources, world forestry, wildlife biology, wood products engineering, and zoology.

The Syracuse University libraries and the libraries at SUNY Upstate Medical University are within walking distance of ESF. Moon Library shares an online library catalog with Syracuse University, which also provides access to hundreds of Web-based databases (bibliographic and full text).

All Syracuse University collections may be searched by using the online public access catalog located in Moon Library and through the World Wide Web client. Other collections located throughout the United States are readily accessible through interlibrary loan.

The library building opened in 1968, and can seat 400 people. The main reading areas are located on the upper level adjacent to the open stacks. The reference, reserve and circulation area are located in the center of the building. The main level of the library includes computer workstations for the library catalog, databases and Internet searching; individual study carrels; a conference room; library faculty offices; a writing support center; and tutoring areas, which create a learning commons atmosphere. The archives and special collections, a computer laboratory and library processing areas are located on the lower level.

Services provided by the library faculty and staff include a credit course in information literacy (ESF 200), orientation programs, class lectures, user aids and reference desk services.

The library is a wireless environment where students may use their personal laptops for work. A few laptops are available for loan from the reserve desk.

The College Archives, located in Moon Library, contain historical items relevant to the college and forestry development in New York. The special collections area of the archives includes rare and valuable books and folios, as well as the Fletcher Steele collection on landscape architecture and a collection on papermaking donated by Thomas Cook, an ESF alumnus.

Academic Computing Services

www.esf.edu/computing/acadcomp.htm

The use of computing technology is critical to the educational experience at ESF. Four public computing labs are maintained by ESF Computing and Network Services (CNS) for general campus use. All labs are open seven days a week during most of the academic year and contain PC hardware, printers and software commonly in use by ESF academic programs. In addition to these ESF campus computing

resources, Syracuse University's Information Technology and Services manages public computer labs where ESF students can access required resources for both class work and research. Several of these labs are open 24 hours a day, seven days a week.

The ESF Computing Center labs in Baker Laboratory and Moon Library consist of Windows-based PCs with multi-format color and black-and-white printing facilities. From these labs, students have access to significant services through the ESF campus network, Syracuse University's campus network, and the Internet. Additionally, all ESF students are assigned electronic mail accounts through Syracuse University for their e-mail needs. This e-mail address is used by both ESF and SU for all official electronic communications with students.

CNS supports students and faculty at ESF by maintaining the software available over the network and resident on ESF Computing Center PCs. Software available to students includes word processing applications, CAD and graphics packages, statistical packages, database management/spreadsheet applications, various compilers, and other miscellaneous course-specific software.

Additional computing facilities on the ESF campus are provided by the individual academic programs for specialized uses such as modeling and geographic information systems. The specific descriptions of these resources are located within the faculty sections of this catalog.

Connections to the ESF campus network and the Internet can be made through ESF's Evergreen wireless network from the main level of Moon Library, and the Alumni Lounge and the Snack Bar in Marshall Hall. Syracuse University's wireless network, AirOrange, can be accessed from a variety of locations around the SU Campus and from most residence halls. ESF students living in Syracuse University residence halls will find all of the dormitories wired for direct connections from student rooms to the Syracuse University campus network and the Internet.

Analytical and Technical Services

www.esf.edu/ats

Analytical and Technical Services provides an array of centralized analytical services including nuclear magnetic resonance spectrometry (NMR), gas chromatography-mass spectrometry (GC/MS), liquid chromatography-mass spectrometry (LC/MS), and inductively coupled plasma-optical emission spectrometry (ICP-OES). The unit also provides services including operation of a chemical and laboratory apparatus stockroom, microcomputer repair, instrument and equipment repair and fabrication, micromechanical repair and experimental apparatus fabrication, and coordination of scientific glassblowing repair.

Specialized Facilities

Specialized facilities on the Syracuse campus include electron microscopes; plant growth chambers; air-conditioned greenhouses; a bio-acoustical laboratory; radioisotope laboratory; computing center; and specialized instrumentation including a nuclear magnetic resonance spectrometer with both liquids and solids capability, electron spin resonance spectrometer, gas chromatography, mass spectrometer, ultracentrifuge, and X-ray and infrared spectrophotometer.

The paper science and engineering laboratory features a semi-commercial paper mill with accessory equipment. The Faculty of Construction Management and Wood Products Engineering has a complete strength-of-materials laboratory as well as a pilot-scale plywood laboratory and a machining laboratory.

Greenhouses and forest insectary are used to produce plant and insect material for instruction. Extensive collections are available for study, including wood samples from all over the world, botanical materials, insects, birds, mammals, and fishes.

Geographic Information Systems (GIS)

Geographic information systems are collections of capabilities for acquiring, storing, managing, manipulating, analyzing, displaying and reporting data or information which has locational or spatial attributes. The college faculty recognizes the power and utility of GIS for generating fundamental knowledge about the world, and for many practical environmental applications. In recognition of the importance of geo-spatial modeling and analysis to all programs of study and research at the college, the Council for Geo-spatial Modeling and Analysis (CGMA) was formed in 1991 to develop coherent programs of instruction, research and public service.

Geo-spatial modeling and analysis instruction and research at ESF builds upon existing strengths in mapping science and engineering, including surveying, photogrammetry, remote sensing, hydrology, environmental engineering, and waste management. It also builds on strengths in environmental applications, including environmental science, natural resources management, planning and design.

Extensive research and advanced instruction facilities are located in the college's mapping science laboratory and these facilities continue to expand. Additional resources exist at other facilities at ESF and Syracuse University, including an internationally recognized faculty in the areas of cartographic theory and geographic analysis.

Any program at ESF can include a component of GIS instruction and practice with proper coordination. In addition, much more concentrated study, application, and research using GIS is available through engineering, environmental studies, forest and natural resources management, and landscape architecture.

Division of Engineering faculty and students are interested in spatial data acquisition, environmental database development, environmental modeling, site selection, and facility design. The study of GIS in engineering may be coordinated with programs in photogrammetry and mapping, environmental assessment and engineering, image processing, and water resources.

Environmental Studies faculty and students are interested in policy issues associated with environmental information, and applications within metropolitan environments. The faculty's academic programs offer students special opportunities to pursue an interdisciplinary program that is tailored to their needs, and can include instruction in GIS and GMA applications and research.

Forest and Natural Resources Management uses GIS to focus on forest management and planning, including inventory analysis, harvest planning and multiple use management. Since resources management is essentially spatial in nature, both undergraduate and graduate programs benefit from these technologies.

Landscape Architecture students and faculty are interested in the application of CAD, GIS, and video technologies for landscape analysis, planning and design. These technologies are integrated into required coursework, and advanced bachelor's and master's degree students may pursue additional learning in computer applications.

The Cranberry Lake Campus

www.esf.edu/clbs

The Cranberry Lake Campus is approximately 1,000 acres of forested property in the northwestern Adirondacks bounded by 150,000 acres of New York forest preserve lands and Cranberry Lake.

Situated within the 984-acre Charles Lathrop Pack Experimental Forest, ESF's Cranberry Lake Biological Station is home to a 10-week summer field program in environmental biology. The facilities are intensely used during the summer in a comprehensive curriculum of upper-division and graduate-level courses. Use of the campus before and after the summer session varies to include individual research projects, cooperative studies with other agencies, and visits by groups from both the college and other institutions.

The Newcomb Campus

www.esf.edu/aec

Located in the central Adirondack Mountains, the Newcomb Campus is the largest of the regional campuses and home to the

Adirondack Ecological Center (AEC), where extensive studies of animal biology and ecology are conducted. This campus contains a wide variety of vegetative types and wildlife. It is the site of a year-round general research and forest management program.

The Huntington Wildlife Forest, a 15,000-acre property, provides an exceptional resource for experimentation in ecology and natural resources management. It contains several small bodies of water including Rich Lake. The Adirondack Interpretive Center, under cooperative agreement with the Adirondack Park Agency, is located on the property and open to the public throughout the year.

The Tully Campus

The Tully Campus consists of the Heiberg Memorial Forest and the Tully Field Station. It is located about 25 miles south of Syracuse.

Heiberg Memorial Forest, situated on the northern end of the Allegheny Plateau, includes 3,000 acres of diverse terrain and forest growth. The forest is used as an outdoor teaching laboratory and for intensive research and public service activities. All-weather classroom buildings accommodate instruction and public service programs. The forest is actively managed for forest products including wood products, Christmas trees, maple syrup, clean water and wildlife. Visitors use the property for a wide variety of outdoor recreation activities.

The Wanakena Campus

www.esf.edu/rangerschool

The Wanakena Campus is situated on the western plateau of the "Lakes Region" of the Adirondacks. Located on the Oswegatchie River about 65 miles northeast of Watertown and 35 miles west of Tupper Lake, it includes the James F. Dubuar Forest and the Ranger School.

The campus and its 2,800-acre instructional and demonstration forest support the college's associate in applied science degree programs in forest technology and land surveying technology. It is the oldest forest technician program in the country.

The campus also is home to the Summer Session in Field Forestry, a seven-week session devoted to introductory instruction in field forestry principles and techniques. Attendance at this session is required for all students entering forest resources management and the dual option in forest ecosystem science.

The Warrensburg Campus

The Warrensburg Campus, in the southeastern Adirondacks, consists of the Charles Lathrop Pack Demonstration Forest, an area of some 2,600 acres of heavily forested land noted for its eastern white pine stands. The forest has been under intensive management since 1927 for the combined purposes of instruction, research and demonstration in forestry and allied fields. Pack Forest also hosts the New York State Department of Environmental Conservation's Environmental Education Camp and the home office of the Greater Adirondack Resource Conservation and Development Council. A one-mile wheelchair-accessible nature trail is open to the public, and the property is used by thousands of visitors for day-use recreation.

The Field Stations

ESF operates several field stations, which directly support the instruction, research and public service programs of the institution.

The 44-acre **Forest Experiment Station** in Syracuse is located about three miles from the main campus and is used to support main campus academic and research programs. The station includes a tree nursery, four arboreta, four greenhouses and a research laboratory. The **Field Station** in Tully has 66 acres devoted to both short- and long-term out-plantings in support of various research projects. An irrigation system and layout of level planting sites makes it an excellent facility for developing hybrids, grafting, conducting short-term experiments, and for heritability research. Both the Experiment Station and the Field Station are used extensively for public recreation such as hiking and cross-country skiing.

The college also owns a magnificent island, featuring the **Ellis International Laboratory**, in the heart of the Thousand Islands/St. Lawrence River area off the village of Clayton. Accessible only by boat, the island is home to ESF's **Thousand Islands Biological**

Station and is an appropriate spot for the college-wide, cooperative, and international environmental monitoring and research activities conducted in the St. Lawrence Seaway area.

College Research and Outreach

Both research and outreach have been integral components of the college's mission areas since the institution's founding in 1911.

New knowledge generated through research has become the central economic resource of our time. ESF engineers, biologists, chemists, resource managers, and landscape architects explore pressing social and economic problems as well as new technologies for New York's benefit.

Four themes—applied ecology and conservation biology; renewable materials, energy and biotechnology; sustainable systems and communities; and environmental and natural resources information systems—provide a context to integrate and synthesize the cultural, natural and industrial perspectives embracing all of ESF's academic, research and outreach programs.

Faculty, staff and students contribute service hours to numerous professional organizations, community groups, governments, and civic associations locally and internationally.

Research

www.esf.edu/research/orp.htm

The college's commitment to scientific inquiry stretches back to its second year of existence. In 1912, Dean Hugh P. Baker initiated the college's first research project by joining forces with the U.S. Forest Service in a study designed to determine the species and quantities of wood being used by firms in New York state.

Since that date, ESF's research programs have attracted a worldwide clientele of industrial, governmental, professional and scientific groups. Through liaison with them, the research program maintains its vigor and relevancy to the world's most important environmental issues. Research support amounts to more than \$12 million per year.

Examples of recent studies are acid precipitation and forest ecosystems, the restoration of sturgeon and Atlantic salmon in New York waters, the development of a system for integrating wildlife with forest management, the natural production of migratory fish in lakes and streams, renewable bioproducts and bioenergy from lignocellulosic biomass including wood to ethanol as a biofuel, the development of a forest resource management and planning support system, new wood pulping and bleaching processes leading to pollution-free water and air effluents, the development of polymeric materials for artificial human organs and the evaluation of radio-frequency drying methods for lumber.

Although most of the organized research at the college is based in the faculties, there are a variety of centers and institutes that help focus and coordinate some special efforts.

Specialized Research Units

Adirondack Ecological Center

www.esf.edu/aec

The Adirondack Ecological Center (AEC) is located on the Huntington Wildlife Forest in the geographic center of the six-million-acre Adirondack Park wilderness. The AEC provides a support base for ecological research in the region, including housing, laboratory, computer and library facilities.

A resident staff maintains an extensive historical database and continually monitors environmental variables, such as weather and atmospheric chemistry, vegetation and wildlife populations.

Currently, more than 100 students and scientists conduct research at the center. Their projects range from the effects of acid precipitation on tree growth to the influence of forest disturbance on biodiversity in the Adirondack region. Major programs include wildlife ecology, fisheries science, hydrology, forestry and ecosystem dynamics. Graduate students conduct most research, but undergraduates are encouraged to become involved as seasonal field assistants.

The Huntington Wildlife Forest, a 15,000-acre property, provides an exceptional resource for experimentation in ecology and natural resources management. The Huntington is host to the Adirondack Visitors Interpretive Center, which is operated by the Adirondack Park Agency and open to the public throughout the year.

American Chestnut Research and Restoration Center

www.esf.edu/faculty/efb/chestnut

The American Chestnut Research and Restoration Center conducts basic and applied research with the long-term goal of developing blight-resistant American chestnut trees. The center will also endeavor to reintroduce these resistant trees back into forest ecosystems of New York and the rest of the eastern United States. The project evolved from basic research into identifying pathogen-resistance genes and developing chestnut tissue culture. Center goals now include field test plantings of tissue culture derived chestnuts, genetic engineering of chestnut with putative pathogen resistance genes, studying gene expression in chestnut, developing pollen-mediated delivery of resistance genes, studying the rhizosphere ecosystem of chestnut trees, encouraging public participation to identify rare remnant surviving chestnut trees, collecting and exchanging viable nuts and establishing large restoration plantations throughout New York.

Ongoing activities include basic research on various single and pyramided resistance gene designs, regulating gene expression, plant tissue culture and gene transfer into American chestnut trees, transformation of pollen and use of transformed pollen for artificial pollination, field testing resistance-gene constructs in a model tree species, hybrid poplar, collecting rare chestnut germplasm, and establishing germplasm archives throughout New York.

SUNY Center for Brownfield Studies

www.sunybrownfields.esf.edu

The SUNY Center for Brownfield Studies, headquartered at ESF, is an educational and research initiative aimed at remediation, environmental management and contamination cleanup, coupled with redevelopment of underutilized contaminated real properties known as "brownfields." The center provides undergraduates and graduate students with varied expertise, disciplines and skills necessary for returning negatively impacted properties to productive use. Both public and private sectors teach and learn at the center and contribute to the research that will ultimately enhance society's ability to evaluate, remediate and redevelop brownfield sites.

The center focuses on three major areas:

- Academic and training programs to deliver a holistic curriculum that encompasses developing skills and knowledge for undergraduate, graduate and non-matriculated students who are interested in brownfield remediation and redevelopment
- Agency, municipal and community outreach and support programs that have become the "go to" place for training and advice on state and federal brownfield programs for regulation and funding, and technical assistance on remediation and real estate
- Research and development of innovative, ecologically-based technologies for cost-effective, implementable, and protective solutions to on-site contamination

The center's programs are funded by several sponsors, including New York State Senate, New York State Department of Environmental Conservation and Niagara Mohawk—A National Grid Company. It includes four SUNY partners in the center: SUNY Institute of Technology, SUNY Morrisville, Mohawk Valley Community College and Herkimer County Community College.

Cellulose Research Institute

www.esf.edu/Cellulose

The Cellulose Research Institute's (CRI) mission is to stimulate development and dissemination of new fundamental knowledge about cellulose and related biopolymers, leading to their increased utilization.

The CRI was founded in 1957 in response to an initiative of the cellulose-utilizing chemical industries. CRI members have played major roles in areas such as the physical chemistry of polymers, lignin and wood chemistry, hemicellulose composition and determining the distribution in plant cell walls, the molecular and supramolecular structure of cellulose and related polymers. Several members have received the American Chemical Society's Anselme Payen Award for outstanding cellulose chemistry research.

With the recent move into the state-of-the-art Edwin C. Jahn Laboratory, the CRI enters the 21st century with renewed vigor. The addition of 600 MHz solid state NMR, new laboratories for polymer molecular-weight characterization, thermal analysis and molecular modeling offers researchers and collaborators an outstanding facility for long-range academic/industrial research and development.

Some areas of current interest include nondestructive methods of characterizing cellulosic process streams, preparation of cellulose nanocrystals for use in reinforced polymers, bioconversion of hemicellulose and cellulose into commercially useful biopolymers, and development of novel, environmentally-benign cross-linking agents for cellulose. The application of structural chemistry and modeling to understanding fundamental changes in cellulose such as mercerization continues as a CRI focus. Another activity is the offering of a distance-learning course in carbohydrate and polysaccharide chemistry (FCH 540) through the SUNY Learning Network and the development of short courses in aspects of cellulose chemistry.

SUNY Center for Sustainable and Renewable Energy

SUNY Chancellor Robert L. King designated ESF as the SUNY Center for Sustainable and Renewable Energy in March 2002. This designation marks ESF as the system-wide voice for the advancement of biofuels and energy-saving bioproducts, biomass, wind, solar, geothermal and all other forms of sustainable and renewable energy.

The center serves as a site for resources and programs for scientific research and draws on the expertise of all ESF faculties as well as the research talent throughout the SUNY system and the Syracuse Center of Excellence in Environmental Systems and Renewable Energy. SUNY-ESF's applied research agenda supports the SUNY center's research from hydrogen storage to lignocellulosic ethanol to gasification to biomass feedstock development. The SUNY center is an active party in the New York Public Service Commission New York Renewable Portfolio Standard development and hearing process.

Working in concert with the U.S. departments of Energy and Agriculture, ESF scientists have conducted more than \$12 million of research to maximize the production of woody biomass from salix (willow), develop a sustainable biorefinery based on wood biomass, and have conducted both co-firing and gasification demonstration tests.

Today, ESF is conducting significant fuel cell and fuel cell membrane research and is working with the New York Power Authority and the New York State Energy Research and Development Authority to install and operate a 250 kw molten carbonate fuel cell. This project will test the process' ability to provide crucial, distributive, "green" power.

In addition, ESF's longstanding and proven successful Salix Consortium continues to provide feedstock for the co-firing, gasification, manufacture of levulinic acid for biofuels and bioproducts like specialty and commodity biochemicals, biopharmaceuticals and biopolymers and plastics.

Center for Community Design Research

fla.esf.edu/ccdr

The Council for Community Design Research is a public service and research arm of the Faculty of Landscape Architecture at ESF. Established in 1998 in response to an increased demand for community outreach and a growing national concern for the condition of communities, the council builds on the Faculty's long tradition of design service and a strong working knowledge of communities. The council works in partnership with communities, elected officials, agencies and not-for-profit organizations to provide technical assistance, educational programs, and research projects that build community capacity to manage sustainable futures.

Faculty and students work through the council to:

- Help communities address difficult environmental and social conditions through community-based physical design and planning
- Develop civic capacity to manage sustainable communities
- Increase community access to resources and information
- Identify and investigate critical issues facing communities and offer solutions
- Foster design literacy and develop public appreciation for the value of design and planning

The council provides technical assistance, educational programs and materials directly to communities and works with partner organizations to develop research projects to address statewide concerns.

Technical assistance is intended to help address community specific issues in a timely manner. This work ranges from the distribution of technical and case study materials, to strategic organizational assistance, facilitation of public planning sessions, and development of conceptual planning studies.

Educational programs introduce local leaders and community residents to the planning and design process and tackle regionally specific issues and opportunities through "hands on" workshop projects. Workshops, training manuals and publications present planning and design issues and concepts in a visual, non-technical manner. Educational objectives vary for specific programs; however, they generally address design literacy, leadership development, communication strategies and organizational capacity.

Research initiatives are based on collaborative partnerships between public and private institutions, agencies and organizations. The council organizes roundtable discussions and symposia to consider critical community issues and develop research agendas. The council supports the development of research proposals and facilitates the coordination of multidisciplinary project teams.

Council for Geo-spatial Modeling and Analysis

www.esf.edu/cgma

The council serves as an umbrella organization for the approximately 20 ESF faculty and staff and 30 to 40 graduate students who currently teach and conduct research across a broad range of geo-spatial topics. These activities primarily are directed through the Faculties of Environmental and Forest Biology, Forest and Natural Resources Management, Environmental Resources and Forest Engineering, Landscape Architecture, and Environmental Studies. There are expanding interests for uses of geo-spatial modeling and analysis in the faculties of chemistry (chemical ecology and environmental chemistry), construction management and wood products engineering, and paper science and engineering.

In addition, the council enjoys close cooperation with Syracuse University, especially the Department of Geography, School of Information Studies, and College of Engineering and Computer Science.

Teaching and research interests emanate from topic areas as diverse as photogrammetric and geodetic engineering, landscape ecology, soil mapping, image analysis, forest and hydrologic models, environmental information systems, spatial data acquisition, remote sensing data and processing, computer mapping, wetland evaluation and assessment, urban forestry and rural development.

College teaching and research facilities have expanded rapidly in recent years. Existing facilities provide an excellent base for current operations and programs. Resources include a mapping science laboratory, numerous laboratories devoted to specific applications, modern computer clusters and Syracuse University computing facilities. All facilities enjoy full network capability and support. The laboratories contain a wide array of modern desktop and workstation computers with supporting software to perform processing in positioning, GIS, graphics, photogrammetry, remote sensing, and programming. Support hardware includes video, printer, plotter, scanner, digitizer and related equipment. There is a full array of global positioning system (GPS) equipment, including a base station located at the Syracuse campus.

Council on Hydrologic Systems Science

www.esf.edu/hss

The Council on Hydrologic Systems Science conducts research and provides outreach on knowledge essential to wise ecosystem use and sustained yield of appropriate quality water. The special focus of the council is bio-geohydrologic processes in natural forested systems, including relationships to water supply and wastewater treatment systems. This organized unit deals with water dependent products of sustainable value in integrated water resource systems.

Much of the research occurs in the northeast United States including the Adirondack Mountains, Catskill Mountains, Finger Lakes and Croton watershed in New York, the White Mountains in New Hampshire and the Laurentian Great Lakes. Research occurs throughout the world, including ongoing investigations in Europe and Asia.

Having a strong interdisciplinary nature, this council consists of faculty members from ESF and Syracuse University. ESF academic units participating in the council include chemistry, environmental and forest biology, environmental resources and forest engineering, and forest and natural resource management. Syracuse University academic units include civil and environmental engineering and earth sciences. ESF became a charter member of the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CHUAIS) in August 2001.

Through the council, faculty members provide workshops, conferences, publications, consultation and advising to municipalities, state and federal agencies, corporations, regional watershed advisory groups, technical committees and professional organizations. For example, council members were instrumental in planning and presenting the American Water Resources Association (AWRA) national meeting held at the college. Faculty have served on the AWRA Environmental Advisory Board, the Onondaga Lake Partnership, New York State Technical Committee, and numerous local, state and regional water resource committees.

Council on McIntire-Stennis Forestry Research

www.esf.edu/research/sponprog/special/ms/msprogram.htm

The council coordinates ESF's research through the federal McIntire-Stennis Cooperative Forestry Research program, which provides knowledge essential to the efficient and effective use of the nation's forest resources. Timber production, forest land management, wood utilization, and the associated development of new products and distribution systems are the key elements of forestry research. This research deals with other products of the forest, including wildlife, recreation, water, range and environmental quality, whose production, management and distribution are an inextricable part of the long-term productivity and profitability of the integrated system of forest resources.

In addition, McIntire-Stennis research has the objective of helping to create and maintain a highly qualified cadre of forest scientists through their direct involvement in the research projects as part of their graduate education. These young men and women, educated in the sciences fundamental to forestry, will ultimately help to maintain the security and well-being of this country through

service in private industry, in various levels of government, and in academic institutions as managers and scientists.

Empire State Paper Research Institute

<http://espri.esf.edu>

The Empire State Paper Research Institute (ESPRI) is a college-wide, industry-supported research program in the pulp and paper field. It performs investigations in cooperation with the Empire State Paper Research Associates, Inc. (ESPRA), which is comprised of pulp and paper companies in several countries. The institute was established in 1945 when the industry recognized the growing need for new scientific concepts and processes to improve the functional performance of papermaking materials and products.

The institute is housed in the J. Henry Walters Hall and is staffed by scientists who are internationally recognized for their accomplishments. The institute provides basic and applied research for long-range industry development, and its program has widened in scope to cover many areas of pulping and papermaking, including oxygen and bio-pulping and bleaching, internal and surface structures of paper, sheet drying, paper coating, printability and other paper properties, and energy efficiencies. Extensive research facilities include two pilot paper machines.

Great Lakes Research Consortium

www.esf.edu/glrc

The Great Lakes Research Consortium (GLRC) involves 16 educational institutions in a collaborative effort to understand and improve the Great Lakes ecosystem. Headquartered at ESF, the consortium's other member institutions are the SUNY colleges at Brockport, Buffalo, Cortland, Fredonia, Geneseo, Oswego, Plattsburgh and Potsdam; the SUNY centers at Albany, Binghamton and Buffalo; Rochester Institute of Technology; Hobart and William Smith Colleges; and Clarkson, Cornell, St. Lawrence and Syracuse universities. Nine universities in the province of Ontario, Canada participate in the consortium.

The consortium's goals are to facilitate research and scholarship involving Great Lakes issues, the education of students on topics related to the Great Lakes ecosystem and the dissemination of information gathered through consortium-sponsored research. The GLRC administers two cooperative grants programs, sponsors scholarly workshops and research task forces, coordinates fall and spring seminar series, maintains a database of New York Great Lakes scientific and scholarly work, and publishes a biannual newsletter, a research review and a bimonthly e-mail newsletter.

A student-faculty conference is held each year, providing a forum for students to display their research and affording the opportunity for scientists and scholars to come together to share their ideas and form new collaborations. The consortium occasionally holds a Great Lakes summer institute at one of the member schools. The institute features field- and laboratory-based courses taught by Great Lakes scientists for students at participating institutions.

Joachim Center for Forest Industry, Economy and Environment

www.esf.edu/joachim

The Joachim Center focuses on improving the understanding and resolution of environmental problems facing the forest products and related industries. The ultimate objective is maintaining a high-quality natural environment and profitable, vigorous and competitive industries. The goals of the center are achieved through four program areas:

- Objective intellectual inquiry into sustaining contributions to a strong economy made by harvesting, processing and manufacturing timber, a renewable natural resource, into industrial and consumer products and the maintenance of a high-quality living environment
- Development and promotion of a research agenda aimed at creating effective solutions for the most critical environmental issues facing forest-based and related industries

- Advancement of a better industry understanding of environmental issues facing the forest products industry, government environmental organizations and the public, with the objective of finding beneficial solutions
- Support for resident instruction, research and public service at ESF to address the complex engineering, management and policy issues that have an impact on profits, employment, economic growth and the natural environment

Michael M. Szwarc Polymer Research Institute
www.esf.edu/polymer

The Michael M. Szwarc Polymer Research Institute was established to promote the advancement of polymer science through education and research, to coordinate diversified activities of polymer scientists and engineers in the Central New York area, and to develop strong cooperative programs with polymer-based industries nationwide. It is a consortium of associate members drawn from several organizations and institutions. The institute sponsors new educational and research ventures, encourages individual and cooperative research programs, participates in academic programs leading to the B.S., M.S. and Ph.D. degrees, and promotes continuing education and new developmental opportunities for scientists. The institute strives to maintain itself as a center of excellence in polymer science and engineering.

The institute's history dates back to the early 1950s when ESF was one of only two academic institutions in the United States offering a graduate program in polymer science. The direct outcome of ESF's initiative is that many graduates of this program now hold leading faculty positions in academic institutions in the United States and abroad or hold important managerial positions in polymer-related industries. The State University of New York recognized the achievements of ESF's polymer program and, in 1966, established the State University Polymer Research Center. Scientists from around the world have engaged in the center's research activities, and the accomplishments of its staff have been documented in more than 1,500 scientific publications.

The ever-expanding application of polymer products in recent years forecasts that some 70 percent of chemistry and chemical engineering graduates will be engaged in polymer research and development in their careers in one way or another. Polymer scientists and technologists enjoy an abundance of job opportunities and high salaries.

Presently, the institute comprises faculty members from SUNY-ESF, SUNY-Albany and Syracuse University, as well as members from industry. The institute is administered by the Faculty of Chemistry, where an intensive curriculum of polymer science is offered for undergraduate, as well as graduate students. All students in the polymer program participate actively in research projects that are interwoven with academic programs.

N.C. Brown Center for Ultrastructure Studies
www.esf.edu/faculty/wpe/ncb.htm

The N.C. Brown Center for Ultrastructure Studies, located in Walters Hall, is a central microscopy facility that provides teaching, research, and public service. It is equipped to provide students, faculty, and research staff with access to modern microscopy techniques. These techniques include light microscopy, scanning electron microscopy, transmission electron microscopy, video microscopy, digital imaging, and image analysis.

Among the major items of equipment in the center are a JEOL 2000EX 200 KV transmission electron microscope; a JEOL 5800 low vacuum scanning electron microscope equipped with an EDAX energy dispersive x-ray analyzer; and an array of specialized light microscopes to include: Nomarski DIC, video-enhanced contrast, fluorescence, and a high-resolution digital camera. Ancillary equipment includes high-vacuum evaporators, microtomes, ultramicrotomes, and critical-point driers. The center's resources include specimen preparation rooms, photographic darkrooms, and an image analysis facility.

The primary mission of the center is teaching. Its course offerings include microscopy and image analysis, scanning electron microscopy, transmission electron microscopy, and microtechnique. Research is the second major function and the center provides support to students, research staff, and faculty who are conducting structural studies. Public service is extended to industry and regional colleges, as well as to local high school groups and technology-oriented organizations.

New York Center for Forestry Research and Development
www.esf.edu/centerweb

The mission of the New York Center for Forestry Research and Development (NYCFRD) is to conduct research relevant to the needs of New York's forest industry. The center's focus is on applied research and providing information to the forestry community in the state. To the extent possible, scientists conduct research to foster the economic well-being of the citizens of New York. An important component of the center's work is in technology transfer—the process of translating research results to appropriate clientele.

A client advisory board, working in cooperation with individual faculty members, industrial cooperators and other potential co-sponsors, aids project selection and program development and evaluates and supports research and technology-transfer efforts. The participatory approach enhances the missions of the center, its sponsors, ESF and other cooperators.

Recent efforts have assisted new technologies, products and markets in added value for wood residues for New York industries.

Randolph G. Pack Environmental Institute
www.esf.edu/es/pack.htm

The purpose of the Randolph G. Pack Environmental Institute is to enhance the ESF faculty's ability to create and disseminate knowledge about environmental concerns of high public interest. It focuses on how public decisions affecting the environment are made, concentrating on topics such as public participation, environmental equity and environmental sustainability. The institute promotes these interests through research and public service activity in community, state, national and international venues.

The institute supports meetings and research efforts of graduate students and interdisciplinary faculty groups towards the objectives listed above. Specific past project publications include:

- Smardon, R., J. Felleman, S. Senecah, E. Myers and K. Olvany. 1996, 2nd ed. *Protecting Floodplain Resources: A Guidebook for Communities*. Federal Interagency Floodplain Management Task Force and USGPO, FEMA 268, 41pp.
- Smardon, R. C. and B. J. Nordenstam (eds.) 1998. *Adirondacks and Beyond: Understanding Air Quality and Ecosystem Relationships*. Special Issue of *Environmental Science and Policy*, 1(3):139-267.
- Faust, B. B. and R. C. Smardon (eds.). 2001. *Environmental Knowledge, Rights and Ethics: Co-managing with Communities*. Special Issue of *Environmental Science and Policy* 4(4/5): 147-249.
- Smardon, R.C. and B. B. Faust (eds.). 2006. *Biosphere Reserve Management in the Yucatan Peninsula of Mexico: Resources, Collaborations, and Conflicts*, Special Issue. *Landscape and Urban Planning* 74(3-4): 159-334.

Renewable Materials Institute

The mission of the Renewable Materials Institute is to develop and promote the use of renewable materials, their associated technologies and process engineering. Core studies are on wood and wood-based materials conducted for a variety of sponsors on specific problems. Incorporated under the institute are the Salix Consortium and the Tropical Timber Information Center.

Roosevelt Wild Life Station

www.esf.edu/resorg/rooseveltwildlife/default.html

The Roosevelt Wild Life Station is a partnership of scientists, educators, and public and private sector leaders dedicated to protecting New York's biological heritage and enhancing New York's future through science-based conservation of natural resources. The mission is to help build long-term economic vitality on environmental quality. Activities focus on predicting the impacts of regional and global economic forces on New York's natural resources, communicating this information to the public, and facilitating public policy based on intelligent conservation of those resources.

- **Research.** The goal is to provide new scientific knowledge to find creative solutions to the challenges of developing economic opportunity that is built on a base of environmental quality.
- **Education/Outreach.** The goal is to convey what we learn to the public and foster an understanding and appreciation for conservation issues through short courses and conferences, professional outreach publications, nature interpretation classes for science teachers, and Web-accessible conservation information.
- **Policy.** The goal is to equip policy makers with science-based tools to make management decisions that will foster economic development while enhancing environmental quality.

The Roosevelt Wild Life Station plays a key role in developing a class of broadly trained conservation professionals. It provides fellowships to graduate students to permit them to engage in cutting-edge research on biodiversity issues under the mentorship of an ESF faculty; it provides summer internships to undergraduate students to allow them to participate in conservation research under the guidance of a graduate student or faculty member.

President Theodore Roosevelt was an environmental visionary whose name the Roosevelt Wild Life Station honors and whose legacy of natural resource conservation it works to perpetuate.

Salix Consortium

The New York-based Salix Consortium project is a multi-partner endeavor to facilitate the commercialization of willow biomass crops as a locally grown, renewable, lignocellulosic, woody feedstock for bioenergy and bioproducts in the Northeast and Midwest regions of the United States.

Tropical Timber Information Center

www.esf.edu/faculty/wpe/ttic.htm

The Tropical Timber Information Center (TTIC) provides identification of wood samples and information about general characteristics and technical properties of the world's timbers. These services are directed toward the needs of importers and users of tropical woods.

The center began operation in 1975 as part of the Faculty of Construction Management and Wood Products Engineering and is one of only two such sources of information in the western hemisphere. The center carries out special studies under contract. The technical base for operation of the TTIC is the Faculty's 35,000-specimen H.P. Brown Memorial Wood Collection of authenticated wood samples and extensive reference materials in Moon Library. Both of these resources have been built up over the past 60 years by close cooperation with institutions throughout the world. Primary efforts at the center include responding to requests for services from users of tropical woods, expanding the collection and developing an advanced computer system on properties and uses of the world's timbers.

U.S. Department of Agriculture Forest Service Cooperative Research Unit

The Northeastern Research Station of the U.S.D.A. Forest Service maintains a research center at the college. Since 1978, the Cooperative Research Unit has been conducting research on urban forest effects on environmental quality. The center's efforts provide increased opportunities for faculty and students to collaborate with

Forest Service scientists in studies of urban vegetation and environmental problems.

Graduate Education and Research Initiative

The Graduate Education and Research Initiative (GERI) is designed "to retain and attract premier faculty and graduate students, secure outside governmental and corporate support, and develop a university climate that spawns creativity."

To maximize the return on the state's contribution, SUNY's doctoral-granting campuses each have identified those centers of excellence or targets of opportunity in which they can make the most significant advances in research and graduate education and which hold the greatest potential for attracting additional resources to the State of New York. By focusing limited funds on carefully selected centers of excellence, the participating institutions maximize their contributions to the achievement of the initiative's broader goals, while remaining responsive to the needs of the specific areas they serve.

The college has advanced four programmatic themes: biotechnology in forestry, environmental systems science, polymer science and technology, and process engineering.

Biotechnology in Forestry

www.esf.edu/biotech

The biotechnology initiative is committed to the pursuit of excellence in graduate education and research in the general area of study and to forging links with industries and governmental agencies concerned with biotechnology. The initiative is a multidisciplinary effort by the faculty of these four graduate programs: environmental and forest biology, environmental and forest chemistry, forest resources management, and environmental and resource engineering. A major objective is to develop practical research to help meet state and national needs in forestry and forest product utilization.

An M.S. in one of these four graduate programs or a related discipline, can be followed by a Ph.D. program. Graduate research assistantships are available for outstanding students in fields related to forest biotechnology.

Under the initiative, research and its applications are focused on plant molecular biology; plant and pest interactions including fungi, bacteria, viruses, mycoplasma-like organisms, and insects; biomass and xenobiotic conversions; and forest products and productivity.

Faculty areas of research include molecular taxonomy; transformations of trees and fungi; multicopy gene variability; molecular ecology and chemical messengers; molecular biology of fungi; construction of DNA vectors; fungal dsRNA and pheromones in biological control; in-vitro selection for disease resistance; mechanisms of pathogenicity and disease resistance and their genetic control; tissue, shoot, protoplast, and single cell culture; bioconversion of lignocellulose and hemicelluloses; enzymatic photostabilization of paper pulp; microbial detoxification of hazardous wastes; trace metal metabolism by phytoplankton; microbial treatment of wastewater; and selection and breeding for wood quality, growth rate and disease resistance.

Available facilities include molecular biology research and teaching laboratories, a tissue culture clean room, controlled environment chambers, modern air-conditioned glasshouses, NMR and GC-mass spectrometers, HPLCs, fermentation systems and radioisotope and ultrastructure laboratories. Access to the cell sorter and DNA and peptide synthesizers and sequencers at Syracuse University is also available.

Environmental Systems Science

Environmental systems science is the quantitative and integrative study of physical, chemical, biological and socio-economic processes and mechanisms applied to ecosystems. It is integrative because it draws from faculty and research activity in the faculties of chemistry, environmental and forest biology, environmental studies, environmental resources and forest engineering, and forest and natural resources management.

The approach of the Faculty of Chemistry to environmental systems science emphasizes interactions between environmental processes and chemical elements and species in environmental systems. Current studies include behavior of trace organic contaminants in the Great Lakes, trace metal uptake by phytoplankton, characterization of natural organic compounds in water, identification and characterization of air and water particles, and development of improved sampling and analytic methods for air and water.

The Faculty of Environmental and Forest Biology stresses ecosystem analysis and modeling. The diverse faculty has particularly strong backgrounds within the northern hardwood forests, tropical forests, temperate and tropical rivers, lakes and wetland ecosystems. Specific research projects related to systems ecology include nutrient flows in Adirondack ecosystems; changing tree species dynamics related to changing patterns of climate, precipitation chemistry and pathogens; long-term ecological research on disturbance and recovery in the Caribbean National Forest; phosphorus dynamics linking rivers and lakes in both upstate New York and Montana; and procedures for enhancing the recovery from disturbance of ecosystems in both the Adirondacks and in India.

The approach of the Faculty of Environmental Studies to environmental systems science stresses sustainable development as a basic concept, environmental information systems as a means for organizing environmental data, and environmental program analysis as a critical review of environmental policy programs. Current research revolves around international applications of integrated environmental planning, wetland systems assessment and evaluation, cross-cultural environmental perception, and environmental information system utilization and accuracy.

The approach of the Faculty of Environmental Resources and Forest Engineering to environmental systems science emphasizes hydrology and water resources, including wastewater engineering, solid and hazardous waste management and geo-spatial modeling and analysis. Current research activity is focused on remote sensing, digital image measurements, air photo analysis, water quality analysis, modeling and treatment, and solid/hazardous waste systems analysis and treatment.

The Faculty of Forest and Natural Resources Management stresses resources information management, forest growth modeling and silviculture, forestry economics and policy analysis, and urban greenspace systems ecology. Current research includes studies of forest soil and site productivity, remote sensing and geographic information systems application to forest management, exurban, urban and wildland-urban interface management and silviculture and the impact of acidic deposition on forest soils.

Polymer Science and Technology

www.esf.edu/polymer

The Michael M. Szwarc Polymer Research Institute, a SUNY systemwide polymer research center located in the Faculty of Chemistry, provides the site, resources and program for scientific research in which graduate students conduct their experimental studies, and the chemistry faculty supervise the graduate education for M.S. and Ph.D. degrees.

Research areas in polymer science available through the institute and supported by GERI include the following: ion-conducting polymers (polymer electrolytes), functionalized polysiloxanes, X-ray contrast polymers, ring-opening polymerizations of cyclic siloxanes; theoretical studies on elastomers and polymer rubbery state, theory of stress-induced crystallization; new methods of polymer synthesis, stepwise polymerization, synthesis of temperature stable polymers; polymer blends, alloys, and solid phase multicomponent miscible systems; and polymer membranes for gas and liquid separations.

Also under study are the structure, morphology, and dynamics of polysaccharides by diffraction analysis and molecular modeling; use of solid-state NMR methods for studying both the static and dynamic aspects of polymer structure, the interrelation of structure in solid and liquid phases, the production and characterization of microbial-

origin biopolymers; and enzymatic corrosions of biomass to useful products.

Process Engineering

Serving as a bridge between science and technology, process engineering creates practical applications from scientific discoveries, providing the means for converting material resources into useful products. Design, control and optimization of manufacturing units and systems are key elements of process engineering, while increased attention is given to energy efficiency and waste reduction, and extensive use of computer simulation both in research and practice.

At ESF, activity in process engineering is centered in the Division of Engineering, and is strengthened by long-standing ties with forest products industries through units such as the Empire State Paper Research Institute. However, process engineering relates closely to all of the Faculties and institutes of the college, and links and stimulates the applied aspects of the other three specialties in the GERI program. As this program progresses, ESF aims to become a major center of education and research in process engineering.

ESF Outreach

ESF has provided a diverse array of outreach endeavors since the college was founded in 1911. ESF outreach links the college's scientific, engineering and technology, planning and design, and policy and management programs and resources to the needs of professionals, citizens and organizations throughout New York and the world. Outreach programs embody the college's commitment to scientific inquiry, excellence in teaching and learning, and service. Educational outreach programs and curriculum materials for teachers and students represent our commitment to the Syracuse City School District and to all New York urban, rural and suburban schools. Continuing education programs include conferences, meetings, workshops and short courses for professionals; credit course opportunities for non-matriculated students; and community education programs for personal enrichment. Research and demonstration programs take place on the main campus in Syracuse and through a multiple campus and field station system that includes about one million square feet of facilities in 186 buildings on 25,000 acres of land. The following material highlights several activities.

Continuing Education

www.esf.edu/ce

ESF Outreach continuing education programs extend the resources and knowledge found at the college to the people of New York. Credit courses, conferences, workshops and short courses, are presented to a wide variety of audiences.

Working in cooperation with government agencies at all levels, professional groups and representatives of business and industry, ESF faculty provide opportunities for continuing and professional education by designing courses at the theoretical and applied, basic and advanced levels.

Faculty-driven programs attract participants from both the public and private sectors representing local, regional, national and international interests. Audiences include environmental consultants and engineers; forest owners, managers and operators; scientists and researchers; wood and construction engineers; paper products manufacturers and researchers; conservation and recreation personnel; wildlife managers; landscape architects and local and regional planners; and concerned citizens.

The college's continuing education programs include credit or noncredit courses offered on campus or at off-campus sites. Designed to meet the needs of busy adults, programs vary in length from hour-long seminars to full-semester graduate level courses.

Community Education. Continuing education also provides personal enrichment for members of the local community. The unique expertise of the college faculty is extended to the community through public short courses, lecture series and forums. Community

members are invited to make recommendations for public service or continuing education activities to the ESF Outreach office.

Conference Services. The college provides conference services for meetings of professional associations, technical and academic societies, government, industry, environmental and community organizations, and other groups whose interests correspond with the mission of the college. Programs range from small seminars to week-long international meetings at locations ranging from urban campuses, conference centers and hotels to rustic retreats.

The college can provide meeting facilities for groups of up to 450. Through its ties with Syracuse University and area hotel convention sites, groups of 2,000 or more can be accommodated. Lodging and catering are available through nearby hotels and Syracuse University.

The college's regional campuses in the Adirondacks and Central New York are attractive sites for conferences. Inquiries about facilities, services and costs are invited.

Nonmatriculated Students. Most of the credit courses offered at ESF are available to students not enrolled in a degree program. By registering through ESF Outreach, a student may develop additional expertise in a professional area, earn credit applicable toward a college degree, develop the prerequisites necessary to enter more advanced courses at ESF or elsewhere, or sample courses as an aid to determining a future major or career.

Educational Outreach

www.esf.edu/eo

ESF is committed to serving and working collaboratively with educators, students, and others in order to bring the best environmental science, engineering, and design teaching and learning to all of our students. Programs and services include "ESF in the High School," a program that makes it possible for qualified high school teachers and students to benefit from college mentors and credit-bearing courses; Stalking Science Education in The Adirondacks, a program that supports teachers' efforts to make science more exciting for students by rekindling a passion for teaching, exploring critical conservation education themes, and instilling an appreciation for the state's natural resources; and the Urban Initiative, a program that generates interest among urban students for studying environmental sciences, and promotes research and teaching related to urban environmental issues.

Service Learning Program

www.esf.edu/students/csl

Public service is a vital component of ESF's mission, reflecting its commitment to making the world a better place. Through the college's service learning program, students can participate in this mission of service, contributing to the larger community while gaining invaluable experience and earning course credit.

Students enrolled in any of ESF's designated service learning courses spend time working in the community on service projects related to their field of study. Through these courses, the traditional classroom is extended beyond the bounds of our campus, offering energizing, "real-world" learning experiences. The community benefits from student help and knowledge, even as students gain inspiration and a richer understanding of the value of their work.

See page 13 for additional information.

Tree Pest Information Service

www.esf.edu/lfs/treepest.htm

Established in 1950, the Tree Pest Information Service is one of ESF's oldest public service endeavors. The unit focuses on insects and diseases associated with urban, forest and plantation trees. Additionally, the service provides the public with information on plants, wildlife problems and a range of household pests. Personnel respond to more than 1,000 calls and site visits each year.

The Tree Pest Information Service assists commercial concerns, forest industry, government agencies, primary and secondary schools, colleges, and the general public. It also assists in basic research, and collects materials for use by agencies such as the New York State Department of Environmental Conservation and the U.S. Forest Service, as well as for the college.

The service uses the college's resources and capabilities to provide identification of various organisms, pest remediation recommendations and tree health information, and to produce and distribute technical and nontechnical publications.

Wood Utilization Service

The Wood Utilization Service is the oldest public service and demonstration effort of the College of Environmental Science and Forestry. These services were established to provide support to the New York secondary forest product industry and the related industries of construction, architecture and consumer products.

ESF faculty from the Division of Engineering provide services to business and industry, municipalities, local, state and federal government agencies, retail, consumer and professional associations and the public regarding wood utilization. Services take the form of consulting, advising, testing, demonstrations and use of ESF's unique wood processing and wood testing laboratories. Division faculty respond to telephone and written requests, conduct laboratory testing, respond to requests for on-site evaluations and discussions, and make presentations at major industry and professional association meetings. A recent presentation was made at the American National Standards Institute general meeting in Chicago. Consultations were recently provided to a major Central New York furniture manufacturer, a national consumer products association, New York City Parks and Recreation and two lumber companies. A presentation on national occupational safety standards was made to the Associated General Contractors of New York. The Tropical Timber Information Center, in responding to more than 50 requests a year, seeks assistance from Wood Utilization faculty.

Other Public Services

The college, throughout its history, has continued to respond to its specific legislative mission in the area of public service. The principal formal public service activities include community education and information, technical advice and guidance to local, state and federal agencies and organizations, and technical assistance to the forest and wood-using industries.

The complete list of ESF's public service contributions is lengthy, but two examples are the Tree Pest and Disease Service, which provides technical advice to private citizens and to governmental agencies, and the participation of faculty in Central New York's Poison Control Center. Altogether, the college's public service and continuing education programs reach thousands of New York residents each year.

Division of Engineering

WILLIAM P. TULLY, Director
309 Bray Hall
315-470-6510

Graduate Program in Environmental and Resource Engineering

The graduate program in Environmental and Resource Engineering (ERE) applies science and engineering to the conservation, restoration, holistic development, and improved utilization of the natural environment and its related resources. It represents synthesis of the professional specialties of three academic faculties that comprise the Division of Engineering. These are the Faculty of Environmental Resources and Forest Engineering (ERFEG), the Faculty of Paper Science and Engineering (PSE), and the Faculty of Construction Management and Wood Products Engineering (CMWPE).

The master of science, master of professional studies, and doctor of philosophy degrees are awarded in ERE.

Information on graduate admissions begins on page 24 and academic policies on page 20.

Applicants for the M.S. are required to have a bachelor's degree in science or engineering and are expected to have at least one year of study in each of the following subjects: biological science, calculus, chemistry, computer science, and physics.

All students entering M.P.S. programs must have a baccalaureate degree. Prospective students should contact the Faculty chair for specific information regarding pre- or co-requisites.

A minimum total of 30 credit hours is required for the M.S. and M.P.S. Coursework requirements are determined by the faculty in the specific study areas. Students select a study area at the time of application for admission to the program.

Under general requirements for the Ph.D. degree (page 14), the environmental and resource engineering program requires a minimum total of 60 graduate credits. These credits must include a minimum of 30 credits of coursework, and include not more than 30 credits for dissertation. As tool requirements, students must demonstrate competence in two of the three following areas: computer science, statistics or advanced mathematics, and a language other than English commonly used in science or engineering practice. The doctoral preliminary examination may be required of students who have not earned a master's degree that required a thesis.

A study plan that formally identifies an individual's program requirements is developed for each student as soon as possible, but at least during the first year of graduate study. This plan includes all required and elective courses as well as a tentative schedule for completion.

Options and Areas of Study

Within the graduate program in environmental and resource engineering there are three options: environmental resources and forest engineering; paper science and engineering; and construction management and wood products engineering. Options have alternative curricular requirements addressing different subjects within a degree program. Each option has several areas of study as follows:

Construction Management and Wood Products Engineering Option

The academic objective of areas of study related to construction is to allow students with technical degrees to engage specific construction topics of current interest. There is an overall objective of having the student look at the broad environmental implications of the construction process. The efficient and environmentally correct use of materials and state-of-the-art technology is integrated into each student's practicum, thesis or dissertation, as appropriate.

The purpose of the M.P.S. degree is to update current professional skills and/or to prepare the graduate student for higher levels of management in their general area of expertise. The MPS degree is intended to be a terminal degree, therefore acceptance to the MPS degree in construction management or wood products engineering does not guarantee admission to the MS or PhD programs and *vice versa*. The MPS degree requires 27 credits of graduate-level coursework, a 3-credit practicum based on professional experience, and a capstone seminar. Recommended course lists are available in the Faculty office. The student's study plan (Form 3B) must be approved by the steering committee and faculty chair by the end of the first semester in residence.

Students are accepted into our programs from a variety of backgrounds. When the Faculty of Construction Management and Wood Products Engineering (CMWPE) reviews an applicant's academic and professional experience, it may determine that preparatory coursework is required before entry into the program. Either undergraduate or graduate courses may be recommended to remedy deficiencies depending on circumstances. Remedial coursework should be completed prior to matriculation. Undergraduate courses do not meet the requirements for minimum number of graduate credit hours. Students planning to obtain graduate degrees in the construction management and wood products engineering option should have completed the following undergraduate coursework:

- Mathematics through calculus II
- Physics: one semester with laboratory
- Engineering Mechanics: Statics
- Mechanics of Materials
- Soil Mechanics and Foundations I
- Estimating: coursework or professional experience
- Scheduling: coursework or professional experience

Construction Management and Wood Products Engineering Option, with areas of study in:

Construction and Construction Management (M.S., M.P.S., Ph.D.)

Participating Faculty: KIM, KYANKA, TISS

- Construction project management
- Estimating, cost engineering, building codes and zoning
- Lean construction
- Green construction
- Production management
- Computer graphics and computer applications in engineering
- Structural design

This area of study is for students who plan to specialize in construction management or structures and materials science. 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.

Engineered Wood Products and Structures: Timber Structures Design (M.S., Ph.D.)

Participating Faculty: KYANKA, MORSI-HUSSEIN

- Materials science
- Engineering mechanics and elasticity
- Engineering properties of wood composites
- Computer-aided design
- Static and dynamic properties of wood

The behavior of wood and wood-based components under loads and the effects of duration of the loads are critical elements when

developing engineering codes. Wooden components as small as dowels or as large as bridge beams are considered, using elements of materials science, engineering mechanics and structural engineering. Basic property knowledge, employing theories of elasticity, viscoelasticity and fracture mechanics, is coupled with computer-aided design data to analyze the performance of wood and to solve application problems, such as those encountered in wood-frame construction and timber utility structures. How such factors as chemical fire retardant treatments, adhesive performance and mechanical fastener design interact with use requirements is considered. National and international design codes and their development play an important role in specifying research areas of current interest and need. Fabrication and testing of actual components such as trusses, composite beams, and furniture connections are completed in the Faculty's Wood Engineering Laboratory.

Students entering this program should have a strong background in integral calculus, statics, mechanics, and mechanical and physical properties of wood.

Tropical Timbers (M.S., Ph.D.)

Participating Faculty: ANAGNOST, MEYER

- Identification keys and systematics
- Wood properties and end use suitability
- Life zone analyses
- Expert systems

Studies in tropical timbers take many forms, depending on individual student interests. Often students from other countries bring specific problems and materials with them, so their thesis will find immediate application when they return home. The holdings of the C. deZeeuw Memorial Library and reference wood specimens of the H.P. Brown Memorial Wood Collection of the Tropical Timber Information Center (TTIC), housed in Baker Laboratory facilities, are vital to this work.

Research topics may be formulated to answer questions dealing with anatomy, identification, properties or uses of various woods from around the world, using the TTIC reference materials. These studies may be quite narrow, such as anatomy and physical properties of woods from a particular region, or much broader, such as regional distribution of species and species groups based on life zone research throughout a country or larger geographic area.

Wood Science and Technology (M.S., M.P.S., Ph.D.)

Participating Faculty: ANAGNOST, HANNA, KYANKA, MEYER, MORSI-HUSSEIN, W. SMITH

- Adhesives and finishing
- Processing and machining
- Mechanical and physical properties
- The effects of wood anatomy on the physical and mechanical properties of wood
- Wood biodegradation
- Wood composites
- Dendrochronology

Because wood is renewable, it will meet the needs of modern society for a perpetually available, carbon dioxide-neutral material perfectly suited for a vast array of products. The study area wood science and technology includes detailed research on physical, mechanical, or anatomical aspects of wood and its utilization and leads to the M.S., M.P.S., or Ph.D. degree. Wood science stresses research on the material science of wood, dealing with properties important to its use, or to solve problems in wood utilization by practical applications of such knowledge.

Students entering this program should have an undergraduate degree in wood science or a related area.

Wood Anatomy and Ultrastructure (M.S., Ph.D.)

Participating Faculty: ANAGNOST, HANNA, MEYER

- Wood formation and cell wall organization
- Cytoskeleton of plant cells
- Properties related to anatomy and ultrastructure
- Electron, light and video microscopy

This area requires students to develop an extensive background in all aspects of microscopy: light, scanning electron, transmission electron, video microscopy and image analysis, including microtechniques for effective preparation of specimens for the appropriate instrument. Wood anatomy studies are basic to wood identification, wood utilization, and physical/mechanical properties. These studies may include woods from other continents.

The field of ultrastructure is very broad with applications in many biological, chemical and materials sciences. Applied to wood, it emphasizes the sub-light microscopic structures (smaller than 0.2 micrometers) found in this natural material, either in the mature form or in its formative stages where various organelles of the living cell may be studied for their roles in producing the mature wood cell.

The behavior of wood in its many applications can be observed and explained via microscopy and related instrumentation such as EDXA (energy-dispersive x-ray analysis). State-of-the-art resources and facilities are concentrated in the Center for Ultrastructure Studies, which provides instruction and research support staff.

Students entering this program should have an undergraduate degree in wood anatomy or the biological sciences.

Wood Treatments (M.S., Ph.D.)

Participating Faculty: ANAGNOST, W. SMITH

- Wood-water relationships and wood drying
- Preservative treatments
- Polymer treatments
- Sealants and coatings

Graduate study in the area of wood treatments allows the student to investigate the scientific basis for the improvement of wood and wood products with various treatments, which include drying, preservative treatments and coatings. Preparation for research includes graduate coursework in wood-water relationships and transport processes and additional study in areas such as wood anatomy and ultrastructure, mechanical properties, wood chemistry, wood microbiology, thermodynamics, and engineering economics.

Current research interests include use of innovative techniques to dry and preserve wood, effects of drying method on the subsequent treatability of wood, evaluation of energy usage in lumber drying technologies, improving wood properties with polymer treatments, and moisture migration studies.

Students entering this program should have an undergraduate degree in wood science or a closely related field.

Environmental Resources and Forest Engineering Option, with areas of study in:

Environmental Management (M.S., M.P.S., Ph.D.)

Participating Faculty: DALEY, DAVIS, ENDRENY, J.M. HASSETT, KROLL, W. SMITH

- Environmental modeling
- Hazardous waste management
- Solid waste management
- Energy resources and systems
- Business policy and administration
- Project impact analysis
- Public policy and environmental regulation
- Water resource management

Students in the environmental management area of study take courses in business management, waste management, and environmental law that provide breadth and perspective for the student aspiring to managerial responsibility in public or private employment. Other courses may be recommended to enhance technical and problem-solving skills.

Students in the M.P.S. program must complete at least six 3-credit undergraduate courses from at least three of the following fields as pre- or co-requisites: chemistry, physics, geographic measurements, calculus, statistics, engineering mechanics, ecology, computer science, and economics.

Dedicated greenhouse laboratories are available for students working in solid waste management and hazardous waste site remediation. Typical research conducted in these laboratories includes composting, utilization of residuals such as ash and compost materials, bio- and phyto-remediation of contaminated waters and soils, and plant uptake of contaminants.

Forest Engineering (M.S., Ph.D.)

Participating Faculty: DALEY, DAVIS

- Mechanization, automation, robotics
- Production management and efficiency
- Site modification
- Access design and construction

Students who focus on forest engineering are broadening the traditional areas of logging and harvesting. Emphasis is placed on engineering approaches to the design and analysis of operational systems for such activities as harvesting, construction, transportation, and land management. Graduate programs are based on a familiarity with operations and man-machine systems, biologic-geologic interactions, and various selections as needed from the array of engineering selections.

Geo-spatial Information Systems (M.S., Ph.D.)

Participating Faculty: QUACKENBUSH, SHENG

- Spatial data acquisition
- Environmental database development
- Environmental modeling
- Site selection and facility design

This area of study is available to students who intend to specialize in using geo-spatial information systems (GIS) to incorporate spatial data into a wide range of environmental and engineering applications. Both theoretical and applied graduate study focuses on mapping fundamentals, spatial data acquisition techniques, GIS concepts, theory of spatial analysis and modeling, and environmental applications. Additional educational opportunities include systems analysis, environmental sciences and management, automated cartography, computer science, database systems, and information management.

GIS core courses include spatial data acquisition, courses dealing with GIS concepts and theory, a GIS project, and statistics. These courses may be supplemented by many other courses and educational opportunities at ESF and Syracuse University. Graduate study may be integrated with the wide range of engineering, environmental, and resource management study areas at ESF. For example, GIS study can be expanded to hydrologic modeling, photogrammetry and remote sensing, forest management, environmental engineering, and development and location of facilities. Ample flexibility allows programs to be tailored to the interests and strengths of individuals.

Facilities include numerous GIS software packages based on a range of computing platforms and offering wide-ranging capabilities for both raster and vector processing. The extensive forest properties owned and managed by ESF are an important GIS resource. These properties provide opportunities for environmental research and practice with impressive amounts of current and historical data.

Related capabilities include advanced image processing systems and a wide range of photogrammetry, remote sensing, and surveying equipment and expertise.

Students with engineering, science, or geography backgrounds are particularly suited to this program of study. Numerous opportunities exist for research and financial support. Cooperative and contractual arrangements exist with many organizations, including local and state government agencies, federal agencies such as the U.S. Department of Agriculture, and private engineering and environmental planning firms. Employment opportunities are exceptional.

Mapping Sciences (M.P.S.)

Participating Faculty: QUACKENBUSH, SHENG

- Geographic information systems
- Global positioning systems
- Photogrammetry and remote sensing
- Image processing

The mapping sciences area of study is available to students who intend to specialize in the development and practice of mapping technologies for environmental and engineering applications by introducing a broad spectrum of mapping topics while emphasizing principles and techniques. Students may specialize further by taking more advanced courses or participating in specialized projects. Study programs are flexible and may be tailored to the interests and strengths of individuals. ESF's graduate programs related to mapping have a proven career placement record and job opportunities remain very strong.

Students in the M.P.S. program must complete at least six 3-credit undergraduate courses from at least three of the following fields as pre- or co-requisites: chemistry, physics, geographic measurements, calculus, statistics, engineering mechanics, ecology, computer science, and economics. For the mapping sciences area of study, these requirements are further specified to include at least one year of study in calculus and physics and an undergraduate course in surveying. (Some or all of these prerequisites may be satisfied while attending ESF.) The mapping sciences graduate program requires a core of four introductory courses in photogrammetry, remote sensing, geographic information systems, and global positioning systems. Additional courses in any or all of these mapping topics then complete the M.P.S. degree requirements. With advisor approval, students may also take courses in statistics, computing, environmental sciences and management, and many other courses.

Facilities are excellent and expanding, with a focus provided by the Mapping Sciences Laboratory operated by the Faculty of Environmental Resources and Forest Engineering. This facility provides full-featured and current image processing systems; current and popular geographic information systems; a full range of optical/mechanical and analytical/digital photogrammetry instruments; extensive equipment for image interpretation; global positioning system (GPS) receivers and base station; and extensive surveying capacity.

Photogrammetry and Remote Sensing (M.S., Ph.D.)

Participating Faculty: QUACKENBUSH, SHENG

- Analytical and digital photogrammetry
- Resources monitoring and assessment
- Digital image processing and classification
- Remote sensing systems analysis
- Global positioning systems

This area of study is available to students who intend to specialize in theoretical and applied study in sensing systems and the location, measurement, analysis and description of ground features and earth resources. Studies include in-depth coverage of photographic systems, photogrammetric measurement techniques and applications, and visual image analysis. Digital imaging systems

are covered extensively, with an emphasis on earth-orbiting sensors. Advanced courses in photogrammetry and digital image analysis cover theory and techniques for enhancing and/or extracting selected features from an image. Theoretical courses are complemented by practical exercises, courses organized to work on relevant projects and independent study opportunities.

Unique opportunities are available to integrate photogrammetry, remote sensing and other aspects of mapping science in a coherent fashion. Students are expected to complete one year of calculus and physics and a course in surveying as pre- or co-requisites. A core of courses in photogrammetry, remote sensing, global positioning systems, geo-spatial information systems, and statistics may be supplemented by many other courses. This flexibility allows programs to be tailored to the interests and strengths of individual students. All students obtain fundamental coverage of geometric and radiometric theory, analysis, interpretation and applications. Further specialization through many advanced graduate courses or continued general study is then possible. Study programs may also be extended into GIS, either emphasizing spatial data acquisition for GIS databases or focusing on using a GIS database to improve remote sensing analyses. Study programs may also lead into the optimization of image acquisition and analysis, using modeling methods, as well as correction of image data for atmospheric and sensor calibration effects.

Facilities are excellent and expanding, with a focus provided by the Mapping Sciences Laboratory operated by the Faculty of Environmental Resources and Forest Engineering. Capabilities include full-featured image processing; advanced digital analysis of hyperspectral and multiband digital image data; a full range of optical/mechanical and analytical/digital photogrammetry instruments; extensive equipment for image interpretation; sensor and atmospheric modeling systems; photographic acquisition and processing; many different GIS; global positioning system (GPS) receivers and base station; and extensive surveying capacity

Students with engineering, science or geography backgrounds are particularly suited to this program of study. Program flexibility also allows specialization in any aspect of the above subjects from within other degree programs (e.g., forest resources management, landscape architecture, environmental and forest biology). Numerous opportunities exist for research and financial support. Cooperative and contractual arrangements exist with many agencies and firms, including the U.S. Department of Agriculture, the U.S. military, NOAA and NASA.

Water Resources Engineering (M.S., Ph.D.)

Participating Faculty: S. CHATTERJEE, DALEY, ENDRENY, J.M. HASSETT, KROLL, TULLY

- Stochastic and deterministic modeling
- Hydrology and hydraulics
- Pollutant fate and transport
- Stream restoration
- Management of solid wastes and industrial residuals
- Field applications
- Water resource systems engineering

Studies deal with evaluating hydrologic systems and managing water resources. Emphasis is placed on engineering and related societal impacts for planning and choosing between alternative solutions to water resource problems, in recognition of environmental, economic, legal, social and managerial constraints. Analytical techniques using statistics, numerical analyses, and computer applications are emphasized. Modeling efforts include GIS and remote sensing applications, distributed and real-time models, and model calibration and validation. Students are required to take at least one course in each of the following four areas: hydraulics, systems engineering, hydrogeology, and pollutant fate and transport. Dedicated laboratories and field sites are available for students working in water resource engineering.

Paper Science and Engineering Option, with areas of study in:

Chemistry of Pulping and Bleaching (M.S., Ph.D.)

Participating Faculty: AMIDON, FRANCIS, LAI, SCOTT

- Reaction mechanisms and kinetics
- Applications of biotechnology
- Lignin and carbohydrate chemistry
- Chemicals from wood and pulping residues
- Energy from wood and pulping residues
- Chemical modification in mechanical pulping
- Catalytic and activation effects

This area of study focuses on chemical relationships and reactions basic to the manufacture and bleaching of paper pulp, as well as some papermaking operations. Courses in theoretical and applied chemistry are indicated, as well as specialized courses addressed directly to pulping and bleaching. Research centers on these same topics, currently stressing new and improved processes to increase energy efficiency and reduce environmental impact. These include studies on the pre-extraction of wood chips to produce acetic acid from acetyl groups, production of hydrogen and carbon monoxide from gasification of wood and pulping effluents, delignification and brightening with oxygen, hydrogen peroxide and ozone, enzyme treatment of effluent streams, mechanisms of carbohydrate reactions, and photosensitization of bleached pulps.

Colloid Chemistry and Fiber Flocculation (M.S., Ph.D.)

Participating Faculty: AMIDON, KELLER, RAMARAO

- Paper sheet formation mechanisms
- Wet-end chemistry and physics
- Effects of additives in fiber networks

This study area deals with colloidal phenomena in the papermaking process, in particular the interaction among fibers, fine particles, polymeric additives, and electrolytes in stock preparation and sheet formation. Student programs feature courses in chemical engineering and colloid, polymer and physical chemistry, adding appropriate work in mathematics, statistics and papermaking processes. Research topics fall into two categories: fundamental colloidal behavior of particles, and behavior of paper stock on the paper machine. In the latter, extensive use is made of pilot plant facilities in Walters Hall. Presently under investigation are adsorption-desorption behavior of polymers in papermaking, the chemistry and physics of reactive sizes on model surfaces, and principles of sheet formation.

Fiber and Paper Mechanics (M.S., Ph.D.)

Participating Faculty: ANAGNOST, S. CHATTERJEE, HANNA, KELLER, KYANKA, RAMARAO

- Fiber orientation and sheet properties
- Adsorption and transport of moisture in paper materials
- Mechano sorptive phenomena

Mechanical behavior of fibers, paper and board, and other fiber networks and composites depends upon variables of material, process and structure at all levels, especially structural anisotropy. Recommended courses focus on mechanical and chemical engineering, mechanics of materials, physics, mathematics and statistics, microscopy, and wood and fiber properties. Research topics are basic in nature, designed to describe and model quantitatively the properties and behavior of fibers and fibrous structures. Current projects include studies of transient moisture sorption by paper materials, the effect of moisture on mechanical properties, influence of sheet structure on properties, use of image processing to characterize deformational behavior of paper, and determination of elastic constants of paper. Several members of the

engineering faculty of Syracuse University collaborate closely in this work.

Renewable Energy and Bioprocess Engineering (M.S., Ph.D.)

Participating Faculty: AMIDON, S. CHATTERJEE, FRANCIS, LAI, LIU, RAMARAO, SCOTT, STIPANOVIC

- Energy from biomass and other renewable sources
- Bioseparations of lignocellulosic materials into useful components
- Bioprocessing of renewable materials
- Creation of new bioproducts using ecologically sustainable processes

This area of study encompasses both the use of renewable and sustainable resources (e.g., wood) for the production of chemicals, advanced materials, and fuel, as well as the use of bioprocessing technology to produce such products. Such bioproducts extend to the production of energy from renewable resources including the use of gasification, co-firing of byproducts, anaerobic digestion, solar, and the production of ethanol. Courses include chemical engineering, advanced chemistry, biotechnology, bioengineering, building on a strong base of mathematics, chemistry, and biology. Current research projects in this area include the bioseparation of xylan from hardwoods, the production of ethanol and acetic acid from wood hemicelluloses, development of separation processes for various bioproducts, gasification, enzymatic processing of lignocellulosic materials, and chemical production from sustainable resources as a replacement for non-renewable fossil fuels.

Process and Environmental Systems Engineering (M.S., M.P.S., Ph.D.)

Participating Faculty: S. CHATTERJEE, J.M. HASSETT, RAMARAO, SCOTT, TULLY

- Behavior and control of units and systems
- Reduction of air and water pollution
- Modeling and simulation of papermaking
- Processing of fibrous wastes

Process engineering links research with development, design, operation, and optimization of manufacturing methods and equipment, seeking improvement through technological innovation consistent with environmental and resource stewardship. Principles of engineering science and mathematics are applied to analysis and dynamic modeling of units and systems, with increasing use of computers in both research and professional practice. Research here includes process dynamics and control, studies of new pulping and bleaching processes, characterization and treatment of waste streams, byproduct recovery, and computer simulation of paper processing systems. The extensive laboratories and pilot plant in Walters Hall are strongly supported by computing facilities and expertise on campus, including the Center for Computer Applications and Software Engineering (CASE) of Syracuse University. Appropriate advanced courses in engineering, mathematics and computer science are available to suit individual student interests and needs.

Pulp and Paper Technology (M.S., M.P.S., Ph.D.)

Participating Faculty: AMIDON, FRANCIS, HANNA, LAI, LUNER, SCOTT

- Pulping conditions and fiber properties
- Fungal and enzymatic treatments
- Chemicals and energy as byproducts
- Statistical analysis of paper structure
- Recycling of papermaking fibers

Studies in this area deal closely with processes involved in the manufacture of pulp and paper. Courses concerned with this subject

are central to a student's program, extended and enriched with selected courses in chemistry, polymers, chemical engineering, process control, applied mathematics, and computer applications. Current research projects include non-sulfur pulping, biopulping, chemicals and energy as byproducts, effects of wet pressing and press drying on sheet properties, pulping of tropical woods, and computer simulation and control of papermaking. Supporting this work is an experimental pulp and paper mill with two complete paper machines, a pressurized refiner and extensive auxiliary equipment.

Advanced (Graduate) Certificate in Advanced Engineering Tools

Advanced engineering tools (AET) is a collection of capabilities for acquiring, storing, managing, manipulating, analyzing, displaying, and reporting data or information that relates to locations. This certificate program provides participants with skills in global positioning, geographic information systems, and computer-aided design, including 3-D CAD. Students will have access to and will learn how to apply this technology to complete projects. The curriculum consists of five technical courses and a professional practicum course designed to provide participants with a culminating experience in a relevant business setting where they will test a variety of skills supporting the technical coursework of the program.

Applicants must hold a bachelor's degree from an accredited institution in engineering, science or a related area. Applicants must have prerequisite background in topics that are fundamental to using advanced engineering tools including pre-calculus and quantitative problem-solving (calculus is desired). Students may meet prerequisites through undergraduate or graduate coursework, or by permission of the faculty admissions committee. **Students who are matriculated in ESF graduate degree programs are not eligible to earn the Advanced Certificate in Advanced Engineering Tools.**

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.

Students will complete 15 credit hours of graduate coursework, with an average grade of B or better in the following required courses: ERE 550 Introduction to Geographic Information Systems (3); ERE 566 Global Positioning Systems I (1); ERE 610 Computer-Aided Design and Drafting (3); ERE 658 Construction Contracts and Specifications (3); ERE 596 Special Topics (3); ERE 898 Professional Experience/Synthesis (2)

Advanced (Graduate) Certificate in Bioprocessing

This bioprocessing certificate 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 proposed certificate program is to provide:

1. Graduate education in bioprocessing that leads to a documented level of competency for practice;
2. A structured and documented course of study at the graduate level; and
3. 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.

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 graduate coursework with an average grade of B or better in the following required courses:

- ERE 501 Microbiology for Bioprocessing (3);
- ERE 502 Bioseparations (3);
- ERE 503 Bioprocess Plant Design (3);
- ERE 898 Professional Experience/Synthesis (3);
- CEN 600 Selected Topics in Chemical Engineering: Process Engineering and Qualification (3)

Students who are matriculated in ESF graduate degree programs are not eligible to earn the Advanced Certificate in Bioprocessing.

Division of Environmental Science

Bachelor of Science in Environmental Science

JAMES M. HASSETT, Undergraduate Program Director
312 Bray Hall
315-470-6633 FAX 315-470-6958

Mission and Objectives Statement

The faculty members who deliver the program in environmental science perform teaching, research and public service activities to promote environmental practices to meet the needs of present and future generations of New Yorkers and other citizens of the world.

The **objectives** of the faculty who deliver the program in environmental science are to prepare baccalaureate students who:

- Will engage in environmental work while employed by government agencies and industry or in private consulting 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.

Program **outcomes** for environmental science are to produce graduates who:

- Are knowledgeable of examples of global, regional and local environmental problems and issues,
- Are competent to perform in a graduate education or entry-level work environment,
- Have a sufficient knowledge base and tools to function effectively,
- Have the ability to conceptualize environmental problems in terms of unifying principles,
- Are capable of utilizing a systems approach to problem solving, and
- Can communicate their ideas and expectations effectively.

Additionally, the undergraduate program in environmental science aims to produce graduates who exhibit the following attributes:

- Knowledge—both in understanding basic principles and in creativity in problem solving
- Skills—originality and method of problem solving
- Attitude—ethics, self-discipline, perseverance
- Can function effectively in a multidisciplinary team/environment
- Understand the need for life-long learning

Undergraduate Program Requirements

The undergraduate curriculum in environmental science consists of two broad categories of courses. The general education component provides students with knowledge and skills that are useful and important for all educated persons. The professional courses provide students with direct preparation for a career.

Students may be admitted directly as first-year freshmen at ESF, or through a variety of transfer options. See page 22 for more information. Regardless of which way students enter ESF, they must complete both the general and professional education requirements.

Lower Division Course Requirements (49-52 credits)

COURSES			CREDITS
APM	106	Survey of Calculus and Its Applications II	4
APM	153	Computing Methods	3
CLL	190	Writing and the Environment	G 3

CLL	290	Writing, Humanities and the Environment	G	3
EFB	120	Global Environment		3
EFB	226	General Botany	G	4
EFB	285	Principles of Zoology		4
ESC	132	Orientation Seminar: Environmental Science		1
		OR		
ESF	332	Seminar for New Transfer Students		0
EST	200	Cultural Ecology	G	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
FOR	207	Introduction to Economics	G	3
PHY	211	General Physics I		3
PHY	221	General Physics Laboratory I		1
PHY	212	General Physics II		3
PHY	222	General Physics Laboratory II		1

Electives (15 credits)

Electives				6
General Education: American History		G		3
General Education: Western Civilization		G		3
General Education: The Arts		G		3

Professional Courses (13 credits)

APM	391	Introduction to Probability and Statistics		3
EFB	320	General Ecology		4
ESF	200	Information Literacy Senior Seminar		1
				5

Environmental Science Core (one course from each area; 12-14 credits)

Courses are chosen from the list on the next page. 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.

The Physical Environment	3-4
The Living Environment	3-4
The Geographical Environment	3
The Social Environment	3

Advanced Courses in Chemistry, Biology or Mathematics (2 courses; 8 credits)

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.

Advanced Course in Chemistry, Biology or Mathematics (with laboratory)	4
Advanced Course in Chemistry, Biology or Mathematics (with laboratory)	4

Environmental Science Option (5 courses within option; 15-16 credits)

Courses are chosen from the list on this page. 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.

Environmental Information and Mapping	15-16
Watershed Science	16
Health and the Environment	15-16
Earth and Atmospheric Systems Science	15
Environmental Analysis	16
Environmental Engineering Science	15

Second Option or Minor (12-16 credits)

Courses are chosen from the list of option courses or from the list of minors on page 9. 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.

TOTAL MINIMUM CREDITS FOR THE DEGREE 125 CREDITS

Environmental Science Core Courses

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

ERE	223	Statics and Dynamics	4
ERE	310	Environmental Measurements and Spatial Information	3
ERE	351	Basic Engineering Thermodynamics	2
FCH	210	Elements of Organic Chemistry	4
FCH	221	Organic Chemistry I	3
FCH	222	Organic Chemistry I Laboratory	1
FCH	360	Physical Chemistry	3
FOR	338	Meteorology	3
FOR	340	Watershed Hydrology	3
FOR	345	Introduction to Soils	3
GOL	106	Environmental Geology	3

The Living Environment

EFB	303	Introductory Environmental Microbiology	4
EFB	326	Diversity of Plants	3
EFB	336	Dendrology	3
EFB	352	Elements of Entomology	3
EFB	355	Invertebrate Zoology	4
EFB	385	Comparative Vertebrate Anatomy	4
EFB	440	Mycology	3
EFB	462	Animal Physiology: Environmental and Ecological	3
EFB	483	Mammal Diversity	3
EFB	485	Herpetology	3
EFB	486	Ichthyology	3

The Geographical Environment

ERE	371	Surveying for Engineers	4
ERE	450	Introduction to Geographic Information Systems	3
FEG	352	Introduction to Remote Sensing	3
LSA	311	Natural Processes in Design and Planning	3
GEO	302	Worlds of Food and Famine	3
GEO	305	Population Change	3
GEO	315	Science, Society and Environmental Conflict	3
GEO	388	Geographic Information and Society	3

The Social Environment

CLL	390	Introduction to Literature of Nature	3
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EFB/EST	220	Urban Ecology	3
EST	361	History of the American Environmental Movement	3
EST	390	Social Processes and the Environment	3
FOR	312	Sociology of Natural Resources	3
FOR	465	Natural Resources and Environmental Policy	3

Environmental Science Option Courses

Students must complete at least one option. In addition, students must complete a second option, a minor, or an approved self-designed option. 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.

Environmental Information and Mapping

ERE	371	Surveying for Engineers	4
ERE	450	Introduction to Geographic Information Systems	3
FEG	352	Introduction to Remote Sensing	3
OR			
FEG	363	Photogrammetry I	3
FOR	556	Spatial Modeling	3
OR			
FOR	557	Practical Vector GIS	3
OR			
GEO	381	Cartographic Design	4
ERE	496	Special Topics	3

Watershed Science

EFB	415	Ecological Biogeochemistry	3
FEG	340	Engineering Hydrology and Hydraulics	4
FOR	340	Watershed Hydrology	3
FOR	345	Introduction to Soils	3
FOR	443	Forest Hydrology	3

Health and the Environment

EFB	303	Introductory Environmental Microbiology	4
EFB	307	Principles of Genetics	3
EFB	308	Principles of Genetics Laboratory	1
EFB	325	Cell Physiology	3
EFB	385	Comparative Vertebrate Anatomy	4
EFB	462	Animal Physiology: Environmental and Ecological	3

Earth and Atmospheric Systems Science

CIE	471	Environmental Chemistry and Analysis	3
OR			
FCH	510	Environmental Chemistry I	3
EFB	415	Ecological Biogeochemistry	3
EFB	524	Limnology	3
OR			
FCH	496	Special Topics: Oceanography	3
FOR	338	Meteorology	3
FOR	340	Watershed Hydrology	3

Environmental Analysis

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 Electroanalysis Techniques	3
FOR	338	Meteorology OR	3
FOR	340	Watershed Hydrology OR	3
FOR	345	Introduction to Soils	3
GEO	388	Geographic Information and Society OR	3
ERE	450	Introduction to Geographic Information Systems OR	3
FEG	352	Introduction to Remote Sensing	3

Environmental Engineering Science

ERE	440	Water Pollution Engineering	3
ERE	441	Air Pollution Engineering	3
ERE	506	Hazardous Waste Management	3
PSE	370	Principles of Mass and Energy Balance	3
PSE	473	Mass Transfer	3

UNDERGRADUATE MINORS

Students who meet the admission requirements may enroll in any of the undergraduate minors offered at ESF (see page 9).

Graduate Program in Environmental Science (GPES)

RICHARD C. SMARDON, Graduate Program Director
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www.esf.edu/es

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. It maintains a strong academic orientation, facilitating student and faculty engagement of fundamental environmental challenges such as federalism, participatory democracy, the uses and limits of scientific prediction, risk and sustainability.

The mission of GPES is to provide interdisciplinary education, research and public service to foster effective environmental stewardship and to prepare students to address environmental concerns and problems comprehensively. The program provides for the following:

- Multidisciplinary approach: recognition of the necessity to approach environmental problems with input from several disciplines and professions
- Holistic perspective: awareness of and deference to the interdependence of elements within broadly defined ecosystems, including physical, biological, social and economic systems
- Topical grounding: competency to understand and apply the principles of a particular subject of environmental inquiry in sufficient depth to interact with other disciplines and professional fields
- Realistic experience: internships, focused projects, theses and seminars provide for direct interaction of legal, economic, political and social systems which underlie decision making

The program's internal structure incorporates a common core that provides a broad policy-oriented foundation for the focused areas of

study. Students applying to GPES must select which area of study they intend to pursue.

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.

Entering students should be adequately prepared to engage graduate level work in the program. The following undergraduate courses are pre- or co-requisites for all master's students: statistics, ecology and microeconomics or environmental economics. Courses in political science are strongly recommended.

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

The master of science degree is designed as a three-year experience.

CORE REQUIREMENTS

A core of nine credit hours in applied social sciences is required. In addition, a total of six credit hours is required in research methods. Course options which satisfy these requirements are designated by the area of study faculty.

AREA OF STUDY REQUIREMENTS

A minimum of 15 credit hours (excluding ENS 899) is required in the area of study, as determined by the major professor and area of study faculty. Area of study subcommittees maintain advising lists of courses pre-approved to satisfy the 15-credit area of study requirement. The student's major professor or steering committee may designate additional courses. Five study areas are available to M.S. students: environmental policy and democratic processes, environmental and community land planning, environmental systems and risk management, water and wetland resource studies, and environmental communication and participatory processes.

THESIS REQUIREMENTS

A minimum of six credit hours of research is required 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.

Master of Professional Studies

The master of professional studies degree is a 39-credit-hour experience aimed at professional applications of environmental knowledge.

CORE REQUIREMENTS

A total of 21 credit hours is required. These must include nine credit hours of applied social sciences in environmental policy and regulation, and democratic processes. In addition, a total of six credit hours is required in environmental science and six credit hours is required in methods courses emphasizing applications of technical knowledge.

AREA OF STUDY REQUIREMENTS

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. Five study areas are available to M.P.S. students: environmental policy and democratic processes, environmental and community land planning, environmental systems and risk management, water and wetland resource studies, and environmental communication and participatory processes.

SYNTHESIS REQUIREMENTS

Students select either an internship for three to six credit hours or prepare a synthesis paper for three credit hours. All students must present a capstone seminar in their final semester. No terminal comprehensive examination is required.

Applicants with a minimum of three years of post-baccalaureate, full-time professional experience directly related to the intended area of study may apply for six credit hours of advanced standing in the program, reducing their degree requirements to 33 credit hours. Partial credit for experience cannot be awarded. When awarded for prior work experience, the six credit hours are applied toward the synthesis requirement.

Doctor of Philosophy

The Ph.D. program provides a unique opportunity to develop environmental policy-related research within a strong college community of environmental analysts and to draw upon the expertise of scholars at Syracuse University. All applicants are expected to have completed a master's research thesis. A copy of the thesis abstract should accompany the application. In addition, 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.

Areas of Study

Environmental Communication and Participatory Processes (M.S., M.P.S., Ph.D.)

Participating Faculty: DeBAISE, KUEHN, LAWLER, MEISNER, SENECAH, WHITMORE

This study area addresses the communicative dynamics of the formation of attitudes. It includes decision making, public policy, public participation, campaign development, organizational effectiveness, and conflict prevention and resolution, which all hinge on the ability of participants to communicate and use information effectively, strategically and ethically. GPES students with this option will be prepared to enter diverse arenas of industry, non-government organizations and government structures well equipped to facilitate and participate in effective interactions among individual citizens, nongovernment organizations, publics, agencies, bureaucracies, scientists and others. They will have the skills and knowledge that will allow them to choose the more appropriate and effective process structures and strategies to reach objectives.

Environmental and Community Land Planning (M.S., M.P.S., Ph.D.)

Participating Faculty: CARTER, DEMING, DOBLE, M. HALL, HAWKS, SCHUSTER, SHANNON

Environmental and community land planning is concerned with orderly, efficient, equitable and aesthetic development of land with special concern for the state of the natural environment, the physical character of communities, and decision making at state, county and local levels of government. Planning balances competing demands on land and environment brought about by expanding urban and rural development, and enhancing viable natural and cultural resources is an important planning perspective. Another perspective involves the guiding of private and public development processes within a pluralistic political environment in order to promote sustainable communities while at the same time respecting fiscal, environmental and legal constraints.

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 Systems and Risk Management (M.S., M.P.S., Ph.D.)

Participating Faculty: ENDRENY, C. HALL, JOHNSON, KROLL, LUZADIS, MITCHELL, NAKATSUGAWA, NORDENSTAM

The environmental systems and risk management study area focuses on problems in environmental and natural resource policy in which scientific and technical issues are of central importance. The program is designed for graduate students with a science or engineering background. Current research includes spatial model construction, ecosystems modeling, development of model assessment and selection criteria, environmental risk assessment, use of technical information by regulatory agencies, land use forecasting for public policy decision making, and water resources assessment and planning. The environmental systems and risk management area of study provides a unique opportunity to study interdisciplinary problems. Specific coursework in environmental systems and risk management is supplemented by traditional disciplinary coursework in engineering or the natural sciences and policy analysis.

Environmental Policy and Democratic Processes (M.S., M.P.S.)

Participating Faculty: FELLEMAN, LAWLER, LUZADIS, MALMSHEIMER, MEISNER, MORAN, NORDENSTAM, SENECAH, SMARDON, WAGNER

The environmental policy and democratic processes study area addresses problems of environmental decision making at a time of rapid institutional and social change. How our society can best meet the growing challenges of environmental stewardship through mandated and voluntary public participation in decision making is the central question. This concern is increasingly important to many segments of modern society, and we intend that students acquiring knowledge in this study area will be prepared to contribute positively to these processes in career pursuits.

The focus of this study area is on developing new understanding of public participation in environmental decision making, against the backdrop of environmental policymaking and program implementation. Particular attention is given to (a) the variety of organizations involved in participation, which generally are the institutions and agencies of government, citizen-based non-governmental organizations and the business or industrial sector; (b) the availability and utility of environmental information for these groups; and (c) the participation and integration of all informed stakeholders into environmental decision making. This tripartite scheme of organizations, information and participation frames student programs of study, and suggests important directions for student and faculty research efforts.

The study area advances understanding of these questions of participatory democracy for environmental decision making through research and instruction, and is particularly suited to inquisitive students with degrees in environmental studies, political science, geography, engineering and other fields that provide interdisciplinary backgrounds in natural and social science.

Water and Wetland Resource Studies (M.S., M.P.S., Ph.D.)

Participating Faculty: ENDRENY, KROLL, LIMBURG, LUTZ, MORAN, SMARDON

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.

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.

Environmental and Natural Resources Policy (Ph.D.)

www.esf.edu/enrp

Participating Faculty: FELLEMAN, FLOYD, GERMAIN, LUZADIS, MALMSHEIMER, MANNO, MORAN, NORDENSTAM, SENECAH, SMARDON, WAGNER

The environmental and natural resources policy Ph.D. program is a collaborative program offered by both the Faculty of Environmental Studies and the Faculty of Forest and Natural Resources Management. This study area investigates how societies formulate and implement decisions regarding environmental and natural resources. Doctoral students integrate the biophysical sciences and policy-related social sciences to solve important problems in environmental and natural resources policy with applications throughout the world. The program offers an opportunity to work with outstanding faculty members on applied and theoretical studies.

Faculty members conduct studies at international, national, state and local levels on sustainability, implementation and administration of environmental, natural resources, and forest management programs and economic and institutional influences and impacts of government and non-government policies. The applications include environmental, natural resources and forest policy and administration; and environmental, natural resources, forest and ecological economics.

The environmental and natural resources policy (ENRP) doctoral program is a highly individualized program with coursework and research determined in consultation with the student, major professor and steering committee. Some coursework requirements may be met by transferring graduate credits as approved by the steering committee. Students may also fulfill coursework requirements by completing courses offered by the Maxwell School of Citizenship and Public Affairs at Syracuse University. Specific degree requirements are described in the Handbook for Environmental and Natural Resources Policy Ph.D., available in 320 Bray Hall, 107 Marshall Hall, and on the ENRP Web site.

Students are expected to complete requirements resulting in a coherent body of theory, a depth of understanding in a specified area of biophysical science, appropriate research methods, and advanced policy analysis and understanding.

The following four core competencies must be satisfied prior to the doctoral candidacy examination. A minimum of 12 credits is required in each area.

- Natural science: graduate courses (500 level or higher) in a definable area of biophysical science
- Policy-related social science: 600-level or higher courses including at least one government course and one economics course
- Research methods: 600-level or higher courses including a general research methods course (required), qualitative methods, quantitative statistical methods, GIS, or spatial statistics
- Advanced environmental and natural resources policy: 600-level or higher courses including policy analysis and program evaluation (required).

Graduates have careers as university professors and advanced policy or program analysts. They often become leaders in government, legislatures, corporations, not-for-profit organizations, advocacy groups and academic institutions, consulting firms and village associations throughout the world.

Certificate of Graduate Study in Environmental Decision Making

Purpose

The certificate of graduate study in environmental decision making is designed for graduate students 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' primary professional interests in the fields identified. Because students in each of these programs will engage important environmental policy, program implementation and decision-making processes in their professional efforts, the distinctive environmental orientation of this certificate program will help students to better understand some of the complexities of environmental decision making from their unique professional perspectives.

The focus of certificate study is on environmental decision making, which can be defined as the process by which stakeholders in environmental outcomes engage in communications to seek solutions to environmental problems. Familiarly, decision making can refer to environmental policy making by governmental institutions, but a meaningful understanding of the topic in today's world will also include processes such as information acquisition and dissemination and such notions as negotiation, mediation, information policy and public participation as part of the decision-making lexicon. The decision-making focus furthermore expands the scope of stakeholders to include not only the institutions and agencies of government, but also the large variety of citizen-based nongovernmental organizations and the business and industrial private sector.

Student Eligibility

Graduate students currently matriculated and in good academic standing in their law, management, public administration, or information studies degree programs at Syracuse University are eligible to apply for entrance into the certificate program. Applications from any other sources cannot be accepted at this time.

Administrative Procedures

Application and admissions procedures, compliance with college requirements for successful graduate study and the awarding of certificates are all administered by the ESF dean of Instruction and Graduate Studies. If enrollment limitations are established, acceptances will be made on a rolling basis, according to the date of receipt of applications.

Student applications are made by completing the application form found in the advising guide. This provides contact information for applicants and verifies their matriculated status at Syracuse University. Upon completion of program credit-hour requirements, students file a certificate request form, which identifies completed coursework and initiates actions to produce official transcripts, leading to the award of the certificate.

Forms are available in the college's Office of Instruction and Graduate Studies, 227 Bray Hall, and in the Faculty of Environmental Studies Office, 107 Marshall Hall. To assist certificate students in making suitable course selections and to answer related program questions, students should contact Dr. Richard Smardon, 106 Marshall Hall.

Academic Advisement

Prospective students are encouraged to speak with their Syracuse University academic advisors about the advisability of and timing for entering this certificate program. Students might also wish to contact the following persons, who are knowledgeable of certificate goals and requirements:

- Law: Margery Connor, associate dean for Student Affairs
- Management: Peter Koveos, associate dean
- Public Administration: Christine Omolino, program coordinator
- Information Studies: Thomas Martin, professor

Division of Forest Resources

CHAD P. DAWSON, Director
320 Bray Hall
315-470-6536; FAX 315-470-6535

A central issue challenging society in the 21st century is the need for appropriate management of the world's renewable natural resources and the preservation and enhancement of environmental quality. Contemporary society requires from our natural resources goods and services that range from paper and lumber to clean water to recreation, to maintaining biodiversity. These needs must be met without ecosystem degradation. Understanding how ecosystems function, and how to provide for conflicting demands of society, is the challenge addressed by the Division of Forest Resources. The division, consisting of the Faculty of Forest and Natural Resources Management and the Faculty of Environmental and Forest Biology, is charged with providing intellectual leadership in these issues through diverse programs of undergraduate and graduate education.

The two Faculties comprising the division encompass more than half of the college's faculty members. They have a wide array of expertise including conservation biology, resource management and policy, wildlife ecology, fisheries science, silviculture, natural economics, tropical ecology, geographic information systems, plant ecology, forest management, and ecosystem sciences. Additional areas include biostatistics, molecular biology, genetics, plant biotechnology, operations research, forest entomology and forest pathology, hydrology and watershed management, outdoor recreation and tourism, soil science, environmental law, environmental ethics, and landscape ecology. This assemblage of faculty is among the strongest in the world, providing excellent opportunities for education in resource management and biological sciences.

Educational offerings in the division consist of programs in forest resources management, natural resources management, environmental and forest biology, and the dual option in forest ecosystem science. Students in the dual option take core courses in both programs. Considerable flexibility is allowed on technical electives. Consequently, students can complete the dual option in four years plus a summer. Students who graduate in the dual option will find many opportunities for careers with public agencies, private firms and nonprofit organizations. They also are well prepared to enter graduate programs in management of natural resources, ecological research, or other areas of applied forest biology.

Program requirements for the undergraduate dual option in forest ecosystem science are located beginning on page 85 in the Faculty of Forest and Natural Resources Management section of this catalog.

Faculties in the Division of Forest Resources offer graduate programs leading to the master of professional studies, master of science, and doctor of philosophy degrees in virtually all areas of study concerned with forest resources. The combination of a B.S. degree in one discipline and an M.P.S. degree in another integrates ESF's strengths in forest resources management and environmental biology. For example, the forest resources management M.P.S. requirements are easily adaptable to a joint program with environmental biology. The environmental biology M.P.S. allows students with forestry undergraduate degrees to specialize in many facets of forest biology and ecology.

The undergraduate and graduate programs in the division prepare graduates for professional careers that depend upon an understanding of natural systems. Environmental biology graduates enter careers where knowledge of basic and applied ecology is paramount. Forest resources management graduates often undertake careers where the management and manipulation of natural systems is a major concern. The dual option in forest ecosystem science offers the opportunity to obtain and apply expertise in both of these areas.

Students completing undergraduate or graduate programs in environmental biology, forest and natural resources management, or the dual option in forest ecosystem science have gone on to a wide variety of positions. Examples include aquatic or terrestrial ecologist, university professor, biology teacher, botanist, entomologist, environmental analyst, environmental conservation officer, extension specialist, fisheries biologist, forester, game biologist, geneticist, forest pathologist, microbiologist, naturalist, nursery manager, park naturalist, research scientist, science teacher, timber buyer, watershed manager, wildlife biologist, and zoologist. Graduates of the forest technology program are employed as technicians in forestry, surveying and environmental fields, and many advance to professional positions.

Graduates may find employment with private firms in natural resources policy and administration, with nonprofit conservation groups, and in education and interpretation. The division's programs also form the academic foundation for subsequent specialized study and training at the graduate level. Alternatively, graduate study permits the exploration of a new academic/professional area.

Information regarding the Faculty of Environmental and Forest Biology begins on page 63. Information on the Faculty of Forest and Natural Resources Management begins on page 81.

The Faculty of Chemistry

JOHN P. HASSETT, Chair
118 Jahn Laboratory
315-470-6855; FAX 315-470-6856
www.esf.edu/chemistry

The academic programs in chemistry emphasize fundamental chemical phenomena as well as links from chemistry to the biological and applied sciences. Programs include courses in traditional areas of chemistry, with advanced study in fields pertaining to environmental, life and materials sciences. Emphasis on the investigative function of chemical science is manifest in the wide array of ongoing research projects within the Faculty.

Bachelor of Science in Chemistry

The Faculty of Chemistry offers three options leading to the bachelor of science degree: biochemistry and organic chemistry of natural products, environmental chemistry, and natural and synthetic polymer chemistry. Each option offers an advanced core 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

Participating Faculty: BOYER (Plant and Algal Biochemistry), GINER (Organic and Natural Products Chemistry), NOMURA (Biochemistry and Biotechnology), WEBSTER (Organic Chemistry, Chemical Ecology), WINTER (Polymer Biochemistry)

Biochemistry and organic chemistry of natural products stresses a chemical approach to problems in the life and health sciences. After obtaining a strong foundation in analytical, physical and organic chemistry, these studies are supplemented by advanced courses in natural products chemistry, natural biopolymers, spectroscopy, and biochemistry. Professional electives in botany, chemical ecology, genetics and molecular biology provide the background for interactions 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, and the origin and function of biologically active natural compounds.

Environmental Chemistry

Participating Faculty: BOYER (Environmental Biochemistry), DIBBLE (Environmental Chemistry), J.P.HASSETT, Chair (Environmental Chemistry), JOHNSON (Environmental Chemistry), KIEBER (Environmental Chemistry, Oceanography), TEECE (Organic Geochemistry)

Environmental chemistry stresses applications of fundamental chemical principles to describe and predict behavior of chemicals in the environment. Courses in air and water chemistry are supplemented by advanced courses in analytical, physical, or organic chemistry. A wide variety of courses in biology, engineering, geology, and environmental policy are also available. Research areas include phase-partitioning of organic compounds in water, characterization of particles in air and water, atmospheric and smog chemistry, aqueous photochemistry, sampling methods for trace contaminants in air and water, biological alkylation of metals, analysis of organic particles in water, characterization of natural organic matter in soil and water, behavior of major ions and nutrients in water, and global change.

Natural and Synthetic Polymer Chemistry

Participating Faculty: CABASSO (Polymer Chemistry and Membrane Science), CALUWE (Organic Chemistry, Synthetic Polymer Chemistry), A. CHATTERJEE (Polymer Physical Chemistry), DONAGHY (Inorganic Chemistry), GITSOV (Organic and Physical Polymer Chemistry), NOMURA (Biosynthesis and Biopolymer Chemistry), STIPANOVIC (Physical Chemistry, Materials Science of Polymers), WINTER (Physical and Biopolymer Chemistry)

Undergraduates in the natural and synthetic polymer option take advanced courses in mechanisms of polymerization and polymer synthesis, in the physical properties and characterization of polymers, and in the 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, textiles, 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 chemical waste. The program offers an excellent background both for direct entry into industrial chemistry and graduate study in areas such as chemistry, biotechnology or polymer science.

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 noted below.

Undergraduate Program Requirements

Lower Division Required Courses (47 credits):

COURSES			CREDITS
CLL 190	Writing and the Environment	G ¹	3
CLL 290	Writing, Humanities and the Environment	G	3
EFB 226	General Botany	G	4
EFB 285	Principles of Zoology		4
FCH 132	Orientation Seminar: Chemistry ²		1
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 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
MAT 295	Calculus I	G	4
MAT 296	Calculus II		4
PHY 211	General Physics I		3
PHY 221	General Physics Laboratory I		1
PHY 212	General Physics II		3
PHY 222	General Physics Laboratory II		1

Upper Division Electives (16 credits):

Math Elective	4
Computing Elective	3

¹ Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet the general education standards established by SUNY is listed on page 8 and on the Internet at www.suny.edu/provost/GeneralEducation/CourseList/ESFGERCourses.pdf

² Required of all students regardless of entry level.

General Education Course	G	3
General Education Course	G	3
General Education Course	G	3

Upper Division Required Courses (32 credits):

CHE 411	Inorganic Chemistry		3
CLL 405	Writing for Science Professionals		3
ESF 200	Information Literacy		1
FCH 325	Organic Chemistry III		3
FCH 360	Physical Chemistry I		3
FCH 361	Physical Chemistry II		3
FCH 380	Analytical Chemistry I		4
FCH 381	Analytical Chemistry II		3
FCH 384	Spectrometric Identification of Organic Compounds		2
FCH 495	Introduction to Professional Chemistry		1
FCH 497	Undergraduate Seminar		1
FCH 498	Introduction to Research ³		5

Electives (minimum of 17 credits):

Elective		3
General Education Course	G	3
General Education Course	G	3
Professional Electives ⁴		8-9

Option Courses (9 credits)

Biochemistry and Natural Products Option

FCH 530	Biochemistry I		3
FCH 531	Biochemistry Laboratory		3
FCH 532	Biochemistry II		3

Environmental Chemistry Option

FCH 510	Environmental Chemistry I		3
FCH 511	Environmental Chemistry II		3
FCH 515	Methods of Environmental Chemical Analysis		3

Natural and Synthetic Polymer Chemistry Option

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 THE DEGREE

121 CREDITS

Graduate Programs

Graduate degrees require an appropriate program of courses at ESF and at 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. Please see Graduate Academic Policies for complete information on coursework requirements. In addition, doctoral students must pass two preliminary examinations and a doctoral candidacy examination.

³ Students may replace this requirement to allow time for special interest, by petition to the Faculty.

⁴ Students should complete a two-semester set of professional electives chosen from a list of courses available in the Faculty 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. Students in the biochemistry and natural products chemistry option are advised to take FCH 524 Topics in Natural Products Chemistry.

Requirements for a Master of Science or Doctor of Philosophy degree also include a research thesis or dissertation. Current research projects encompass polymer chemistry, membrane science, and carbohydrate chemistry; biochemistry and microbiology; organic chemistry of natural products and chemical ecology; environmental chemistry of the air, water, and soils.

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

Graduate studies in biochemistry reflect the college's interests in microbial, insect, 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.

A wide variety of research topics are available ranging from plant physiology to biotechnology. Selective research topics include: microbial and algal production of biologically active natural products and their importance in cell biology (BOYER, GINER); chemical communication and recognition between organisms (WEBSTER); marine algal toxins (BOYER); trace metal/nitrogen physiology of symbiotic plants and algae (BOYER); and the structure/function of natural biopolymers (NOMURA, WINTER); metabolic and protein engineering (NOMURA); global gene expression studies of biopolymer-producing bacteria (NOMURA). Also, the use of microorganisms for the production of specialty chemicals including polysaccharide interconversions, and the application of bacterial and fungal enzymes and peptides in the bioremediation of environmental problems are explored.

Environmental Chemistry (M.S., Ph.D.)

Research for graduate students in environmental chemistry is central to their program and includes both experimental and theoretical considerations. Frequently, the problems to be addressed are transdisciplinary in nature. Thus, coursework is carefully selected from areas of chemistry, biology, geology, engineering, mathematics and computer science in order to support the student's particular research needs in conjunction with fieldwork and laboratory experiments. Special topics in analytical-environmental chemistry or for methods development are often arranged.

Environmental chemistry faculty members currently have active research interests in both aquatic and atmospheric systems. These include: the thermodynamics and kinetics of binding hydrophobic organic compounds by dissolved humic substances in water, the development of techniques for measuring the extent to this binding in both laboratory and field environments, and the characterization of poorly understood humic substances by techniques such as NMR (J.P. HASSETT); the study of chlorinated hydrocarbons in the Niagara River-Lake Ontario-St. Lawrence River system, and their interaction with sediments, dissolved substances and organisms (J.P. HASSETT); the exchange of chlorinated hydrocarbons and other trace organics between aqueous and atmospheric phases in the environment (DIBBLE, J.P. HASSETT, KIEBER); understanding the role of organic matter in a variety of atmospheric, aquatic and sedimentary processes (DIBBLE, J.P. HASSETT, JOHNSON, KIEBER); the development of probe systems to study free radical processes and photochemical transformations of dissolved organic matter in natural waters (KIEBER); understanding the dynamics of the oceanic carbon and sulfur cycles and the importance of sunlight-driven photochemical transformations of organic matter in natural waters (KIEBER); the application of computer-assisted SEM/EDXA to individual particle analysis in atmospheric, aquatic and suspended sediment samples (JOHNSON); the dynamics of calcium carbonate precipitation in hard water lakes (JOHNSON); the biomethylation of As, Sn, and Hg in soil/plant systems (JOHNSON); the study of spatial and temporal patterns in childhood lead poisoning (JOHNSON); the kinetics of elementary reactions that control the degradation of volatile organic compounds and the resulting yields of ozone, aerosols, and air toxics (DIBBLE); the identification of novel intermediates formed in the degradation of aromatic compounds in

the atmosphere (DIBBLE); the application of laser spectroscopy and high-level quantum chemical calculations to atmospheric chemistry (DIBBLE); application of stable isotope techniques to elucidating sea turtle diet and trophic relationships in reef-building corals (TEECE).

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

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. Current topics of interest to the natural products faculty are the following: structure and function of natural metal chelators (BOYER); marine and freshwater algal toxins (BOYER); synthesis and biosynthesis of biologically active natural products (GINER); analysis and structure determination of steroidal compounds (GINER); isolation and identification of insect and mammalian pheromones and other semiochemicals such as alleomones and kairomones (WEBSTER); and synthesis of new natural products (semiochemicals) with particular emphasis on stereochemistry (WEBSTER).

Polymer Chemistry (M.S., Ph.D.)

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 a one-year sequence in either physical or organic chemistry of polymers and such additional courses as the student and advisor consider necessary. Special topics in a broad 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. Current topics of research interest within the polymer faculty include the following: preparation, modification and technology of polymeric membranes (CABASSO); preparation, properties and applications of radiopaque polymers (CABASSO); inorganic polymers (CABASSO); applied electrochemistry, fuel cells, electrodes and electrosynthesis (CABASSO); novel methods of cellulose and cellulosic modification (CALUWE); clustering and percolation in polymer mixtures (A. CHATTERJEE); flow-induced effects on polymer miscibility (A. CHATTERJEE); synthesis and characterization of polymers with novel architectures that incorporate dendritic, hyper-branched, star-like or cyclic fragments; amphiphilic copolymers; self-assembly and supramolecular chemistry (GITSOV); biomass conversion to biodegradable polyesters (NOMURA); biopolymer polymer rheology and stimuli responsive fluids (STIPANOVIC); controlled release applications of environmentally benign polymer gels (STIPANOVIC); diffraction methods, NMR, and dynamic molecular modeling approaches to polymer structure determination and prediction (WINTER); biomass conversion to industrial polysaccharides (WINTER).

Research Facilities

Graduate research laboratories are located in Edwin C. Jahn Laboratory, a state-of-the-art, 70,000 sq. ft. research facility opened in 1997. These labs are well equipped for polymer studies, chemical and biochemical research. Available instrumentation includes ICP, IR, FTIR, GC/MS, UV/VIS, fluorescence, LC/MS, liquid and solid-state multinuclear NMR (300 and 600 MHz), and ORD/CD spectrometers. Ultrastructure study facilities include X-ray diffraction equipment, an atomic force microscope, and electron microscopes. Chromatographic equipment includes instrumentation for analytical and preparative liquid and gas chromatography. Jahn Laboratory is equipped for the use of radioisotopes in research including a separate radioisotope laboratory. Liquid and solid scintillation counters, and a multichannel analyzer are available. Other facilities include excimer-pumped dye laser, DSC, torsion pendulum, membrane and vapor phase osmometry, solution and solid-state light-scattering photometers, dynamic oscillatory viscometer, tensile/compression test unit, and a computational environment including Silicon Graphics work stations and network access to Syracuse University and the Internet. Field equipment includes a boat, water and sediment samplers, in-situ sensors for major chemical and physical parameters, fixed wavelength radiometers and spectroradiometers.

The Faculty of Construction Management and Wood Products Engineering

SUSAN E. ANAGNOST, Interim Chair
 153 Baker Laboratory
 315-470-6880; FAX 315-470-6879
www.esf.edu/faculty/wpe/

Participating Faculty

ANAGNOST, Interim Chair, (Anatomy, Ultrastructure and Wood Decay), HANNA (Ultrastructure and Microscopy), KIM (Cost Engineering, Estimating, Construction Management, Lean Construction), KYANKA (Construction, Applied Mechanics, Engineering Design), MEYER (Wood Properties, Wood Utilization, Anatomy), MORSI-HUSSEIN (Structural Engineering, Mechanics), W. SMITH (Wood Preservation, Seasoning, Processing, Marketing), TISS (Construction Safety, Planning and Scheduling, Construction Management)

The Faculty of Construction Management and Wood Products Engineering offers two bachelor of science degrees: construction management, and wood products engineering. Both degrees prepare students for a wide variety of professional careers, either in the construction industry or in wood products manufacturing, marketing or design. Instruction is tailored to the interests of individual students through the selection of electives taken at both ESF and Syracuse University. A minor in business management is available for qualified students through Syracuse University (see page 9). Students interested in this minor should meet with their advisor as soon as possible.

Professional growth of students is stimulated by active membership in student chapters of professional construction and wood science organizations. Students are encouraged to join at least one organization that is of particular interest to them: the Student Construction Association (affiliated with The Associated General Contractors of America and General Building Contractors of New York State), and the Forest Products Society.

Many students who enter programs in construction management or wood products engineering are transfer students. Graduates of A.S. programs in liberal arts, math/science, and engineering/science as well as A.A.S. programs in architectural, civil, construction, mechanical, and wood technologies are encouraged to apply. Students with or without two-year degrees who meet all lower-division requirements and have 62 credits in acceptable coursework transfer as juniors for a four-semester program. Students who have completed precalculus, but have not completed chemistry and/or physics or have not met most of their general education requirements generally finish in five or six semesters.

Bachelor of Science in Construction Management

The commercial construction industry represents almost 6 percent of the nation's gross domestic product. Because of this economic importance the industry is very competitive. Also, there are many small firms whose presence increases competition. With more construction companies bidding on jobs, organizations with the best-prepared professionals using the latest technology are the most successful. This competition applies not only to contractors, but also to many others involved in construction operations such as engineers, human resource managers, and material and equipment suppliers. People engaged in this industry must have state-of-the-art skills and knowledge to thrive.

The construction management degree program prepares students for management careers in the construction industry. The objectives

of the program are twofold: to provide an understanding of basic engineering and environmental considerations, and to study the various methods used to take a design into the field and construct a quality structure in the most efficient and effective manner with minimal environmental impacts.

Particular attention is given to the study of engineering principles. Students learn the behavior of construction materials and study the analysis of various structural components and systems are studied. Courses include construction safety, construction equipment, construction methods, building codes and zoning, specifications, planning and scheduling, estimating, construction management, structural analysis, soil mechanics, and computer applications.

Environmental concerns are incorporated within the program by addressing workplace safety, environmental impact evaluation, and codes concerning structural, fire, and hazardous material requirements. Emphasis on environmental and personal safety includes asbestos mitigation, noise pollution, air monitoring and sampling techniques. Energy efficiency in buildings is studied based upon the New York state energy conservation code and federal guidelines. Legal and social aspects are integrated into the program in the later stages.

Graduates of the construction management program are well prepared for careers in a very challenging and dynamic field. Positions held by alumni include construction project manager, safety director, project engineer, construction engineer, field engineer, and planner/scheduler.

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 62 credits of college coursework, in courses comparable to the lower-division course requirements.

Undergraduate Program Requirements

Lower Division Required Courses¹ (42 credits)

COURSES		CREDITS
WPE	132 Orientation Seminar: Wood Products Engineering ²	1
APM	105 Calculus I	G ³ 4
APM	106 Calculus II	4
CLL	190 Writing and the Environment	G 3
CLL	290 Writing, Humanities and the Environment	G 3
EFB	120 Global Environment	3
ERE	221 Engineering Mechanics: Statics	3
ERE	362 Mechanics of Materials	3
FCH	150 General Chemistry I	G 3
FCH	151 General Chemistry Laboratory I	1
FOR	207 Introduction to Economics	G 3
PHY	211 General Physics I	3
PHY	221 General Physics Laboratory I	1

¹ Students who enter as freshmen complete a one-credit course, WPE 132, and 8 credits of electives. Students who enter as transfer students complete a zero-credit course, ESF 332, and at least 9 credits of electives at the lower division.

² Required for students who enter as freshmen.

³ Meets the requirements for general education skills and knowledge oreo. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed on page 8 and on the Internet at www.suny.edu/provost/GeneralEducation/CourseList/ESFGERCourses.pdf

Electives⁴ (28 credits)

Electives			16
General Education Course: American History	G	3	
General Education Course: Other World Civilizations	G	3	
General Education Course: Western Civilization	G	3	
General Education Course: The Arts	G	3	

Upper Division Required Courses (54 credits):

ESF	332	Seminar for New Transfer Students ⁵	0
APM	391	Introduction to Probability and Statistics	3
CIE	337	Soil Mechanics and Foundations I	4
CIE	338	Soil Mechanics and Foundations II	3
		OR	
		Elective	3
ERE	371	Surveying for Engineers	4
FEG	300	Engineering Design	1
FOR	360	Principles of Management	3
WPE	331	Construction Safety	3
WPE	335	Cost Engineering	3
WPE	342	Light-Frame Construction	3
WPE	343	Construction Estimating	3
WPE	387	Wood Structures and Properties	3
WPE	404	Timber Design Project	3
WPE/LSA	410	Computer-Aided Design and Drafting	3
WPE	422	Composite Materials	3
WPE	453	Construction Planning and Scheduling	3
WPE	454	Construction Project Management	3
WPE	455	Construction Contracts and Specs	3
WPE	497	Senior Seminar	3

Electives (12 credits) 12

TOTAL MINIMUM CREDITS FOR THE DEGREE 129 CREDITS

Bachelor of Science in Wood Products Engineering

The bachelor of science degree in wood products engineering is accredited by the Society of Wood Science and Technology.

The mission of the program is to provide for the educational, research and public service needs of wood-based forest products industries. Most activities are directed toward the forest products industry of New York, but the Faculty of Construction Management and Wood Products Engineering has a long tradition of national and international service.

Students in the wood products engineering program benefit from the expertise of professors involved in a variety of research projects. Graduates of this program pursue careers in a variety of fields, including manufacturing, marketing, building construction and renovation, and wood science.

The program provides a broad education, encompassing study of the anatomical, physical, and mechanical properties of wood. Students learn to apply basic and engineering sciences to the broad

⁴ Students who enter as freshmen complete a minimum of 8 credits of electives at the lower division plus the one-credit orientation seminar. Students who enter as transfer students must complete a minimum of 9 credits of electives at the lower division and the zero-credit transfer seminar.

⁵ Required for students who enter as transfer students.

spectrum of products made from wood and its derivatives. Subject areas cover the physical and mechanical properties of wood and components utilizing wood, their industrial applications, manufacturing and marketing of wood products, and the economic aspects of this renewable resource. A materials science approach is used, similar to the specialized studies associated with metallurgy, plastics, and other engineering materials.

A core curriculum is supplemented by elective concentration areas to allow students to design their own specialized courses of study. The curriculum has been planned to produce graduates who understand why wood behaves as it does and who can contribute to the utilization and production of virtually any type of wood product.

Each student is required to develop an educational plan designed to meet career objectives. The career objectives may be broad in scope or sharply focused, depending on the student's background and expectations for the future. Elective concentration areas are marketing, production, building construction and renovation, and wood science. Recommended courses for each concentration are developed in consultation with faculty advisors.

Essential knowledge for all wood products engineering graduates:

- Identification, properties, and uses of wood
- Classification of tree species; relations between species and genera of important North American timber species including growth ranges
- Wood-moisture relationships
- Wood protection
- Production of solid wood and composite products
- Wood mechanics — design of wood structural elements
- Use of wood in construction and other engineered applications such as furniture

Additionally, other courses address environmental concerns and natural resource professionalism to provide the well-rounded educational experience required of a graduate from a leading wood science and technology curriculum offered at one of the foremost colleges dealing with renewable natural resources.

A total of 126 credit hours is required for graduation. Recommended electives for each concentration area are available from faculty advisors.

Elective concentration area details:

Marketing: Often, graduates enter the wholesale or retail sales fields, dealing with forest products and/or other building materials. Others work for suppliers to the forest products industry, marketing products such as paints, coatings or adhesives, or work for machine manufacturers. Concentration courses to provide skills listed below include business classes from the Syracuse University School of Management.

Essential knowledge for marketing concentration graduates:

- The importance of forest products in the international marketplace
- Economic importance of forest products
- The role of marketing in the distribution of goods
- Characteristics of the forest products marketplace

Production: Students selecting the production concentration prepare themselves for careers in a wide variety of manufacturing operations, ranging from primary plywood or particleboard mills to secondary production operations such as the manufacture of millwork or furniture.

Essential knowledge for production concentration graduates:

- Production scheduling
- Wood manufacturing operations
- Operations management
- Personnel and labor relations.

Building Construction and Renovation: In the United States many structures are needed to satisfy the continuing demand for business, commercial, and residential space. Construction and renovation of wood-based structures help meet this need. A growing field is the renovation of old structures to meet altered uses, such as offices, stores, or restaurants placed in old factories and various uses for old residences. Historic preservation of old structures requires

consideration of not only the original architecture and use of the structures but also modern concepts for building integrity and safety.

Essential knowledge for building construction and renovation concentration graduates:

- Traditional light frame and heavy timber engineering and design
- Historical and modern buildings and their preservation
- Building codes and zoning practices
- Essentials of lumber grading
- Planning and managing the construction process
- Management and entrepreneurship.

Wood Science: Students generally take courses dealing with the biological aspects of wood (e.g., anatomy, tree growth-wood quality relations, effects of decay) or the physical characteristics of the material (e.g., physical properties, mechanical and engineering properties, the physics of preservation or seasoning).

Some wood science students are preparing themselves for graduate school and eventually enter a career in research, such as in a private or government research laboratory, or for a trade association or service organization. Others find rewarding and challenging careers in teaching or industrial settings.

Essential knowledge for wood science concentration graduates:

- Relations between tree growth and wood properties
- Wood-water relationships; the effects of moisture on the properties of wood
- Decay processes
- Evaluation and analysis of the physical and mechanical properties of wood

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 62 credits of college coursework, in courses comparable to the lower-division course requirements.

Undergraduate Program Requirements

Lower Division Required Courses⁶ (36 credits)

WPE	132	Orientation Seminar: Wood Products Engineering ⁷		1
APM	105	Calculus I	G ⁸	4
APM	106	Calculus II		4
APM	153	Computing Methods		3
CLL	190	Writing and the Environment	G	3
CLL	290	Writing, Humanities and the Environment	G	3
EFB	120	Global Environment		3
EFB	226	General Botany	G	4
FCH	150	General Chemistry I		3
FCH	151	General Chemistry Laboratory I		1
FOR	207	Introduction to Economics	G	3
PHY	211	General Physics I		3
PHY	221	General Physics Laboratory I		1

Electives (18):

Electives ⁹		6
General Education Course: American History	G	3

⁶ Students who enter as freshmen complete a one-credit course, WPE 132 and students who enter as transfer students complete a zero-credit course, ESF 332.

⁷ Required for students who enter as freshmen.

⁸ Meets the requirements for General Education skills and knowledge core. A complete listing of ESF or Syracuse University courses that meet the General Education standards established by SUNY is listed on page 8 and on the Internet at www.suny.edu/provost/GeneralEducation/CourseList/ESFGERCourses.pdf

⁹ Students who enter as freshmen complete a one-credit orientation seminar. Students who enter as transfer students must complete the zero-credit transfer seminar.

General Education Course: Other World Civilizations	G	3
General Education Course: Western Civilization	G	3
General Education Course: The Arts	G	3

Upper Division Required Courses (48 credits):

ESF	332	Seminar for New Transfer Students ¹⁰		0
APM	391	Introduction to Probability and Statistics		3
EFB	336	Dendrology		3
ERE	221	Engineering Mechanics: Statics		3
ERE	362	Mechanics of Materials		3
FEG	300	Engineering Design		1
FOR	333	Managerial Economics for Environmental Professionals		3
WPE	322	Mechanical Processing		3
WPE	326	Fluid Treatments		3
WPE	342	Light-Frame Construction		3
WPE	376	Decay of Wood Products		3
WPE	387	Wood Structures and Properties		3
WPE	388	Wood and Fiber Identification Laboratory		2
WPE	404	Timber Design Project		3
WPE	420	Adhesives, Sealants, and Coatings		3
WPE	422	Composite Materials		3
WPE	444	Wood Products Marketing		3
WPE	497	Senior Seminar		3

Elective Concentration courses¹¹ 15

Electives 9

TOTAL MINIMUM CREDITS FOR THE DEGREE 126 CREDITS

Graduate Program

The Faculty of Construction Management and Wood Products Engineering offers graduate education leading to the master of science, master of professional studies, and doctor of philosophy degrees through the program in environmental and resource engineering.

Areas of graduate research include construction management and engineering, wood science and technology, wood anatomy and ultrastructure, tropical timbers, wood treatments, engineered wood products, and timber structures. These areas of research are described in the section on Division of Engineering (page 44). Students with backgrounds in wood science and technology, construction, engineering, or the sciences can pursue graduate study in this field.

Laboratory facilities include a computer facility with estimating, scheduling, project management, wood engineering design, computer aided design and drafting, finite element analysis and other specialized software.

Other laboratory facilities include a mechanical testing laboratory with a wide range of testing machines, electronic data acquisition facilities, shaker table and frequency analyzers, and complete wood processing facilities including a dry kiln and wood preservation equipment.

One of the largest wood collections in the world, the H. P. Brown Memorial Wood Collection, is used to support the graduate research

¹⁰ Required for students who enter as transfer students.

¹¹ All students must complete at least 18 credit hours of elective concentration courses selected from an advisor-approved sequence of available courses. Examples of acceptable courses are: Syracuse University courses in the general management studies, entrepreneurship or marketing minors; WPE 343 Construction Estimating; PHY 212 General Physics II; FCH 221 Organic Chemistry I; APM 485 Differential Equations for Scientists and Engineers.

program of the Tropical Timber Information Center. The center also maintains the Carl deZeeuw Memorial Library. A major renovation to the teaching and research laboratories is nearing completion and a number of new laboratories already have been created.

A complete microscopy and image analysis laboratory is provided by the N.C. Brown Center for Ultrastructure Studies. This equipment includes a transmission electron microscope, scanning electron microscopes with energy dispersive x-ray analysis and particulate analysis accessories, and a wide variety of light microscopes

equipped with image enhancement and various video image analysis capabilities. Graduate students using this equipment have the best available systems to relate the macroscopic behavior of wood to its anatomical characteristics.

The Renewable Materials Institute conducts research in the broad area of sustainable development of wood resources and the uses of wood products.

The Faculty of Environmental and Forest Biology

DONALD J. LEOPOLD, Chair
242 Illick Hall
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www.esf.edu/efb

Programs in environmental and forest biology provide students with a firm foundation in basic biology, ecosystem dynamics and environmental science. The programs encompass a variety of interconnected disciplines concerned with living systems, and treat not only the form, function and evolution of organisms, but their life requirements, tolerances and interactions that are central to the stewardship of renewable natural resources and the maintenance of environmental quality.

Modern society places critical importance on natural resources and the quality of our environment has greatly broadened the services that a well-trained biologist can render. The faculty is committed to meet a dynamically changing array of opportunity through coursework enriched by an active program of research. The undergraduate programs, described below as majors and options, prepare students for employment or graduate study in a broad range of disciplines. Graduate students may develop a course of study under the guidance of a major professor and graduate committee within any of several areas of study (see page 70).

The academic programs stimulate interest in the recognition and understanding of plants, animals, fungi, bacteria and protists and deal with dynamic changes in biological systems in the context of ecology, conservation biology, physiology, genetics and evolution.

Undergraduate Programs

The Faculty of Environmental and Forest Biology (EFB) offers seven undergraduate degrees and a dual option in collaboration with the Faculty of Forest and Natural Resources Management. 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, forest health, natural history and interpretation, 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. Full program descriptions follow short discussions of general opportunities in the Faculty of Environmental and Forest Biology.

Pre-health Professions

Degrees in either environmental biology or biotechnology will prepare students for admission to a variety of professional schools in health-related areas, including human and veterinary medicine. A rigorous foundation in the basic biological sciences, calculus, physics and organic chemistry is provided by the core requirements of these majors. Potential electives include certain benchmark courses that admissions committees of professional schools frequently look for, such as comparative vertebrate anatomy and animal physiology. Pre-veterinary students will find strong supporting courses and faculty interest in vertebrate biology, and pre-medical students can pursue such relevant elective subjects as microbiology and environmental toxicology. In addition, ESF students take advantage of Syracuse University's broad array of relevant courses and the advising, counseling and resources of the Health Professions Advisory Program. Students can earn credit for a variety of internships, such as paid or volunteer work in clinics and other professional settings.

Internships

A variety of internships are available, either in the summer or academic year. These are arranged in cooperation with the student's advisor and may carry course credits under EFB 420 Internship in Environmental and Forest Biology. Agencies actively involved with the internship program include the U.S. Fish and Wildlife Service, New York State Department of Environmental Conservation, Upstate Freshwater Institute, The Nature Conservancy, the National Park Service and the U.S. Geological Survey. Internships also are commonly associated with a local zoo. Field-based internships can, with approval, count toward the three-credit field experience elective required by most EFB degree programs.

Field Experience

Field reality is a vital component of the programs in environmental and forest biology. Each student, except those in biotechnology, is required to attend a three-credit hour integrated course in field biology (EFB 202) at the Cranberry Lake Biological Station in the Adirondack Mountains, normally taken between the freshman and sophomore years. An additional three credits in a field experience elective is required, and this can be obtained at Cranberry Lake or through another approved field experience, either that same summer or subsequently. Students are encouraged to participate in as many field and internship experiences as possible during their college career. Additional field station courses beyond the six-credit requirement will be counted as elective credits. The college runs field programs in areas that recently have included Africa, Australia, Brazil, Ireland, and the Caribbean (Dominica and Yucatan). Additional opportunities exist in the School for Field Studies courses, which are offered around the world, as well as in many excellent programs throughout the United States. The EFB field program coordinator maintains a list of residential field stations. It is the student's responsibility to obtain current information on the various field stations and to work with an advisor to select courses that meet EFB program requirements and educational needs.

Cranberry Lake Biological Station (CLBS)

www.esf.edu/clbs

Cranberry Lake, the third largest body of water in the Adirondacks, and its environs are ideally suited for a biology summer program. The surrounding topography is rolling hill and lake country dotted with numerous small ponds, bogs and stream drainages. Because 80 percent of the shoreline is in state ownership, the lake remains pristine, unspoiled by recreational developments and pollution problems. Much of the original forest cover in the region was harvested a century ago; today a rich variety of community types occupy those sites as the vegetation reverts to natural conditions. The remaining virgin forests also provide students with many examples of stable ecosystems, each type reflecting the particular environmental conditions controlling forest development. A wealth of wildlife parallels the variety of cover types. The area provides easy access to a wide range of additional ecosystems, ranging from bog to alpine vegetation.

Facilities include four classroom-laboratories; a computer cluster; field and laboratory equipment; a dozen power boats; dining facilities for 120; faculty quarters and cabins; an administration building; 12 cabins housing 6-8 students each; a recreation hall; and several smaller, supporting buildings.

The program extends through June and July, divided into two sessions. Courses are designed to emphasize and effectively utilize the unique nature of this Adirondack setting, and all involve daily field trips into the surrounding forest and aquatic ecosystems.

Information about the summer program, including courses and fees, may be obtained from the Director, Cranberry Lake Biological Station, State University of New York College of Environmental Science and Forestry, Syracuse, N.Y. 13210, or on the Internet.

Bachelor of Science in Environmental Biology

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.

With appropriate electives, students who complete the degree program will meet requirements for a wide range of federal, state, municipal and private-sector positions that call for training in biological sciences. (Students interested in federal and state positions should review civil service publications and become familiar with specific course requirements early enough to make timely elective choices.) General subject requirements for graduate study in virtually any area of biology also will be met.

Environmental biology is the broadest of the seven biology majors at ESF, covering topics from molecules to ecosystems, but nearly all the courses in the specialized area are also available as electives. Sufficient elective space exists to allow completion of a minor during the four-year program. In choosing electives, some students sample from the widest spectrum of classes in environmental biology; this is common for those wishing to enter graduate school for further, career-oriented education. Other students focus their electives to some extent, depending on their interests and their educational and career goals.

Through a joint degree program with Syracuse University, students pursuing the B.S. in environmental biology can couple a strong program in basic biological sciences with necessary education courses required to qualify for certification as biology teachers in grades 7-12 under New York regulations. Refer to page 12 for additional information.

Undergraduate Program Requirements

Required Courses (62 credits)

COURSES			CREDITS
APM 105	Survey of Calculus and Its Applications I	G ¹	4
APM 391	Introduction to Probability and Statistics		3
CLL 190	Writing and the Environment (or English with a focus on writing)	G	3
CLL 290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB 120	Global Environment		3
EFB 132	Orientation Seminar: Environmental Biology ²		1
EFB 226	General Botany (or General Biology I)	G	4

¹ Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed on page 8 and on the Internet at www.suny.edu/provost/GeneralEducation/CourseList/ESFGERCourses.pdf

² Transfer students take ESF 332 Seminar for New Transfer Students (0 credit), and take EFB 202 at their earliest opportunity.

EFB 285	Principles of Zoology (or General Biology II)		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 325	Cell Physiology		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 ³		4
PHY 101	Major Concepts of Physics I ⁴		4
APM 106	Survey of Calculus and Its Applications II		4
	OR		
PHY 102	Major Concepts of Physics II ⁴		4
	OR		
FCH 223/ 224	Organic Chemistry II with laboratory		4

The summer following the first or second year, students must take:

EFB 202	Ecological Monitoring and Biodiversity Assessment		3
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Electives (64 credits)

General Education Course: Social Sciences	G	3
General Education Course: American History	G	3
General Education Course: The Arts	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilizations	G	3
Directed Electives		25
Open Electives		24

TOTAL MINIMUM CREDITS FOR THE DEGREE 126 CREDITS

Directed Electives

At least 25 upper-division credits must be earned in biological coursework. Of these, the following subject distribution requirements must be met. Lists of acceptable elective courses are available in the student handbook and from the curriculum coordinator.

- Field Experience Elective (3 credits)
- Organismal Structure and Function (3 credits)
- Organismal Diversity (3 credits from each of three of the following four categories)
 - Diversity of Microorganisms
 - Diversity of Plants
 - Diversity of Invertebrate Animals
 - Diversity of Vertebrate Animals

Bachelor of Science in Wildlife Science

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

³ FCH 221 and 222, taken together, will satisfy the requirement for organic chemistry; this substitution should be made only if FCH 223/224 is elected.

⁴ Physics I also can be satisfied by PHY 211 and PHY 221, taken together. Physics II also can be satisfied by PHY 212 and PHY 222, taken together.

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.

Students obtain background in the basic sciences (math, chemistry, physics), then learn the basic ecological principles and evolutionary forces that affect wildlife and their associated habitats. Coursework then addresses the assessment and management of wildlife resources as well as the biology and natural history of various taxonomic groups. Students are advised to enhance career opportunities via taxonomic proficiency with one or more plant or animal groups, special skills such as GIS, and practical working experience as an intern, volunteer or paid employee of a conservation agency.

The program prepares students for careers with state and federal agencies as well as an array of domestic and international non-governmental organizations. Diverse job functions include management of wildlife on state, federal or private lands; inventory and assessment of wildlife populations and associated habitats; and interaction with the public to convey the value and rationale of wildlife conservation programs and initiatives. Students who excel academically will also be prepared to continue toward a graduate degree, which can greatly expand employment opportunities and is often necessary for even entry-level, career-track positions.

Undergraduates in wildlife science take advantage of ESF's field stations, which are unmatched nationally and provide myriad opportunities. These properties include the 15,000-acre Adirondack Ecological Center and the Cranberry Lake Biological Station in the Adirondacks, as well as the Heiberg Forest south of Syracuse. Many of the courses taken by wildlife science undergraduates include field exercises at these facilities, and the properties are also used for undergraduate research and other projects in which undergraduate students can become involved.

Undergraduate Program Requirements

Required Courses (69 credits)

APM	105	Survey of Calculus and Its Applications I	G ¹	4
APM	391	Introduction to Probability and Statistics		3
CLL	190	Writing and the Environment (or English with a focus on writing)	G	3
CLL	290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB	120	Global Environment		3
EFB	132	Orientation Seminar: Environmental Biology ²		1
EFB	226	General Botany (or General Biology I)	G	4
EFB	285	Principles of Zoology (or General Biology II)		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	413	Introduction to Conservation Biology		3
EFB	462	Animal Physiology		3
EFB	490	Wildlife Ecology and Management		3
EFB	491	Wildlife Practicum		2
EFB	493	Wildlife Habitats and Populations		4
ERE	450	Introduction to Geographic Information Systems		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
PHY	101	Major Concepts of Physics I ⁴		4

The summer following the first or second year, students must take:

EFB	202	Ecological Monitoring and Biodiversity Assessment		3
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Electives (57 credits)

General Education Course: American History	G	3
General Education Course: Social Sciences	G	3
General Education Course: The Arts	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilizations	G	3
Directed Electives		21
Open Electives		21

TOTAL MINIMUM CREDITS FOR THE DEGREE 126 CREDITS

Directed Electives

Twenty-one elective credits must be obtained in the following subject areas, through specified courses that are designed for juniors or seniors (i.e., courses numbered 300 or higher). Lists of acceptable courses are available from the student handbook and the curriculum coordinator. The subject areas are:

1. Field experience (3 credits)
2. Vertebrate Diversity (6 credits)
3. Plant Diversity (3 credits)
4. Invertebrate Diversity (3 credits)
5. Policy/Communications (6 credit)

Bachelor of Science in Aquatic and Fisheries Science

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. This field of study has a long history; for example, the American Fisheries Society was founded in 1870 and the American Society of Limnology and Oceanography in 1948. Aquatic systems and their organisms are sufficiently distinct from terrestrial systems that numerous professional organizations and scientific journals have been founded specifically to foster communication among aquatic science professionals.

At ESF, Wilford E. Dence conducted pioneering studies on aquatic systems in New York in the early 1900s. The present aquatic program at ESF builds on that early tradition with a wide array of aquatic courses. Our program has national and international recognition and includes a balance of applied and basic aquatic science. Students in our program thus have the opportunity to interact with faculty and graduate students involved with diverse studies on aquatic systems.

Undergraduate students considering a career in aquatic and fisheries science need a solid foundation of basic sciences (math, chemistry, physics, statistics) combined with a broad training in organismal biology, ecology and evolution. Upper-division courses focus more specifically on aquatic systems and fishes, including field experience, methods of assessment and principles for management. Students should broaden themselves with studies on the natural history and diversity of various animal and plant groups. Other recommended subjects include communications, ecosystem science,

social and economic principles, ecological modeling, and hydrology. ESF's many field stations provide important opportunities for field-oriented studies, both for taking formal courses and for directed independent research. Practical experiences such as a senior synthesis or internship also provide an important complement to formal courses.

Career opportunities for students with a B.S. in aquatic and fisheries science are in the areas of fisheries science, wetland science, limnology, marine biology and oceanography. Jobs are with federal and state agencies, research institutions, private consulting firms and nongovernmental organizations, both local and international. The better students will have opportunities to continue with graduate studies, which will broaden career options and lead to positions with greater responsibility and higher salary. To pursue a career in research and teaching in a university, a Ph.D. is generally required.

Undergraduate Program Requirements

Required Courses (71 credits)

APM	105	Survey of Calculus and Its Applications I	G ¹	4
APM	391	Introduction to Probability and Statistics		3
CLL	190	Writing and the Environment (or English with a focus on writing)	G	3
CLL	290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB	120	Global Environment		3
EFB	132	Orientation Seminar: Environmental Biology ²		1
EFB	226	General Botany (or General Biology I)	G	4
EFB	285	Principles of Zoology (or General Biology II)		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	325	Cell Physiology		3
EFB	388	Ecology of Adirondack Fishes		3
		OR		
EFB	486	Ichthyology		3
EFB	421	Ecology of Fresh Waters		3
		OR		
EFB	524	Limnology		3
FOR	207	Introduction to Economics	G	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 ³		4
PHY	101	Major Concepts of Physics I ⁴		4
APM	106	Survey of Calculus and Its Applications II		4
		OR		
PHY	102	Major Concepts of Physics II ⁴		4
		OR		
FCH	223/ 224	Organic Chemistry II with laboratory ³		4

The summer following the first or second year, students must take:

EFB	202	Ecological Monitoring and Biodiversity Assessment		3
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Electives (55 credits)

		General Education Course: American History	G	3
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General Education Course: The Arts	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilizations	G	3
Directed Electives		27
Open Electives		16

TOTAL MINIMUM CREDITS FOR THE DEGREE 126 CREDITS

Directed Electives

At least three upper-division credits must be earned in each of the following subject areas. Lists of acceptable elective courses are available in the student handbook and from the curriculum coordinator.

- A. Field Experience Elective
- B. Animal Structure and Function
- C. Organismal Diversity (three credits from each of two categories)
 - a. Plants and Microbes
 - b. Invertebrate and Vertebrate Animals
- D. Physical/Chemical Environment
- E. Environmental Systems Science
- F. Management
- G. Analytical Tools
- H. Communications

Bachelor of Science in Conservation Biology

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.

A focus on biological diversity and an intrinsic valuation of nature is what distinguishes conservation biology from wildlife management (with its somewhat more utilitarian perspective and a focus on populations of birds and large mammals) and from general environmental biology (with a broad focus on environmental issues). Conservation biologists seek ways to integrate biological perspectives with social, economic, legislative and political ones to achieve conservation goals.

The courses associated with this major reflect the interdisciplinary and holistic nature of conservation biology. After obtaining a foundation in basic science communication, and general education subjects, students learn the evolutionary and ecological forces that have generated the patterns of biodiversity around us, through courses in organismal biology, evolutionary and systematic biology, population biology, ecology and ecosystem science.

An introductory course in conservation biology and one in problem solving in conservation biology familiarize students with the dimensions of the current biodiversity crisis and the management tools available to mitigate for it. These, in combination with a selection of advanced courses in conservation biology, a senior synthesis and an internship or research experience in conservation biology, cover the breadth of biological, social, political, and economic aspects of the biodiversity crisis.

The program prepares students for employment in a variety of government agencies at the municipal level (for example, as land use planners), state level (such as with the New York Department of Environmental Conservation or State Heritage Inventory), federal level (such as with the U.S. Fish and Wildlife Service, U.S. Geological Survey, U.S. Forest Service, or National Park Service), and occasionally at the international level (such as with the United Nations Environment Programme). Many private conservation agencies such as The Nature Conservancy preferentially hire broadly

trained conservation biologists. Ecological consulting firms are an increasingly important source of employment for conservation biologists. Training in conservation biology also provides a strong basis for postgraduate education and rewarding careers in research, teaching and environmental education.

Undergraduate Program Requirements

Required Courses (63 credits)

APM	105	Survey of Calculus and Its Applications I	G ¹	4
APM	391	Introduction to Probability and Statistics		3
CLL	190	Writing and the Environment (or English with a focus on writing)	G	3
CLL	290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB	120	Global Environment		3
EFB	132	Orientation Seminar: Environmental Biology ²		1
EFB	226	General Botany (or General Biology I)	G	4
EFB	285	Principles of Zoology (or General Biology II)		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	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		3
		OR		
EFB	498	Research Problems in Environmental and Forest Biology		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
PHY	101	Major Concepts of Physics I ⁴		4

The summer following the first or second year, students must take:

EFB	202	Ecological Monitoring and Biodiversity Assessment		3
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Electives (63 credits)

General Education Course: American History	G	3
General Education Course: Social Sciences	G	3
General Education Course: The Arts	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilizations	G	3
Directed Electives		30
Open Electives		18

TOTAL MINIMUM CREDITS FOR THE DEGREE 126 CREDITS

Directed Electives

Thirty credit hours of upper-division elective courses must be distributed among the following subject areas, as indicated. Lists of

acceptable courses can be obtained from the student handbook or from the curriculum coordinator.

- A. Field Experience Elective (3 credits)
- B. Organismal Diversity (12 credits, at least one course in three of the following four categories)
 - a. Diversity of Microorganisms
 - b. Diversity of Plants
 - c. Diversity of Invertebrate Animals
 - d. Diversity of Vertebrate Animals
- C. Applied Conservation Biology (6 credits)
- D. Human Dimensions (3 credits)
- E. Communications and Interpretation (3 credits)
- F. Technical Skills (3 credits)

Bachelor of Science in Forest Health

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 expertise in these areas for decades, but only recently have they been merged in an academic major.

The forest health major prepares biology-oriented students for employment in positions that deal with maintaining the health of forest resources. The major is distinct from those in Faculty of Forest and Natural Resources Management and the forest ecosystem science major (dual option), which provides skills and preparation in forest management. Employers today have expressed a need for a deeper understanding of the science behind the trees. Positions requiring a forest health background are found in federal and state agencies, nonprofit organizations, and the private sector. With good performance, the forest health major prepares students for graduate study in preparation for higher-level positions, such as forest pathologist, entomologist, or mycologist.

The curriculum provides a solid foundation in mathematics and the physical sciences (chemistry, physics) followed by courses focusing on forest trees and their requirements, the basic ecological principles that shape forest ecosystems, and the management of these ecosystems. Other required courses introduce students to the identification and impact of biological agents of disease and physical damage, and to the methods by which these are monitored. The flexibility of the major will permit students to pursue more intensive training in integral forest health specialties, such as forest pathology and forest entomology, or to obtain even broader knowledge in related fields such as forestry, microbiology, mycology, and ecology. Field experience is an important element of the program, and is integral to several required courses and many of the directed electives. Two of the requirements are field courses at the Cranberry Lake Biological Station.

Undergraduate Program Requirements

Required Courses (89 credits)

APM	105	Survey of Calculus and Its Applications I	G ¹	4
APM	391	Introduction to Probability and Statistics		3
CLL	190	Writing and the Environment (or English with a focus on writing)	G	3
CLL	290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB	120	Global Environment		3
EFB	132	Orientation Seminar: Environmental Biology ²		1
EFB	226	General Botany (or General Biology I)	G	4

EFB	285	Principles of Zoology (or General Biology II)	4
EFB	303	Introduction to 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	325	Cell Physiology	3
EFB	336	Dendrology	3
EFB	340	Forest and Shade Tree Pathology	3
EFB	351	Principles of Forest Entomology	3
		OR	
EFB	352	Elements of Entomology	3
EFB	439	Forest Health Monitoring	3
EFB	440	Mycology	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 ³	4
FOR	321	Forest Ecology and Silviculture	4
FOR	345	Introduction to Soils	3
FOR	360	Principles of Management	3
PHY	101	Major Concepts of Physics I ⁴	4

The summer following the first or second year, students must take:

EFB	202	Ecological Monitoring and Biodiversity Assessment	3
EFB	345	Forest Health (CLBS)	3

Electives (37 credits)

General Education Course: Social Sciences	G	3
General Education Course: American History	G	3
General Education Course: The Arts	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilizations	G	3
Directed Electives		9
Open Electives		13

TOTAL MINIMUM CREDITS FOR THE DEGREE 126 CREDITS

Directed Electives

Nine credit hours of electives related to forest health are required. A list of approved courses can be found in the student handbook, or obtained from the curriculum coordinator.

Bachelor of Science in Natural History and Interpretation

Natural history is the description of nature and differs from ecology in placing less emphasis on quantification and more on careful observation. The over-arching goal is to elucidate patterns and relationships in the natural world and assimilate this information into human affairs. It uses traditional and modern tools, often with an aesthetic component, to differentiate the natural world, and focuses on identification, life history, distribution, abundance and interrelationships among and between individuals, populations and species. The field has a long and distinguished history including figures such as Darwin, Wallace and E. O. Wilson who are recognized for their seminal contributions to biology and ecology. Following a meteoric rise in popularity during the 19th century, natural history declined as new experimental and quantitative approaches came to dominate biology. In recent years,

however, both the recognition of the role of biology in an holistic view of the planet, and the increasing emphasis on the value of education as the key to a sustainable future, have brought about a resurgence of interest in natural history and, crucially, its interpretation. Interpretation is defined as a communications process that reveals meanings and relationships about natural, cultural, historical and recreational resources. While interpretation may be viewed as a process to communicate any subject matter, historically it has always been linked with natural history. The methods of interpretation were forged by naturalists.

The courses associated with the undergraduate major in natural history and interpretation reflect the interdisciplinary and holistic nature of this subject area. Students become well-grounded in the natural sciences and in the skills specific to communication. This major seeks to integrate training in organismal biology, including a required field component, with in-depth training in the literature and context of natural history and a suite of environmental interpretation offerings. Students gain work experiences through an internship, where the recently acquired knowledge and skills in this arena can be applied.

The program prepares students for employment in nature centers, science museums, federal and state agencies, zoos, urban parks, arboreta and aquaria, as well as in the ecotourism industry and travel agencies that sponsor natural history opportunities, such as birding and whale watching. Training in natural history and interpretation also provides a strong basis for a rewarding career in teaching and environmental education and can act as a springboard for entry into graduate programs.

Undergraduate Program Requirements

Required Courses (69 credits)

APM	105	Survey of Calculus and Its Applications I	G ¹	4
APM	391	Introduction to Probability and Statistics		3
CLL	190	Writing and the Environment (or English with a focus on writing)	G	3
CLL	290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB	120	Global Environment		3
EFB	132	Orientation Seminar: Environmental Biology ²		1
EFB	215	Interpreting Science Through Art	G	3
EFB	226	General Botany (or General Biology I)	G	4
EFB	285	Principles of Zoology (or General Biology II)		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	404	Natural History Museums and Modern Science		3
EFB	405	Literature of Natural History		2
EFB	406	Great Naturalist Seminar		1
EFB	416	Introduction to Environmental Interpretation		3
EFB	420	Internship in Environmental and Forest Biology		3
FOR	372	Fundamentals of Outdoor Recreation		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
PHY	101	Major Concepts of Physics I ⁴		4

The summer following the first or second year, students must take:

EFB 202	Ecological Monitoring and Biodiversity Assessment	3
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Electives (57 credits)

General Education Course: American History	G	3
General Education Course: Social Sciences	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilizations	G	3
Directed Electives		24
Open Electives		21

TOTAL MINIMUM CREDITS FOR THE DEGREE 126

Directed Electives

Twenty-four credit hours in upper-division coursework must be distributed among the following subject areas, as indicated. Depending on category, acceptable courses are listed below, or can be found in lists in the student handbook or obtained from the curriculum coordinator.

- A. Conservation Biology (3 credits): EFB 490 Wildlife Ecology and Management or EFB 413 Introduction to Conservation Biology
- B. Advanced Communication (3 credits): CLL 405 Writing for Science Professionals or LSA 300 Computer Graphics for Design Communications
- C. Advanced Interpretation (3 credits): EFB 417 Perspectives of Interpretive Design or EFB 521 Principles of Interpretive Programming
- D. Organismal Diversity (12 credits): four courses, at least one from each group
 - a. Diversity of Microorganisms
 - b. Diversity of Plants
 - c. Diversity of Invertebrate Animals
 - d. Diversity of Vertebrate Animals
- E. Field Experience Electives (3 credits)

Bachelor of Science in Biotechnology

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.

Undergraduate Program Requirements

Required Courses (79 credits)

APM 105	Survey of Calculus and Its Applications I	G ¹	4
APM 106	Survey of Calculus and Its Applications II		4
BTC 132	Orientation Seminar: Biotechnology		1
BTC 401	Molecular Biology Techniques		3
BTC 497	Research Problem Design and Professional Development		1
BTC 498	Research Problems in Biotechnology		3
BTC 499	Senior Project Synthesis		1
CLL 190	Writing and the Environment (or English with a focus on writing)	G	3
CLL 290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB 226	General Botany (or General Biology I)	G	4
EFB 285	Zoology (or General Biology II)		4
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 Physiology		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 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		4
PHY 102	Major Concepts of Physics II ⁴		4

The summer following the third year, students must take:

BTC 420	Internship in Biotechnology		3
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Electives (44 credits)

General Education Course: American History	G	3
General Education Course: Social Sciences	G	3
General Education Course: The Arts	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilizations	G	3
Directed Electives		9
Open Electives		20

TOTAL MINIMUM CREDITS FOR THE DEGREE 123 CREDITS

Directed and Open Electives

Nine credits of coursework related to biotechnology must be selected from a list of approved subjects, obtainable in the student handbook or from the curriculum coordinator. Seventeen credits of open electives can be selected without subject constraints, with the help of a faculty advisor.

Bachelor of Science in Forest Ecosystem Science (Dual Option)

This option is offered jointly by the Faculty of Forest and Natural Resources Management and the Faculty of Environmental and Forest Biology. A complete description of program requirements begins on page 85 in the FNRM section of this catalog.

Graduate Program

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. — The master of science degree entails a research-based thesis (6-12 credits) 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. The 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. — The master of professional studies degree is offered under two options, each requiring a total of 42 graduate credits (including three graduate seminars). This program 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: At least 30 of the 42 credits required must be taken in residence at ESF. Coursework in this option includes seminars (EFB 797), and a maximum of 6 credits earned in EFB 798, or 898. Neither a comprehensive examination nor a capstone seminar is required.

Professional Experience Option: 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. Coursework for this option includes seminars (EFB 797) and a maximum of 3 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 (7-12), 12 credits of student teaching and coursework will be accepted as equivalent to a professional experience.

Ph.D. — 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.

Facilities and Academic Setting

The center of activity for environmental and forest biology is Illick Hall, with laboratories, classrooms, controlled spaces and equipment in a modern building in which 8,000 square meters of working space is available for graduate study and research.

Laboratories, many of them temperature controlled, and one sound-controlled, are provided for study and research in plant development, physiology, tissue culture, molecular biology, biochemistry and toxicology, ecology and animal behavior. An herbarium, mycological collections, insect and other invertebrate collections, an artificial stream and the Roosevelt Wild Life Collection of vertebrates are maintained as resources for the academic program. Eight rooftop glasshouse units, three of them air-conditioned and one incorporated into a five-room indoor-outdoor insectary, are important to the full array of interests in plant science and plant-animal interactions. An important catalyst for graduate studies is the revitalized Roosevelt Wild Life Station, which helps to focus teaching, research and outreach in field studies.

Students and faculty have access to a variety of sophisticated instrumentation; a computer center and many computer clusters; diverse analytical equipment and measuring devices, including automated DNA sequencer; gas-liquid chromatography; and comprehensive analytical expertise. The N.C. Brown Center for Ultrastructure Studies offers coursework and research in scanning and transmission electron microscopy.

Supportive to the program are the academic resources and courses at Syracuse University, SUNY's Upstate Medical University and the several campus facilities described elsewhere in this catalog. Our students also participate in courses and utilize faculty and facilities at Cornell University and several SUNY campuses in cooperative exchanges.

Excellent field sites and facilities are available for research in all aspects of the program. In addition to the college's several campuses and field stations that offer a broad diversity of forest types, sites and conditions, there are New York State Department of Environmental Conservation lands, the Montezuma National Wildlife Refuge, the Adirondack Mountains and the transition zones near Lake Ontario, Oneida Lake and Cicero Swamp. These areas offer a variety of habitat diversity from aquatic, wetland and terrestrial zones. The ponds, streams and lakes in Central New York and the St. Lawrence River are regularly used by graduate students in aquatic ecology, fisheries biology and ecosystem science. Faculty and students have access to a broad array of boats, motors, nets and sophisticated field sampling instrumentation.

Additional academic facilities enhancing the graduate program include the Adirondack Ecological Center (www.esf.edu/aec) and the revitalized Roosevelt Wild Life Station (www.esf.edu/resorg/Rooseveltwildlife/default.htm).

Further academic advantages stem from the urban setting of the Syracuse campus. Nearby Onondaga Lake is a prominent feature that serves as a focus for many research and teaching activities. The greater Syracuse area provides a convenient laboratory for studies basic to urban ecology: urban wildlife, the growth and protection of woody vegetation, greenspace maintenance, the utilization of waste beds for plant growth, the detoxification of pollutants and the restoration of terrain stripped of vegetation. Disposal of industrial and human wastes requires deeper understanding of the role of plants, animals and microorganisms in the biodegradation of organic matter. The conversion of organic materials into useful fuel, into additives for plant growth, or into protein feeds for domestic animals are stimulating topics.

Funding Opportunities

In addition to graduate assistantships, various awards are available to graduate students in environmental and forest biology. These include the Alexander Wetlands Award, Chamberlain Award, the Dence Memorial Fellowship, Henrietta and John Simeone Fellowship in Forest Entomology, the Robert L. Burgess Graduate Scholarship in Ecology, the Josiah L. Lowe - Hugh Wilcox Graduate Fellowship, the Leroy C. Stegeman Award, the Robert Zabel Award and the Outstanding Young Botanist Award. These awards are made by the faculty chair at the recommendation of a faculty committee selection process.

Areas of Study

Nine areas of study are available: conservation biology, ecology, entomology, environmental interpretation, environmental physiology, fish and wildlife biology and management, forest pathology and mycology, and plant science and biotechnology. One area, chemical ecology, is shared with the Faculty of Chemistry. Additional information on each of these areas of study is available by telephone, e-mail or written request to any of the professors listed. Programs that bridge two or more areas may be developed by the student and steering committee.

Conservation Biology (M.S., M.P.S., Ph.D.)

Participating Faculty: BALDASSARRE (Wetlands, Birds, Waterfowl), FARRELL (Riverine Fish Ecology, Freshwater Coastal Wetlands, Great Lakes), FRAIR (Vertebrate and Landscape Ecology), GIBBS (Genetics and Ecology in Birds, Reptiles and Amphibians), C. HALL (Systems Ecology, GIS), HORTON (Ecology, Fungal Communities, Mycorrhizal Relationships), KIMMERER (Plant Restoration Ecology, Bryology), LEOPOLD (Wetlands, Restoration Ecology, Rare Species Conservation), LIMBURG (Riverine Fish and Estuarine Ecology), LOMOLINO (Mammalian Diversity, Biogeography), NORTON (Ecology and Evolution, Invertebrates, Arachnids), PORTER (Wildlife Conservation, Habitat Management), POWELL (Genetic Engineering in Plant Conservation), RINGLER (Aquatic and Fisheries Restoration, Fish Ecology and Behavior), SAUNDERS (Science Education and Environmental Interpretation), SCHULZ (Aquatic Ecology, Plankton), SHIELDS (Conservation Theory, Genetics, Behavior in Birds and Mammals, Forensic DNA Analysis), STEWART (Tropical Fish Ecology and Systematics, Lake Systems Ecology), TEALE (Insect Behavior, Pheromones), TURNER (Physiological Ecology), UNDERWOOD (Wildlife Ecology), WEIR (Conservation Mycology)

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. The field is a response of the scientific community to the biodiversity crisis. Conservation biologists view nature's diversity as important and having inherent value. Training in this field includes experience with the fundamental disciplines and theory of conservation biology, as well as specialization in conservation issues. Students are encouraged to explore the human dimensions of biological conservation through coursework in other Faculties of the college, and to acquire firsthand experience in the application of biological knowledge to problems by working for a conservation agency. Students find employment in a variety of government and private conservation agencies and in academic institutions. Many also work as administrators, policymakers, teachers and communicators. Current research areas in Environmental and Forest Biology include global climate change, endangered species biology, conservation genetics theory and practice, behavioral ecology, habitat fragmentation, restoration ecology, exotic species biology and control, forest and wetland ecosystem management, tropical ecology, ecological monitoring, conservation education and harvest management.

Ecology (M.S., M.P.S., Ph.D.)

Participating Faculty: BALDASSARRE (Wetlands), FRAIR (Vertebrate and Landscape Ecology), GIBBS (Vertebrate Conservation Biology, Genetic Considerations, Reptiles and Amphibians), C. HALL (Systems Ecology), HORTON (Ecology, Fungal Communities, Mycorrhizal Relationships), KIMMERER (Bryocology, Restoration Ecology), LEOPOLD (Dendrology, Community Ecology), LIMBURG (Fish Ecology), LOMOLINO (Mammalian Diversity, Biogeography), MITCHELL (Biogeochemistry), NAKAS (Microbiology), NORTON (Invertebrates), PARRY (Forest Insects, Biological Control), PORTER (Vertebrate Ecology), RINGLER (Aquatic Ecology, Fish Behavior), SCHULZ

(Limnology), SHIELDS (Vertebrate Behavior), STEWART (Aquatic Ecology), TURNER (Physiological Ecology), WEIR (Mycology)

This integrative study area allows students to investigate the relationships of organisms to their environment and those factors which 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.)

Participating Faculty: ABRAHAMSON (Forest Insects, Pest Management), CASTELLO (Virology, Insect Vectors), NAKATSUGAWA (Toxicology), NORTON (Soil Arthropods, Systematics), PARRY (Forest Insects, Biological Control), RINGLER (Aquatic Entomology), TEALE (Insect Pheromones), TURNER (Physiology)

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.)

Participating Faculty: LEOPOLD (Freshwater Wetlands, Forest Ecology, Rare Plants), PORTER (Wildlife Biology and Management), SAUNDERS (Wildlife Ecology, Mammalogy), TEALE (Insect Ecology, Pest Management), WEIR (Fungi and Humans)

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 associate Visitor 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.)

Participating Faculty: CASTELLO (Plant Virology), FERNANDO (Plant Developmental Biology), MITCHELL (Environmental Energetics), NAKAS (Microbial Physiology), NAKATSUGAWA (Insect and Vertebrate Toxicology), SMART (Plant Physiology), TURNER (Animal Physiology)

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.)

Participating Faculty: BALDASSARRE (Waterfowl), FRAIR (Vertebrate and Landscape Ecology), GIBBS (Vertebrate Conservation Biology, Genetic Considerations, Reptiles and Amphibians), LIMBURG (Fish and Riverine Ecology), LOMOLINO (Mammalian Diversity, Biogeography), PORTER (Vertebrate Ecology), RINGLER (Fisheries, Aquatic Ecology), SHIELDS (Vertebrate Behavior), SCHULZ (Plankton Ecology, Limnology), STEWART (Fisheries, Aquatic Ecology), TURNER (Vertebrate Physiology), UNDERWOOD (Wildlife Population Dynamics)

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. Graduate education is rapidly becoming a universal prerequisite to employment as a professional fisheries or wildlife biologist. A major strength is the diversity of cooperators including the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, U.S. Geological Survey and the New York State Department of Environmental Conservation.

Areas of research include population habitat relationships, predator ecology, fish behavior, wildlife in Adirondack ecosystems, urban wildlife relationships, endangered species studies, feeding ecology of fishes, stream ecology, Great Lakes fisheries, ecology of larval fishes and estuarine properties of Great Lakes wetlands.

Forest Pathology and Mycology (M.S., M.P.S., Ph.D.)

Participating Faculty: ABRAHAMSON (Forest Pathology, Entomology), CASTELLO (Forest Pathology), FERNANDO (Plant Developmental Ecology), KRETZER (Molecular Biology, Evolution), NAKAS (Microbiology), POWELL (Plant Pathology and Molecular Biology), SMART (Plant Physiology, Molecular Biology)

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 Science and Biotechnology (M.S., M.P.S., Ph.D.)

Participating Faculty: CASTELLO (Virology), FERNANDO (Plant Developmental Biology), C. HALL (Systems Ecology), HORTON (Ecology, Fungal Communities, Mycorrhizal Relationships), KIMMERER (Bryocology, Restoration Ecology), KRETZER (Molecular Biology, Evolution), LEOPOLD (Dendrology, Community Ecology), MCGEE (Plant Ecology), NAKAS (Microbiology), POWELL (Plant Pathology and Molecular Biology), SMART (Plant Physiology, Molecular Biology)

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 man 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.)

Participating Faculty: BOYER (Environmental Biochemistry), GINER (Natural Insecticides), NAKAS (Microbial Ecology), NAKATSUGAWA (Xenobiotic Plant-Animal Interactions), TEALE (Insect Pheromones), TEECE (Chemical-Thermal Relationships), WEBSTER (Pheromone Chemistry)

The area of study in chemical ecology is offered through collaboration between the Faculty of Environmental and Forest Biology and the Faculty of Chemistry. Interested students should apply to the Faculty 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.

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 Faculty of Environmental Resources and Forest Engineering

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www.esf.edu/erfeg

Participating Faculty:

DALEY (Water Resources, Solid and Hazardous Waste Management, Ecological Engineering, Environmental Restoration), DAVIS (Forest Harvest Systems, Forest Operations), ENDRENY (Environmental Engineering, Engineering Hydrology, Watershed Management), J.M. HASSETT, Chair (Environmental Engineering, Water Resources), KROLL (Stochastic and Deterministic Hydrology, Environmental and Water Resource Systems Engineering), MOUNTRAKIS (Brownfield Studies, Geo-Spatial Information Systems, Mapping Sciences, Water Resources), QUACKENBUSH (Survey Engineering, Spatial Measurements, Geo-spatial Information Systems) SHENG (Photogrammetry, Remote Sensing, Geographic Information Systems (GIS), and their applications), TULLY (Structures, Engineering Hydrology, Water Resources)

The Faculty of Environmental Resources and Forest Engineering performs teaching, research and public service activities to promote engineering practices to meet the needs of present and future generations of New Yorkers and other citizens of the world. The Faculty offers an accredited program in forest engineering. The program originated at ESF in 1971. With more than 700 graduates now in engineering practice, this unique program offers a breadth of engineering science and design coursework unparalleled in the United States. Required coursework in the humanities and social sciences ensures a well-balanced educational experience for graduates entering professional practice in engineering or those moving directly on to graduate school.

Bachelor of Science in Forest Engineering

The objectives of the program are to prepare baccalaureate students who:

- Will engage in professional engineering practice while employed by government agencies, industry and private consulting 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 natural resources engineering, mapping sciences and water resources; 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.

A broad base of study in the fundamentals of engineering enables graduates to enter professional practices that focus on civil works as well as use and protection of soil, water, air and other renewable and nonrenewable resources to ensure sustainable development.

Emphasis in this unique program is placed on applications in resource inventory and evaluation; site analysis and development; environmental monitoring and impact assessment; environmental systems design, evaluation and management; structures and transportation systems; pollution abatement and residuals management; and environmental site remediation.

The special importance of continual measurement and evaluation of the broad-scale parameters that affect the resource

base provides unique opportunities for study to students aiming toward professional careers involving the conceptualization, design and maintenance of geographically referenced resource information systems.

Graduates of the program enjoy many benefits derived from their capstone-curriculum course in engineering planning and design. This project-oriented course serves to help the student integrate four years of education to solve complex design problems commonly encountered in professional practice.

Students with an interest in graduate study can plan their undergraduate studies along an individualized track to prepare themselves for ESF's master of science program in environmental and resource engineering. In this way, students who qualify will be admitted to a quality graduate program with minimal inconvenience or interruption in their studies.

In addition, qualified graduates in search of additional education find ready acceptance to engineering graduate schools throughout the country.

The forest engineering program is accredited by the Engineering Accreditation Commission/Accreditation Board for Engineering and Technology (EAC/ABET).

Students having advanced placement credits are encouraged to work closely with their advisor in order to best prepare for various upper-division elective sequences in technology, science, design or management.

The undergraduate curriculum in forest engineering consists of two broad categories of courses. The general education component provides students with knowledge and skills that are useful and important for all educated persons. The second category, professional courses, provides students with direct preparation for a career.

Students may be admitted directly as first-year freshman students at ESF, or through a variety of transfer options. To enter the curriculum at the sophomore or junior level, a transferring student must have acceptable college credit in the designated coursework areas or suitable coursework substitutions. Regardless of which way students enter ESF, they must complete both the general and professional education requirements.

Undergraduate Program Requirements

Lower Division Required Courses (60-61 credits)

COURSES				CREDITS
APM	153	Computing Methods for Engineers and Physical Scientists	PE ¹	3
CLL	190	Writing and the Environment	G ² , NS ³	3
CLL	290	Writing, Humanities and the Environment	G	3
EFB	226	General Botany	G, NS	4
ELE	231	Electrical Engineering Fundamentals	PE, E	3
ERE	221	Engineering Mechanics: Statics	PE, E ⁴	3

¹ Professional engineering course

² Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed on page 8 and on the Internet at www.suny.edu/provost/GeneralEducation/CourseList/ESFGERCourses.pdf

³ Natural science course

⁴ Engineering course

ERE	222	Engineering Mechanics: Dynamics	PE, E	2
ERE	225	Engineering Graphics	PE	1
ERE	362	Mechanics of Materials ⁵	PE, E	3
FCH	150	General Chemistry I	NS	3
FCH	151	General Chemistry Laboratory I	NS	1
FCH	152	General Chemistry II	NS	3
FCH	153	General Chemistry Laboratory II	NS	1
FEG	132	Orientation Seminar: Forest Engineering ⁶	PE	1
FOR	207	Introduction to Economics	G	3
MAT	295	Calculus I	G, M ⁷	4
MAT	296	Calculus II	M	4
MAT	397	Calculus III	M	4
MAT	485	Differential Equations/Matrix Algebra	M	3
PHY	211	General Physics I	NS	3
PHY	221	General Physics Laboratory I	NS	1
PHY	212	General Physics II	NS	3
PHY	222	General Physics Laboratory II	NS	1

FEG	363	Photogrammetry I	ED	3
FEG	410	Structures	ED	4
FEG	420	Harvest Systems Analysis		1
FEG	430	Engineering Design Analysis	E	3
FEG	437	Transportation Systems	ED	3
FEG	454	Power Systems	ED	2
FEG	489	Forest Engineering Planning and Design	ED	3
FOR	321	Forest Ecology and Silviculture		3
FOR	360	Principles of Management		3
MAE	341	Fluid Mechanics	E	4

Electives (12 credits)

Elective in Engineering Design Sequence ¹⁰	ED	6
General Education Course	G	3
General Education Course	G	3

TOTAL MINIMUM CREDITS FOR THE DEGREE 132-133 CREDITS

Electives (6 credits)

General Education Course	G	3
General Education Course	G	3

Upper Division Required Courses (55 credits)

APM	395	Probability and Statistics for Engineers	M	3
CIE	337	Soil Mechanics and Foundations I	ED ⁸	4
EFB	336	Dendrology		3
ERE	351	Basic Engineering Thermodynamics	E	2
ERE	371	Surveying for Engineers	E	4
ERE	440	Water Pollution Engineering	ED	3
ESF	332	Seminar for New Transfer Students ⁹		0
FEG	300	Engineering Design	ED	1
FEG	340	Engineering Hydrology and Hydraulics	ED	4
FEG	350	Introduction to Remote Sensing for Engineers	E	2

Graduate Programs

Graduate studies and research are primarily concerned with environmental and resource-related problems. Students with a bachelor of science degree in engineering or in forestry, natural sciences, physics, or mathematics have the opportunity to design an individual program of graduate study. The Faculty of Environmental Resources and Forest Engineering participates in graduate education leading to the advanced certificate in advanced engineering tools, and the master of science, master of professional studies and doctor of philosophy degrees in environmental and resource engineering. See page 44 for further information about graduate program options in environmental and resource engineering.

Support for graduate study and research in these areas is both internal and external. The internal support includes modern laboratory and instrumentation facilities in the engineering faculties at both ESF and Syracuse University. Exceptional support exists for programs in environmental engineering measurements in the form of remote sensing and photogrammetric laboratories and the extensive properties owned by the college at which research may be conducted. Dedicated laboratories are also available for students working in water resources engineering, solid waste management and hazardous waste site remediation.

⁵ Students who transfer to ESF typically take this course as part of their upper-division requirements, having already completed a general education course at the lower division.

⁶ Required for students who enter as freshmen.

⁷ Math course

⁸ Engineering design course

⁹ Required for students who transfer to the upper division.

¹⁰ An upper-division engineering course that is part of an advisor-approved sequence that complements other engineering coursework and provides the equivalent of at least one credit hour of depth in the design and synthesis component of the program. Courses include: CIE 332 Structures II, CIE 338 Soil Mechanics II, ERE 441 Air Pollution Engineering, FEG 464 Photogrammetry II, ERE 445 Hydrologic Modeling, ERE 506 Hazardous Waste Management, or Advanced Topics in Hydraulics

The Faculty of Environmental Studies

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Participating Faculty

DeBAISE (Environmental Writing), FELLEMAN (Environmental Decision Making, Environmental Information Policy), M. HALL (Urban Ecosystems), JAEGER (Environmental Writing), JASER (Environmental Writing), LAWLER (Literature of Nature), MANNO (Sustainable Development, Ecological Economics), MEISNER (Environmental Thought and Communication), MORAN (Environmental Policy and Politics), NORDENSTAM (Environmental Risk Perception and Assessment, Environmental Policy and Policy Analysis), SENECAH (Environmental Interest Groups, Environmental Communication Processes), SMARDON, Chair (Landscape and Environmental Planning, Visual Resource Analysis, Environmental Assessment/Administration, Wetland Assessment), WHITMORE (Environmental Writing)

Visiting Faculty

KEENAN (Cultural Ecology)

Supporting Faculty

CARTER (Community Planning and Design), DEMING (Landscape Design, History and Theory; Urban Design; Design Research), DOBLE (Community Planning and Design), ENDRENY (Hydrologic Modeling), C. HALL (Systems Ecology), J.M. HASSETT (Environmental Modeling, Waste Management, Public Policy and Environmental Regulation, Energy Resources and Systems), HAWKS (Community Planning and GIS), JOHNSON (Environmental Chemistry), KROLL (Environmental Modeling), KUEHN (Recreation Management), LEOPOLD (Aquatic Ecology), LIMBURG (Aquatic Ecology), LUTZ (Wetland Ecology), LUZADIS (Natural Resource Policy), MALMSHEIMER (Natural and Environmental Resource Law), MITCHELL (Biogeochemistry, Nutrient Cycling), NAKATSUGAWA (Toxicology, Health Impacts of Chemicals), SAUNDERS (Environmental Interpretation), SCHUSTER (Recreation Planning), SHANNON (Urban Analysis and Design), WAGNER (Environmental Economics)

Adjunct Faculty

BRECHIN (Environmental Sociology), D. CARTER (Writing), CONENA (Writing), COURTWRIGHT (Writing), DURKIN (Environmental Risk Assessment), EFFLER (Water Quality Modeling), EMERY (Research Geographer), FERRANTE (Watershed Ecology and Management), GOLDSMITH (Environmental Law), HUNT (Environmental Health Effects), KUSLER (Water and Wetland Policy), NOWAK (Urban Ecosystems), SAGE (Community Building), TAYLOR (Writing), WALKER (Writing)

Bachelor of Science in Environmental Studies

To address environmental issues, we must first understand the problems that underlie them. Because those issues and problems exist at the interface of complex human and natural systems, understanding them requires the right synthesis of scientific, social, and cultural knowledge. Addressing those problems also requires scientific, social and cultural skills. The Environmental Studies program at SUNY-ESF offers students just those sorts of learning and skill-development opportunities in the context of a well-rounded, yet substantial, education.

The program has been carefully designed to provide students with as comprehensive an understanding of environmental affairs as is

possible in an undergraduate education. That means learning about the scientific diagnosis of environmental issues and having enough scientific knowledge to work with scientists. It also means learning about the technological, social and cultural causes of those issues. Finally, it means understanding the diversity of approaches needed to treat the problems. In the pursuit of these objectives, we bring together philosophical, theoretical and practical perspectives on a wide range of environmental concerns. In this way, our program prepares students with the knowledge, skills and experience to work for a more ecologically sustainable and socially just world.

Because the environmental studies program is broadly multi-disciplinary as well as interdisciplinary, it provides students with a broad-based liberal education and asks them to be proficient across a breadth of scholarly and practical areas. Graduates of the environmental studies program have gone on to graduate school in many different disciplines as well as to law and medical school. They have also proceeded to work in nongovernmental organizations (NGOs), education, government, and the private sector, pursuing careers in such areas as policy, advocacy, conservation, consulting, administration, law, and education to name just a few.

Guiding Principles

There are six principles that guide the design and implementation of the environmental studies program:

- *holistic interdisciplinary education*: we seek to offer our students an education that demonstrates the interconnectedness and integration of the many disciplines and fields that intersect with environmental concerns.
- *critical skills*: we encourage our students to be active learners and prepare them with invaluable life-long skills, including research, analysis, writing, and critical thinking.
- *diversity and complexity*: we encourage our students to recognize and value the diversity and complexity of ecological and social systems, and of the perspectives that inform society's understanding of environmental affairs.
- *ecological literacy*: we seek to develop students' awareness, knowledge, and appreciation of the intrinsic values of ecological processes and communities.
- *justice and equity*: we encourage students to value social and ecological justice and equity in all contexts.
- *thoughtful professionalism*: we seek to prepare our students to be reflective and sensitive, yet also effective and professional, in whatever endeavors they choose to pursue.

Program Description

In the first two years of the program students develop a foundation in the humanities, social sciences, 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.

In the final two years of the program, students may choose to pursue one of three specializations: environmental communication and culture, environmental policy, or biological science applications. In each of these options, students have the flexibility to pursue more specific interests. Also, several undergraduate minors, including a minor in urban environments, are available.

Environmental Communication and Culture: This option focuses on the many ways that communication, broadly defined, intersects environmental affairs. These include activism, media, education, public participation, and conflict resolution. In addition, the option helps students explore the diversity of ways that environmental

problems are understood, and ways that cultural meanings of nature are expressed, including through literature and the arts.

Environmental Policy: This option is concerned with how environmental policies are created, implemented and contested. It emphasizes legislative, regulatory, and collaborative approaches to environmental issues.

Biological Science Applications: This option is designed for students interested in the interface between biology and socio-economic issues. It provides an emphasis on biology with an eye to the interaction with societal issues ranging from education to habitat management.

In addition to traditional courses available through the core environmental studies curriculum and in the options, our program features the following:

- community engagement through service learning in a number of courses
- internships that provide valuable hands-on experience
- opportunities to study abroad for a semester

The scope and complexity of coursework within the environmental studies program demands both discipline and commitment from students seeking this degree. But the value of a broad education is widely acknowledged by educators and professionals. We hope that in offering this program we can prepare students not only to work in the diverse field of environmental protection, but also in any area that might interest them after graduation.

The undergraduate curriculum in environmental studies 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. General education courses also help prepare students for advanced courses leading to a specific profession. The second category, professional courses, provides students with direct preparation for specialization in environmental studies and career opportunities.

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.

The following table outlines the specific course requirements for the degree in environmental studies. Please refer to the student handbook, available online at www.esf.edu/es, for details on how individual courses meet program requirements and for lists of courses that fulfill specific requirements.

Undergraduate Program Requirements

Lower Division Environmental Studies Core Courses (62-63 credits)

COURSES			CREDITS
EST	132	Orientation Seminar: Environmental Studies ¹	1
APM	296	Precalculus OR	G ³ 4
APM	105	Survey of Calculus and its Applications ²	
APM	255	Computing Applications	3
CLL	190	Writing and the Environment	G 3
CLL	290	Writing, Humanities and the Environment	G 3

¹ For students who enter as freshmen.

² Students who pursue the biological science applications option need to complete APM 105 Survey of Calculus and its Applications.

³ Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed on page 8 and on the Internet at www.suny.edu/pravast/GeneralEducation/CourseList/ESFGERCourses.pdf

EFB	120	Global Environment		3
EFB	226	General Botany	G	4
EFB	285	Principles of Zoology ⁴		3-4
OR				
GOL	106	Environmental Geology		
ESF	200	Information Literacy		1
EST	200	Cultural Ecology	G	3
EST	221	Introduction to American Government		3
EST	245	Nature and Popular Culture		3
FCH	150	General Chemistry I		3
FCH	151	General Chemistry Laboratory I		1
FOR	207	Introduction to Economics	G	3
		General Education Course: American History	G	3
		General Education Course: Western Civilization	G	3
		General Education Course: The Arts Electives ⁵	G	3
				12-13

Upper Division Environmental Studies Core Courses (34-35 credits)

ESF	332	Seminar for New Transfer Students ⁶		0
APM	391	Introduction to Probability and Statistics		3
CLL	410	Writing for Environmental Professionals		3
EFB	320	General Ecology		4
EST	321	Government and the Environment		3
EST	361	History of the American Environmental Movement OR		3
EST	366	Attitudes, Values and the Environment		
EST	388	Psychological Principles of Risk Communication OR		3
EST	390	Social Processes and the Environment Upper Division Computing OR		3-4
				Natural Science Course
				Electives
				9
				Senior Synthesis
				3

Environmental Communication and Culture Option Requirements (27 credits)

CMN	393	Environmental Discourse		3
CMN	493	Environmental Communication Workshop		3
CRS	338	Communication in Organizations		3
		Environmental Communication and Culture Methods Courses ⁷		6
		Environmental Communication and Culture Option Courses ⁷		12

Environmental Policy Option Requirements (27 credits)

ENS	550	Environmental Impact Analysis OR		3
				Law Course

⁴ Students who pursue the biological science applications option need to complete EFB 285 Principles of Zoology.

⁵ Students who pursue the biological science applications option need to complete FCH 152 and FCH 153 General Chemistry II and General Chemistry Laboratory II as one of these electives.

⁶ Only for students who enter as transfer students.

⁷ Lists of possible courses are available in the ES Student Handbook, online at www.esf.edu/es.

Policy Methods Courses ⁷	6
Law Course ⁷	3
Environmental Policy Option Courses ⁷	15

Biological Science Applications Option Requirements⁸ (27 credits)

Microbes Course ⁷	3
Plants Course ⁷	3
Animals Course ⁷	3
Geographic Information Systems course ⁷	3
Policy or Law Course ⁷	3
Biology Focus Area Courses ⁷	12

TOTAL MINIMUM CREDITS FOR THE DEGREE 122-125 CREDITS

Note: Total credits must include a minimum of 51 credit hours at the 300 level or above.

Undergraduate Minors

Students who meet eligibility requirements may take one of three minors in business: marketing, entrepreneurship, or general management studies; or the minor in computer and information technology. The minors are composed of courses taught at ESF and at Syracuse University. To be eligible for admission to one of the business minors, students must have a cumulative grade point average of 2.750 or better after one semester at ESF. To be eligible for admission to the minor in computer and information technology, students must have a cumulative grade point average of 2.800 or better after one semester at ESF.

In addition, ESF offers a campus-wide minor in urban environmental science that allows students to gain the ability to identify and analyze the biophysical and social aspects of urban environmental issues from a systems science perspective; develop awareness of how diverse social, cultural and urbanization forces influence human perception of, and relation to the environment; and develop the ability to synthesize efficient, equitable and sustainable management, policy and design strategies to improve and sustain the quality of life in the urban community. A complete description of minors available to ESF students is on page 9.

Graduate Program in Environmental Science (GPES)

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. It maintains a strong academic orientation, facilitating student and faculty engagement of fundamental environmental challenges such as federalism, participatory democracy, the uses and limits of scientific prediction, risk and sustainability.

The mission of GPES is to provide interdisciplinary education, research and public service to foster effective environmental stewardship and to prepare students to address environmental concerns and problems comprehensively. The program provides for the following:

- Multidisciplinary approach: recognition of the necessity to approach environmental problems with input from several disciplines and professions

⁸ Please note the specific lower division required courses for students in the biological science applications option. See footnotes 2, 4 and 5 above.

- Holistic perspective: awareness of and deference to the interdependence of elements within broadly defined ecosystems, including physical, biological, social and economic systems
 - Topical grounding: competency to understand and apply the principles of a particular subject of environmental inquiry in sufficient depth to interact with other disciplines and professional fields
 - Realistic experience: internships, focused projects, theses and seminars provide for direct interaction of legal, economic, political and social systems which underlie decision making
- The program's internal structure incorporates a common core that provides a broad policy-oriented foundation for the focused areas of study. Students applying to GPES must select which area of study they intend to pursue.

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.

Entering students should be adequately prepared to engage graduate level work in the program. The following undergraduate courses are pre- or co-requisites for all master's students: statistics, ecology and microeconomics or environmental economics. Courses in political science are strongly recommended.

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

The master of science degree is designed as a three-year experience.

CORE REQUIREMENTS

A core of nine credit hours in applied social sciences is required. In addition, a total of six credit hours is required in research methods. Course options which satisfy these requirements are designated by the area of study faculty.

AREA OF STUDY REQUIREMENTS

A minimum of 15 credit hours (excluding ENS 899) is required in the area of study, as determined by the major professor and area of study faculty. Area of study subcommittees maintain advising lists of courses pre-approved to satisfy the 15-credit area of study requirement. The student's major professor or steering committee may designate additional courses. Five study areas are available to M.S. students: environmental policy and democratic processes, environmental and community land planning, environmental systems and risk management, water and wetland resource studies, and environmental communication and participatory processes.

THESIS REQUIREMENTS

A minimum of six credit hours of research is required 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.

Master of Professional Studies

The master of professional studies degree is a 39-credit-hour experience aimed at professional applications of environmental knowledge.

CORE REQUIREMENTS

A total of 21 credit hours is required. These must include nine credit hours of applied social sciences in environmental policy and regulation, and democratic processes. In addition, a total of six credit hours is required in environmental science and six credit hours is required in methods courses emphasizing applications of technical knowledge.

AREA OF STUDY REQUIREMENTS

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 into the program. Five study areas are available to M.P.S. students: environmental policy and democratic processes, environmental and community land planning, environmental systems and risk management, water and wetland resource studies, and environmental communication and participatory processes.

SYNTHESIS REQUIREMENTS

Students select either an internship for three to six credit hours or prepare a synthesis paper for three credit hours. All students must present a capstone seminar in their final semester. No terminal comprehensive examination is required.

Applicants with a minimum of three years of post-baccalaureate, full-time professional experience directly related to the intended area of study may apply for six credit hours of advanced standing in the program, reducing their degree requirements to 33 credit hours. Partial credit for experience cannot be awarded. When awarded for prior work experience, the six credit hours are applied toward the synthesis requirement.

Doctor of Philosophy

The Ph.D. program provides a unique opportunity to develop environmental policy-related research within a strong college community of environmental analysts and to draw upon the expertise of scholars at Syracuse University. All applicants are expected to have completed a master's research thesis. A copy of the thesis abstract should accompany the application. In addition, 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.

Areas of Study

Environmental Communication and Participatory Processes (M.S., M.P.S., Ph.D.)

Participating Faculty: DeBAISE, KUEHN, LAWLER, MEISNER, SENECAH, WHITMORE

This study area addresses the communicative dynamics of the formation of attitudes. It includes decision making, public policy, public participation, campaign development, organizational effectiveness, and conflict prevention and resolution, which all hinge on the ability of participants to communicate and use information effectively, strategically and ethically. GPES students with this option will be prepared to enter diverse arenas of industry, non-government organizations and government structures well equipped to facilitate and participate in effective interactions among individual citizens, nongovernment organizations, publics, agencies, bureaucracies, scientists and others. They will have the skills and knowledge that will allow them to choose the more appropriate and effective process structures and strategies to reach objectives.

Environmental and Community Land Planning (M.S., M.P.S., Ph.D.)

Participating Faculty: CARTER, DEMING, DOBLE, M. HALL, HAWKS, SCHUSTER, SHANNON

Environmental and community land planning is concerned with orderly, efficient, equitable and aesthetic development of land with special concern for the state of the natural environment, the physical character of communities, and decision making at state, county and local levels of government. Planning balances competing demands on land and environment brought about by expanding urban and rural development, and enhancing viable natural and

cultural resources is an important planning perspective. Another perspective involves the guiding of private and public development processes within a pluralistic political environment in order to promote sustainable communities while at the same time respecting fiscal, environmental and legal constraints.

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 Systems and Risk Management (M.S., M.P.S., Ph.D.)

Participating Faculty: ENDRENY, C. HALL, JOHNSON, KROLL, LUZADIS, MITCHELL, NAKATSUGAWA, NORDENSTAM

The environmental systems and risk management study area focuses on problems in environmental and natural resource policy in which scientific and technical issues are of central importance. The program is designed for graduate students with a science or engineering background. Current research includes spatial model construction, ecosystems modeling, development of model assessment and selection criteria, environmental risk assessment, use of technical information by regulatory agencies, land use forecasting for public policy decision making, and water resources assessment and planning. The environmental systems and risk management area of study provides a unique opportunity to study interdisciplinary problems. Specific coursework in environmental systems and risk management is supplemented by traditional disciplinary coursework in engineering or the natural sciences and policy analysis.

Environmental Policy and Democratic Processes (M.S., M.P.S.)

Participating Faculty: FELLEMAN, LAWLER, LUZADIS, MALMSHEIMER, MEISNER, MORAN, NORDENSTAM, SENECAH, SMARDON, WAGNER

The environmental policy and democratic processes study area addresses problems of environmental decision making at a time of rapid institutional and social change. How our society can best meet the growing challenges of environmental stewardship through mandated and voluntary public participation in decision making is the central question. This concern is increasingly important to many segments of modern society, and we intend that students acquiring knowledge in this study area will be prepared to contribute positively to these processes in career pursuits.

The focus of this study area is on developing new understanding of public participation in environmental decision making, against the backdrop of environmental policymaking and program implementation. Particular attention is given to (a) the variety of organizations involved in participation, which generally are the institutions and agencies of government, citizen-based non-governmental organizations and the business or industrial sector; (b) the availability and utility of environmental information for these groups; and (c) the participation and integration of all informed stakeholders into environmental decision making. This tripartite scheme of organizations, information and participation frames student programs of study, and suggests important directions for student and faculty research efforts.

The study area advances understanding of these questions of participatory democracy for environmental decision making through research and instruction, and is particularly suited to inquisitive students with degrees in environmental studies, political science,

geography, engineering and other fields that provide interdisciplinary backgrounds in natural and social science.

Water and Wetland Resource Studies (M.S., M.P.S., Ph.D.)

Participating Faculty: ENDRENY, KROLL, LIMBURG, LUTZ, MORAN, SMARDON

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.

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.

Environmental and Natural Resources Policy (Ph.D.)

www.esf.edu/enrp

Participating Faculty: FELLEMAN, FLOYD, GERMAIN, LUZADIS, MALMSHEIMER, MANNO, MORAN, NORDENSTAM, SENECAH, SMARDON, WAGNER

The environmental and natural resources policy Ph.D. program is a collaborative program offered by both the Faculty of Environmental Studies and the Faculty of Forest and Natural Resources Management. This study area investigates how societies formulate and implement decisions regarding environmental and natural resources. Doctoral students integrate the biophysical sciences and policy-related social sciences to solve important problems in environmental and natural resources policy with applications throughout the world. The program offers an opportunity to work with outstanding faculty members on applied and theoretical studies.

Faculty members conduct studies at international, national, state and local levels on sustainability, implementation and administration of environmental, natural resources, and forest management programs and economic and institutional influences and impacts of government and non-government policies. The applications include environmental, natural resources and forest policy and administration; and environmental, natural resources, forest and ecological economics.

The environmental and natural resources policy (ENRP) doctoral program is a highly individualized program with coursework and research determined in consultation with the student, major professor, and steering committee. Some coursework requirements may be met by transferring graduate credits as approved by the steering committee. Students may also fulfill coursework requirements by completing courses offered by the Maxwell School of Citizenship and Public Affairs at Syracuse University. Specific degree requirements are described in the Handbook for Environmental and Natural Resources Policy Ph.D., available in 320 Bray Hall, 107 Marshall Hall, and on the ENRP Web site.

Students are expected to complete requirements resulting in a coherent body of theory, a depth of understanding in a specified area of biophysical science, appropriate research methods, and advanced policy analysis and understanding.

The following four core competencies must be satisfied prior to the doctoral candidacy examination. A minimum of 12 credits is required in each area:

Natural science: graduate courses (500 level or higher) in a definable area of biophysical science

Policy-related social science: 600-level or higher courses including at least one government course and one economics course

Research methods: 600-level or higher courses including a general research methods course (required), qualitative methods, quantitative statistical methods, GIS, or spatial statistics

Advanced environmental and natural resources policy: 600-level or higher courses including policy analysis and program evaluation (required).

Graduates have careers as university professors and advanced policy or program analysts. They often become leaders in government, legislatures, corporations, not-for-profit organizations, advocacy groups and academic institutions, consulting firms and village associations throughout the world.

Certificate of Graduate Study in Environmental Decision Making

Purpose

The certificate of graduate study in environmental decision making is designed for graduate students 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' primary professional interests in the fields identified. Because students in each of these programs will engage important environmental policy, program implementation and decision-making processes in their professional efforts, the distinctive environmental orientation of this certificate program will help students to better understand some of the complexities of environmental decision making from their unique professional perspectives.

The focus of certificate study is on environmental decision making, which can be defined as the process by which stakeholders in environmental outcomes engage in communications to seek solutions to environmental problems. Familiarly, decision making can refer to environmental policy making by governmental institutions, but a meaningful understanding of the topic in today's world will also include processes such as information acquisition and dissemination and such notions as negotiation, mediation, information policy and public participation as part of the decision-making lexicon. The decision-making focus furthermore expands the scope of stakeholders to include not only the institutions and agencies of government, but also the large variety of citizen-based nongovernmental organizations and the business and industrial private sector.

Student Eligibility

Graduate students currently matriculated and in good academic standing in their law, management, public administration, or information studies degree programs at Syracuse University are eligible to apply for entrance into the certificate program. Applications from any other sources cannot be accepted at this time.

Administrative Procedures

Application and admissions procedures, compliance with college requirements for successful graduate study and the awarding of certificates are all administered by the SUNY-ESF dean of Instruction and Graduate Studies. If enrollment limitations are established, acceptances will be made on a rolling basis, according to the date of receipt of applications.

Student applications are made by completing the application form found in the advising guide. This provides contact information for applicants and verifies their matriculated status at Syracuse University. Upon completion of program credit-hour requirements, students file a certificate request form, which identifies completed

coursework and initiates actions to produce official transcripts, leading to the award of the certificate.

Forms are available in the college's Office of Instruction and Graduate Studies, 227 Bray Hall, and in the Faculty of Environmental Studies Office, 107 Marshall Hall. To assist certificate students in making suitable course selections and to answer related program questions, students should contact Dr. Richard Smardon, 106 Marshall Hall.

Academic Advisement

Prospective students are encouraged to speak with their Syracuse University academic advisors about the advisability of and timing for entering this certificate program. Students might also wish to contact the following persons, who are knowledgeable of certificate goals and requirements:

- Law: Margery Connor, associate dean for student affairs
- Management: Peter Koveos, associate dean
- Public Administration: Christine Omolino, program coordinator
- Information Studies: Thomas Martin, professor

The Faculty of Forest and Natural Resources Management

CHAD P. DAWSON, Chair
320 Bray Hall
315-470-6536; FAX 315-470-6535
www.esf.edu/faculty/for

The Faculty of Forest and Natural Resources Management (FNRM) offers programs leading to the bachelor's, master's and doctoral degrees at the main college campus in Syracuse, N.Y. and two programs leading to the associate in applied science (A.A.S.) degree at the Ranger School in Wanakena, N.Y. See page 103 for information about the associate of applied science degrees in forest technology and land surveying technology.

Faculty

ABRAHAMSON (Integrated Vegetation Management, Woody Biomass Energy), ABDEL-AZIZ (Applied Mathematics), BEVILACQUA (Forest Measurements, Statistics), BRIGGS (Forest Soils, Silviculture), DAVIS (Forest Operations, Harvest Planning, Operations Research), DAWSON, Chair (Recreation Management, Wilderness Management), DREW (Tree Physiology, Forest Ecology, Physiological Ecology), FLOYD (Public Policy in Forest and Natural Resources Management), GERMAIN (Sustainable Forestry Systems, Business), HERRINGTON (Resource Information Management, Geographic Information Systems), KUEHN (Recreation Resources Management and Tourism), LAUTZ (Hydrology, Watershed Management), LAVIE (Applied Mathematics), LUZADIS (Non-market Values, Ecological Economics), MALMSHEIMER (Forest and Natural Resources Law and Policy), MAYNARD (Tree Improvement, Plant Tissue Culture and Transformation), MORRISON (Resource Sociology and Urban Forestry), C. NOWAK (Silviculture, Intensive Forestry, Forest Vegetation Management), NYLAND (Silviculture and Forest Management), SCHUSTER (Recreation Resources Management), STEHMAN (Statistics, Environmental Sampling), STELLA (Watershed Management), VONHOF (Natural Resources History), WAGNER (Forest Resource Economics, Business), E. WHITE (Soils, Tree Nutrition), YANAI (Forest Soils, Ecosystem Nutrient Cycling, Simulation Modeling), ZHANG (Biometrics, Quantitative Silviculture)

Adjunct Faculty:

BICK, BURNS, CASTRO, HEISLER, NEUHAUSER, D. NOWAK, ROBISON, STOUT, VERVERS, D. WHITE, WOOD

Mission and Vision

ESF's forest and natural resources management programs are science-based and values-driven. The integration of values and scientific facts characterize professions that are successful in democracies. ESF-trained foresters and natural resource managers are able to integrate these two threads in America's complex society.

The mission of ESF forest and natural resources management programs is to produce knowledge and to transmit it to 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 on a sustainable basis for people.

The faculty's vision of professional forest and natural resource managers is that they are: problem solvers who master disciplinary knowledge and skills, then integrate them to protect and manage forest and natural resources; and leaders who help people solve the more complex problems with the world's forest and natural resources.

ESF forest and natural resources management's educational goals, as a consequence, are to:

- Understand forests and related natural resources — how they function and their dynamics;

- Be skilled in manipulating forests and predicting the consequences;
- Monitor citizen and owner values of forests and other natural resources and be respectful of them; and
- Integrate values with scientific facts and know the limits of our knowledge.

Undergraduate Programs

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:

- Management skills including leadership, communication skills, and teamwork;
- Scientific knowledge and technical skills in measurements and analysis for management;
- The ability to analyze and solve resource management problems using both social and biophysical sciences, and
- 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 complete an upper-division option in environmental and natural resources management, recreation resources management or water resources management.

Bachelor of Science in Forest Resources Management

Professional forestry education has been featured at ESF since the College's founding in 1911. Today's forest resources management program is based on a clear vision that combines professional competency with a strong foundation in the biophysical sciences, humanities, and social sciences to meet society's needs for forest managers.

Many ESF students enjoy trees and forests and want to work in forested settings. They appreciate nature, and want to master the knowledge and skills needed to conserve and manage forests and the environment. With 25,000 acres of college forest lands as teaching and research laboratories, ESF provides many opportunities to meet student needs for experiential learning. The forest technology program at ESF's Wanakena campus prepares students for careers in field forestry and is a route to the forest resources management program that emphasizes field practice. Internships with forest-based organizations in the private, public and nonprofit sectors amplify these hands-on experiences. Practical experience is combined with learning concepts and problem solving and critical thinking skills in the classroom and laboratory on ESF's Syracuse campus. The educational outcomes of the forest resources management degree program are among the best anywhere in North America.

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, 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 resource management fields.

The educational program in forest resources management, leading to the first professional degree in forestry of the bachelor of science in forest resources management is 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.

Forest management offers a wide variety of employment opportunities. Our graduates are working throughout the United States as professional foresters and natural resource managers in public agencies, private industry, and for nonprofit organizations. Their duties range from timber management to recreation planning to environmental education, to name a few.

The undergraduate curriculum in forest resources management 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.

Summer Program in Field Forestry

The Summer Program in Field Forestry is required for ALL students in forest resources management. 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 two courses: FOR 301 Adirondack Forest Ecology and Dendrology and FOR 303 Introduction to Forest Resources Measurements. Students must complete the summer program before the junior year. However, the summer program may be completed after the freshman year. We encourage students to complete the summer program early because it expands job opportunities.

Program Admission

Students may follow one of three paths to enter and complete the forest resources management program:

- The freshman path is for students who enter ESF as a freshman and complete all degree requirements at ESF with the Summer Program in Field Forestry after the first or second year (first year preferred).
- The combined A.A.S./B.S. path is for students who wish to have more field measurement and field problem-solving skills and leadership development in context of forestry problems. The first year can be at ESF or another campus and the second year is spent at the Ranger School, Wanakena campus. Students then complete their B.S. degree requirements at ESF. This path can usually be completed in a total of four years.
- The transfer path is for students who complete all or part of their lower division coursework at another two- or four-year campus, attend the Summer Program in Field Forestry the summer before entering ESF and complete the upper-division requirements at ESF. Students preparing to transfer to ESF with full junior status must have earned at least 60 credits of college coursework.

Undergraduate Program Requirements

Lower Division Required Courses (53 credits)

COURSES			CREDITS
APM 105	Survey of Calculus and Its Applications I	G ¹	4
APM 391	Introduction to Probability and Statistics		3

¹ Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed on page 8 and on the Internet at www.suny.edu/provost/GeneralEducation/CourseList/ESFGERCourses.pdf

CLL 190	Writing and the Environment	G	3
CLL 290	Writing, Humanities and the Environment	G	3
CMN 220	Public Presentation Skills for Environmental Professionals		3
EFB 226	General Botany	G	4
EFB 285	Principles of Zoology		4
ESF 200	Information Literacy		1
EST 200	Cultural Ecology	G	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
FOR 132	Orientation Seminar: Forest and Natural Resources Management ²	PE ³	1
FOR 203	Western Civilization and the Environment	G	3
FOR 207	Introduction to Economics	G	3
FOR 332	Forest Ecology	PE	3
FOR 360	Principles of Management		3
PHY 211	General Physics I		3
PHY 221	General Physics Laboratory I		1

Electives (9 credits)

General Education Course: American History	G	3
General Education Course: The Arts Humanities Elective ⁴	G	3
		3

Upper Division Required Summer Courses (4 credits)

The summer following the first or second year, students must take:

FOR 301	Adirondack Forest Ecology and Dendrology	PE	1
FOR 303	Introduction to Forest Resources Measurements	PE	3

Upper Division Required Courses (39 credits)

EFB 336	Dendrology	PE	3
ESF 332	Seminar for New Transfer Students ⁵		0
FOR 322	Forest Mensuration	PE	3
FOR 323	Forest Biometrics		3
FOR 324	Natural Resources Information Systems		3
FOR 333	Managerial Economics for Environmental Professionals	PE	3
FOR 334	Silviculture	PE	4
FOR 345	Introduction to Soils	PE	3
FOR 370	Timber Management	PE	4
FOR 372	Fundamentals of Outdoor Recreation	PE	3
FOR 373	Forest Operations	PE	4
FOR 465	Natural Resources and Environmental Policy	PE	3
FOR 490	Integrated Resource Management	PE	3

Electives (24 credits)

Technical Electives ⁶	PE	12
Electives	PE	12

TOTAL MINIMUM CREDITS FOR THE DEGREE 129 CREDITS

² Required for students who enter as freshmen.

³ Professional education course

⁴ The program requires an additional humanities course.

⁵ Required for students who enter as transfer students.

⁶ Technical electives must include at least one course in vegetation manipulation, water resources, forest health, and wildlife management. Students should consult with their advisor and the Forest and Natural Resources Management Handbook for recommended courses.

Bachelor of Science in Natural Resources Management

The natural resources management program is based on a vision that combines professional competency in management skills with a strong foundation in the social and biophysical sciences. Students interested in this program typically are drawn to natural settings and environments, enjoy nature, and want to develop the professional knowledge and skills needed to conserve, steward and manage natural resources and the environment. ESF provides a wide variety of opportunities to meet student needs utilizing 25,000 acres of forest lands as teaching laboratories and college faculty in many natural resource management disciplines. Internships with natural resource-based organizations in the business, public and nonprofit sectors provide additional hands-on experiences. Experiential field learning is combined with learning concepts and skills in the classroom and laboratory on ESF's Syracuse campus.

The natural resources management program allows students to develop professional skills that employers tell us are the most important traits they look for in new employees. These traits are developed through a broad base of classes in the natural sciences, social sciences and humanities, communication, and quantitative and qualitative problem-solving skills. The majority of work scheduled during the first two years (lower division) is in these areas. This major prepares students to be well-rounded natural resources managers with an emphasis in environmental and natural resources management, recreation resources management, or water resources management and prepares them with a foundation for future graduate work.

Natural resources management offers a wide variety of employment opportunities. Graduates work throughout the United States in public agencies, private industry, and for nonprofit organizations. Their duties range from policy analysis for federal agencies to resource managers for nonprofit organizations; from recreation planning for state park agencies to recreation management in federal wilderness areas; and from watershed hydrologists to land managers maintaining surface water quality.

Students enrolled in the natural resources management degree program must complete one of three management-focused options: environmental and natural resources management, recreation resources management, or water resources management.

Environmental and Natural Resources Management Option

The environmental and natural resources management option is designed for students interested in careers managing natural and environmental resources. As human demands on the environment increase, society needs managers that understand the economic, demographic, social, and political issues that drive resource use allocation. Students learn how to integrate and balance the complexities of managing both resources and people recognizing that resource decisions involve value-driven conflicts. The option provides a comprehensive foundation in environmental and natural resources issues and an understanding of both biophysical and social science.

Students in the option are encouraged to enroll in one of the three ESF business minors: management studies, entrepreneurship, or marketing. These minors provide students with professional groundwork in business administration, such as accounting, finance, entrepreneurship, marketing, and human resources. Managers use this foundation for effective and efficient management and for successful program implementation.

This option allows students to customize their program of study by focusing on a particular resource or group of resources. It provides graduates the knowledge and skills necessary to work in a variety of managerial, legislative, regulatory, and other positions for environmental consulting firms, nonprofit organizations, public agencies, and industry. Option graduates may also choose to pursue graduate studies in a variety of disciplines, including policy, law, administration, or biological processes.

Recreation Resources Management Option

The recreation resources management option provides students with the opportunity to combine resources management with recreation management. This is a resources-oriented curriculum with consideration of the social, economic, and environmental factors related to their management. In addition, outdoor recreation courses provide professional insight into planning and managing natural resources for recreational users, tourists and visitors.

Consideration of the demand for public and private lands for recreational activities, or human dimensions, is placed in the curriculum after the student has a good understanding of the natural resources management situation. Understanding the motivations, preferences, and behavior of recreational users is necessary to integrate the human dimensions into natural resource management.

Recreation, tourism, and travel are an inter-related industry that is important to the economy of New York, northeastern region, and the entire nation. Recreation and tourism activities have both positive and negative social, economic, and environmental impacts at the local, regional, national, and global level. Natural resources managers need to be able to manage both the resource itself as well as a wide variety of users, such as campers, anglers, hikers, bird watchers, skiers, boaters, and others who enjoy forests, lakes, streams, mountains, and rural environments.

Water Resources Management Option

Water resources management prepares students for professional careers or graduate study in the rapidly expanding field of water resources. Protection, restoration, maintenance, and enhancement of aquatic resources are essential to society. Management of watersheds is becoming more important as the population increases and demand for high-quality water supplies grows.

As the name implies, this is a resource-oriented option. It is built on course offerings and faculty strengths throughout ESF and Syracuse University. These include the physical, chemical, and biological characteristics of water in its many natural and managed contexts. Equally important, the legal, social, political, and economic dimensions of water can be studied by students with policy and management aspirations.

Graduates may qualify for civil service hydrology positions, or find a variety of employment opportunities in public agencies, planning groups, private consulting firms, and non-profit organizations.

Summer Program in Field Forestry

The Summer Program in Field Forestry is required for ALL students in natural resources management. The summer 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 two courses: FOR 301 Adirondack Forest Ecology and Dendrology and FOR 303 Introduction to Forest Resources Measurements.

Students must complete the summer program before the junior year. However, the summer program may be completed after the freshman year. We encourage students to complete the summer program early because it expands job opportunities.

Program Admission

Students may follow one of three paths to enter and complete the natural resources management program:

- The freshman path is for students who enter ESF as a freshman and complete all degree requirements at ESF with the Summer Program in Field Forestry after the first or second year (first year preferred).
- The combined A.A.S./B.S. path is for students who wish to have more field measurement and field problem-solving skills and leadership development in context of forestry problems. The first year can be at ESF or another campus and the second year is spent at the Ranger School, Wanakena campus. Students then complete their B.S. degree requirements at ESF. This path can usually be completed in a total of four years.

- The transfer path is for students who complete all or part of their lower-division coursework at another two or four-year campus, attend the Summer Program in Field Forestry the summer before entering ESF and complete the upper-division requirements at ESF. Students preparing to transfer to ESF with full junior status must have earned at least 60 credits of college coursework.

Undergraduate Program Requirements

Lower Division Required Courses (52-53 credits)

APM	105	Pre-Calculus or Survey of Calculus and Its Applications I	G ⁷	3-4
APM	391	Introduction to Probability and Statistics		3
CLL	190	Writing and the Environment	G	3
CLL	290	Writing, Humanities and the Environment	G	3
CMN	220	Public Presentation Skills for Environmental Professionals		3
EFB	226	General Botany	G	4
EFB	285	Principles of Zoology		4
EFB	320	General Ecology		4
ESF	200	Information Literacy		1
EST	200	Cultural Ecology	G	3
FCH	150	General Chemistry I		3
FCH	151	General Chemistry Laboratory I		1
FCH	152/ 153	General Chemistry II and General Chemistry Laboratory II		4
PHY	211/ 221	General Physics I and General Physics Laboratory I		4
FOR	132	Orientation Seminar: Forest and Natural Resources Management ⁸	PE ⁹	1
FOR	202	Introduction to Sociology		3
FOR	203	Western Civilization and the Environment	G	3
FOR	207	Introduction to Economics	G	3
FOR	360	Principles of Management		3

Electives (9 credits)

		General Education Course: American History	G	3
		General Education Course: The Arts Humanities Elective ¹⁰	G	3

Upper Division Required Summer Courses (4 credits)

The summer following the first or second year, students must take:

FOR	301	Adirondack Forest Ecology and Dendrology	PE	1
FOR	303	Introduction to Forest Resources Measurements	PE	3

Upper Division Required Courses (12 credits)

ESF	332	Seminar for New Transfer Students ¹¹		0
FOR	333	Managerial Economics for Environmental Professionals	PE	3
FOR	345	Introduction to Soils ¹²	PE	3
FOR	465	Natural Resources and Environmental Policy	PE	3
FOR	490	Integrated Resource Management	PE	3

⁷ Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed on page 8 and on the Internet at www.suny.edu/provost/GeneralEducation/CourseList/ESFGERCourses.pdf

⁸ Required for students who enter as freshmen.

⁹ Professional education courses

¹⁰ The program requires an additional humanities course.

¹¹ Required for students who enter as transfer students.

¹² Or a geology course

Upper Division Elective Courses (25 credits)

		Applied Biology and Ecology Electives ¹³	PE	6
		Mathematics, Statistics, or Geospatial Analysis Elective	PE	3
		Senior Thesis, Internship, or Independent Study	PE	3
		Electives	PE	9

Environmental and Natural Resources Management Option Required Courses (24 credits)

CLL	405	Writing for Science Professionals	PE	3
FOR	321	Forest Ecology and Silviculture	PE	3
FOR	324	Natural Resources Information Systems	PE	3
FOR	488	Natural Resources Administration Law	PE	3
		Directed Electives in Environmental and Natural Resources Management	PE	12

Recreation Resources Management Option Required Courses (15 credits)

FOR	372	Fundamentals of Outdoor Recreation	PE	3
FOR	473	Planning and Development of Forest Recreation Areas	PE	3
FOR	475	Sociology and Psychology of Leisure Behavior	PE	3
FOR	476	Tourism Planning	PE	3
FOR	488	Natural Resources Administration Law	PE	3

AND at least nine credits from the following courses (9 credits)

EFB	390	Wildlife Ecology and Management		4
EFB	416	Introduction to Environmental Interpretation	PE	3
EFB	417		PE	3
FOR	478	Wilderness and River Recreation Management	PE	3
FOR	487	Fisheries Science and Management	PE	3

Water Resources Management Required Courses (24 credits)

FOR	321	Forest Ecology and Silviculture	PE	3
FOR	324	Introduction to GIS in Resources Management	PE	3
FOR	338	Meteorology	PE	3
FOR	340	Watershed Hydrology	PE	3
FOR	443	Forest Hydrology	PE	3
		Directed Electives in Hydrology, Ecosystems, or Management	PE	9

TOTAL MINIMUM CREDITS FOR THE DEGREE 122 CREDITS

Bachelor of Science in Forest Ecosystem Science

The bachelor of science in forest ecosystem science degree program 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. ESF provides a wide variety of opportunities to meet student needs utilizing 25,000 acres of forest lands as teaching laboratories. Internships with natural resource-based organizations in the business, public and nonprofit sectors provide additional hands-on experiences. Experiential field

¹³ Students should consult with their advisor and read the *FNRM Handbook* for lists of applied biology and ecology courses that can be elected to meet degree requirements.

learning is combined with learning concepts and skills in the classroom and laboratory on ESF's Syracuse campus.

The program allows students to develop professional skills that employers look for in new employees. These skills are developed through a combination of core courses required in the undergraduate programs in forest resources management and in environmental biology. Forest ecosystem science offers a wide variety of employment opportunities. Graduates work throughout the United States in public agencies, private industry, and for nonprofit organizations. They also are well prepared to enter graduate programs in management of natural resources, ecological research, or other areas of applied forest biology.

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.

Summer Program in Field Forestry

The Summer Program in Field Forestry is required for ALL students in forest ecosystem science. 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 two courses: FOR 301 Adirondack Forest Ecology and Dendrology and FOR 303 Introduction to Forest Resources Measurements.

Forest ecosystem science students must complete the summer program before the junior year. However, the summer program may be completed after the freshman year. We encourage students to complete the summer program early because it expands job opportunities.

Program Admission

Students may follow one of three paths to enter and complete the forest ecosystem science program:

- The freshman path is for students who enter ESF as freshmen and complete all degree requirements at ESF with the Summer Program in Field Forestry after the first or second year (first year preferred).
- The combined A.A.S./B.S. path is for students who wish to have more field measurement and field problem solving skills and leadership development in context of natural resource problems. The first year can be at ESF or another campus and the second year is spent at the Ranger School on the Wanakena campus. Students then complete their B.S. degree requirements at ESF. This path can usually be completed in a total of five years.
- The transfer path is for students who complete all or part of their lower-division coursework at another two- or four-year campus, attend the Summer Program in Field Forestry the summer before entering ESF, and complete the upper-division requirements at ESF. Students preparing to transfer to ESF with full junior status must have earned at least 60 credits of college coursework.

Program Requirements

Lower Division Required Courses (52 credits):

COURSES		CREDITS
APM 105	Calculus and Its Applications I	G ¹⁴ 4
APM 106	Calculus and Its Applications II	4
APM 391	Introduction to Probability and Statistics	3

¹⁴ Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet the general education standards established by SUNY is listed on page 8 and on the Internet at www.suny.edu/provost/GeneralEducation/CourseList/ESFGERCourses.pdf

CLL 190	Writing and the Environment	G	3
CLL 290	Writing, Humanities and the Environment	G	3
EFB 226	General Botany	G	4
EFB 285	Principles of Zoology		4
ESF 200	Information Literacy		1
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
FOR 132	Orientation Seminar: Forest and Natural Resources Management	PE ¹⁵	1
FOR 207	Introduction to Economics	G	3
FOR 332	Forest Ecology	PE	3
FOR 360	Principles of Management		3
PHY 211	General Physics I		3
PHY 221	General Physics Laboratory I		1

Lower Division Elective Courses (12 credits):

	General Education Course: American History	G	3
	General Education Course: The Arts	G	3
	General Education Course: Western Civilizations	G	3
	General Education Course: Other World Civilizations	G	3

Upper Division Required Summer Courses (4 credits):

The summer following the first or second year, students must take:

FOR 301	Adirondack Forest Ecology and Dendrology	PE	1
FOR 303	Introduction to Forest Resource Measurements	PE	3

Upper Division Required Courses (minimum 54 credits):

EFB 307	Principles of Genetics		3
EFB 308	Principles of Genetics Laboratory		1
EFB 311	Population Ecology and Evolution	PE	3
EFB 325	Cell Physiology		3
EFB 336	Dendrology	PE	3
EFB 351	Elements of Forest Entomology	PE	3
EFB 390	Wildlife Ecology and Management	PE	4
EFB 445	Plant Ecology	PE	3
FOR 322	Forest Mensuration	PE	3
FOR 323	Forest Biometrics	PE	3
FOR 324	Natural Resources Information Systems	PE	3
FOR 333	Managerial Economics for Environmental Professionals	PE	3
FOR 334	Silviculture	PE	4
FOR 345	Introduction to Soils	PE	3
FOR 370	Timber Management	PE	4
FOR 372	Fundamentals of Outdoor Recreation	PE	3
FOR 465	Natural Resources and Environmental Policy	PE	3
FOR 490	Integrated Resource Management	PE	3

Upper Division Elective Courses (9 credits):

	Directed Elective: Vegetation Management	PE	3
	Directed Elective: Watershed Management	PE	3
	Directed Elective: Organismal Diversity	PE	3

TOTAL MINIMUM CREDITS FOR THE DEGREE 132 CREDITS

¹⁵ Professional education course.

Undergraduate Minors

Forest and natural resources management students who meet eligibility requirements may take one of three minors in business: marketing, entrepreneurship, or management studies, or the minor in computer and information technology. The minors comprise courses taught at ESF and at Syracuse University. To be eligible for admission to one of the business minors, students must have a cumulative grade point average of 2.750 or better after one semester at ESF. To be eligible for admission to the minor in computer and information technology, students must have a cumulative grade point average of 2.800 or better after one semester at ESF.

ESF offers a campus-wide minor in urban environmental science that allows students to (1) gain the ability to identify and analyze the biophysical and social aspects of urban environmental issues from a systems science perspective; (2) develop students' awareness of how diverse social, cultural and urbanization forces influence human perception of, and relation to the environment; and (3) foster students' ability to synthesize efficient, equitable and sustainable management, policy and design strategies to improve and sustain the quality of life in the urban community. Graduates of the program can make important professional contributions in forest and natural resources issues like urban forestry, urban hydrology, and urban wildlife. A complete list of required and elective courses is available in the FNRM Handbook. A complete description of minors available to ESF students is on page 9.

Graduate Programs

The Faculty of Forest and Natural Resources Management (FNRM) 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. Faculty with nationally and internationally recognized expertise define the area of study's subject matter and guide students through an individually-designed program of study appropriate to student goals and aspirations. The FNRM graduate program prepares students for careers in resource administration, management, scientific research, professional education, and a variety of other specialized positions related to the sustainable management of forest ecosystems. Students with non-natural resources bachelor's or master's degree and a strong interest in forests are encouraged to apply.

Master of Forestry (M.F.): The M.F. degree is designed to provide students with non-forestry baccalaureates a professional education in forestry. As such, the degree is designed to be students' first professional degree in forestry. The degree is appropriate for students who want to 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 at least 30 graduate credits of coursework. At least 24 of the coursework credits must be taken in residence at ESF. Students must also complete a set of core forestry courses that meet the accreditation standards of the Society of American Foresters. The current Forest and Natural Resources Management Graduate Handbook (www.esf.edu/for/GradHandbook.pdf) specifies these requirements.

Master of Professional Studies (M.P.S.): 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 is designed to be the first professional degree in forest and natural resources management. It is appropriate for students with a baccalaureate degree in a natural resources-related discipline interested in enhancing their knowledge of forest and natural

resources management, and for students with other baccalaureate degrees seeking an 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 current Forest and Natural Resources Management Graduate Handbook (www.esf.edu/for/GradHandbook.pdf) specifies these requirements.

Master of Science (M.S.): The M.S. degree enables students to investigate practical forest and natural resources research problems and apply their specialized knowledge to solve those problems. The degree provides students with coherent body of theory and a set of appropriate methods to test that theory by completing a thesis. The M.S. degree is appropriate for students entering professions that require a research-based degree (such as environmental agencies and organizations that focus on science) and for students planning on completing a Ph.D. degree.

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.): The Ph.D. degree 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 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 number of peer-reviewed articles in influential journals. The degree is appropriate for students interested in advanced positions as forest and natural resources educators, managers, and analysts.

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.

Research Facilities and Faculty

FNRM students work with faculty in a variety of sophisticated laboratories. Graduate students have access to diverse analytical equipment and measuring devices, and comprehensive, investigative computing capabilities. Field research occurs throughout the world, particularly in the Northeast. ESF's 25,000 acres on regional New York state campuses and field stations offer a broad diversity of forest ecosystems for teaching and intensive research that evaluates terrestrial and aquatic environments. Faculty and students also pursue research on lands managed by the State Department of Environmental Conservation, USDA Forest Service, National Wildlife Refugees, National Park Service, and Bureau of Land Management. Many students also conduct research and serve internships in Washington, D.C., New York City, Albany, and other international, national, regional, and state resource management headquarters.

FNRM graduate students work closely with faculty recognized by their students and peers as among the best in the world. FNRM faculty include SUNY Distinguished Teaching Professors and Distinguished Service Professors, as well as recipients of the SUNY Chancellor's Award for Excellence in Teaching, the SUNY Chancellor's Award for Professional Service, and the ESF President's Public Service Award. More than a third of FNRM professors have been awarded the ESF Distinguished Teacher Award by the ESF student body, many more than once. ESF professors also serve in leadership roles in professional societies.

Funding Opportunities

More than 70 percent of full-time FNRM graduate students receive partial or full support through graduate research or teaching assistantships. Awards range from \$10,500 to \$27,000 per year. All fully-supported students receive tuition scholarships, and health insurance. In addition to assistantships, FNRM annually awards several fellowships, based on students' accomplishments and promise for future professional and personal development. We also offer some graduate student stipends to support semester-long and summer internship experiences.

Collaborative Arrangements

FNRM encourages interdisciplinary graduate programs. This often involves selecting steering committee members from other ESF faculties and SU departments, or more formally, by arranging for joint study with other college Faculties 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: School of Management, Maxwell School of Citizenship and Public Affairs, S.I. Newhouse School of Public Communications, and School of Education.

Concurrent degree programs usually add at least an additional year to a normal master's program of study. To be eligible, a student must have been matriculated full-time at the college for at least one semester, must have a grade point average of at least 3.500, and must 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.

Areas of Study

The FNRM graduate degree program offers students opportunities to pursue individualized advanced study in seven areas of study or an interdisciplinary doctoral program. Each area of study description includes a sampling of faculty members' research interests and employment opportunities. With more than 75 graduate students currently in FNRM programs, these examples are only highlights from the wealth of opportunities available. Additional information about each of these areas of study is available by telephone, e-mail, or written request to any of the professors listed, and at: www.esf.edu/for/grad.htm.

Environmental and Natural Resources Policy (M.S., M.P.S.)

Participating Faculty: FLOYD, GERMAIN, LUZADIS, MALMSHEIMER, WAGNER

The environmental and natural resources policy area includes professional and scientific studies examining how society makes and implements decisions regarding its forest and natural resources. The program exposes students to a coherent body of theory, a set of appropriate methods, and challenging applications. The applications include:

- Forest, environmental, and ecological economics, and
- Forest and natural resources policy.

Faculty members are conducting studies at international, national, state, and local levels on sustainability, implementation and administration of forest and natural resources programs, and economic and institutional influences and impacts of government and nongovernment policies.

Policy graduates find jobs with government, consulting firms, not-for-profit organizations, advocacy groups and academic institutions. Graduates often begin their careers as policy or program analysts and many become leaders in government, legislatures, corporations, consulting firms, and academia at institutions throughout the world.

Forest and natural resources policy students often supplement their ESF coursework with courses from Syracuse University's Maxwell School of Citizenship and Public Affairs. A number of students enroll

in a concurrent master of public administration (M.P.A.) degree program.

Forest Ecosystem Science and Applications (M.S., M.P.S., Ph.D.)

Participating Faculty: ABRAHAMSON, BEVILACQUA, BRIGGS, DREW, GERMAIN, MAYNARD, C. NOWAK, NYLAND, VOLK, E. WHITE, YANAI

Graduate study in forest ecosystems includes the basic science of biophysical processes and how these processes are manipulated for ecological and social benefit. The applications include:

- Forest ecology and silviculture
- Forest genetics and tree improvement
- Forest soil classification and productivity
- Integrated vegetation management
- Intensive silviculture of plantations
- Nutrient cycling and simulation modeling
- Tree physiology and physiological ecology
- Urban and greenspace forestry

Students focusing on ecological physiology or forest ecology study competitive and synergistic interactions among plants or interactions among plants and the physical environment in urban or forest settings, in the northern hardwood region, or in the tropics. Study in forest genetics focuses on the genetic structure of natural and managed populations of forest trees, or on using the latest tools of biotechnology to enhance the ability of forest trees to resist biotic and abiotic stresses. Students studying nutrient cycling assess the impact of land use on the structure and function of forest soils, or explore methods for insuring soil stability and productivity. Studies in silviculture and forest tree improvement evaluate the means for altering the composition, character, and dynamics of tree communities of varying composition and the stages of development using information and understanding from ecological, managerial, and social sciences. Besides sustaining stable and resilient forested ecosystems, including plant and animal habitat, forest management often strives to provide ancillary values for recreation and aesthetics, water quality, and the recovery of wood products and other commodities. Students in this area of study frequently take courses in related disciplines such as forest pathology and entomology, plant biotechnology, hydrology and watershed management, wildlife and fisheries biology, landscape architecture, biometrics, forest economics, and forest policy management.

The growing concern with forests as forest ecosystems is expanding the need for professionals in this area of study. Graduates have careers as specialists or researchers with a wide variety of public agencies, universities, industrial firms, and nonprofit organizations. Opportunities are likely to grow steadily in the U.S. and other nations during the next decade.

Forest Hydrology and Watershed Management (M.S., M.P.S., Ph.D.)

Participating Faculty: FLOYD, HERRINGTON, LAUTZ, STELLA, YANAI

Water quantity and water quality are important to the highly urbanized northeastern U.S. and are among the most pressing environmental issues globally. Within the watershed management and forest hydrology area of study, students have the opportunity to investigate hydrological processes, land use and water quality, and water supply management and policy. The applications include:

- Forest and watershed hydrology
- Hydrologic processes and modeling
- Soil and water conservation
- Water resources policy
- Watershed geospatial modeling and analysis

Students enter this area of study with undergraduate backgrounds in natural resources, environmental sciences, management and policy, and many other areas. Courses in the option are watershed-based and highly interdisciplinary. The option also has strong links to other programs at ESF and Syracuse University in biogeochemistry, engineering, hydrogeology, ecology and numerical modeling. Faculty research focuses on the watershed as the fundamental landscape unit for studying the fluxes of water, energy and matter in the environment. Graduate students' research projects often have ties to externally funded research watersheds in the region and may take

the form of combined field, laboratory and modeling studies. Career opportunities exist with all levels of government, and in consulting, research, and education.

Forest Management and Operations (M.F.)

Participating Faculty: BEVILACQUA, BRIGGS, DAVIS, FLOYD, GERMAIN, NOWAK, WAGNER

The master of forestry (M.F.) 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.

Students with an undergraduate degree in a related discipline (e.g., ecology, biology, wildlife, chemistry) can complete the M.F. degree in 12-18 months. Students with a general science background, but little or no natural resources experience, will require 18-24 months to complete the program. More than four semesters may be required for students from non-science backgrounds who need additional basic undergraduate coursework as part of their program of study. The curriculum is designed for fall admission, but spring semester admission is possible.

Natural Resources Management (M.S., M.P.S., Ph.D.)

Participating Faculty: BRIGGS, DREW, GERMAIN, LUZADIS, MALMSHEIMER, C. NOWAK, NYLAND, VOLK

The natural resources management area includes professional and scientific studies regarding how organizations make and implement decisions on the ground for forests and related natural resources. The applications include:

- Environmental and ecological economics
- Forest resource management
- International forest policy and management
- Multiple use planning and management
- Urban and community forestry

Graduate studies in this area often integrate other areas of study, especially forest ecosystems, watershed hydrology and management, environmental and natural resource policy, and quantitative methods. Most students include a specialty like economics, statistics, or ecology as part of their graduate program of study. Faculty members conduct studies on urban forests, harvesting practices on small forest ownerships in New York, sustainable forestry practices on private and public forestlands, multiple-use management throughout North America, and social forestry in several tropical nations.

Job opportunities are growing. Industry, government, consulting firms, and not-for-profit organizations employ graduates from this area of study as analysts and managers. Research opportunities are available in both research and operating organizations.

Quantitative Methods in Forest Science and Management (M.S., M.P.S., Ph.D.)

Participating Faculty: BEVILACQUA, DAVIS, HERRINGTON, STEHMAN, WAGNER, ZHANG

Quantitative techniques are valuable both for managing forest resources and for conducting research on forests. Graduate study of quantitative methods is designed to develop skills in the application of mathematical, statistical, and computer-based problem analysis and solution. The applications include:

- Applied statistics
- Forest growth and yield modeling
- Forest inventory and mensuration
- Geospatial modeling and analysis

- Operations research
- Spatial sampling of environmental factors

Areas of faculty research include statistical methods of sampling and data analysis, optimization methodologies for forest resources management, forest biometrics, and natural resources applications of geographic information systems. Additional courses in quantitative methods are available through Syracuse University. Students enter this area of study with diverse backgrounds. Some students have an undergraduate degree in areas such as the biological sciences, forestry, wildlife, or agriculture, and concentrate on strengthening their quantitative skills. Other students have earned degrees in mathematics, statistics, or computer science, and focus on resource management.

Students who earn their degrees in the quantitative methods area of study have career opportunities as specialists with a wide variety of public organizations, such as the U.S. Forest Service, U.S. Geological Survey, NASA, and state planning agencies. Industrial firms are looking for quantitative experts in a variety of applications, as are consulting firms and some of the major environmental non-profit organizations.

Recreation Resources Management (M.S., M.P.S., Ph.D.)

Participating Faculty: DAWSON, SCHUSTER, KUEHN

Recreation and tourism, including ecotourism, are major economic factors in the U.S. and other nations. Graduate study in this area provides students with a broad understanding of the nature and purpose of outdoor recreation and tourism and how they relate to natural resources. The program emphasizes the role of and inter-relationships between the public and private sectors in providing facilities, services, and programs in recreation and tourism. The applications include:

- Human dimensions of recreational use
- Recreation resource planning
- Wilderness and river recreation management

Faculty research focuses on recreation resource management and the human dimensions of recreational use and management. Individual student programs combine study in resources management with relevant studies in the social and political sciences and the development of analytic capabilities needed to implement recreation management plans and programs. Examples of student interest include recreation planning, ecotourism planning, and wilderness visitor management. Coursework in environmental interpretation, management, and other disciplines is encouraged.

Career opportunities exist with a wide variety of public agencies, private firms, and nonprofit organizations. Tourism is a major economic sector in New York and many other states, and often is the top source of foreign exchange in developing nations and nations with strong natural resources bases such as Australia. Recreation studies in many colleges and universities offer career opportunities for graduates who want to combine teaching and research activities.

Environmental and Natural Resources Policy (Ph.D.)

www.esf.edu/enrp

Participating Faculty: FELLEMAN, FLOYD, GERMAIN, LUZADIS, MALMSHEIMER, MANNO, MORAN, NORDENSTAM, SENECAH, SMARDON, WAGNER

The environmental and natural resources policy Ph.D. program is a collaborative program offered by both the Faculty of Environmental Studies and the Faculty of Forest and Natural Resources Management. This study area investigates how societies formulate and implement decisions regarding environmental and natural resources. Doctoral students integrate the biophysical sciences and policy-related social sciences to solve important problems in environmental and natural resources policy with applications throughout the world. The program offers an opportunity to work with outstanding faculty members on applied and theoretical studies.

Faculty members conduct studies at international, national, state and local levels on sustainability, implementation and administration of environmental, natural resources, and forest management

programs and economic and institutional influences and impacts of government and non-government policies. The applications include environmental, natural resources and forest policy and administration; and environmental, natural resources, forest and ecological economics.

The environmental and natural resources policy (ENRP) doctoral program is a highly individualized program with coursework and research determined in consultation with the student, major professor, and steering committee. Some coursework requirements may be met by transferring graduate credits as approved by the steering committee. Students may also fulfill coursework requirements by completing courses offered by the Maxwell School of Citizenship and Public Affairs at Syracuse University. Specific degree requirements are described in the Handbook for Environmental and Natural Resources Policy Ph.D., available in 320 Bray Hall, 107 Marshall Hall, and on the ENRP Web site.

Students are expected to complete requirements resulting in a coherent body of theory, a depth of understanding in a specified area of biophysical science, appropriate research methods, and advanced policy analysis and understanding.

The following four core competencies must be satisfied prior to the doctoral candidacy examination. A minimum of 12 credits is required in each area.

- Natural science: graduate courses (500 level or higher) in a definable area of biophysical science
- Policy-related social science: 600-level or higher courses including at least one government course and one economics course
- Research methods: 600-level or higher courses including a general research methods course (required), qualitative methods, quantitative statistical methods, GIS, or spatial statistics
- Advanced environmental and natural resources policy: 600-level or higher courses including policy analysis and program evaluation (required).

Graduates have careers as university professors and advanced policy or program analysts. They often become leaders in government, legislatures, corporations, not-for-profit organizations, advocacy groups and academic institutions, consulting firms and village associations throughout the world.

The Faculty of Landscape Architecture

RICHARD S. HAWKS, Chair
331 Marshall Hall
315-470-6544; FAX 315-470-6540
www.fla.esf.edu

Participating Faculty

CARTER (Urban Design, City and Regional Planning, Development Process, Sustainable Communities, Planning and Design Theory), CURRY (Site Planning, Urban Analysis and Design, Historic Preservation), DEMING (Landscape Design, History and Theory, Urban Design, Design Research), DOBLE (Community Planning and Design, Citizen Participation, Site Planning and Design, Graphics, Education), HAWKS, Chair (Community Planning and Design, Natural Factors in Design, University Campus Design and Planning), HOFFMAN (Design with Emphasis on Grading and Drainage, Visual Resources), MILLER (Graphic Communication, Urban Design, Plant Materials), POTTEIGER (Cultural Landscape History, History of Landscape Architecture, Design Theory and Methodology), REUTER (Ecology in Landscape Planning, Design and Management of Wetlands, Computer Applications in Environmental Planning and Design Simulation), SHANNON (Site Planning and Design, Urban Analysis and Design, Sustainable Design and Development, Rural Community Planning), STRIBLEY (Design and Behavior, Public Participation, Urban Design, Parks and Recreation, Site Planning and Design), TOLAND (Landscape and Urban Ecology, Site Design, Urban Infrastructure Planning, Land Planning, Urban Streetscape)

The alteration of the physical environment has been a product of human activity since the earliest human settlements. While environments of enduring beauty and vitality occasionally resulted, the history of environmental manipulation more often demonstrated degradation and abuse of the landscape. As the knowledge of natural and human processes has expanded, environmental change has been transformed over the centuries from the casual efforts of many to an enterprise requiring skilled individual effort and often demanding multidisciplinary attention.

Since 1911 the landscape architecture program at ESF has been educating practitioners and teachers, designers and planners, advocates and policy makers who have contributed their careers to a viable, sustainable integration of natural and cultural communities.

The program is one of the largest in the United States, with 12 full-time faculty supported by several adjunct professors and visiting instructors. Faculty interests range from design and history to landscape narratives, from materials and construction to regional planning, from ecological planning to urban design, from theoretical landscapes to historic preservation.

The Faculty of Landscape Architecture offers three degree programs designed to educate students to contribute in varied ways to the wise use of land and landscape. Each provides a basis for students to establish career directions in the profession of landscape architecture. 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.L.A. fast track option.

Support Facilities

Support facilities within landscape architecture include access to a wide variety of computing equipment and applications for graphics, image processing, CAD, GIS, 3-D modeling, desktop publishing, presentations, and other Internet and professional applications. Advanced computing is supported through the Computer Aided Visualization Laboratory (CAV Lab). The program also provides individual studio workspace for each student, and office space for special research and public service projects. In addition, the Faculty of Landscape Architecture maintains an extensive collection of more than 30 years of student projects done abroad for the FLA Off-Campus Program, as well as other archival materials dating to 1913.

Bachelor of Landscape Architecture

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 American Society of Landscape Architects (ASLA).

The B.L.A. degree is granted at the end of five years of study and requires the successful completion of 150 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 undergraduate curriculum 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 through practice and application of the basic principles and skills of landscape architecture design, land manipulation and engineering, applied ecology, and communications. Studio instruction holds a special place within the program because it mimics the professional environment where students will integrate these principles and skills in order to solve landscape architectural problems. The number of students in a studio section is limited to 15 because this type of problem-based learning relies on intensive interaction and mentoring relationships with studio faculty. 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.

The major objective of the B.L.A. program is to develop basic proficiency in design, engineering, and communication skills necessary for formal admission into the profession of landscape architecture. When the prerequisite period of work experience has been completed, a person holding a B.L.A. degree may apply to take the examination leading to a license to practice landscape architecture. At present, the State of New York requires those holding a five-year B.L.A. degree to complete a three-year period of internship in the field prior to applying for the licensing examination. Other states have varying requirements for obtaining licensure.

As in any area of professional study, students seeking the B.L.A. degree are expected to demonstrate a high level of commitment and scholarship in their studies. This professional commitment is demonstrated by a desire to serve society in an objective, rational, and ethical manner.

Students receiving a B.L.A. degree have entered the profession as employees in public agencies, not-for-profits, or in private offices offering landscape architectural services. Also, B.L.A. graduates have entered graduate schools in landscape architecture, planning, urban design, regional design, and specific specialties including historic preservation, environmental policy, public administration, recreation, management, and research.

Off-Campus Program

The off-campus program is the Faculty of Landscape Architecture's undergraduate centerpiece, and one of the most unique educational programs within the State University of New York. Since 1970, more than 1,300 students have studied in more than 50 different countries and throughout the United States.

The off-campus program is centered on the idea of an "experiential studio." It is quite different, however, from most studio- or laboratory-based programs that teach using example and participation. Prior to the off-campus semester, students identify a

particular design-related study topic, then develop plans to leave the traditional university setting and travel to locations that are uniquely suited to the topic. Students see and experience exemplary works of landscape architecture in the best locations in the world. At the same time, students learn from experiencing unfamiliar places, cultures and languages, and gain an insight into the natural and cultural environment—a sense of place that is unattainable in the campus classroom. Finally, students learn lessons about themselves and American culture that are equally valuable as landscape architects and as citizens in a larger society.

Studies may take any of several forms—they may be relatively independent, focusing on a particular student's interests and aspirations (self-described study); they may be directed by a faculty member's interests or research (faculty described study); or they may be more applied and directed by a local group or organization on site, similar to an internship arrangement (work study). Each off-campus group is coordinated and advised by a participating faculty member, and assisted by an on-site consultant (usually a local alumni, landscape architect, or university professor). Each student spends a full, 15-week semester "off-campus" pursuing the study, earning 15 credit hours. Typically the off-campus study is undertaken during the fall semester of the fifth year.

Each student in the B.L.A. program is required to participate in an off-campus experience and students must achieve a cumulative GPA of 2.000 or greater prior to participation. The off-campus program requires students to pay for tuition, books and materials, room and board, and travel costs to the location of study.

Sustainable Futures

The sustainable futures studio is an off-campus program offered during the summer in cooperation with the Monteverde Institute in Monteverde, Costa Rica. Students who have completed at least their junior year with a cumulative GPA of 3.0 or better may apply to participate in the program as a means to satisfy the off-campus program requirement. Sustainable futures is a studio internship through which participating students undertake a range of service learning community design and planning projects for existing rural communities and non-governmental organizations (NGO) in the Monteverde region. The internship work focuses on sustainable design and development and includes a multidisciplinary design studio with architects, landscape architects and urban planners; lecture and seminar components in sustainable design, ecotourism, and local culture and ecology; and intensive Spanish language training. The studio is co-sponsored by SUNY-ESF, SUNY Buffalo, the University of Maryland, and the University of Illinois. Opportunities to participate in the Fund for the Improvement of Postsecondary Education (FIPSE) sponsored U.S.-Brazil Higher Education Consortia Program are also available. The FIPSE partnership, with Universidade de Brasilia and Universidade Federal do Rio Grande do Sul, adds an international curriculum and cultural dimension to students' studies "through a combination of bilateral curricular innovation and study abroad."

Program Expenses

In addition to the normal college expenses, students must plan for special expenses such as studio equipment and materials, field trips, and the off-campus semester.

- Studio equipment and materials. In a design curriculum, students normally spend more for expendable supplies than they would on books for a lecture course. The cost of equipment, printing, and materials for studio courses is typically between \$300 and \$400 each semester. Upon submission, studio projects become the property of the Faculty of Landscape Architecture. While projects are normally returned, they may be retained temporarily for display or permanently kept as part of the archives.
- Field trips. Landscape architecture students may be required to participate in a field trip as part of their studio courses. These trips are used to acquaint students with the exemplary works of landscape architecture found in Boston, Montreal, New York,

Ottawa, Philadelphia, Toronto, Washington, D.C., or other cities in the Northeast. The typical cost of transportation, meals and lodging for field trips range between \$300 and \$400.

- Off-campus semester. This is a self-designed and student-budgeted program. If a student plans well, there is no need for this semester to cost any more than one spent in Syracuse. Typical expenses during the 2003-2004 academic year, including tuition, were between \$8,000 and \$10,000. However, a few students had expenses as high as \$12,000 because of the study location they chose and the extracurricular opportunities they enjoyed while abroad. These additional costs are the responsibility of the student and are not covered by financial aid.
- Computers. Proficiency with computers and associated design software are essential to the success of students in the landscape architecture curriculum. Students are required to purchase a laptop computer with appropriate software for use in the design studios by the beginning of the fall of the junior year, and will be required for participation in the following courses: LSA 326, LSA 327, LSA 422, LSA 423, LSA 460, and LSA 470. Equipment guidelines are available from the Faculty of Landscape Architecture. Anticipated costs for computing equipment (hardware and software) may be between \$2,500 and \$3,500 over the course of the student's tenure at ESF.

Prerequisites for Transfer Entry

The breadth of learning in the B.L.A. program makes it imperative that entering students prepare themselves with a broad range of foundation coursework. The environmental issues that students will engage require a strong background in the natural and social sciences, as well as in the arts and humanities. In addition, competency in graphics, written and oral communication, mathematics, and computer applications is required. Due to the specialized nature of much of this coursework, it is highly recommended that students wishing to transfer into the B.L.A. program consider doing so **no later than the beginning of the sophomore year**. Students wishing to transfer with greater than beginning sophomore standing are required to submit a portfolio of visually expressive design or graphic work for review. If students have met the sophomore transfer requirements, have completed 62 or more credit hours of coursework at another college or university, and submit portfolio work suggesting they have sufficiently advanced skills in design and graphic communication, they may be granted junior status and can enter into the core B.L.A. studio sequence.

Portfolios

Freshman applicants are not required, but are highly encouraged to submit a portfolio of their creative work for review; transfer applicants seeking greater than first semester sophomore standing are **required** to submit a portfolio as a part of their application for admission.

Faculty members embrace a broad conception of the term "creative work," ranging from pencil sketching to poetry; however, for the purpose of indicating an aptitude for landscape architecture, portfolio work should focus on visually expressive examples, including both traditional and digital media. Submittals will be used to assess drawing and other graphic communication skills, as well as spatial awareness and the ability to visualize and convey design ideas. Portfolio items should be no larger than 11-by-17-inch, generally consisting of good-quality photographic or xerographic reproductions, or in Adobe PDF, PowerPoint, or JPEG digital format on standard CD-R, CD-RW, or DVD media. Color slides or prints of large or 3-D work, or digital HTML "Web page" portfolios are also acceptable. Applicants should not send original artwork or rolled materials. Portfolios can be returned if accompanied by a self-addressed, pre-posted return envelope.

Undergraduate Program Requirements

Lower Division Required Courses (47 credits)

COURSES			CREDITS
CLL	190	Writing and the Environment	G ¹ 3
CLL	290	Writing, Humanities and the Environment	G 3
CMN	220	Public Presentation Skills	3
EFB	226	General Botany	G 4
ESF	200	Information Literacy	1
GEO	172	World Cultures	G 3
LSA	132	Orientation Seminar: Landscape Architecture	1
LSA	182	Drawing Studio	G 3
LSA	205	Art, Culture, and Landscape I	G 3
LSA	206	Art, Culture, and Landscape II	3
LSA	220	Introduction to Landscape Architecture	3
LSA	226	Foundation Design Studio I	4
LSA	227	Foundation Design Studio II	4
LSA	311	Natural Processes in Design and Planning	3
LSA	312	Social and Cultural Factors in Design and Planning	3
MAT	112	Algebraic Operations and Functions	G 3

Electives (15 credits)

General Education: American History	G	3
General Education: Social Sciences	G	3
Biological Science Elective		3
Natural/Physical Science Elective		3

Upper Division Required Courses (76 credits)

CLL	410	Writing for Environmental Professionals	3
EFB	334	Woody Plants in the Natural and Built Landscape	2
LSA	300	Computer Graphics	3
LSA	326	Landscape Architectural Design Studio I	5
LSA	327	Landscape Architectural Design Studio II	5
LSA	342	Landscape Architecture Construction Technology	4
LSA	343	Landscape Materials and Structures	3
LSA	405	History of Landscape Architecture	3
LSA	422	Landscape Architectural Design Studio III	5
LSA	423	Planting Design and Practice	5
LSA	424	Preparation for Off-Campus Design Thesis Studio	1
LSA	425	Orientation for Off-Campus Design Thesis Studio	3
LSA	433	Planting Design and Practice	3
LSA	451	Comprehensive Land Planning	3
LSA	455	Professional Practice in Landscape Architecture	3
LSA	460	Off-Campus Design Thesis Studio	15
LSA	461	Off-Campus Final Presentation Seminar	1
LSA	470	Thematic Landscape Design Studio	6

¹Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed on page 8 and on the Internet at www.suny.edu/pravast/GeneralEducation/CourseList/ESFGERCourses.pdf

Electives (12 credits)

Electives

12

TOTAL MINIMUM CREDITS FOR THE DEGREE

150 CREDITS

B.L.A./M.S. Fast Track

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 150 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.

Program Requirements

Fast-Track Option A – Summer start

Fourth Year, Summer

LSA	460	Off-Campus Design Studio Thesis Studio (summer option only)	15
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Fifth Year (25-28 credits)

LSA	455	Professional Practice in Landscape Architecture	3
LSA	461	Off Campus Final Presentation Seminar	1
LSA	470/670	Thematic Landscape Studio	6
LSA	596	Special Topics in Landscape Architecture	3
LSA	640	Research Methodology	3
LSA	697	Topics and Issues of Landscape Architecture	Audit
LSA	799	Thesis Proposal Development Directed Electives	3 6-9

B.L.A. program completed with a minimum of 150 credits earned

Sixth Year (12-24 credits)

LSA	899	Master's Thesis Research Directed Elective(s)	6-12 6-12
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Students may register for LSA 899 Master's Thesis Research as necessary for completion up to the time limit of the M.S. program.

M.S. program completed with a minimum of 180 credits (minimum 30 graduate credits)

Fast-Track Option B – Fall start

Fifth Year (24-27 credits)

LSA	455	Professional Practice in Landscape Architecture	3
LSA	470/670	Thematic Landscape Design Studio	6

LSA	596	Special Topics in Landscape Architecture	3
LSA	625	Orientation for Off-Campus Experiential Studio	Audit
LSA	640	Research Methodology	3
LSA	697	Topics and Issues of Landscape Architecture	Audit
		Directed Electives	6-9

Fifth Year, Summer (6-12 credits)

LSA	760	Off-Campus Experiential Studio (must be linked to thesis)	12
		OR	
LSA	798	Research Problem (must be linked to thesis)	6

B.L.A. program completed with a minimum of 150 credits

Sixth Year (18-24 credits)

LSA	899	Master's Thesis Research ²	6-12
		Graduate-level Directed Elective(s)	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.

M.S. PROGRAM COMPLETED WITH A MINIMUM OF 180 CREDITS (MINIMUM 30 GRADUATE CREDITS)

Graduate Programs

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.

Three degree tracks address the needs of the students with these differing educational backgrounds. The master of science (M.S.) in landscape architecture is a two-year academic degree program for applicants who have completed a first professional degree in landscape architecture or a professional degree in environmental design, planning, or preservation. The degree may be earned through two years of full-time study or up to seven consecutive semesters (3-1/2 years) of study. 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. Finally, a fast-track option enables qualified candidates within the college's B.L.A. program to proceed directly into the M.S. program and work on both degrees. Refer to the previous section for information on the fast-track options.

The M.S. program serves the advanced professional or the aspiring academic. It is highly flexible and can be customized to reflect the breadth and depth of a student's interests. 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.).

Students seeking a multidisciplinary education may choose to pursue a concurrent degree within the College of Environmental

Science and Forestry or at Syracuse University. For additional information about concurrent degree programs, see page 16.

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 Faculty of Environmental Studies section of this catalog.

M.L.A. Program Requirements

M.L.A. Required Courses (minimum of 66 credits)

LSA	220	Introduction to Landscape Architecture	Audit
LSA	500	Computer Graphics for Design Communications	3
LSA	552	Graphic Communication	3
LSA	600	Design Studio I	4
LSA	601	Design Studio II	4
LSA	605	History of Landscape Architecture	3
LSA	611	Natural Processes in Planning and Design	3
LSA	615	Site Construction, Grading, Drainage, Road Layout	3
LSA	620	Design Studio III—Advanced Site Design	4
LSA	625	Off-Campus Orientation Seminar	2
LSA	633	Planting Design and Practice	3
LSA	640	Research Methodology	3
LSA	645	Construction Documentation Studio	3
LSA	650	Behavioral Factors of Community Design	3
LSA	652	Community Development and Planning Process	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	760	Off-Campus Experiential Studio	6-12
		OR	
LSA	898	Professional Experience	
LSA	799	Capstone or Thesis Proposal Development	3
LSA	800	Capstone Studio	6

Electives (as determined in consultation with major professor)

M.S. Program Requirements

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. Required Courses (7 credits)

LSA	640	Research Methodology	3
LSA	697	Topics and Issues in Landscape Architecture	1
LSA	799	Capstone or Thesis Proposal Development	3

Elective Courses (minimum of 17 credits)

LSA	899	Masters Thesis Research: minimum of 6 credits	
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TOTAL MINIMUM CREDITS FOR THE DEGREE 30 CREDITS

² Additional semesters of LSA 899 may be completed as necessary.

Areas of Study

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.

The studios, seminars and lecture courses provide introductory and advanced exploration into the theories, principles and practices of design, planning, preservation, and revitalization, as well as the search for new paradigms. The courses are supported by a wide range of electives in the Faculties at the College of Environmental Science and Forestry and Syracuse University. There are also a significant number of opportunities for public service and research in the communities of New York State and beyond.

This area of study is especially appropriate in an era that calls for the redefinition of the American city, the retrofitting of the post-WWII suburb, the conservation and rejuvenation of rural and regional landscapes, and the exploration of traditional and new design paradigms that create sustainable symbiosis of community and place. The courses explore how to design and plan the socially interactive, environmentally sound, aesthetically pleasing settlement patterns that engender a strong sense of place and of citizenship.

There are abundant opportunities for careers in urban design, rural preservation and development, city and regional planning and corporate facilities planning. This focus is for graduate students interested in design, planning and research at the community scale via public, private, academic or nontraditional practice.

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 conservation practices.

Required courses and directed electives provide the student with introductory and advanced investigations into the history, theory, and practices of cultural landscape design and stewardship, in the context of broader cultural and environmental concerns. Core courses are supported by a wide range of elective offerings both in the college and at Syracuse University.

The study of cultural landscapes is of vital concern in this era of globalization and rapid urban and suburban transformations. Not only are cultural landscapes important places in which we stage our lives, but they are also part of a larger system of cultural and social heritage which affects our identities as individuals, communities and nations. Areas of expertise associated with the study of cultural landscapes include preserving relationships between natural and cultural resources; developing policies and techniques for preservation, rehabilitation, restoration and reconstruction of cultural landscapes; mediating alternative ideas of stewardship and balancing them within a collective sense of place; using cultural landscapes as the basis for contemporary design and development;

and understanding the variety and history of human experience through patterns, forms and stories in the landscape.

There are a growing number of domestic and international career opportunities that address cultural landscapes in public, private and academic practices. Graduates might work in fields such as preservation planning, sustainable tourism, land use planning, urban design, interpretive design, or cultural history and theory.

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 ecology as they relate to the practice of landscape architecture. 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.

Students will have an opportunity to develop a theoretical and analytical framework for describing different landscapes and their ecological components from different levels: the individual organism perspective, a population and community point of view, and ultimately at the ecosystem level.

Landscape ecology includes an integration of landscape issues: disturbance, fragmentation, landscape manipulation, fundamental ecological processes, composition and structure, and environmental influences. Urban ecology includes integration of climatology, geomorphology and soils, hydrology, plant and animal communities, and ecological engineering and restoration. Both landscape and urban ecology are affected by human landscape perceptions, attitudes toward the environment or landscape types, patterns of settlement, and socio-economic issues and behavior. All these elements will be used to develop an understanding of the ecological essence of landscapes in order to design ecologically sustainable settlements that promote human quality of life.

There are growing numbers of domestic and international opportunities that address landscape and urban ecology issues in academic, public, private and nontraditional practice. Graduates might be involved in research and consultancy in urban forestry, ecological design, and urban planning. Employment opportunities for landscape ecologists are most frequently with public agencies, while urban ecologists are more often employed in the private sector.

This study area is supported by a wide range of electives in other faculties at ESF and Syracuse University as well as an urban forestry research program of the U.S. Forest Service based at ESF.

Final Integrative Experience

Both M.S. and M.L.A. students must complete an integrative experience. The M.S. student 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. The M.L.A. student must participate in the capstone studio and complete a 6-credit independent design project during the final semester of the program. Both M.S. and M.L.A. students must disseminate the results of their integrative studies through capstone seminars.

The M.L.A. program requires 66 credit hours. At least 42 of those credit hours must be at the graduate level. The M.S. program requires between 30 and 42 credit hours (depending on background and experience), at least 30 of which must be at the graduate level.

Prerequisites and Admission Requirements

Students seeking admission to the M.L.A. program may apply to enter based on education and experience. Admission requires:

1. An undergraduate degree
2. Graduate Record Examination scores
3. A minimum 3.000 (4.000=A) cumulative grade point average is generally required for admission. However, other circumstances may be considered (e.g., work experience) for those below this standard.

4. Three letters of recommendation
5. A completed course is recommended in each of the following six areas:
 - a. botany, biology, or ecology
 - b. geology, geomorphology, or earth science
 - c. anthropology, psychology, or sociology
 - d. computer applications
 - e. drawing, drafting
 - f. art or architecture history
6. A portfolio of creative work, which may include samples of photography, writing, drawing, digital designs or other related artistic expressions. Portfolios can be returned if accompanied by a self-addressed, pre-posted return envelope.

Students seeking admission to the M.S. program or admission to the M.L.A. program with advanced standing must additionally provide:

1. Transcripts from an accredited or recognized design or planning degree with a minimum 3.000 (4.000=A) cumulative grade point average. However, other circumstances may be considered (e.g., work experience) for those whose credentials are below this standard.
2. A portfolio of design work (required for M.L.A. program applicants and strongly encouraged for M.S. applicants)

Applicants may be assessed as deficient in one or more areas deemed important to their admission to graduate study in the program. Courses taken to make up deficiencies (e.g., English for international students) may not count toward the credit hours required for the graduate degree.

Applications should be completed prior to February 15 for fall admission. Visits to the college are highly recommended.

Graduate Assistantships

Students with associated professional degrees may be considered for a graduate assistantship (stipend and tuition scholarship) upon admission, depending upon qualifications and portfolio. Other students may apply for landscape architecture graduate assistantships after the first year of the first professional degree track. Assistantships may also be available with community service or research projects, and are awarded by individual faculty to students with the necessary qualifications.

A limited number of teaching assistantships is awarded each year to highly qualified candidates seeking an academic career.

Individuals with prior landscape architectural work experience who intend to pursue a career in teaching at the university level are encouraged to discuss their options with the graduate program coordinator in the Faculty of Landscape Architecture.

Research and Community Service

Research and community service are important aspects of the graduate experience in landscape architecture. Students may participate in the funded studies directed by individual faculty, or in unique studies of their own design. Furthermore, many community service projects are performed in the context of a design studio, thereby bringing real world problems into the studio as a learning experience. In this way, the on-going efforts of students and faculty help to further develop the body of knowledge of the field, while providing a challenging academic environment for the students.

Faculty of Landscape Architecture members believe that computer and video technologies are very important to the future of the profession. They are committed to exploring the application of digital technologies to the practice of landscape architecture, and encourage the use of these technologies by the students. Advanced students may choose to specialize in the application and integration of computer technologies as part of their final integrative experience.

Some of the vehicles currently available for research and community service include Your Town—The Citizens Institute for Rural Design, an award-winning program that provides rural planning/design workshops and technical assistance to rural

communities throughout the United States; the Center for Community Design Research, a research and public service vehicle for in-depth exploration of community and place, and for imparting design literacy through community education; and the Center for Brownfield Studies, an educational initiative focused on environmental management and the redevelopment of brownfield properties.

College and Regional Context

Students in the graduate program in landscape architecture have an excellent opportunity to draw upon the extensive college expertise in ecology, natural sciences, resources management, engineering, forestry, and many other environmental disciplines. Add to this the resources available through Syracuse University, such as architecture, geography, and the Maxwell School of Citizenship and Public Affairs, and the breadth of academic choices offered to a student at ESF becomes very significant.

The city of Syracuse has the largest concentration of professional landscape architectural offices in the Central New York region. This centralized location also provides easy access to major metropolitan centers such as Toronto, Montreal, New York, Boston, and Buffalo, and to unique rural and natural landscapes, such as Lake Ontario, the Finger Lakes, the Catskills, and the Adirondacks. Basic geography, therefore, provides the student with a wide diversity of natural and cultural contexts in which to pursue academic and career goals.

Regional, National and Global Opportunities

Major areas of recent research activity include cultural landscape preservation, visual analysis, rural town planning, ecotourism and wetland impact mitigation. Recent public service activities include neighborhood urban design, campus design, arboretum and botanical garden design and environmental management. Research and public service activities have been funded or sponsored by the National Park Service, the National Endowment for the Arts, The Nature Conservancy, the U.S. Forest Service, the New York State Council on the Arts, the State University of New York Construction Fund, the New York State Office of Parks, Recreation and Historic Preservation, private corporations and such communities as the cities of New York, Philadelphia, Syracuse and Utica. Students participate in these projects through funded assistantships, coursework, and independent studies.

Graduate students may take advantage of extensive opportunities to conduct research or do internships abroad. The Faculty of Landscape Architecture requires all B.L.A. candidates to spend a semester off campus and most of the faculty annually travels abroad to visit and work with those students. As a result, the faculty can also offer graduate students a rich network of contacts and sponsors for graduate exploration in Europe, Latin America, the Far East and elsewhere. These opportunities support the expanding role of landscape architecture in addressing such globally important issues as metropolitan development, environmental conservation and symbiosis between community and place. Graduate research projects abroad have taken place in Italy (urban design), Mexico (ecotourism), Czechoslovakia (urban plazas), Wales (cultural landscape preservation), Northern Ireland (cultural landscapes), Indonesia (sense of place), Canada (rehabilitation of urban parks), Costa Rica (sustainable futures), Brazil (community design) and Spain (historic Moorish landscapes, and sustainable cities).

Planning, Design and Management of Sustainable Communities

Graduate students may also participate in the Ibero-American Consortium on Sustainable Communities. The consortium includes the Faculty of Landscape Architecture at ESF, the Faculty of Forest Sciences at the University of Chile, the Faculty of Forest Engineering at the Polytechnic University of Madrid and the Center for Environmental Studies in Vitoria-Gasteiz, Spain. The agenda for this new consortium includes biennial international conferences on sustainable community planning and design, design competitions, community design charettes, exchanges of students, faculty and staff, parallel and combined research and public service projects, and

the founding of landscape architecture programs in Santiago, Chile and Vitoria-Gasteiz, Spain. Graduate students will find opportunities for independent research, classroom/studio studies abroad and for internships, conferences and design charettes. The activities of the consortium are particularly (but not exclusively) geared to the interests of students seeking preparation in landscape and urban ecology.

At ESF, graduate studies in landscape architecture are strongly supported with computer aided visualization (CAV) technologies,

including computer-aided design (CAD) and graphics, geographic information systems (GIS), image processing, desktop publishing (DTP), multimedia and video/digital presentation technology, and other analytical support systems. Educational opportunities are enhanced further with the inclusion of expertise from allied faculty at ESF and Syracuse University.

The Faculty of Paper Science and Engineering

THOMAS E. AMIDON, Chair
205 Walters Hall
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www.esf.edu/pse

Participating Faculty:

AMIDON, Chair (Biorefinery, Fiber Properties, Paper Properties, Management, Pulping, Bleaching, De-inking), S. CHATTERJEE (Transport Phenomena, Design, Simulation, Pollution Abatement), FRANCIS (Bioenergy, Chemical Engineering and Pulping), LAI (Chemistry of Wood, Pulping, Bleaching, Bioproduct Development), LIU (Bioengineering, Fermentation, Kinetics, Separation, Pulping, Bleaching, Fiber Properties), RAMARAO (Chemical Engineering, Instrumentation, Flow Phenomena, Process Control), SCOTT (Biotechnology, Bioprocess Engineering, Paper Machine Operations, Recycling, Modeling)

The paper engineering, paper science, and bioprocess engineering programs provide a broad base of study in the field of paper and bio-based products to prepare men and women for professional positions in the pulp, paper, bioproduct and other industries. This bio-based industry is the fifth largest in the nation and is very strong internationally. The college pioneered instruction for the pulp and paper industry in 1920 with the formation of a paper science and engineering faculty and has maintained a leading position in this area of professional education. Recently, the Faculty's pioneering efforts have led to new technologies in the biorefinery, biochemical, and bioprocessing areas.

These programs have a long-standing reputation for preparing graduates for such rewarding positions as research chemists, process engineers, technical service representatives, and managers. Graduates have advanced to positions of leadership in research, management, technical operations, and sales in the pulp and paper industry as well as allied industries of heavy equipment manufacture, process chemicals, and other bio-based industries. Other graduates have gone on to successful careers in medical, chemical and other varied fields.

The programs provide education in the physical sciences and chemical engineering, with specific emphasis on those aspects that relate to the sustainable manufacture of pulp and paper, and other products from wood and other lignocellulosic materials. This includes the chemistry, anatomy, and components of wood; the conversion of wood to pulp, paper, and other products; and the chemistry and physics of paper and paper formation. The engineering programs include the basics of chemical engineering with a foundation of unit operations and specialized courses, for example, in air and water pollution abatement from an industrial perspective. The paper engineering program extends this foundation to present a chemical engineering education tailored specifically to the pulp and paper industry. The bioprocess engineering program extends a chemical engineering education with a focus on biomass feedstocks and biological processes rather than a focus on petroleum. The industry is now using advanced chemistry and biotechnology to improve its utilization of renewable carbon and hydrogen in lignocellulosics. The paper science program takes a more science-based (e.g., chemistry or biology) approach to the study of pulp and paper systems. With the science program, students are able to more deeply explore a particular aspect of the industry. The paper engineering and paper science programs have identical first years, allowing students to switch between programs without loss of course credits. Similar lower-division schedules among all three programs allow students to switch programs with only minimal disruption.

The Faculty of Paper Science and Engineering is located in Walters Hall, which is devoted to education and research in pulp, paper, bioproduct, bioenergy, and allied fields. In addition to a large number of special purpose laboratories and highly

sophisticated scientific equipment, there is a pilot plant equipped with machinery and instrumentation for studies of pulping, pulp cleaning and screening, recycling, refining, and papermaking. Equipment includes two complete paper machines, one 48-inch and one 12-inch; two pressurized refiners for mechanical pulping; and auxiliary equipment. An environmental engineering laboratory includes various methods of paper recycling and waste treatment. A state-of-the-art laboratory for testing paper and other materials is in service. Facilities also include equipment for the biological treatment and the separation processes for production of specialized chemicals and polymers from wood, including a 400-liter fermenter, nanoseparation equipment, and incubators for the growth of lignolytic organisms. This equipment, as well as the extensive chemical engineering laboratory, is employed for both education and research. Computer hardware and software are continually updated for teaching and research in process control and simulation.

The paper engineering program is accredited by the Engineering Accreditation Commission/Accreditation Board for Engineering and Technology (EAC/ABET).

Bachelor of Science in Bioprocess Engineering

The bioprocess engineering program prepares students for careers as engineers in biologically-related fields, filling positions that are typically filled by chemical engineers following additional training. As we begin the 21st century, growth and development worldwide will need to be done in a sustainable manner that looks to the long-term future of the environment. The bioprocess engineering program seeks to educate engineers versed in the traditional chemical engineering fields with a focus on developing products and energy from sustainable sources, especially from wood and other lignocellulosic materials rather than non-renewable sources such as fossil fuels.

Students study a broad base of topics in the fundamentals of engineering focused on the chemical and biological processing of raw materials from sustainable sources. Emphasis in this program is on using renewable biomass resources to replace petroleum in energy and industrial product applications. Examples of such technology include the production of ethanol, acetic acid, polymers, and other chemicals that have traditionally been produced from fossil fuels such as oil, coal, and natural gas.

Students gain valuable experience through a capstone-design experience in which they work on significant problems in the design and implementation of new technologies. In addition, a summer internship is required of all students during which they gain valuable skills and experience in terms of technical knowledge and professional development. Both of these experiences serve to integrate the knowledge gained in their coursework with real-world work experiences commonly seen in their first positions after graduation.

The curriculum consists of a number of categories of courses. The general education component, which is required of all ESF students, broadens the students' perspectives on global and societal issues, an important component of any education. Students also take a number of courses in math and the basic sciences—chemistry, physics, and biology—to provide the background for the courses that prepare students for engineering practice. The engineering courses cover a variety of topics that are traditional for a chemical engineering program, supplemented with courses specific to bioprocess engineering.

Students may be admitted to the bioprocess engineering program as first-year students with appropriate science backgrounds from their high school or as transfer students at any level with accommodations for coursework requirements. Students who have

the associate degree in engineering science, chemical technology, biological sciences, or general science and mathematics are encouraged to apply as transfer students.

Undergraduate Program Requirements

Lower Division Required Courses (56 credits)

APM	153	Computing Methods	PE ¹	3
APM	485	Differential Equations for Engineers and Scientists	M ²	3
BPE	132	Orientation Seminar: Bioprocess Engineering	ES ³	1
CLL	190	Writing and the Environment	G ⁴	3
CLL	290	Writing, Humanities, and the Environment	G	3
EFB	226	General Botany	G,NS ⁵	4
EFB	285	Principles of Zoology	NS	4
FCH	150	General Chemistry I	NS	3
FCH	151	General Chemistry Laboratory I	NS	1
FCH	152	General Chemistry II	NS	3
FCH	153	General Chemistry Laboratory II	NS	1
FCH	221	Organic Chemistry I	NS	3
FCH	222	Organic Chemistry Laboratory I	NS	1
FCH	223	Organic Chemistry II	NS	3
FCH	224	Organic Chemistry Laboratory II	NS	1
FOR	207	Introduction to Economics	G	3
MAT	295	Calculus I	G,M	4
MAT	296	Calculus II	M	4
MAT	397	Calculus III	M	4
PHY	211	General Physics I	G,NS	3
PHY	221	General Physics Laboratory I	NS	1

Electives (12 credits)

		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 (46 credits)

APM	395	Probability and Statistics for Engineers	M	3
BPE	304	Summer Internship in Bioprocess Engineering OR	ES	2
	305	Co-op Experience in Bioprocess Engineering OR		
	498	Research Experience in Bioprocess Engineering		
BPE	310	Colloid and Interface Science in Bioprocess Engineering	ENG ⁶	3
BPE	320	Bioseparations	ENG	3
BPE	335	Transport Phenomena	ENG	3
BPE	336	Transport Phenomena Laboratory	ENG	1
BPE	421	Bioprocess Kinetics and Systems Engineering	ENG	3
BPE	440	Bioprocess and Systems Laboratory	ENG	3

¹ Professional education course

² Moth Course

³ Engineering science course

⁴ Meets the requirements for general education skills and knowledge oreo. A complete listing of ESF or Syracuse University courses that meet the general education standards established by SUNY is listed on page 8 and on the Internet at www.suny.edu/provost/GeneralEducation/CourseList/ESFGERCourses.pdf

⁵ Natural science course

⁶ Engineering course

BPE	481	Bioprocess Engineering Design	ENG	3
CLL	405	Writing for Science Professionals		2
ERE	223	Statics and Dynamics	ES	4
ERE	362	Mechanics of Materials	ES	3
ESF	200	Information Literacy		1
PSE	361	Engineering Thermodynamics	ENG	3
PSE	370	Principles of Mass and Energy Balances	ENG	3
PSE	371	Fluid Mechanics	ENG	3
PSE	480	Engineering Design Economics	ENG	3

Free Electives (3 credits)

Free Elective				3
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Directed Electives (15 credits)

in biology, chemistry and engineering, selected from the following:

Biology Elective Courses (3-6 credits)

BTC	401	Molecular Biology Techniques		3
BTC	425	Plant Biotechnology		3
BTC	426	Plant Tissue Culture Methods		3
EFB	120	Global Environment		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 Physiology		3
EFB	326	Diversity of Plants		3
EFB	336	Dendrology		3
EFB	400	Toxic Health Hazards		3
EFB	413	Introduction to Conservation Biology		3
EFB	427	Plant Developmental Biology		3
EFB	440	Mycology		3
EFB	445	Plant Ecology		3
EFB	505	Microbial Ecology		3
EFB	516	Ecosystems		3
EFB	518	Systems Ecology		4
EFB	522	Ecology, Resources and Development		2
EFB	530	Plant Physiology		3
EFB	531	Plant Physiology Laboratory		2
FOR	321	Forest Ecology and Silviculture		3
FOR	345	Introduction to Soils		3
WPE	376	Decay of Wood Products		3

Chemistry Elective Courses (3 credits)

CHE	375	Structural and Physical Biochemistry		3
FCH	390	Drugs from the Wild		3
FCH	440	Introduction to Chemical Ecology		3
FCH	524	Topics in Natural Products Chemistry		3
FCH	530	Biochemistry I		3
PSE	350	Pulping and Bleaching Processes		3

Engineering Elective Courses (6-9 credits)

CEN	461	Environmental Chemistry and Analysis		3
CEN	545	Physiochemical Methods in Waste Treatment		3
CIE	341	Environmental Engineering I		3
CIE	342	Environmental Engineering II		4
ERE	440	Water Pollution Engineering		3
ERE	441	Air Pollution Engineering		3
ERE	506	Hazardous Waste Management		3

Students must take at least 6 credits of additional courses in engineering. At least one course must be from the environmental

engineering courses listed above. Additional engineering electives may be any upper-division engineering course approved by the advisor. The directed electives must total at least 15 credits.

TOTAL MINIMUM CREDITS FOR THE DEGREE

132

Summer Orientation Program

All entering students (both first-year and transfer students) in the bioprocess engineering program are required to participate in the BPE Orientation Program (BPE 132) held at the end of May at an ESF field location in the Adirondacks. The exact dates of the three-day program are typically established in March. It is quite beneficial for students to attend this orientation before starting classes, as the student can learn a great deal about the curriculum and the biological industry. The purpose of the program is to familiarize the student with the basic aspects of the bioprocess industry, to prepare the student for the fall courses, and to prepare the student for summer job interviews that also begin in the fall semester. The orientation program includes tours of industrial facilities and extensive discussions of the tours.

Internships, Co-ops, and Research Experiences

Bioprocess engineering students enjoy the advantage of hands-on learning in the bioprocess and allied industries through internships and co-ops. All students are required to complete a two-credit internship, co-op, or research program in the industry. Internships provide students with valuable experience, financial benefits, and two credits toward graduation. Students must submit a report for completion of the internship.

Students who complete a co-op in addition to the 12-week internship find the experience highly valuable because they are often able to see engineering projects through to their completion. Generally, students who have had the co-op experience are recruited for permanent employment.

The co-op position, when taken in conjunction with the summer internship, consists of a work period approximately seven months in duration, either beginning in May and ending in December, or beginning in January and ending in August. Usually it takes students who complete a co-op one extra year to complete degree requirements. Co-op students are enrolled for two credits and are required to submit a project report to fulfill the requirements for the class.

The employment interview schedule begins in mid-October following the Syracuse Pulp and Paper Foundation's annual meeting. Some companies schedule interviews for co-ops and summer internships at the same time they hold interviews for permanent positions. Other companies choose to hold interviews for co-ops and interns in the spring semester.

Bachelor of Science in Paper Engineering

The paper engineering program is designed to provide greater depth in chemical engineering education for students preparing for an engineering career in the pulp, paper, and allied industries. Students graduating from this program are well-suited for employment as process engineers in the paper and allied chemical industry, as well as many other career opportunities. 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, products and equipment.

Courses present the principles of engineering with the disciplines and examples selected especially for the pulp and paper industry. Courses include study in the basic sciences—chemistry, physics, computer science—as well as engineering topics such as statics and dynamics, mechanics, thermodynamics, transport phenomena, electricity, and design. The general education component, which is required of all ESF students, broadens the students' perspectives on

global and societal issues, an important component of any education. The engineering courses cover a variety of topics that are traditional for a chemical engineering program, supplemented with courses specific to pulp and paper engineering.

Students in the program gain valuable experience through a capstone-design experience in which they work on significant problems in the design and implementation of new technologies. In addition, a summer internship is required of all students in which they gain valuable skills and experience in terms of technical knowledge and professional development. Both of these experiences serve to integrate the knowledge gained in their coursework with real-world work experiences commonly seen in their first positions after graduation.

Students may enter the bachelor of science program as first-year students or as transfer students at any class level with accommodations for program requirements. Students who have the associate degree in engineering science, chemical technology, general engineering, chemistry, or general science and mathematics are encouraged to apply as transfer students.

Undergraduate Program Requirements

Lower Division Required Courses (55 credits)

COURSES			CREDITS
APM	153	Computing Methods	PE ⁷ 3
APM	485	Differential Equations for Engineers and Scientists	M ⁸ 3
CLL	190	Writing and the Environment	G ⁹ 3
CLL	290	Writing, Humanities and the Environment	G 3
ERE	225	Engineering Graphics	PE 1
FCH	150	General Chemistry I	G, NS ¹⁰ 3
FCH	151	General Chemistry Laboratory I	NS 1
FCH	152	General Chemistry II	NS 3
FCH	153	General Chemistry Laboratory II	NS 1
FCH	221	Organic Chemistry I	NS 3
FCH	222	Organic Chemistry I Laboratory	NS 1
FCH	223	Organic Chemistry II	NS 3
FCH	224	Organic Chemistry II Laboratory	NS 1
FCH	380	Analytical Chemistry I	NS 3
FOR	207	Introduction to Economics	G 3
MAT	295	Calculus I	G, M 4
MAT	296	Calculus II	M 4
MAT	397	Calculus III	M 4
PHY	211	General Physics I	G, NS 3
PHY	221	General Physics Laboratory I	NS 1
PHY	212	General Physics II	NS 3
PHY	222	General Physics Laboratory II	NS 1

Electives (12 credits)

General Education Course: American History	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilizations	G	3
General Education Course: The Arts	G	3

⁷ Professional education course

⁸ Math course

⁹ Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet the general education standards established by SUNY is listed on page 8 and on the Internet at www.suny.edu/provost/GeneralEducation/CourseList/ESFGERCourses.pdf

¹⁰ Natural science course

Upper Division Required Courses (55 credits)

APM	395	Probability and Statistics for Engineers	M	3
BPE	335	Transport Phenomenon	ENG ¹¹	3
CLL	405	Writing for Science Professionals	PE	3
ERE	440	Water Pollution Engineering	ENG	3
ESF	200	Information Literacy	PE	1
FCH	360	Physical Chemistry I	NS	3
PSE	132	Orientation Seminar: Paper Science and Engineering	ES ¹²	1
PSE	300	Introduction to Papermaking	ES	3
PSE	302	Pulp and Paper Laboratory Skills	ES	1
PSE	304	Mill Experience	ES	2
PSE	350	Pulping and Bleaching Processes	ES	3
PSE	351	Pulping and Bleaching Laboratory	ES	2
PSE	361	Engineering Thermodynamics	ENG	3
PSE	370	Principles of Mass and Energy Balances	ENG	3
PSE	371	Fluid Mechanics	ENG	3
PSE	436	Pulp and Paper Unit Operations	ENG	3
PSE	465	Paper Properties	ES	4
PSE	468	Papermaking Processes	ES	3
PSE	480	Engineering Design Economics	ENG	3
PSE	481	Engineering Design	ENG	3
WPE	386	Structures and Properties of Wood	PE	2
WPE	390	Fiber Identification Laboratory	PE	1

Science Directed Electives (6 credits)

Select from the following:

FCH	361	Physical Chemistry II	NS	3
PSE	466	Paper Coating And Converting	ES	3
PSE	467	Papermaking Wet End Chemistry	ES	3

Engineering Directed Electives (12 credits)

Select from the following:

ELE	231	Electrical Engineering Fundamentals I	ENG	3
ERE	223	Statics And Dynamics	ENG	4
ERE	362	Mechanics Of Materials	ENG	3
ERE	441	Air Pollution Engineering	ENG	3
PSE	477	Process Control	ENG	3

TOTAL MINIMUM CREDITS FOR THE DEGREE 140 CREDITS

Bachelor of Science in Paper Science

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, the allied chemical industry, as well as in applications of chemistry and biology. This program prepares the student for careers in the technical, managerial, or technical representative areas that extend in many directions.

The program consists mainly of chemistry, some engineering courses, and specialized courses relating to the manufacture and use of pulp and paper products. The student may choose to complete one of the options described below, with some options requiring the completion of a minor. The option electives allow the student to specialize in a subject area of interest. This program prepares the student for careers in the technical, management, or technical representative areas with opportunities to extend interests in other directions.

¹¹ Engineering course

¹² Engineering science course

Students may be admitted to the paper science program as first-year students with appropriate science backgrounds from their high school or as transfers at any level with accommodations for coursework requirements. Students who are preparing to transfer to ESF with junior status, for example, must have earned at least 60 credits of college coursework in courses comparable to the lower-division course requirements. Students with fewer background courses may be admitted as transfer students but should expect to stay longer at the college. Some latitude is available if the student's background includes most of the courses shown under "lower division required courses." Students who have the associate degree in engineering science, chemical technology, or science and mathematics are encouraged to apply as transfer students. The engineering science associate degree is well suited to the paper science program.

Undergraduate Program Requirements

Lower Division Required Courses (48 credits)

APM	153	Computing Methods	PE	3
CLL	190	Writing and the Environment	G	3
CLL	290	Writing, Humanities and the Environment	G	3
ERE	225	Engineering Graphics	PE	1
FCH	150	General Chemistry I	G, NS ¹³	3
FCH	151	General Chemistry Laboratory I	NS	1
FCH	152	General Chemistry II	NS	3
FCH	153	General Chemistry Laboratory II	NS	1
FCH	221	Organic Chemistry I	NS	3
FCH	222	Organic Chemistry I Laboratory	NS	1
FCH	223	Organic Chemistry II	NS	3
FCH	224	Organic Chemistry II Laboratory	NS	1
FCH	380	Analytical Chemistry I	NS	3
FOR	207	Introduction to Economics	G	3
MAT	295	Calculus I	G,M	4
MAT	296	Calculus II	M	4
MAT	397	Calculus III	M	4
PHY	211	General Physics I	G,NS	3
PHY	221	General Physics Laboratory I	NS	1
PHY	212	General Physics II	NS	3
PHY	222	General Physics Laboratory II	NS	1

Electives (12 credits)

General Education Course: American History	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilizations	G	3
General Education Course: The Arts	G	3

Upper Division Required Courses (40 credits)

CLL	405	Writing for Science Professionals		3
ESF	200	Information Literacy		1
FCH	360	Physical Chemistry I		3
FCH	361	Physical Chemistry II		3
PSE	132	Orientation Seminar: Paper Science and Engineering	ES	1
PSE	300	Introduction to Papermaking	ES	3
PSE	302	Pulp and Paper Laboratory Skills	ES	1
PSE	304	Mill Experience	ES	2
PSE	350	Pulping and Bleaching Processes	ES	3
PSE	351	Pulping and Bleaching Laboratory	ES	2
PSE	370	Principles of Mass and Energy Balances	ENG ¹⁴	3
PSE	465	Paper Properties	ES	4

¹³ Natural science course

¹⁴ Engineering course

PSE	466	Paper Coating and Converting	ES	3
PSE	467	Papermaking Wet End Chemistry	ES	3
PSE	468	Papermaking Processes	ES	3
WPE	386	Structures and Properties of Wood		2
WPE	390	Fiber Identification Laboratory		1

Engineering Electives (12 credits selected from the following:)

BPE	335	Transport Phenomena	ENG	3
ERE	440	Water Pollution Engineering	ENG	3
ERE	441	Air Pollution Engineering	ENG	3
PSE	361	Engineering Thermodynamics	ENG	3
PSE	371	Fluid Mechanics	ENG	3
PSE	436	Pulp and Paper Unit Operations	ENG	3
PSE	477	Process Control	ENG	3
PSE	480	Engineering Design Economics	ENG	3
PSE	481	Engineering Design	ENG	3

Technical Elective Courses (14-18 credits)

Students completing the paper science program must complete 14-18 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 college-wide minors listed below:

- Bioprocess Science
- Computer and Information Technology
- Construction Management
- Entrepreneurship
- General Management Studies
- Marketing

Students not completing one of the listed minors must complete at least 14 credits of Faculty-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 Faculty-approved areas

Free Electives (3-6 credits)

TOTAL MINIMUM CREDITS FOR THE DEGREE 132 CREDITS

Summer Orientation Program

All entering students (both freshman and transfer students) in the paper science or paper engineering programs are required to participate in the PSE 132 Orientation Program held at the end of May at an ESF field location in the Adirondacks. The exact dates of the three-day program are typically established in March. The purpose of the program is to familiarize the student with the basic aspects of the paper industry, to prepare the student for the fall courses, and to prepare the student for summer job interviews that also begin in the fall semester. The orientation program includes tours of pulp and paper mills and extensive discussions of the tours. It is quite beneficial for students to attend this orientation before starting classes, as the student can learn a great deal about the curriculum and the paper industry.

Internships and Co-ops

Paper science and paper engineering students enjoy the advantage of hands-on learning in the pulp, paper, and allied

industries through paid internships and co-ops. All students are required to complete a two-credit, 12-week summer intern program in the industry (PSE 304). Internships provide students with valuable experience, financial benefits, and two credits toward graduation. Students must submit a mill report for completion of the internship.

Students who complete a co-op in addition to the 12-week internship find the experience highly valuable because they are often able to see engineering projects through to their completion. Generally, students who have had the co-op experience are recruited for permanent employment.

The co-op position is approximately seven months in duration, either beginning in May and ending in December, or beginning in January and ending in August. Usually it takes students who complete a co-op one extra year to complete degree requirements. Co-op students are enrolled for two credits and are required to submit a co-op project report in addition to the mill report required for the two-credit summer internship course.

The employment interview schedule begins in mid-October following the Syracuse Pulp and Paper Foundation's annual meeting. Some companies schedule interviews for co-ops and summer internships at the same time they hold interviews for permanent positions. Other companies choose to hold interviews for co-ops and interns in the spring semester.

Minors

Students are eligible to take any of the minors that are offered at ESF. The two minors most commonly completed are the general management studies minor and the computer and information technology minor, which are summarized below. See page 9 for complete description of the course requirements for these and other minors at ESF.

Bioprocess Science Minor

The bioprocess science minor is available to students in the paper science and paper engineering programs who maintain a minimum cumulative GPA of 2.8, and who desire to develop greater knowledge of bioprocess science and its related fields.

Computer and Information Technology Minor

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 of the basic principles behind software development, students can more effectively use these tools in their chosen fields. The minor courses can be used to satisfy the technical electives in the paper science program.

General Management Studies Minor

The general management studies minor may be taken in conjunction with the bioprocess science, paper science, or paper engineering programs. In the paper science program, the minor courses can be used to satisfy the technical electives. Students should complete a course in microeconomics and a course in accounting prior to entering the junior year.

Paper Science Minor

The paper science minor is available to students in the bioprocess engineering program who maintain a minimum cumulative GPA of 2.8, and who desire to develop greater knowledge of paper science and its related fields.

Graduate Program

The faculty participates in graduate education leading to the master of science, master of professional studies, and doctor of philosophy degrees through the Division of Engineering. See page 44 for more information.

Graduate studies reflect the strong trend toward diversification in the industry and offer opportunities for study in a variety of subjects related to the manufacture of pulp and paper as well as other products and chemicals from sustainable raw material sources. Individual study programs are designed to meet specific personal needs.

An important component of the M.S. and Ph.D. programs is thesis research under direction of a major professor. Much of this research is carried out under the auspices of one of the outstanding research facilities of the world, the Empire State Paper Research Institute (ESPRI), a renowned organization supported jointly by ESF and the Empire State Paper Research Associates, an international consortium of leading pulp and paper companies. ESPRI's research activities aim to generate new information regarding the fundamentals, the science, the engineering and the technology of the production of products and chemicals from renewable resources such as wood. Recent work has been directed to fundamental investigations of pulping, bleaching, coproducts from wood, additives, paper recycling, effluent disposal, the papermaking process, the properties of paper, reactions of wood components during mechanical and

chemical treatments, novel wood component separation techniques, new biotechnologically-based pulping methods, process modeling paradigms, the structure of wood and wood fibers, evaporation, fluid dynamics, heat transfer, and chemical recovery. Pilot scale equipment in Walters Hall is often used as an integral part of these research programs.

Many research projects are carried out in cooperation with other college faculties. Examples of such projects include a wide-ranging study of toxicity of paper industry effluents in cooperation with the Faculty of Environmental and Forest Biology, and a cooperative project on the theoretical and experimental analysis of the mechanical properties of fiber and paper with the Department of Mechanical and Aerospace Engineering at Syracuse University. Cooperative studies enable access to the latest equipment in the computer field, including supercomputers.

The faculty enjoys excellent external support in the form of graduate assistantships, fellowships, and grants from ESPRI, and other industry sources, as well as a number of government granting agencies.

The Ranger School

CHRISTOPHER L. WESTBROOK, Director
Wanakena Campus
315-848-2566 FAX 315-848-3249
www.esf.edu/rangerschool

Participating Faculty

ALLEN (Timber Harvesting and Transportation, Fire Control), BRIDGEN (Silviculture, Dendrology, Aerial Photogrammetry, Utilization), DONOVAN (Forest Ecology), WEBB (Surveying), SAVAGE (Forest Mensuration, Recreation, Wildlife, Dendrology), WESTBROOK, Director (Surveying, Leadership and Problem Solving, Water)

Visiting Faculty

SEHNERT (Surveying)

About the Ranger School

In 1912, approximately 2,800 acres of land in the Adirondack Mountains were donated to the college as a site for the development of a ranger school. Since that time, the forest technology program has trained nearly 4,000 graduates, most of whom are now working in a variety of forestry professions, and it has earned the Ranger School a national reputation for excellence. The program is administered by and is an integral part of the Faculty of Forest and Natural Resources Management. This unique model of a single professional faculty offering all levels of study from technical through postdoctoral emphasizes the teamwork approach to forest resource science and management espoused by the faculty.

The curriculum educates students in forest and surveying technologies. The degree of associate in applied science (A.A.S.) in forest technology or land surveying technology is awarded. Within the curriculum there are two areas of study: forest technology and surveying. Fall semester coursework is the same for forest technology and surveying students. In the spring semester, however, students interested in surveying take 18 credit hours of surveying coursework in place of forestry-oriented courses.

Since the Ranger School is situated within a forest, some applicants may mistakenly believe that the experience is one of forest lore and wilderness survival. We strongly emphasize that the curricula demand high-quality academic achievement. Program completion requires concentrated and consistent study. Classes are scheduled from 8 a.m. to 5 p.m. Monday through Friday, with classroom and laboratory or field time equally divided. The intensity of the program normally requires a minimum of 70 hours a week of evening and weekend study, daily classes, and laboratory/field exercises. Several short trips are made during the year in connection with courses in dendrology, silviculture, forest management, forest recreation, wildlife ecology and surveying.

Associate of Applied Science in Forest Technology

This degree 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.

Graduates immediately find jobs at the technical level and are generally classified as forest technicians or forestry aides in initial employment positions. Forestry agencies and wood-using industries employ forest technicians as an important part of their forest management teams, usually as the "people on the ground" who plan and execute the field practice of forestry, normally under the supervision of a professional forester.

Students interested in a baccalaureate degree should investigate the Faculty of Forest and Natural Resources Management's bachelor's degree curriculum described beginning on page 81. 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 forest technology program should pay close attention to the footnotes under "freshman year."

The freshman year forest technology curriculum consists of general studies courses which may be taken at any accredited four-year, community, or agricultural college, or college of technology.

The second year of the curriculum is offered at the Wanakena Campus. Presented in a varied forest environment, the curriculum's emphasis is on fundamental forestry knowledge and applied field training as well as the relationship between forest technology and managerial needs. About 50 percent of studies are devoted to field exercises, most of which are held at the school's James F. Dubuar Forest. This excellent forest backdrop for the technology program provides a diverse laboratory for instructional purposes.

Program Requirements

First Year Required Courses (30 credits)

Completed at a college of the student's choice

COURSES	CREDITS
General Biology	8
English with a Focus on Writing	6
Trigonometry	3
Economics	3
Electives ¹	10

Second Year Required Courses (48 credits)

FTC 200	Dendrology	3
FTC 202	Introduction to Surveying	4
FTC 204	Introduction to Forest Measurements and Statistics	4
FTC 206	Forest Ecology	4
FTC 208	Spatial Analysis of Forest Resources	5
FTC 210	Leadership and Forest Technology	4
FTC 211	Silviculture	5
FTC 213	Forest Inventory Practicum	2
FTC 215	Timber Harvesting, Transportation, and Utilization	5
FTC 217	Forest Protection	5
FTC 219	Introduction to Wildlife and Recreation Management	4
FTC 221	Forest Management	3

TOTAL MINIMUM CREDITS FOR THE DEGREE

78 CREDITS

Associate of Applied Science in Land Surveying Technology

Many graduates of the Ranger School find the land surveying profession to be an exciting, challenging and rewarding career choice. As land values increase, technology advances, and laws and regulations become more complex, the education of land surveyors has become increasingly important. This degree was developed to address the current educational needs of the student interested in

¹ Students intending to apply to a four-year program after earning an A.A.S. degree should use electives to meet lower-division requirements.

pursuing a career in surveying, as well as the needs of surveying employers. Students who choose this program will be exposed to the fundamentals of forest technology that are important to the land surveyor and will receive a more in-depth education in the area of surveying technology.

This degree was designed to provide the student with knowledge and skills in surveying measurements and computations; the ability to work and communicate effectively with professional land surveyors, survey technicians, lawyers, and the general public; an understanding of the principles and practices of surveying with particular emphasis on boundary surveying; and an understanding of land resource concepts important to the surveyor. Students graduate with an A.A.S. degree in land surveying technology.

Generally, graduates are employed by privately-owned, small- to mid-size surveying firms specializing in boundary, construction, and topographic surveying. Graduates are employed as entry-level technicians performing a variety of tasks including operating various surveying instruments, note keeping, drafting, and computer operation. Employment is also available with local, state and federal agencies such as the state Department of Transportation, state Department of Environmental Conservation, U.S. Forest Service, and Bureau of Land Management.

At least one year of educational credit is given toward land surveying licensure in New York. Additional educational credit may be granted based on the student's previous educational experience. Additional field and office experience under the direct supervision of a licensed land surveyor is needed prior to application to obtain a license.

Transfer into other baccalaureate programs at a variety of institutions is possible; however, students are encouraged to consult with the appropriate admissions office to discuss transfer options.

During the first year, students who plan on enrolling are encouraged to take general physics, small business management, or additional mathematics as electives.

Given the nature of the curriculum, the availability of high-tech equipment, and the necessity of individualized instruction, entry into this area of study is limited to 12 students.

Program Requirements

First Year Required Courses (30 credits)

Completed at a college of the student's choice

General Biology	4
Physics	4
English with a Focus on Writing	6
Trigonometry	3
Economics	3
Electives ²	10

Second Year Required Courses (48 credits)

FTC 200	Dendrology	3
FTC 202	Introduction to Surveying	4
FTC 204	Introduction to Forest Measurements and Statistics	4
FTC 206	Forest Ecology	4
FTC 208	Spatial Analysis of Forest Resources	5
FTC 210	Leadership and Forest Technology	4
FTC 215	Timber Harvesting, Transportation, and Utilization	5
FTC 223	Introduction to Water Resources	1
FTC 251	Advanced Surveying Measurements and Computations	5
FTC 253	Surveying Law	3
FTC 255	Boundary Surveying	3

² Students intending to apply to a four-year program after earning an A.A.S. degree should use electives to meet lower-division requirements.

FTC 257	Construction and Topographic Surveys	3
FTC 259	Introduction to Computer Aided Drafting and Design	4

TOTAL MINIMUM CREDITS FOR THE DEGREE

78 CREDITS

Combining Forest Technology and Forest Resources Management

There are several advantages of combining a Ranger School forest technology 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 forest technology concentration to the forest resources management program 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. A maximum of 32 transfer credit hours from the sophomore year of the forest technology program will be counted toward the B.S. degree. All other requirements as set forth in the forest resources management program option must be met.

Students contemplating subsequent transfer should concentrate their freshman year electives in the social sciences and humanities. Students should also complete the first semester in chemistry, one semester in physics, and a course in calculus prior to transferring. It is possible to be admitted without these courses, but subsequent progress in the program becomes more difficult.

Life at Wanakena

The Ranger School of the College of Environmental Science and Forestry is located on the banks of the Oswegatchie River near the hamlet of Wanakena, approximately 65 miles northeast of Watertown and 35 miles west of Tupper Lake. The program's buildings and its surrounding forest border on the river, which flows directly into Cranberry Lake. This managed forest, containing both hardwood and coniferous species, covers an area some three miles long with widths varying up to two miles. On two sides, state forest preserve lands bound the forest. The forest is also adjacent to several square miles of virgin timber within the Adirondack Forest Preserve.

The main building consists of a central service unit with two dormitory wings. The central unit contains classrooms, laboratories, computer room, a student lounge and kitchen, faculty offices, library, kitchen and dining hall, student exercise and recreation room, and conference room. A \$6 million renovation project was completed in early 2003 that significantly expanded and upgraded the facilities.

Faculty and staff houses are nearby on the campus. Other buildings include a maintenance shop, garages, a sugarhouse, and storage buildings.

The close proximity of faculty offices and student quarters and the intensive field work pattern enables students to consult easily and frequently with the faculty. The program considers this traditional close student-faculty association to be of major benefit in its educational program.

A small library of approximately 1,500 volumes consists of highly specialized materials required for the teaching and study programs of the curriculum.

Students taking the second year of the curriculum at the Ranger School are required to live in the campus's dormitories. Married students may request an exception to bring their families and rent private accommodations in the vicinity. Such accommodations are not plentiful. Each married student should make rental arrangements well in advance of the registration date.

The Ranger School does not maintain an infirmary, nor does it employ a physician or nurse. There are two physicians as well as an excellent community hospital in nearby Star Lake, N.Y. In emergency situations, the program transports sick or injured students to the local physician of their choice or to the hospital. Health and accident policies for students are available through Syracuse University, and it is strongly suggested that the student consider such coverage before reporting to the campus. Application forms are available at the Syracuse University Health Center, 111 Waverly Ave., 315-443-2666.

Because of the comparatively isolated location of the Ranger School, a stock of books and supplies used in connection with the second year of the program is maintained on campus for sale to students.

While in residence at the Ranger School, students are held to the general rules and regulations of the College of Environmental Science and Forestry and an additional set of Ranger School "house rules."

Admission

Requirements

Admission into the forest technology curriculum requires the following high school units: English (4 units), social science (3 units), science (2 units, including biology), mathematics (3 units, college preparatory), and electives. Technical report writing, and computer science are suggested electives.

In addition to the academic requirements, all applicants must also meet the following:

1. The applicant must be strongly motivated toward a career in field forestry or surveying.
2. The applicant must be willing and able to meet the physical requirements of the program, which include walking 2 to 6 miles through forest areas, often carrying 15 to 20 pounds of equipment, and using a wide array of hand tools and power equipment.
3. The applicant's parents (if the applicant is under 18 years of age) must be fully aware of the field nature of the study program, its rigorous study-work regime and supporting academic facilities.
4. A physician certification must be submitted. Copies of the certification form are available from the Ranger School.

Questions concerning any of these requirements should be referred to the ESF Office of Undergraduate Admissions, 106 Bray Hall, 315-470-6600.

Procedures

The decision to admit any student to the forest technology program rests solely with the College of Environmental Science and Forestry. Some openings in the program are filled by students who are accepted to the program under the guaranteed transfer option while still seniors in high school, contingent on successful completion of the first year of college. Remaining openings are filled by transfer students who already have attended college. Therefore, it is suggested the potential student, while still a high school senior, follow these procedures:

1. Submit a regular SUNY freshman application for the College of Environmental Science and Forestry, using Curriculum Code 620 (Forest Technology) or Curriculum Code 1825 (Land Surveying Technology). The entry date on the ESF application should be the fall following the expected completion of the first 30 credit hours.
2. Submit a regular application to that school selected for the first year of study, using Curriculum Code 620 or 1825. It is important that students gain entry on their own for the first year of studies. ESF will request information at a later date concerning what institution the student will be attending.

A limited number of outstanding students are admitted directly from high school. For further information, contact the ESF Office of Undergraduate Admissions, 106 Bray Hall 315-470-6600.

Transfer Students

Students with previous college experience or students who are currently enrolled at another college may apply for transfer. However, courses transferred for credit can be applied only to the freshman year course of study, and they must be comparable in subject matter, content, and level. All second-year courses must be taken at the Ranger School, and, therefore, a student cannot transfer any previously earned credit toward the second year. Transfer applicants must submit a recent official copy of their college transcript and a list of courses they anticipate completing prior to enrollment.

Expenses and Financial Aid

Cost of the first year will vary with the specific institution attended.

Estimated costs of the second year of the program at the Ranger School are as follows:

	Tuition	Board, Room	Books, Supplies
N.Y. Resident	\$4,350	\$8,400	Approx. \$2,300
Nonresident	\$10,610	\$ 8,400	Approx. \$2,300

Students in the surveying technology program will need an additional approximately \$450 for supplies. An expense of approximately \$200 for laundry and clothing should be anticipated. There is also a \$20 graduation fee, a student support services fee of \$317, a \$75 student activity fee, a transcript fee of \$10, a technology fee of \$240, and student transportation fees of \$300. There are a limited number of single dorm rooms available for an additional fee. There is also a \$75 resident deposit and a \$75 equipment deposit. The latter two fees are fully or partially refundable, depending on breakage charged to a student during the year.

Financial Aid

Financial aid is available upon acceptance to the College of Environmental Science and Forestry. There are three basic loans, scholarships or grants, and part-time employment.

More detailed information on these financial aid opportunities can be found beginning on page 28 of this catalog and the publication *Financial Assistance at ESF*.

The student must file an application with the Office of Financial Aid at the Syracuse Campus and submit a Family Financial Statement to ACT, Iowa City, Iowa 52243.

Placement

The Ranger School assists in placement of graduates. The excellent reputation that the graduates of the Ranger School at Wanakena have developed in all types of forestry and surveying jobs greatly assists today's graduates to find employment. Employment is common with local, state and federal forestry and land resource agencies, private forestry enterprises, and surveying firms. Positions most frequently filled by recent graduates include state forest ranger, state forest technician, forest aide, industrial forest district supervisor, timber inventory specialist, timber sales supervisor, forest surveyor, forest engineering aide, forest protection technician, forest research technician, forest equipment salesman, tree service technician, and urban park ranger.

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Construction Management and Wood Products Engineering Faculty: Susan E. Anagnost, Chair
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Paper Science and Engineering Faculty: Thomas E. Amidon, Chair
Ranger School: Christopher L. Westbrook, Director

Student Services Offices

Alumni Relations: Justin F. Culkowski, Director
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Financial Aid and Educational Opportunity Program: John E. View, Director
Multicultural Affairs: Raydora Drummer Francis, Director
Registrar: Raymond W. Blaskiewicz, College Registrar
Student Life and Experiential Learning: Julie R. White, Associate Dean

Campus Administrative Offices

Business Affairs: Mark P. Fennessy, Director

Computing and Network Services: Brent Potter, Supervisor
Development: Brenda Greenfield, Director of Development and Executive Director, ESF College Foundation
Environmental Health and Safety: John R. Waisel, Officer
Forest Properties: Richard A. Schwab, Director
Human Resources: Marcia A. Barber, Director
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Information Technology and Institutional Planning: Maureen O. Fellows, Director
News and Publications: Jeri Lynn Smith, Director
Physical Plant: Gary E. Colella, Director
Syracuse Pulp and Paper Foundation: Linda A. Fagan, Project Staff Associate
University Police: Paul K. McGuinness, Chief

Academic and Research Program Units

Computing and Network Systems: James M. Sahn, Coordinator
Analytical and Technical Services: Arthur J. Stipanovic, Director
College Libraries: Elizabeth A. Elkins, Director
Cranberry Lake Biological Station: Alexander Weir, Director
Outreach, Instructional Quality and Technology: Charles M. Spuches, Associate Dean
EnSPIRE Office of Environment and Society: Rachel May, Director
ESF in the High School: Charles M. Spuches, Director
Honors Program: Marla A. Bennett, Director
Research Programs: Neil H. Ringler, Dean
Summer Program in Field Forestry: Christopher L. Westbrook, Director

Institutes and Centers for Research and Service

Adirondack Ecological Center: William F. Porter, Director
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Center for Community Design Research: Cheryl S. Doble, Director
Central New York Biotechnology Research Center: John C. Fieschko, Executive Director
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Council on Hydrologic Systems Science: Myron J. Mitchell, Director
Council on McIntire-Stennis Forestry Research: Neil H. Ringler, Director
Empire State Paper Research Institute: Thomas E. Amidon, Director
Great Lakes Research Consortium: Richard C. Smardon, Director
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FACULTY AND PROFESSIONAL STAFF

DISTINGUISHED PROFESSOR

MYRON J. MITCHELL, Environmental and Forest Biology Faculty

DISTINGUISHED TEACHING PROFESSOR

GUY A. BALDASSARRE, Environmental and Forest Biology Faculty
GEORGE W. CURRY, Landscape Architecture Faculty
DONALD J. LEOPOLD, Environmental and Forest Biology Faculty
DUDLEY J. RAYNAL, Environmental and Forest Biology Faculty
NEIL H. RINGLER, Environmental and Forest Biology Faculty
LEE P. HERRINGTON, Forest and Natural Resources Management Faculty

DISTINGUISHED SERVICE PROFESSOR

RALPH D. NYLAND, Forest and Natural Resources Management Faculty

DISTINGUISHED ADJUNCT PROFESSOR

HARRY L. FRISCH, Chemistry Faculty

DISTINGUISHED SERVICE PROFESSOR EMERITUS

DOUGLAS C. ALLEN, Environmental and Forest Biology Faculty
WILFRED A. CÔTÉ, JR., Construction Management and Wood Products Engineering Faculty

DISTINGUISHED TEACHING PROFESSOR EMERITUS

PETER E. BLACK, Forest and Natural Resources Management Faculty
DANIEL L. DINDAL, Environmental and Forest Biology Faculty
MIKLÓS A. J. GRÁTZER, Forest and Natural Resources Management Faculty
EDWIN H. KETCHLEDGE, Environmental and Forest Biology Faculty

DISTINGUISHED PROFESSOR EMERITUS

CONRAD SCHUERCH, Chemistry Faculty

FACULTY AND PROFESSIONAL STAFF

This listing represents an official record of the State University of New York College of Environmental Science and Forestry faculty and professional staff for 2006. It is designed for use in 2006-2007.

The date in parentheses after each name denotes the first year of service, two or more dates, the term of service.

NASRI ABDEL-AZIZ (2001), *Instructor*, Forest and Natural Resources Management Faculty; B.A., Syracuse University, 1998; M.S., 2001

LAWRENCE P. ABRAHAMSON (1977), *Senior Research Associate*, Forest and Natural Resources Management Faculty and Environmental and Forest Biology Faculty; *Director*, Salix Consortium; B.S., Michigan Technological University, 1964; M.S., University of Wisconsin, 1967; Ph.D., 1969; Chancellor's Award for Excellence in Professional Service, 1996

KIM B. ADAMS (1993), *Instructional Support Specialist*, Environmental and Forest Biology Faculty; B.S., SUNY College of Environmental Science and Forestry, 1991; M.S., 1993

WAYNE G. ALLEN (1979), *Associate Professor*, Forest Technology Program of the Forest and Natural Resources Management Faculty; A.A.S., SUNY College of Environmental Science and Forestry (Ranger School), 1979; B.S., Western Maryland College, 1974; M.S., State University of New York College at Potsdam, 1999; President's ESF Public Service Award, 2006

WAYNE S. AMATO (1995), *Adjunct Professor*, Paper Science and Engineering Faculty; B.S., Newark College of Engineering, 1963; M.S., State University of New York at Buffalo, 1965; Ph.D., Syracuse University, 1970

THOMAS E. AMIDON (2000), *Chair and Professor*, Paper Science and Engineering Faculty; *Director*, Empire State Paper Research Institute; B.S., SUNY College of Environmental Science and Forestry, 1968; M.S., 1972; Ph.D., 1975

SUSAN E. ANAGNOST (1991), *Associate Professor*, Construction Management and Wood Products Engineering Faculty; *Assistant Director*, N.C. Brown Center for Ultrastructure Studies; B.A., Gettysburg College, 1977; M.S., SUNY College of Environmental Science and Forestry, 1982; Ph.D., 1990

MARK J. APPLEBY (1997), *Research Support Specialist*, Forest and Natural Resources Management Faculty; B.S., SUNY College of Environmental Science and Forestry, 1997

RAYMOND J. APPLEBY (1982), *Instructional Support Specialist*, Paper Science and Engineering Faculty; A.S., Columbia-Greene Community College, 1980; President's ESF Public Service Award, 2004

ROBERT W. ARSENEAU (1972), *Senior Programmer/Analyst*, Administrative Computing; A.A.S., Mohawk Valley Community College, 1967; B.S., Syracuse University, 1978

DONALD E. ARTZ (1987), *Administrative Staff Assistant IV*, Office of Research Programs; B.S., State University of New York College at Oswego, 1987

JOHN E. AUWAERTER (2000), *Research Scientist*, Landscape Architecture Faculty; B.A., Middlebury College, 1987; M.A., 1992; M.S., SUNY College of Environmental Science and Forestry, 2000

BRUCE BABENZIE (2003), *Admissions Advisor*, Undergraduate Admissions; B.S., Springfield College, 1967

CAROLINE B. BAILEY (1978), *Senior Staff Assistant*, Landscape Architecture Faculty

ANDREA M. BAIRD (2001), *Instructor*, Chemistry Faculty; B.S., Rochester Institute of Technology, 1997; M.S., 1999

GUY A. BALDASSARRE (1987), *Distinguished Teaching Professor*, Environmental and Forest Biology Faculty; B.S., University of Maine, 1975; M.S., University of Wisconsin, Stevens Point; 1978; Ph.D., Texas Tech University, 1982

ELIZABETH A. BALKO (2003), *Adjunct Assistant Professor*, Environmental and Forest Biology Faculty; B.S., Northern Arizona University, 1983; Ph.D., SUNY College of Environmental Science and Forestry, 1998

BENJAMIN D. BALLARD (1999), *Research Scientist*, Forest and Natural Resources Management Faculty; B.S., SUNY College of Environmental Science and Forestry, 1995; M.S., 1999

JENNIFER BALLARD (1998), *Research Support Specialist*, Forest and Natural Resources Management Faculty; B.A., Kutztown University, 1995

MARCIA A. BARBER (1989), *Director*, Office of Human Resources; B.A., State University of New York College at Brockport, 1980; M.P.A., Syracuse University, 1993

GEORGE R. BATTLES (1987), *Instructional Support Specialist*, Analytical and Technical Services; A.A.S., State University of New York College of Agriculture and Technology at Morrisville, 1966; B.E.T., Rochester Institute of Technology, 1973

CHRISTOPHER P. BAYCURA (2000), *Instructional Support Specialist*, Outreach, Instructional Quality and Technology; A.A.S., State University of New York College of Agriculture and Technology at Morrisville, 1985; B.S., State University College of Arts and Sciences at Brockport, 1987

- RICHARD E. BEAL** (2001), *Associate Director for Educational Outreach, Outreach, Instructional Quality and Technology*; A.S., Monroe Community College, 1989; B.S., State University of New York at Buffalo, 1991; Ph.D., 1997
- MARLA A. BENNETT** (1994), *Assistant Dean, Instruction and Graduate Studies; Director, Honors Program*; A.A.S., State University of New York College of Technology at Delhi, 1979; B.S., Empire State College, 1988; M.P.A., Syracuse University, 1990; Ph.D., 1998; Chancellor's Award for Excellence in Professional Service, 2006
- SUSAN E. BENOIT** (1995), *Senior Staff Assistant, Office of Research Programs*; A.S., Champlain College, 1981; B.S., University of Vermont, 1986
- EDDIE BEVLACQUA** (1998), *Associate Professor, Forest and Natural Resources Management Faculty*; B.S., University of Toronto, 1984; M.S., 1987; Ph.D., 1998
- STEVEN BICK** (1998), *Adjunct Professor, Forest and Natural Resources Management Faculty*; A.S., Herkimer Community College, 1986; B.S., SUNY College of Environmental Science and Forestry, 1988; M.S., 1990; Ph.D., Virginia Polytechnic Institute and State University, 1996
- VANCE M. BLACKBURN** (2004), *Production Coordinator, News and Publications*; B.F.A., State University of New York College at Oswego, 1989
- RAYMOND W. BLASKIEWICZ** (1982), *College Registrar, Registrar's Office*; B.S., SUNY College of Environmental Science and Forestry, 1979; M.S., Syracuse University, 1988
- TIMOTHY M. BLEHAR** (1999), *Personnel Associate, Office of Human Resources*; A.A.S., State University of New York College of Agriculture and Technology at Morrisville, 1982
- KEVIN R. BLISS**, (1999), *Adjunct Assistant Professor, Environmental Studies Faculty*; A.A.S., State University of New York College of Agriculture and Technology at Cobleskill, 1982; B.S. State University of New York College at Oneonta, 1985; M.S., SUNY College of Environmental Science and Forestry, 1987
- TERRY L. BLUHM** (1995), *Adjunct Professor, Chemistry Faculty*; B.S., SUNY College of Environmental Science and Forestry, 1970; M.S., 1973; Ph.D., 1976
- BRUCE C. BONGARTEN** (2005), *Provost and Vice President for Academic Affairs*; B.S., SUNY College of Environmental Science and Forestry, 1973; Ph.D., Michigan State University, 1978
- BRIAN D. BOOTHROYD** (1991), *Facilities Program Coordinator, Physical Plant*; B.P.S., State University of New York at Buffalo, 1981
- WILLIAM R. BORGSTEDE** (1971), *Instructional Support Specialist, Environmental and Forest Biology Faculty*; A.A.S., Miner Institute, 1966; A.A.S., State University of New York College of Technology at Delhi, 1970; B.S., SUNY College of Environmental Science and Forestry, 1975; M.S., Syracuse University; 1978; President's ESF Quality of Worklife Award, 2003
- GREGORY L. BOYER** (1985), *Professor, Chemistry Faculty*; A.S., Reedley College, 1973; A.B., University of California, 1975; Ph.D., University of Wisconsin, 1980
- ALFRED W. BOYLE** (2003), *Adjunct Assistant Professor, Environmental and Forest Biology Faculty*; B.S., SUNY College of Environmental Science and Forestry, 1989; M.S., 1991; Ph.D., Rutgers University, 1999
- MARLENE A. BRAUN** (1996), *Instructional Support Technician, Analytical and Technical Services*; A.A.S., State University of New York College of Agriculture and Technology at Canton, 1975
- STEVEN R. BRECHIN** (2004), *Adjunct Professor, Environmental Studies Faculty*; B.A., Kalamazoo College, 1975; B.S., University of Michigan, 1981; M.R.P., 1983; Ph.D.
- BRUCE W. BREITMEYER** (1983), *Forest Property Manager I, Forest Properties*; B.S.F., University of Michigan, 1975; M.F., 1982
- MICHAEL R. BRIDGEN** (1992), *Professor, Forest Technology Program of the Forest and Natural Resources Management Faculty*; B.S., Pennsylvania State University, 1975; Ph.D., Michigan State University, 1979; Chancellor's Award for Excellence in Teaching Service, 2003
- RUSSELL D. BRIGGS** (1995), *Professor, Forest and Natural Resources Management Faculty*; A.A.S., SUNY College of Environmental Science and Forestry (Ranger School), 1975; B.S., SUNY College of Environmental Science and Forestry, 1979; M.S., 1982; Ph.D., 1985
- ALTON F. BROWN** (1963), *Research Support Specialist, Paper Science and Engineering Faculty*; President's ESF Public Service Award, 1993
- PATRICIA BURAK** (1983), *Adjunct Advisor to International Students, Office of Instruction and Graduate Studies*; B.A., State University of New York College at Oswego, 1973; M.A., State University of New York at Albany, 1974; Ph.D., Syracuse University, 1997
- DOUGLAS A. BURNS** (2003), *Adjunct Professor, Forest and Natural Resources Management Faculty*; B.A., Hope College, 1978; M.S., University of Virginia, 1982; Ph.D., SUNY College of Environmental Science and Forestry, 1999
- KENNETH F. BURNS** (1970), *Instructional Support Specialist, Forest and Natural Resources Management Faculty*; A.A.S., Paul Smith's College, 1969
- WILLIAM M. BURRY** (1997), *Instructional Support Technician, Paper Science and Engineering Faculty*; B.S., SUNY College of Environmental Science and Forestry, 1974; M.A., State University of New York College at Cortland, 1999
- ISRAEL CABASSO** (1981), *Professor, Chemistry Faculty; Director, Michael M. Szwarc Polymer Research Institute*; B.S., Hebrew University, 1966; M.S., 1968; Ph.D., Weizmann Institute of Science, 1973
- PAUL M. CALUWE** (1969), *Professor, Chemistry Faculty*; Ph.D., University of Leuven, Belgium, 1967
- KIMBERLY D. CAMERON** (2004), *Research Scientist, Environmental and Forest Biology Faculty*; B.S., State University of New York College at Cortland, 1995; Ph.D., SUNY College of Environmental Science and Forestry, 2001
- EMANUEL J. CARTER, JR.** (1985), *Associate Professor, Landscape Architecture Faculty*; B.A., Cornell University, 1969; Master of Regional Planning, 1978
- JOHN D. CASTELLO** (1978), *Professor, Environmental and Forest Biology Faculty*; B.A., Montclair State College, 1973; M.S., Washington State University, 1976; Ph.D., University of Wisconsin, 1978
- H. PETER CASTRO** (1990), *Adjunct Professor, Forest and Natural Resources Management Faculty*; B.A., University of California, 1977; M.A., 1981; Ph.D., 1988
- DEBBIE J. CAVINESS** (1996), *Staff Assistant, Alumni Relations*; B.A., St. Bonaventure University, 1990
- THEODORE CERALDI** (2004), *Educator, Outreach, Instructional Quality and Technology*; A.A.S., State University of New York at Farmingdale, 1965; B.A., The Cooper Union for the Advancement of Science and Art, 1970
- PATRICIA CERRO-REEHIL** (1987), *Project Staff Associate, New York Water Environment Association*; A.A.S., Green Mountain College, 1981

AVIK P. CHATTERJEE (1999), *Associate Professor*, Chemistry Faculty; B.S., University of Bristol, UK, 1990; Ph.D., 1994

SIDDHARTH G. CHATTERJEE (1994), *Associate Professor*, Paper Science and Engineering Faculty; B.Tech., Indian Institute of Technology, 1982; M.S., Rensselaer Polytechnic Institute, 1985; Ph.D., 1987

LAURA J. CHUMLEY (1998), *Senior Programmer/Analyst*, Administrative Computing; B.S., University of Tennessee-Knoxville, 1984; M.S., University of Texas-Austin, 1986; Certificate in Client/Server Developer, Center for Business Information Technology, Syracuse University, 1998

GARY E. COLELLA (1986), *Director*, Physical Plant; A.A.S., Auburn Community College, 1963

THOMAS J. CONENA (2002), *Adjunct Associate Professor*, Environmental Studies Faculty; B.A., Syracuse University, 1982; M.S., 1996

MICHAEL J. CONNERTON (2000), *Administrative Staff Assistant I*, Environmental Studies Faculty; A.A.S., State University of New York College of Agriculture and Technology at Cobleskill, 1989; B.S., SUNY College of Environmental Science and Forestry, 1991

JOSEPH D. CORNELL (2003), *Adjunct Professor*, Paper Science and Engineering Faculty; B.Sc., Marshall University, 1988; Ph.D., SUNY College of Environmental Science and Forestry, 2003

JUSTIN F. CULKOWSKI (1978), *Director of Alumni Relations and Admissions Counselor*, Alumni Relations; B.S., SUNY College of Environmental Science and Forestry, 1973; M.B.A., Syracuse University, 1983; NYS/UUP Excellence Award, 1991

GEORGE W. CURRY (1966), *Distinguished Teaching Professor and Endowed Kennedy Choir*, Landscape Architecture Faculty; B.A., Michigan State University, 1962; B.S., 1965; M.L.A., University of Illinois, 1969

STEVEN H. CURTIS (1991), *Lecturer*, Landscape Architecture Faculty; B.L.A., SUNY College of Environmental Science and Forestry, 1969; B.B.A., State University of New York College of Technology at Utica, 1985

DOUGLAS J. DALEY (1996), *Associate Professor*, Environmental Resources and Forest Engineering Faculty; *Director*, SUNY Center for Brownfield Studies; B.S., SUNY College of Environmental Science and Forestry, 1982; M.S., 1984

CRAIG J. DAVIS (1987), *Professor*, Forest and Natural Resources Management Faculty; A.A.S., Williamsport Area Community College, 1978; B.S.F.E., University of Maine, 1982; M.S.F., Purdue University, 1984; Ph.D., 1987

SCHAELON F. DAVIS (1994), *Assistant Director*, Financial Aid ; A.S., Elizabeth Seton College, 1979; B.S., Syracuse University, 1986

CHAD P. DAWSON (1986), *Chair and Professor*, Forest and Natural Resources Management Faculty; *Director*, Division of Forest Resources; B.S., University of Michigan, 1970; M.P.S., Cornell University, 1979; Ph.D., SUNY College of Environmental Science and Forestry, 1983; Chancellor's Award for Excellence in Teaching, 1995

JANINE M. DeBAISE (1996), *Instructor*, Environmental Studies Faculty-Writing Center; B.A., St. Lawrence University, 1983; M.A., Syracuse University, 1985

CHARLOTTE L. DEMERS (1990), *Instructional Support Associate*, Adirondack Ecological Center; A.A.S., Holyoke Community College, 1984; B.S., SUNY College of Environmental Science and Forestry, 1986

M. ELEN DEMING (1993), *Associate Professor*, Landscape Architecture Faculty; B.A., State University of New York at Albany, 1976; M.L.A., Harvard University Graduate School of Design, 1985; Ph.D., 2001

DANETTE J. DESIMONE (1990), *Assistant Director*, Business Affairs; B.S., LeMoyne College, 1986; C.P.A., NYS Education Department, 1988; M.B.A., Syracuse University, 1993

GARY L. DIAMOND (1997), *Adjunct Professor*, Environmental Resources and Forest Engineering Faculty; B.S., University of Maryland, 1974; Ph.D., University of Minnesota, 1980

THEODORE S. DIBBLE (1996), *Associate Professor*, Chemistry Faculty; B.S., University of Michigan, 1987; Ph.D., 1992

CHERYL S. DOBLE (1993), *Associate Professor*, Landscape Architecture Faculty; *Director*, Center for Community Design Research; B.F.A., Syracuse University, 1969; M.S., 1977; M.L.A., SUNY College of Environmental Science and Forestry, 1986; The Foundation Award for Exceptional Achievement in Teaching, 2000

KELLEY J. DONAGHY (2006), *Assistant Professor*, Chemistry Faculty, B.S., Syracuse University, 1989; Ph.D., University of Pennsylvania, 1996

CAREN M. DONOVAN (2003), *Assistant Professor*, Forest Technology Program of the Forest and Natural Resources Management Faculty; A.A.S., SUNY College of Environmental Science and Forestry (Ranger School), 1999; B.A., State University of New York College at Potsdam, 2001; M.S.T., 2003

ALLAN P. DREW (1980), *Professor*, Forest and Natural Resources Management Faculty; B.S., University of Illinois, 1965; M.S., University of Arizona, 1967; Ph.D., Oregon State University, 1974

DAVID M. DRIESEN (2000), *Adjunct Associate Professor*, Environmental Studies Faculty; B.Mus., Oberlin, 1980; M.Mus., Yale School of Music, 1983; J.D. Yale Law School, 1989

DEBRA A. DRISCOLL (1991), *Instructional Support Specialist*, Analytical and Technical Services; B.S., SUNY College of Environmental Science and Forestry, 1980

MARK S. DRISCOLL (1986), *University Instructional Specialist*, Research Programs; A.A., State University of New York College of Technology at Delhi, 1979; B.S., St. John's University, 1982; Ph.D., SUNY College of Environmental Science and Forestry, 1992

RAYDORA S. DRUMMER FRANCIS (2004), *Director*, Multicultural Affairs; B.A., Albertus Magnus College, 1979; M.A., Wheaton College, 1986; Ph.D., Michigan State University, 1995

MICHAEL T. DUGAN (2001), *Coordinator of Annual Giving*, Development Office; B.S., SUNY College of Environmental Science and Forestry, 2000

CLAIRE B. DUNN (1996), *Assistant Director and Senior Editor*, News and Publications; B.A., Glassboro State College, 1977

PATRICK R. DURKIN (1993), *Adjunct Associate Professor*, Environmental Studies Faculty; B.A., State University of New York College at Fredonia, 1986; M.S., Fordham University, 1972; Ph.D., SUNY College of Environmental Science and Forestry, 1979

STEVEN EFFLER (1991), *Adjunct Associate Professor*, Environmental Studies Faculty; B.S., University of Notre Dame, 1968; M.S., Institute of Polymer Science, 1971; Ph.D., Syracuse University, 1975

LAURA A. EISELEN (2005), *Admissions Assistant*, Undergraduate Admissions; B.S., SUNY College of Environmental Science and Forestry, 2004

ELIZABETH A. ELKINS (1973), *Librarian and Director of College Libraries*, F. Franklin Moon Library; B.A., Hartwick College, 1968; M.L.S., State University of New York College at Geneseo, 1970; Chancellor's Award for Excellence in Librarianship, 1980

JO ANNE C. ELLIS (1998), *Associate Librarian*, F. Franklin Moon Library; B.A., Syracuse University, 1971; M.L.S., 1972; President's ESF Quality of Worklife Award, 2005

MARLA R. EMERY (2002), *Adjunct Associate Professor*, Environmental Studies Faculty; B.A., San Jose State University, 1976; M.S.Ed., University of Miami, 1984; Ph.D., Rutgers University, 1998

THEODORE A. ENDRENY (1999), *Associate Professor*, Environmental Resources and Forest Engineering Faculty; B.S., Cornell University, 1990; M.S., North Carolina State University, 1996; M.A., Princeton University, 1998; Ph.D., 1999

DONALD FABER-LANGENDOEN (1998), *Adjunct Assistant Professor*, Environmental and Forest Biology Faculty; B.S., Calvin College, 1981; M.S., University of Toronto, 1984; Ph.D., St. Louis University, 1989

LINDA A. FAGAN (2000), *Project Staff Associate*, Paper Science and Engineering Faculty, B.S., SUNY College of Environmental Science and Forestry, 1993

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NORMAN A. RICHARDS (1963-1997), *Professor Emeritus*, Forest and Natural Resources Management Faculty; B.S., State University College of Forestry at Syracuse University, 1957; M.S., Cornell University, 1959; Ph.D., State University College of Forestry at Syracuse University, 1968

ANATOLE SARKO (1967-1997), *Professor Emeritus*, Chemistry Faculty; Cellulose Research Institute; B.S., Upsala College, 1952; M.S., New York University, 1960; Ph.D., State University College of Forestry at Syracuse University, 1966

MICHAEL SCHAEDEL (1965-1994), *Professor Emeritus*, Environmental and Forest Biology Faculty; B.S., University of British Columbia, 1957; M.S., 1959; Ph.D., University of California, 1964

LELAND R. SCHROEDER (1986-2004), *Professor Emeritus*, Paper Science and Engineering Faculty; A.B., Ripon College, 1960; M.S., Lawrence University (The Institute of Paper Chemistry), 1962; Ph.D., 1965

CONRAD SCHUERCH (1949-1983), *Distinguished Professor Emeritus*, Chemistry Faculty; B.S., Massachusetts Institute of Technology, 1940; Ph.D., 1947

BRADFORD G. SEARS (1941-1976), *Dean Emeritus and Professor Emeritus*, Landscape Architecture Faculty; B.S., New York State College of Forestry, 1939; M.S., State University College of Forestry at Syracuse University, 1948

ROBERT M. SILVERSTEIN (1969-1986), *Professor Emeritus*, Chemistry Faculty; B.S., University of Pennsylvania, 1937; M.S., New York University, 1941; Ph.D., 1949

JOHN B. SIMEONE (1948-1983), *Professor Emeritus*, Environmental and Forest Biology Faculty; B.S., Rhode Island State College, 1942; M.F., Yale University, 1948; Ph.D., Cornell University, 1960

CHRISTEN SKAAR (1946-1948) (1949-1976), *Professor Emeritus*, Construction Management and Wood Products Engineering Faculty; B.S., New York State College of Forestry, 1943; M.S., State University College of Forestry at Syracuse University, 1948; Ph.D., Yale University, 1957

JOHANNES SMID (1956-57) (1960-1995), *Professor Emeritus*, Chemistry Faculty; B.Sc., Free University, Amsterdam, 1952; M.Sc., 1954; Ph.D., State University College of Forestry at Syracuse University, 1957

KENNETH J. SMITH, JR. (1968-1995), *Professor Emeritus*, Chemistry Faculty; B.A., East Carolina University, 1957; M.A., Duke University, 1959; Ph.D., 1962

LEONARD A. SMITH (1964), *Associate Professor Emeritus*, Construction Management and Wood Products Engineering Faculty; B.S., Ch.E., University of Dayton, 1962; M.S., Ch.E., Case Institute of Technology, 1964; Ph.D., SUNY College of Environmental Science and Forestry, 1972

DENNIS O. STRATTON (1978-1997), *Director of Admissions and Inter-Institutional Relations Emeritus*, Student Affairs and Educational Services; B.S., State University of New York College at Cortland, 1965; M.S., 1966; Chancellor's Award for Excellence in Professional Service, 1995

WESLEY E. SUHR (1974-1988), *Associate Professor Emeritus*, Forest Technology Program of the Forest and Natural Resources Management Faculty; B.S., University of Minnesota, 1958; M.S., University of Arizona, 1965

STUART W. TANENBAUM (1973-1993), *Collegewide Professor Emeritus*; B.S., City College of New York, 1944; Ph.D., Columbia University, 1951; NYS/UUP Excellence Award, 1990

JAMES L. THORPE (1965-2000), *Research Associate Emeritus*, Paper Science and Engineering Faculty; B.S., State University College of Forestry at Syracuse University, 1965; M.S., 1967

WILLIAM C. TIERSON (1949-1983), *Director of Wildlife Research Emeritus*; B.S., State University College of Forestry at Syracuse University, 1949; M.F., 1967

TORE E. TIMELL (1951) (1962-1995), *Professor Emeritus*, Chemistry Faculty; Civiling, Royal Institute of Technology, Stockholm, 1946; Tekn. lic., 1948; Teck. Dr., 1950

FREDRICK A. VALENTINE (1956-1995), *Professor Emeritus*, Environmental and Forest Biology Faculty; B.S., St. Cloud State Teachers College, 1949; M.S., University of Wisconsin, 1953; Ph.D., 1957; NYS/UUP Excellence Award, 1990

LARRY W. VANDRUFF (1970-2000), *Professor Emeritus*, Environmental and Forest Biology Faculty; B.S., Mansfield State College, 1964; M.S., Cornell University, 1966; Ph.D., 1970

DANIEL C. WALTON (1963-1991), *Professor Emeritus*, Chemistry Faculty; B.Ch.E., University of Delaware, 1955; Ph.D., State University College of Forestry at Syracuse University, 1962

CHUN-JUAN K. WANG (1959-1997), *Professor Emeritus*, Environmental and Forest Biology Faculty; B.S., Taiwan University, 1950; M.S., Vassar College, 1952; Ph.D., State University of Iowa, 1955; Chancellor's Award for Excellence in Teaching, 1990

DONALD F. WEBSTER (1973-1995), *Librarian Emeritus*; B.A., Hofstra University, 1959; M.L.S. and Diploma in Library Education, Queens College; City University of New York, 1965; Ph.D., Syracuse University, 1983

SARAH P. WEBSTER (1990), *Associate Professor Emeritus*, Environmental Studies Faculty; B.A., Duke University, 1959; M.A., Syracuse University, 1961

ROBERT G. WERNER (1966-69) (1970-1998), *Professor Emeritus*, Environmental and Forest Biology Faculty; B.S., Purdue University, 1958; M.A., University of California, 1963; Ph.D., Indiana University, 1966

ROSS S. WHALEY (1984-2003), *President Emeritus and Professor Emeritus*, Forest and Natural Resources Management Faculty; B.S., University of Michigan, 1959; M.S., Colorado State University, 1961; Ph.D., University of Michigan, 1969

SIDNEY A. WHITT (1968-1976), *Professor Emeritus*, Construction Management and Wood Products Engineering Faculty; B.S., University of Alabama, 1933; M.S., Massachusetts Institute of Technology, 1937; D. Engr. Sc., New York University, 1962

HUGH E. WILCOX (1954-1986), *Professor Emeritus*, Environmental and Forest Biology Faculty; University of California, 1938; M.S., New York State College of Forestry, 1940; Ph.D., University of California, 1950

JOHN M. YAVORSKY (1948-56) (1967-1984), *Professor Emeritus and Dean of Continuing Education Emeritus*; B.S., New York State College of Forestry, 1942; M.S., 1947; Ph.D., State University College of Forestry at Syracuse University, 1955

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 faculties and the college faculty.

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.

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Syracuse University Subject Areas

Descriptions for all Syracuse University courses may be found at the SU Undergraduate Course Catalog at www.syr.edu/publications/undergradcat.

AAS	African American Studies
ANT	Anthropology
APH	Art Photography
CHE	Chemistry
CIE	Civil Engineering
ELE	Electrical Engineering
ETS	English and Textual Studies
FIA	Fine Arts

GEO	Geography
GOL	Earth Sciences
HST	History
LIN	Linguistics
LIT	Literature in Translation
MAT	Mathematics
MAX	Maxwell School
PAF	Public Affairs
PHI	Philosophy
PHY	Physics
PSC	Political Science
REL	Religion
SOC	Sociology

AAS—AFRICAN AMERICAN STUDIES

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

ANT—ANTHROPOLOGY

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

APH—ART PHOTOGRAPHY

These courses are taught at Syracuse University's College of Visual and Performing Arts. Descriptions will be found at www.syr.edu/publications/undergradcat.

APM—APPLIED MATHEMATICS

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 153. Computing Methods for Engineers and Physical Scientists (3)

Introduction to programming structures: flowcharts, language statements and subprograms. Introduction to data structures: arrays, scalars and others. Introduction to data codes: numbers and characters, "natural" and binary. Introduction to algorithms at the procedural level. Spring.

APM 255. Computing Applications (3)

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 360. Introduction to Computer Programming (3)

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 including visual and numerical data presentation, probability including set theory, conditional probability, independence, and counting techniques, the theory of discrete and continuous probability distributions including the usage of commonly employed probability distributions, confidence interval estimation and classical hypothesis testing, probability plots and associated normality and lognormality tests, simple linear regression, and an introduction to ANOVA. Spring. Pre- or co-requisite(s): Calculus through Integral Calculus. Note: Credit will not be granted for both APM 395 and APM 595.

APM 485. Differential Equations for Engineers and Scientists (3)

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)

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)

Two hours of lecture and three hours of laboratory. A treatment of statistical inference, including paired design, group design, linear regression and correlation, one-way analysis of variance and some applications of chi-square. Calculation of statistics, test of hypotheses and proper interpretation of calculated statistics. Fall.

APM 595. Probability and Statistics for Engineers (3)

Three hours of lecture. Calculus-based probability and statistical theory in engineering and the environmental sciences. Descriptive statistics including visual and numerical data presentation, probability including set theory, conditional probability, independence, and counting techniques, discrete and continuous probability distributions, confidence interval estimation and classical hypothesis testing, probability plots and associated normality and lognormality tests, simple linear regression, and an introduction to ANOVA. Spring.

Pre- or co-requisite(s): Calculus through integral calculus.

Note: Credit will not be granted for both APM 395 and APM 595.

APM 620. Analysis of Variance (3)

Three hours of lecture and recitation, and three hours of laboratory. Multi-way classifications in the analysis of variance, with emphasis on the development of models, including randomized blocks, Latin squares, split plots, and factorial designs with fixed effects, random effects and mixed effects; multiple and partial regression and correlation (including curvilinear), using matrix methods; analysis of covariance. Spring.

Prerequisites: Graduate status and an introductory course in statistics covering material through the one-way analysis of variance.

APM 625. Introduction to Sampling Techniques (3)

Two hours of lecture and three hours of laboratory. Introduction to the scientific basis of sampling: selecting an appropriate sampling unit; choosing an efficient design; calculating sampling error; determining a sample size to meet stated objectives. Fall.

Prerequisite: APM 391.

APM 630. Regression Analysis (3)

Three hours of lecture per week. Review of basic statistical concepts and matrix algebra. Classical simple and multiple linear models, indicator or dummy variables, residual analysis, transformation and weighted least squares, influence diagnostics, multicollinearity, nonlinear models and linear mixed models. Statistical computing using SAS and applications in forestry, biology, engineering, and social sciences. Spring.

Prerequisite: APM 391 or equivalent.

APM 635. Multivariate Statistical Methods (3)

Three hours of lecture per week. Review of basic statistical concepts and matrix algebra. Multivariate normal distribution, Hotelling's T^2 , multivariate analysis of variances, principal component analysis, factor analysis, discrimination and classification, cluster analysis, and canonical correlation analysis. Statistical computing using SAS and applications in forestry, biology, engineering, and social sciences. Fall.

Prerequisites: APM 391 or equivalent.

APM 645. Nonparametric Statistics and Categorical Data Analysis (3)

Three hours of lecture. Topics include: review of basic statistics, sign and ranked sign tests, median and Wilcoxon tests, χ^2 binomial tests, χ^2 -test and contingency tables (with correspondence analysis), goodness-of-fit, nonparametric correlation and association analysis, logistic and Poisson regression, nonparametric regression techniques such as LOESS, GAM, and robust regression, bootstrapping and jackknifing. Fall (even years).

Prerequisite: APM 391 or equivalent.

APM 650. Operations Research (3)

Three hours of lecture per week. A survey of optimization techniques to support decision making in the management of natural resources. Techniques examined include linear programming, integer programming, network analysis, nonlinear programming, dynamic programming, and Markov chains. Fall (odd years).

Pre- or co-requisite(s): Calculus and Probability and Statistics.

APM 653. Simulation Design and Analysis (3)
Three hours of lecture. Statistical aspects of computer simulation. Topics examined include: identification and parameterization of probability distributions, evaluation of random number generators, random variate generation, and statistical analysis of simulation output. Fall (even years).
Prerequisite: Probability and Statistics.

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.

BPE—BIOPROCESS ENGINEERING

BPE 132. Orientation Seminar (1)
One hour lecture per week and three-day orientation. Introduction to campus resources available to ensure academic success. Introduction to bioprocess engineering as a field of inquiry and career path. Fall
Note: Credit will not be granted for both BPE 132 and PSE 132 (both undergraduate and graduate versions of the same course).

BPE 304. Summer Internship in Bioprocess Engineering (2)
Twelve weeks full time bioprocessing employment approved by the Faculty between the junior and senior years. The student must submit a comprehensive report and give a presentation to fulfill this requirement. Summer.
Prerequisite: PSE 370 or equivalent.

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 in Bioprocess Engineering (3)
Three hours of lecture per week. Basic principles of colloidal and interfacial science as applied to bioprocesses. Foundation and theoretical understanding as 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, and EFB 226 or equivalent.

BPE 320. 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. Spring.
Prerequisite: BPE 310.

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, and drying. Discussion of specific bioprocess examples. Spring.
Prerequisites: PSE 370, PSE 371.

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 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 320.

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. Fall.
Prerequisites: BPE 320 and BPE 335 or equivalent.
Co-requisite: BPE 421 (or prerequisite).

BPE 481. Bioprocess Engineering Design (3)
Three hours of lecture per week. Methods for estimating capital investment, operating costs and return on investment for bioprocesses. Bioprocess flow sheet synthesis, operability, process simulation, optimization techniques, and preparation for a bioprocess design project. Spring.
Prerequisite: PSE 480.

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.

BTC—BIOTECHNOLOGY

BTC 132. Orientation Seminar (1)
One hour of lecture or discussion. 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 296. Topics in Biotechnology (1-3)
Experimental, interdisciplinary, or special topic coursework in biotechnology for freshmen and sophomore level 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 401. Molecular Biology Techniques (3)
One hour of lecture and six hours of laboratory. Important techniques used in molecular biology research are introduced in the context of a semester-long research exercise. Techniques include the extraction and quantification of genomic DNA, agarose gel electrophoresis, restriction digest, ligation, isolation of plasmid DNA, DNA-DNA hybridization, transformation of *E. coli*, DNA sequencing and the polymerase chain reaction. 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 (3-5)

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. 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 (1-3)

An independent research experience covering topics in biotechnology. Selection of research subject area will be determined by consultation and agreement between the student and appropriate faculty member. Tutorial conferences, discussions, and critiques scheduled as necessary. Final written report required. Fall and Spring or Summer.

Prerequisite: Permission of instructor.

BTC 499. Senior Project Synthesis (1-3)

One hour of discussion or seminar each week with additional credits awarded for independent research on an approved topic. Students will learn to synthesize knowledge from coursework, published research, and their own independent research data to reach logical and valid conclusions. Research results will be compiled and presented in the form of a capstone seminar, term paper, or poster presentation at a research conference. Fall or Spring.

Pre- or co-requisite(s): BTC 420, BTC 498.

CHE—CHEMISTRY

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

CIE—CIVIL ENGINEERING

These courses are taught at Syracuse University's College of Engineering and Computer Science. Descriptions will be found at www.syr.edu/publications/undergradcat.

CLL—COMPOSITION, LIBRARY AND LITERATURE**CLL 190. Writing and the Environment (3)**

Introduction to writing and reading on the college level. The course will require frequent informal writing assignments, an oral presentation and at least two formal writing assignments. Students will acquire the skills to achieve college-level literacy. Fall.

CLL 290. Writing, Humanities, and the Environment (3)

Three hours of discussion and group work. 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: CLL 190.

CLL 296. Special Topics in Composition, Library and Literature (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.

CLL 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.

CLL 390. Introduction to Literature of Nature (3)

Examination of the views of nature and the environment as seen by selected writers, poets and essayists of the 19th and 20th centuries, up to Rachel Carson. The readings, discussions and written assignments will explore the aesthetics, the socio-political climate and the prevailing attitudes toward the environment that formed the backdrop for readings. Intended for students who have had the freshman sequence of writing courses. Fall and Spring.

CLL 405. Writing for Science Professionals (1-3)

Three hours of lecture, discussion, workshops. Principles and practice of writing skills required of science professionals. Develop proficiency in determining the purpose of a document; analyze the audience; select, develop and organize the information in an appropriate design; and write clearly, precisely and effectively. Writing assignments done weekly; rewriting is routinely required. Fall and Spring.

CLL 410. Writing for Environmental Professionals (3)

Three hours of lecture and discussion. Principles and practice of writing skills required of environmental professionals. Develop proficiency in determining the purpose of a document; analyze the audience; select, develop and organize the information in an appropriate design; and write clearly, precisely and effectively. Writing assignments are made weekly; rewriting is routinely required. Fall and Spring.

Prerequisite: Satisfactory completion of a college-level course in basic writing skills.

CLL 490. Literature of Nature (3)

Examination of the views of nature and the environment as seen by contemporary nature writers and environmentalists. The readings, discussions and written assignments will explore the aesthetics, the socio-political climate and the prevailing attitudes toward the environment that form the backdrop for readings. Spring.
Prerequisite: CLL 390 or permission of instructor.

CLL 496. Special Topics in Composition, Literature, and Library Studies (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.

CLL 498. Independent Study (1-3)

Guided individual study of a topic in composition, literature and library. Enrollment is possible at various times during the semester. Fall and Spring.

**CMN—COMMUNICATIONS
(Environmental Studies)**

CMN 220. 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 and Spring.

CMN 340. Electronic Information (3)

Three hours of discussion and group work. An introduction to effective strategies for searching for and evaluating information stored on the Internet; to the federal, state and international laws that apply to the Internet and its users; and to principles of community formation and maintenance as they apply to Internet communities. Spring.
Prerequisite: Junior status.

CMN 393. Environmental Discourse (3)

Three hours of lecture, discussion, workshops, group projects and presentations. The course includes theory and practice of language use, rhetorical analysis and strategies, gender issues, information and advocacy campaigns, and oral presentation skills. Emphasis on symbolic and metaphorical representations of environmental issues from popular culture to environmental impact statements. We will critique discourse in the context of environmental history, institutions, culture, society, gender, race, class and science. Fall.

CMN 440. Environmental Visualization (3)

Three hours of lecture and discussion. The course includes an overview of graphic perception and cognition, a theoretical framework for classifying graphics, and introductions to the use and misuse of visualizations in the effective communication of environmental processes and project proposals to multiple publics. Students will compile a critical workbook of examples and develop a series of preliminary visualizations. Fall.
Prerequisite: Senior status in environmental studies communication and information option or permission of instructor.

CMN 493. Environmental Communication Workshop (3)

Three hours of cooperative learning activities, lecture and discussion. 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.

EFB—ENVIRONMENTAL AND FOREST BIOLOGY

The Faculty of Environmental and Forest Biology offers a diverse array of courses at both undergraduate and graduate levels. Based on student interest, curricula can be designed to accommodate a degree of specialization in one or more subdisciplines of biology.
NOTE: All EFB courses of 300 level and above require a minimum prerequisite of one year of general biology or equivalent. A course at an appropriate level may be taken with permission of instructor.

EFB 120. Global Environment (3)

Three lectures per week. A survey of current global environmental change, including global warming, acidic deposition, the ozone hole, El Nino, loss of biodiversity, and energy and population problems. Socio-economic and political ramifications of global change. Fall and Spring.

EFB 132. Orientation Seminar: Environmental and Forest Biology (1)

One hour of lecture, discussion and/or exercises. Introduction to campus resources available to ensure academic success. Introduction to EFB as a field of inquiry. 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. Incorporates practical field exercises designed to acquaint the student with problem solving. Summer, Cranberry Lake Biological Station.

EFB 215. Interpreting Science Through Art (3)

Three hours of lecture. This course examines the intersections of art and science. Major reciprocal influences in both an historical and contemporary format are treated. Fundamental methods and skills of some artistic processes, e.g., nature illustration and photography, are introduced in a context of practical applications interpreting science. Fall.
Pre-requisite: General biology.

EFB 220. Urban Ecology (3)

Two hours lecture/discussion, three hours of outdoor laboratory. 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 226. General Botany (4)

Three hours of lecture and three-hour laboratory. An introduction to plant biology with special emphasis on the structure and function of the green plant. Fall.

EFB 285. Principles of Zoology (4)

An introduction to the study of vertebrate and invertebrate animals, including reproduction, development, heredity, physiology, form and function, diversity, evolution, and behavior. An integrated laboratory and lecture course that introduces processes of scientific inquiry and provides a basis for understanding the natural world. The course provides the fundamental background for advanced or specialized courses, e.g., in animal physiology, anatomy, taxonomy, ecology, behavior, and fisheries/wildlife sciences. Spring.

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 301. Latin for Scientists (1)

One hour of lecture. Students are taught the basic principles of Latin noun declension and verb conjugation, as well as the general principles of Latin grammar. Students are required to develop a project identifying and deriving uses of Latin in their chosen field of science, usually biology. Fall.

EFB 303. Introductory Environmental Microbiology (4)

Three hours of lecture and three hours of laboratory. An introduction to the biology of microorganisms and viruses and a study of their interactions with other microbes and macroorganisms. Fall.

EFB 307. Principles of Genetics (3)

Three hours of lecture and discussion. 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. 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 320. General Ecology (4)

Three hours of lecture and one three-hour field trip/laboratory. 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 Physiology (3)

Three hours of lecture. Introduction to the dynamics of living systems with emphasis on the universality of the biological world. Fall.
Prerequisite: One semester of organic chemistry.

EFB 326. Diversity of Plants (3)

Two hours of lecture and one three-hour laboratory. An evolutionary survey of plants from unicellular prokaryotes to multicellular eukaryotes. Coverage includes the algae, fungi, bryophytes, lower vascular plants, ferns, gymnosperms and angiosperms. Spring.

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 334. Woody Plants in the Natural and Built Landscape (2)

One hour of lecture, followed by three hours of field or indoor laboratory each week. Required by, and restricted to, undergraduates in the Landscape Architecture program. An introduction to the identification, site requirements, natural history, community ecology, and landscape value of native and exotic trees and shrubs for landscape planting and restoration purposes. Fall.

Prerequisite: Undergraduate standing in the Landscape Architecture program.

EFB 335. Dendrology (2)

One hour of lecture 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 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 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 Faculty of Environmental and Forest Biology. Cranberry Lake Biological Station. Summer.
Prerequisite: EFB 226 or equivalent.

EFB 340. Forest and Shade Tree Pathology (3)

Two hours of lecture 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.
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.
Prerequisites: One year of general biology, and EFB 202 or equivalents.

EFB 351. Principles of Forest Entomology (3)

Two hours of lecture, three hours of laboratory. Elements of insect classification, morphology and physiology; introduction to the role of insects in forested ecosystems; insect surveys, hazard rating,

impact, control and other aspects of applied forest pest management. Designed for students in forest resources management. Spring.

EFB 352. Elements of Entomology (3)

Two hours of lecture, three hours of laboratory/field work. General classification of insects, morphology, physiology, ecology, behavior, and basic principles of population control. Emphasis through illustration is on the role of insects in the forest environment. Fall.

EFB 355. Invertebrate Zoology (4)

Three hours of lecture and three hours of laboratory. Structure, function, classification and evolution of invertebrates. Emphasis on functional biology and ecological interactions. Spring.

EFB 381. Vertebrate Museum Techniques (2)

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. Prerequisite: General biology or general zoology.

EFB 385. Comparative Vertebrate Anatomy (4)

Three hours of lecture and three hours of laboratory. 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 field work 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. Prerequisite: General zoology or general biology.

EFB 390. Wildlife Ecology and Management (4)

Three hours of lecture and one hour of recitation. 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. Spring. Prerequisite: General ecology.

EFB 400. Toxic Health Hazards (3)

Three hours of lecture. 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. Pre-requisites: 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)

Two hour lecture per week and a one-week spring break field trip. This course examines the major roles of contemporary natural history museums as places of research and public education. The contributions of these institutions to science and science education through research, exhibits, collections and programs are emphasized. Participation in an organized instructional visit to natural history

museums during the Spring break is required. Travel expenses to be anticipated. Spring.

Prerequisites: General biology and ecology.

EFB 405. Literature of Natural History (2)

One hour lecture and one hour discussion/seminar. 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 409. Molecular Basis of Evolution (3)

Two hours of lecture and one hour of discussion. The major processes of organic evolution (e.g., mutation, natural selection, speciation and extinction) are discussed in a molecular-level context. Coverage ranges from changes to genic and nongenic regions of the genome to the evolution of entire genomes. Methods used to study molecular evolution and to reconstruct phylogenies are described and demonstrated.

Prerequisites: EFB 307, EFB 308, EFB 325.

Note: Credit will not be granted for both EFB 409 and EFB 609.

EFB 412. Introduction to Chemical Ecology (3)

Three hours of lecture with discussion. 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. 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. 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. 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 416. Introduction to Environmental Interpretation (3)

Introductions to popular activities and products of nature interpretation such as nature trails and traditional nature walks to

explore and illustrate the philosophy, principles and concepts of environmental interpretation. Fall.

Prerequisite: EFB 320.

Note: Credit will not be granted for both EFB 416 and EFB 616.

EFB 417. Perspectives of Interpretive Design (3)

Applications of environmental interpretation theory and methods to nature center programming, science education, and various fields of resource management emphasizing procedures for creating and implementing products such as slide-presentations, publications, exhibits, and nature walks. Spring.

Prerequisite: EFB 320.

E 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.

"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 (3-5)

Full- or part-time employment or volunteer work with an agency, institution, professional group or individual involved in activities consistent with the student's educational and professional goals. The extent of 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. Fall and Spring.

Prerequisite: Permission of an academic sponsor from the environmental and forest biology faculty.

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 427. Plant Developmental Biology (3)

Two hours of lecture and three hours of laboratory. Advances in the fields of plant physiology, genetics, and cell and molecular biology are integrated into a dynamic study of plant structure and development. Topics include fertilization, embryogenesis, gene expression and manipulation, and hormonal and environmental regulation of development. Fall.

Prerequisite: EFB 226.

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 439. Forest Health Monitoring (3)

Three hours of lecture/discussion 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. 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 443. Plant Virology (3)

Two hours of lecture and three hours of laboratory. 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 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.

Prerequisite: EFB 320 or permission of instructor.

Note: Credit will not be granted for both EFB 444 and EFB 644.

EFB 445. Plant Ecology (3)

Two hours of lecture and discussion and one laboratory session. A first course in plant community ecology dealing with the dynamics of community development and change, and the process of community analysis and description. Spring.

Prerequisite: EFB 320.

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. 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 462. Animal Physiology: Environmental and Ecological (3)

Three hours of lecture, discussion and/or exercises. 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. A study of the basic principles of animal behavior, stressing exogenous and endogenous mechanisms of control, with emphasis on the evolution of behavior. Spring.

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 (3)

Two hours of lecture and three hours laboratory. Introduction to the taxonomic, morphological and behavioral diversity of mammals, presented in evolutionary context. Covers distinguishing characteristics at class and ordinal levels, the basic ecological characteristics of all mammals of New York state and the adaptations of mammals to stressful environments. Key methods for field studies and the conservation status of mammals are addressed. Fall.

Prerequisite: EFB 285.

EFB 484. Mammalian Winter Ecology (2)

Six-day field course conducted 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. Modern housing/dining facilities are provided at the Adirondack Ecological Center. There is a course fee. Spring.

Prerequisite: General ecology.

Note: Credit will not be granted for both EFB 484 and EFB 684.

EFB 485. Herpetology (3)

Two hours of lecture and three hours of laboratory. 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. 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.

Prerequisite: EFB 487 or permission of instructor.

EFB 491. Wildlife Ecology and Management Practicum (2)

One-hour discussion and three hours laboratory. Practical contact and experience with wildlife management techniques and programs; relates practices to principles of management. Designed for biology students wishing to pursue careers as wildlife biologists. Spring.

Co-requisite: EFB 490.

Pre- or co-requisite: ESF 200.

EFB 493. Wildlife Habitats and Populations (4)

Three hours of lecture/discussion and one three-hour laboratory; 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 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.

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 or Spring.

EFB 497. Seminar (1)

One hour of presentations and discussion. A topic in environmental and forest biology will be emphasized and its importance to contemporary issues will be addressed. Fall or Spring.

Prerequisite: 90 credit hours.

EFB 498. Research Problems in Environmental and Forest Biology (1-3)

Independent research in topics in forest biology for the superior 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/or Summer.

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. Fall or Spring.

EFB 501. Microbiology for Bioprocessing (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. Laboratory sessions focus on photosynthetic hydrogen production, experimental determination of enzyme kinetics, and polyhydroxyalkanoate production, recovery, and purification. Fall.

Prerequisites: Permission of the instructor; basic understanding of chemistry and biology; appropriate quantitative skills.

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. Fall.

EFB 505. Microbial Ecology (3)

Two hours of lecture and three hours of laboratory. Applied and environmental aspects of microbiology with emphasis on biochemical

interactions. Examining microbial processes and interrelationships in aquatic and terrestrial ecosystems. Spring.
Prerequisite: EFB 303.

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)

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. 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 519. Geographic Modeling (3)

Students learn how to interface the traditional tools of ecological modeling with the new tools of Geographic Information Systems. Geographical modeling involves the simulation of natural earth systems with special consideration given to spatial position, adjacency, clustering, or distribution of system variables. Students will work on a project of their own choosing, learning to write FORTRAN code to model and display system dynamics in both space and time. Spring.

Prerequisites: EFB 518 and a course in GIS.

EFB 521. Principles of Interpretive Programming (3)

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. Ecology, Resources and Development (2)

Examines the emerging field of ecological economics by reviewing traditional economic approaches, especially as applied to evaluating as applied to evaluating nonmarket processes—such as many of the services of nature. Introduces alternative approaches focusing on energy and resources, rather than money, as a basis for wealth and evaluation. Spring.

Prerequisites: 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.

Prerequisite: EFB 320.

EFB 524. Limnology (3)

Three hours of lecture. An introduction to the physics, chemistry and biology of inland waters, with particular emphasis on lakes. The course focuses on lakes as integrated ecosystems, and analyzes perturbations in this environment on the structure and function of the biological communities contained therein. Fall.

Prerequisites: Introductory courses in physics and chemistry, and EFB 320.

EFB 525. Limnology Laboratory (1)

One laboratory or field trip. An introduction to limnological techniques and the procedures for empirically analyzing ecological relations in aquatic ecosystems. Field trips to local aquatic habitats. Fall.

Pre- or co-requisite: EFB 524.

EFB 526. Introduction to Plant Tissue Culture (3)

One hour of lecture and six hours of laboratory designed to introduce students to the scientific and commercial uses of plant tissue culture. Spring.

Prerequisite: EFB 226.

EFB 530. Plant Physiology (3)

Three hours of lecture. 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. An introduction to methods and procedures of physiological research. Spring.

Pre- or co-requisite: EFB 530 or permission of instructor.

EFB 535. Systematic Botany (3)

Two hours of lecture and three hours of laboratory. Identification, nomenclature and classification of flowering plants with special emphasis on local flora and on developing the ability to classify the plants of any region. Fall.

Prerequisite: EFB 226 or EFB 326.

EFB 542. Freshwater Wetland Ecosystems (3)

Three hours of lecture. 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 Insect Ecology and Management (3)

Two hours of lecture and three hours of laboratory. Aspects of insect ecology that are pertinent to integrated pest management are discussed. These aspects include insect survey, monitoring, evaluations, control tactics (with special emphasis on non-chemical approaches to control of forest insect pests), and interactions between pest population ecology and forest stand dynamics.

Students learn to identify the major forest insect pests of North America and the damage that they cause. Fall, odd numbered years.

Prerequisites: EFB 320, EFB 351 or EFB 352.

EFB 554. Aquatic Entomology (3)

An introduction to the identification, life histories and ecology of aquatic insects, with emphasis on genera found in the Northeastern U.S. 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 555. Chemical Ecology of Vertebrates (3)

A survey of chemical interactions within and among species of fish, amphibia, reptiles, birds and mammals, including humans. Signal production, sensory processes, plant-animal interactions, practical applications of chemical ecology and effects of global and local change on chemical ecology processes. Fall and Spring.

Prerequisites: One semester of organic chemistry and at least two of the following: general ecology, animal behavior, introduction to chemical ecology, and a course in vertebrate biology.

EFB 566. Systematic Entomology (3)

Two hours of lecture and three hours of laboratory. 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. 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. 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 (3)

One hour of lecture and six hours of laboratory. Important techniques used in molecular biology research are introduced in the context of a semester-long research exercise. Techniques include the extraction and quantification of genomic DNA, agarose gel electrophoresis, restriction digest, ligation, isolation of plasmid DNA, DNA-DNA hybridization, transformation of *E. coli*, DNA sequencing and the polymerase chain reaction. Additional topics in molecular biology research are chosen and 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 609. Molecular Basis of Evolution (3)

Two hours of lecture and one hour of discussion. The major processes of organic evolution (e.g., such as mutation, natural selection, speciation and extinction) are discussed in a molecular-level context. Coverage ranges from changes to genic and nongenetic regions of the genome to the evolution of entire genomes. Methods used to study molecular evolution and to reconstruct phylogenies are described and demonstrated. Students will organize and lead class discussions.

Prerequisites: EFB 307, EFB 308, EFB 325, or similar courses in genetics and cell physiology.

Note: Credit will not be granted for both EFB 409 and EFB 609.

EFB 610. Ecological Biogeochemistry (3)

Three hours of lecture and discussion. 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 representation 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. 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 616. Introduction to Environmental Interpretation (3)

Introductions to popular activities, special projects, and products of nature interpretation such as nature trails and traditional nature walks to explore and illustrate the philosophy, principles and concepts of environmental interpretation. Requires analysis of several interpretive processes and completion of a paper. Fall.

Prerequisite: EFB 320.

Note: Credit will not be granted for both EFB 416 and EFB 616.

EFB 617. Perspectives of Interpretive Design (3)

Applications of environmental interpretation theory and methods to nature center programming, science education, and various fields of resource management emphasizing procedures for creating and implementing products such as slide-presentations, publications, exhibits and nature walks. Includes analysis and articulation of some interpretive processes. Spring.

Prerequisite: EFB 320.

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)

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, 1 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 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. 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 Developmental Biology** (3)
Two hours of lecture/discussion and three hours of laboratory. Advances in the fields of plant physiology, genetics, and cell and molecular biology are integrated into a dynamic study of plant structure and development. Topics include fertilization, embryogenesis, gene expression and manipulation, and hormonal and environmental regulation of development. Students will write a research paper that applies concepts in plant development to address problems pertaining to their research or to a chosen topic. Fall. Prerequisite: EFB 226. 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 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. 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 EFB 428 and EFB 628.
- EFB 640. Mycology** (3)
Two hours of lecture and three hours of laboratory. 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 641. Phytopathology** (3)
Two hours of lecture and discussion, and three hours of autotutorial laboratory. Principles and concepts of plant pathology. Major diseases of ornamental plants, vegetable crops, fruit crops, field crops and trees. This is an introductory plant pathology course for graduate students in all departments. Spring.
- EFB 643 Plant Virology** (3)
Two hours of lecture and three hours of laboratory. 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. Prerequisite: General ecology or permission of instructor. Note: Credit will not be granted for EFB 644 and EFB 444.

- EFB 645. Plant Ecology** (3)
Two hours of lecture/discussion and one laboratory/discussion section. A first course in plant community ecology for beginning graduate students focusing on dynamics of community development and change and the processes of community analysis and description. Spring. Prerequisite: General Ecology. Note: Credit will not be granted for both EFB 445 and EFB 645.

- EFB 646. Ecology of Mosses** (3)
Two hours of lecture 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 662. Animal Physiology: Environmental and Ecological** (3)
Three hours of lecture, discussion and exercises, 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. Prerequisite: EFB 661 or permission of instructor. 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 towards graduate students in areas involving aquatic sciences and management.

- EFB 684. Mammalian Winter Ecology** (2)
Six-day field course conducted 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. Modern housing/dining facilities are provided at the Adirondack Ecological Center. There is a course fee. Students are required to submit a final paper. Spring. Prerequisite: General Ecology. Note: Credit will not be granted for both EFB 484 and EFB 684.

- 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. 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. Prerequisites: EFB 490 and EFB 491 or graduate status. Note: Credit will not be granted for both EFB 493 and EFB 693.

EFB 733. Techniques in Plant Physiology (2-4)

Comprehensive study of techniques essential for research in plant physiology. Students may choose the instructors they wish to work with, and should consult the instructors for further details. May be repeated for credit in different specialties. Fall. Prerequisites: EFB 531 and biochemistry with laboratory.

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. (Credit hours to be arranged)

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.

ELE—ELECTRICAL ENGINEERING

These courses are taught at Syracuse University's College of Engineering and Computer Science. Descriptions will be found at www.syr.edu/publications/undergradcat.

ENS—ENVIRONMENTAL SCIENCE (GRADUATE)**ENS 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.

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. 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 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, odd years.

ENS 606. Environmental Risk Perception (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, cultural values and public opinion. Fall. Prerequisites: Coursework in psychology, sociology and environmental policy are recommended.

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 611. Environmental Institutions (3)

Three hours of lecture and discussion per week. Examination of the interrelationships of policymaking and environmental program implementation in government, the role of the legal process in environmental management, and techniques for program evaluation. Fall.

ENS 625. Wetland Management Policy (3)

Three hours of lecture and/or discussion per week with occasional field trip. 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, every other year. Prerequisite: EFB 542 or equivalent.

ENS 626. Concepts of Sustainable Development (3)

Three hours of lecture/discussion per week. This course presents the ecological and development principles and theoretical underpinnings guiding local and global initiatives for sustainable development. Four overlapping themes will be 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; and questions of environmental equity and the quality of development. Fall. Note: Credit will not be granted for both ENS 626 and EST 426.

ENS 635. Public Participation and Decision Making: Theory and Application (3)

Three hours of discussion, presentation and exercises. 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.

ENS 645. Mass Media and Environmental Affairs (3)

Three hours of lecture and discussion per week. Introduces students to the mass media's role in environmental affairs. The relationships between media organization, 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. Spring.

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 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.
Prerequisite: Permission of instructor.

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 (Credit hours to be arranged)
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 (Credit hours to be arranged)
Research and independent study for the master's degree and thesis. Fall, Spring and Summer.

ENS 999. Doctoral Thesis Research (Credit hours to be arranged)
Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

ERE—ENGINEERING (ENVIRONMENTAL AND RESOURCE ENGINEERING)

ERE 221. Engineering Mechanics—Statics (3)
Three hours of lecture. Forces and vectors, moments, equivalent force systems, free bodies, structures, section properties. Fall.
Prerequisites: Integral calculus and general physics.

ERE 222. Engineering Mechanics—Dynamics (2)
Two hours of lecture. 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.

ERE 223. Statics and Dynamics (4)
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.

ERE 225. Engineering Graphics (1)
One three-hour session each week over the semester utilizing lecture, discussion and hands-on practice to achieve the goals of basic

understanding and skill with graphics for the purposes stated. Introductory course in graphics as a communication language and analytic/design tool for engineers. Fall and Spring.
Prerequisites: Trigonometry and computer literacy.

ERE 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.

ERE 310. Environmental Measurements and Spatial Information (3)
Two hours of lecture and three hours of laboratory. Fundamental concepts for properly collecting data and information about environmental variables. Collecting spatial information is emphasized through consideration of maps, aerial photographs and other imagery, and field surveying procedures. Spring.

ERE 351. Basic Engineering Thermodynamics (2)
Principles of energy conservation and conversion: first and second laws. Relation to PVT behavior, property functions, equilibria, and heat and mass transfer. Introduction to engineering problem analysis and computer methods. Spring.
Prerequisites: Physics, general chemistry and calculus. Not for credit to students who have successfully completed FCH 360 or equivalent.

ERE 362. Mechanics of Materials (3)
Three hours of lecture. Theories of stress, deformation and stability of common structural materials subjected to various force systems. Spring.
Prerequisites: Integral calculus and statics.

ERE 371. Surveying for Engineers (4)
Three hours of lecture and three hours of laboratory 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, construction surveying including circular and parabolic curves, property and public land surveys, the analysis and treatment of systematic and random errors, foundations and applications of global positioning systems. Laboratory fieldwork and computations culminate in a topographic map. Fall.
Prerequisite: Calculus.

ERE 385. Mechanical Design (3)
The principles of operation and design of mechanical systems common in engineering. Solution of equipment design using such components as springs, gears, motors and transmissions. Strength, reliability and economy are considered. Design projects are oriented to current concerns in construction, environment, and manufacturing. Spring.
Prerequisite: ERE 221; Co-requisites: ERE 222, ERE 362.

ERE 440. Water Pollution Engineering (3)
Two hours of lecture and three hours of laboratory. Introduction to the physical, chemical and biological parameters of wastewater treatment processes and to the principles of the unit operations involved. Study of the design parameters and design procedures of wastewater treatment systems. Fall.
Prerequisite: Physics.

ERE 441. Air Pollution Engineering (3)
Three hours of lecture and discussion. Study of the chemical, physical and meteorological principles of air pollution and its control. Local and global effects of air pollution. The atmospheric survey. Examination of the operating principles and design parameters of the various air pollution control systems. Air quality and emission standards. Fall and Spring.
Prerequisites: FCH 360, MAT 397, PSE 371.

- ERE 445. Hydrologic Modeling** (3)
Three hours of lecture. Deterministic and stochastic models of hydrologic phenomenon. Model development and the use of computer programming to construct, manipulate, and interpret hydrologic models. Theoretical and analytical approaches to describing hydrologic processes, including precipitation, evapotranspiration, infiltration, surface runoff, percolation, groundwater movement and discharge, and streamflow. Distributed, semi-distributed, and lumped parameter models and techniques for model calibration and validation. Fall.
Pre- or co-requisite(s): Introductory computer programming.
Note: Credit will not be granted for both ERE 445 and ERE 645.
- ERE 450. Introduction to Geographic Information Systems** (3)
Two hours of lecture and three hours of laboratory. Definition, development and general concepts of Geographic Information Systems (GIS). Topics will include data acquisition and specification, data processing, data manipulation, and analysis, information output, and selecting and implementing GIS. Fall.
Note: Credit will not be granted for both ERE 450 and ERE 550.
- ERE 496. Special Topics** (1-3)
Lectures, readings, problems and discussions. Topics in environmental or resource engineering as announced. Fall and/or Spring.
- ERE 501. Microbiology for Bioprocessing** (3)
Two hours of lecture and three hours of laboratory/discussion. 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. Laboratory sessions focus on photosynthetic hydrogen production, experimental determination of enzyme kinetics, and polyhydroxyalkanoate production, recovery, and purification. Fall.
Prerequisites: Permission of the instructor; basic understanding of chemistry and biology; appropriate quantitative skills
- ERE 502. 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: ERE/EFB 501.
Note: Credit will not be granted for both BPE 320 and ERE 502.
- ERE 503. Bioprocess Plan 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: ERE 502, CEN 600 (Process Engineering and Qualification) or equivalents.
- ERE 506. Hazardous Waste Management** (3)
Three hours of lecture and discussion. Systematic control of generation, storage, transport, treatment and disposal of hazardous waste. Applicable hazardous waste regulations. Pollutant transport mechanisms. Technology design to investigate, control emissions and remediate sites. Urban economic redevelopment impacts. Fall.
Pre- or co-requisite(s): Chemistry and biology. Permission of instructor for seniors in good standing.
- ERE 525. Construction Methods and Equipment** (3)
Three hours of lecture/discussion. 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. Fall.
Note: Credit will not be granted for both ERE 525 and WPE 350.
- ERE 531. Construction Safety** (3)
Three hours of lecture/discussion. Occupational Safety and Health practices in the construction industry. An overview of the U.S. 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 ERE 531 and WPE 331.
- ERE 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. Synthesis research report on a cost engineering topic required. Fall.
Note: Credit will not be granted for both WPE 335 and ERE 535.
- ERE 540. Engineering Hydrology and Hydraulics** (3)
Three hours of lecture. Introduction to water resources engineering. Hydraulics processes explored include pipe flow, open-channel flow, flows within control structures, and flow through porous media. Hydrologic processes explored include scaling rainfall across time and space, computing the timing and magnitude of watershed runoff, and routing flood waves through detention basins and streams. Engineering analysis to link hydrologic and hydraulic systems and use probability distributions to access the system failure. Spring.
Note: Credit will not be granted for both FEG 340 and ERE 540.
- ERE 543. Construction Estimating** (3)
Three hours of lecture/discussion. 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: Estimating experience or permission of instructor.
Note: Credit will not be granted for both ERE 543 and WPE 343.
- ERE 548. 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. Students will prepare a research paper describing their work on an independent project. Fall.
Note: Credit will not be granted for both FEG 448 and ERE 548.
Pre- or co-requisites: Fluid mechanics or permission of instructor.
- ERE 550. Introduction to Geographic Information Systems** (3)
Two hours of lecture and three hours of laboratory. Definition, development and general concepts of Geographic Information Systems (GIS). Topics will include data acquisition and position specification, data processing, data manipulation, and analysis, information output, and selecting and implementing GIS. Readings

with written assessment will be assigned from the current literature. Participation in a group project is required. Fall.
Note: Credit will not be granted for both ERE 450 and ERE 550.

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 552. Fundamentals of Remote Sensing (3)

Two hours of lecture and three hours of laboratory. Principles and techniques of environmental remote sensing including potentials, limitations, instrumentation and unique requirements. Procedures and principles of acquiring, analyzing and using a wide range of imagery types for environmental applications and design. Both qualitative and quantitative interpretation procedures are presented. Oriented for multidisciplinary participation. Fall or Spring.
Prerequisites: Physics and calculus or permission of instructor.
Note: Credit will not be granted for both FEG 352 and ERE 552.

ERE 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. Spring.
Prerequisites: Physics and Calculus.
Note: Credit will not be granted for both PSE 361 and ERE 561.

ERE 563. Photogrammetry I (3)

Two hours of lecture and discussion; three hours of laboratory and discussion. Basic photogrammetric and photo interpretation concepts as a means of acquiring reliable data for engineering and management planning. Potentials, limitations, instrumentation and unique requirements are considered. Spring.
Prerequisite: ERE 371.
Note: Credit will not be granted for both FEG 363 and ERE 563.

ERE 566. Global Positioning Systems I (1)

Introduction to the Global Positioning System (GPS). Practical use of GPS receivers capable of positioning points to 1 to 5 meters. Planning of GPS surveys, collection of GPS observations and use of GPS software on personal computers to determine positions of targets of interest. Demonstration of porting collected GPS data to a geographic information system. Fall.
Prerequisites: ERE 371 and computer literacy.
Pre- or co-requisite(s): ERE 371 or equivalent and computer literacy.

ERE 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 ERE 570.

ERE 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 PSE 371 and ERE 571 (both undergraduate and graduate versions of the same course).

ERE 580. Coordinate Systems for GIS (1)

Basic principles and procedures related to earth coordinate systems. Topics include ways to specify locations, reference systems (datums), common earth coordinate systems, coordinate transformations, and general approaches to determining location in the field. Spring.
Pre- or co-requisites: Mathematical preparation in geometry, trigonometry, analytical geometry. Knowledge or experience with mapping or GIS.

ERE 585. Microscopy and Photomicrography (3)

Two hours of lecture, one hour of demonstration, and three to five hours of laboratory. Principles of light microscopy and photomicrography with extensive laboratory practice. Fall.
Prerequisite: Permission of instructor.

ERE 596. Special Topics (1-3)

Lectures, conferences, discussions and laboratory. Topics in environmental and resource engineering not covered in established courses. Designed for the beginning graduate student or selected upper-division undergraduate. Fall and/or Spring.

ERE 610. Computer-Aided Design and Drafting (3)

One-half hour lecture, two-and-one-half hour laboratory; and a minimum of six hours additional laboratory 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.
Prerequisite: General knowledge of manual drafting.
Note: Credit will not be granted for both WPE 410 and ERE 610.

ERE 630. Computer Applications in Construction Management (1-3)

Guided individual study. Projects that will be estimated, scheduled or managed exclusively by industry-standard, construction-related software, including Timberline Precision Estimating, Quest Earthworks, Quest for Contractors, Primavera Project Planner, SureTrak Project Manager by Primavera and Expedition by Primavera. A final report with annotated bibliography is required. Spring.
Prerequisite: Permission of instructor.
Note: Credit will not be granted for both ERE 630 and WPE 430.

ERE 643. Water Pollution Engineering (3)

Two hours of lecture and three hours of laboratory. Introduction to the physical, chemical and biological parameters of wastewater treatment processes and to the principles of the unit operations involved. Study of the design parameters and design procedures of wastewater treatment systems. Fall.
Prerequisites: Physics and CHE 356 or permission of instructor.
Note: Credit will not be granted for both ERE 440 and ERE 643.

ERE 645. Hydrologic Modeling (3)

Three hours of lecture. Deterministic and stochastic models of hydrologic phenomenon. Model development and the use of computer programming to construct, manipulate, and interpret

hydrologic models. Theoretical and analytical approaches to describing hydrologic processes, including precipitation, evapotranspiration, infiltration, surface runoff, percolation, groundwater movement and discharge, and streamflow. Distributed, semi-distributed, and lumped parameter models and techniques for model calibration and validation. Fall.

Pre- or co-requisite(s): Introductory computer programming.

Note: Credit will not be granted for ERE 445 and ERE 645.

ERE 652. Remote Sensing Interpretation (3)

Two hours lecture supplemented with individual and group projects. Principles and procedures for processing modern remote sensing imagery for extracting useful information. Types and characteristics of modern sensors, geometric transformation and restoration, enhancement and interpretation of digital imagery, and fundamental aspects of assessing the accuracy of remote sensing analyses. Spring. Prerequisite: ERE 552 or equivalent.

ERE 653. Construction Planning and Scheduling (3)

Three hours of lecture/discussion. 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. Prerequisite(s): Estimating experience and/or equivalent scheduling experience.

Note: Credit will not be granted for both ERE 653 and WPE 453.

ERE 654. Construction Project Management (3)

Three hours of lecture/discussion. 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 and a project based upon Expedition project management software are required. Spring.

Prerequisites: ERE 653, equivalent experience or permission of instructor.

Note: Credit will not be granted for both ERE 654 and WPE 454.

ERE 658. Construction Contracts and Specifications (3)

Three hours of lecture/discussion. 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: Permission of instructor.

Note: Credit will not be granted for both ERE 658 and WPE 455.

ERE 664. Photogrammetry II (3)

Two hours of lecture and three hours of laboratory. General analytic photogrammetry including interior and exterior orientation systems, intersection space resection and orientation. Correction of photo coordinates for film deformation, lens distortions, atmospheric refraction and earth curvature. Introduction to photogrammetric plotters. Planning photogrammetric projects and designing optimum procedures for selected photogrammetric tasks. Fall.

Prerequisite: ERE 563.

Note: Credit will not be granted for both FEG 464 and ERE 664.

ERE 667. 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 PSE 477 and ERE 667.

ERE 670. Principles of Pulping and Bleaching (3)

Two hours of lecture and three hours of laboratory plus literature study of assigned topics, independent project planning and/or laboratory study. Discussion of pulping and bleaching processes. Effects of chemical and physical variables on the wood components and pulp properties; chemistry involved. Experiments in pulping and bleaching and pulp evaluation. Spring.

Prerequisites: Organic, physical and analytic chemistry.

ERE 672. Colloidal and Interface Science Applications in Papermaking (3)

Three hours of lecture. 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 wetend of a papermachine system. The topics of retention of fine solids and dewatering are addressed in detail. Spring.

Pre- or co-requisite: Physical chemistry.

ERE 676. Management in the Paper Industry (3)

Three hours of lecture per week. Provides the student with interactive contact with active executives in the Paper and Allied industries. The student will develop and present studies of business cases in discussion forum to the class. An understanding of how general managers operate to manage an entire organization will be presented by visiting experts, class participation, group presentations, written papers, and examinations. The student will critically review selected literature and present their findings. Spring.

Note: Credit will not be granted for both PSE 456 and ERE 676.

ERE 677. Paper Properties (4)

Three hours of lecture, three hours of laboratory and discussion plus evaluation of literature, independent project planning and/or laboratory study. Evaluation and study of the physical, optical and chemical properties of paper and the interrelationships existing among paper manufacturing methods, papermaking additives, test results and the ultimate properties desired in the finished paper. Fall.

Prerequisite: Permission of instructor.

Note: Credit will not be granted for both PSE 465 and ERE 677.

ERE 678. Paper Coating and Converting (3)

Three hours of lecture per week. Evaluation and study of the various coating materials and processes used by the paper industry.

Introduction to polymers and their use in converting operations, fundamentals and parameters which control their use, effects on final properties of papers. Spring.

Prerequisite: ERE 677.

Note: Credit will not be granted for PSE 466 and ERE 678 (both undergraduate and graduate versions of the same course).

ERE 679. Papermaking Processes (3)

Two hours of lecture and three hours of laboratory. 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, ERE 677.

Note: Credit will not be granted for both PSE 468 and ERE 679.

ERE 682. Transport Processes (3)
Two hours of lecture and three hours of laboratory. The relationship between wood structure and wood permeability, moisture movement, and heat transfer. Fire retardant and wood-preservation treatments. Wood drying. Unsteady-state transport processes. An advanced laboratory problem with report in wood-moisture relationships, wood drying, the relationship between wood permeability and treatability, or wood preservative treatments. Spring.
Prerequisite: WPE 387 or permission of instructor.
Note: Credit will not be granted for both ERE 682 and WPE 326.

ERE 685. Transmission Electron Microscopy (5)
Two hours of lecture, two hours of laboratory/demonstration, minimum of ten hours of individual laboratory. The theory and operation of the transmission electron microscope including specimen preparation, photographic technique and interpretation of micrographs. Spring.
Prerequisite: Permission of instructor.

ERE 686. Wood-Water Relationships (3)
Two hours of lecture and three hours of laboratory. 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.

ERE 691. Air Pollution Engineering (3)
Three hours of lecture and discussion. Study of the chemical, physical and meteorological principles of air pollution and its control. Local and global effects of air pollution. The atmospheric survey. Examination of the operating principles and design parameters of the various air pollution control systems. Air quality and emission standards. Fall.
Prerequisites: Physics and CHE 356 or permission of instructor.
Note: Credit will not be granted for both ERE 441 and ERE 691.

ERE 760. Analytical Photogrammetry I (3)
Two hours of lecture and three hours of laboratory. Mathematical theory of photogrammetry including space resection, orientation, intersection and aerial triangulation. Spring.
Prerequisites: FEG 363, APM 360 and FEG 464.

ERE 770. Biodegradation of Wood (3)
Two hours of lecture and one hour of demonstration/discussion. Biology of lignicolous fungi and their effects on wood properties. Anatomical, chemical and biotechnological aspects of the three major types of wood decay. Spring.
Prerequisite: Permission of instructor.

ERE 785. Scanning Electron Microscopy (5)
Two hours of lecture/demonstration/laboratory. Ten hours of independent laboratory experience per week. The theory and operation of the scanning electron microscope including specimen preparation, photographic technique and interpretation of micrographs. Fall and Spring.
Prerequisite: Permission of instructor.

ERE 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.

ERE 797. Seminar (1-3)
1.) Forest engineering topics. 2.) Paper science and engineering topics. 3.) Wood products engineering topics. Fall and Spring.

ERE 798. Research in Environmental and Resource Engineering (Credit hours to be arranged)
1.) Independent research topics in forest engineering. 2.) Independent research topics in paper science and engineering. 3.) Independent research topics in wood products engineering. Fall, Spring and Summer.

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, Faculty, and any sponsoring organization.

ERE 899. Master's Thesis Research (Credit hours to be arranged)
Research and independent study for the master's degree and thesis. Fall, Spring and Summer.

ERE 999. Doctoral Thesis Research (Credit hours to be arranged)
Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

ESC—ENVIRONMENTAL SCIENCE (UNDERGRADUATE)

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.

ESF—COLLEGE-WIDE

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 309. Honors Exploration Seminar (1)
One hour of group discussion or seminar per week for seven weeks and two additional, individual meetings. Selection and refinement of honors thesis project topic, development of project plan and start of research. Fall and Spring.
Prerequisite: Admission to the ESF Honors Program.

ESF 332. Seminar for New Transfer Students (No Credit)
One hour of weekly lectures and discussions designed to introduce the transfer student to the college and its academic and social environs. 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.
Prerequisite: Admission to the ESF Honors Program.

EST—ENVIRONMENTAL STUDIES

EST 132. Orientation Seminar: Environmental Studies (1)
A one-day retreat, and one hour of lecture and discussion. Occasional field trip. Introduction to effective study strategies, campus resources, the lower-division program, and upper-division study options. Fall.

EST 200. Cultural Ecology. (3)
Three hours of lecture/discussion/oral presentations per week. Students develop skills and fluency in preparing, delivering and evaluating multi-cultural 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 220. Urban Ecology (3)
Two hours lecture/discussion, three hours of outdoor laboratory. 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)
Description of the American political system, its role and functions in society, and the nature of political processes. Examples are drawn from a variety of settings and circumstances, with limited attention to problems involving the natural environment. Fall.

EST 245. Nature and Popular Culture (3)
Three hours of lecture and discussion. An interdisciplinary exploration of the meanings of nature expressed in North American popular culture and of the implications of those meanings for environmental affairs. The expression of dominant 20th century Western ideologies of humanism and consumerism through such phenomena as advertising, nature shows, tourism, theme parks, zoos, rodeos, feature films, weather reports, lawns and the World Wide Web are identified using a mix of cultural studies and philosophy. Fall.

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 on-line 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 hours of lecture and discussion. An investigation of institutional influences on the American environment. Federal government and its role in environmental management and protection is emphasized. The pressures contributing to the formation of environmental policy are introduced. The practical consequences of this system are demonstrated through case studies. Fall or Spring.
Prerequisite: EST 221.

EST 353. Environmental Psychology (3)
Three hours of lecture/discussion; selected field trips. Course develops the concepts and principles of psychology as applied to environmental studies and forestry. Concepts and applications of principles of psychology as applied to environmental studies and forestry. Concepts and applications of psychological data gathering techniques, perception, cognition and environmental education. Spring.
Prerequisites: Introductory psychology; junior status or permission of instructor.

EST 361. History of the American Environmental Movement (3)
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 life-styles. 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. Covers the historical roots of environmental attitudes and values, with special emphasis on how individual attitudes impact environmental issues. Examples of current environmental issues are examined in this context. Required of environmental studies undergraduates; open as an elective to others. Spring.
Prerequisite: At least sophomore status.

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 and discussion. A multidisciplinary social science perspective on the nature of the physical environment, particularly as it relates to the creation of human habitat. Human-environment interactions are viewed at three scales: 1) macro-interactions concerning social and economic issues; 2) meso-interactions concerning behavior of groups; 3) micro-interactions concerning perceptions and attitudes of individuals. Disciplines from which material may be drawn include: anthropology, ethology, geography, political science, psychology and sociology. Spring.

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. Tools for Urban Problem Solving (1)
Two hours lecture/discussion for eight weeks. Develops skills in the following areas: (1) problem solving, (2) leadership and management, (3) communications, (4) conflict management, (5) team building, (6) partnerships, (7) ethics, (8) diversity. Fall.

EST 426. Concepts of Sustainable Development (3)
Three hours of lecture/discussion per week. Presents the ecological and development principles and theoretical underpinnings guiding local and global initiatives for sustainable development. Four overlapping themes will be 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; and questions of environmental equity and the quality of development. Fall
Prerequisite: Upper division status.
Note: Credit will not be granted for both ENS 626 and EST 426.

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.

ETS—ENGLISH AND TEXTUAL STUDIES

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

FCH—CHEMISTRY

FCH 132. Orientation Seminar: Chemistry (1)
One hour of lecture and discussion. 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. 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, thermodynamics and discusses the principles of chemical reactivity. Fall.

FCH 151. General Chemistry Laboratory I (1)
Three hours of laboratory. 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.
Prerequisite: 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.

FCH 153. General Chemistry Laboratory II (1)
Three hours of laboratory. 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 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. Lab 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. 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. 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. 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. 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 325. Organic Chemistry III (4)
Two hours of lecture, one six-hour laboratory. 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. Includes discussion on the properties of gases and liquids, laws of thermodynamics, solutions and colligative properties, and electrochemical cells. Fall.
Prerequisites: One year of college physics, differential and integral calculus.

FCH 361. Physical Chemistry II (3)
Three hours of lecture. Includes discussion on electrochemistry, principles of quantum mechanics, statistical 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. Equilibrium concepts and practical implementations of precipitation, complexation, acid-base and oxidation-reduction processes in quantitative chemical analysis. Fall.
Prerequisites: Two years of undergraduate chemistry and FCH 360 taken concurrently or permission of instructor.

FCH 381. Analytical Chemistry II: Spectroscopic, Chromatographic and Electroanalytical Instrumental Techniques (3)

Two hours of lecture and one three-hour laboratory. 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 361, FCH 380 taken concurrently or permission of instructor.

FCH 384. Spectrometric Identification of Organic Compounds (1-2)

Two hours of lecture and discussion. 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. Spring.

Prerequisites: Organic chemistry; one semester of advanced organic chemistry for second credit.

FCH 390. Drugs from the Wild (3)

Three hours of lecture and discussion. 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 440. Introduction to Chemical Ecology (3)

Three hours of lecture with discussion. 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. Literature surveys and seminars on topics of current research interest and recent advances in chemistry. Spring.

FCH 498. Introduction to Research (5)

Eighteen hours of laboratory, library search and report writing. Solution of a selected research problem using special laboratory techniques. A written report on data, procedures, results and conclusions. Fall and Spring.

FCH 510. Environmental Chemistry I (3)

Three hours of lecture. Introduction to the processes that control chemical behavior in aquatic environments, including precipitation, gas exchange, acid-base, redox, complexation and adsorption reactions. Emphasis will be on explanation and prediction of chemical behavior, using computer models where appropriate.

Examples will be from the areas of water and wastewater treatment, pollutant fates and geochemistry. Spring.

Prerequisites: An introductory course in physical chemistry is required and a short course in computer programming is recommended.

FCH 511. Environmental Chemistry II (3)

Three hours of lecture. Includes a detailed chemical explanation of current topics of concern in environmental chemistry and the chemistry of pollution. Lectures will cover topics relating to air, soil and biota pollutional impact. Fall.

Prerequisite: Chemistry through physical chemistry or permission of instructor.

FCH 515. Methods of Environmental Chemical Analysis (3)

One hour of lecture and six hours of laboratory. 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 524. Topics in Natural Products Chemistry (3)

Three hours of lecture and discussion. 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 530. Biochemistry I (3)

Three hours of lecture. General biochemistry with emphasis on cellular constituents and metabolic reactions. The chemical, physical and biological properties of amino acids, proteins, carbohydrates and their intermediary metabolism will be discussed. The chemistry of enzymes, energy transfers and biological oxidations will also be covered. Fall.

Prerequisite: One year of organic chemistry.

FCH 531. Biochemistry Laboratory (3)

One hour lecture and six hours of laboratory 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. Fall.

Prerequisite: One semester of quantitative analysis with laboratory.

Co-requisite: FCH 530 with permission of instructor.

FCH 532. Biochemistry II (3)

Three hours of lecture. Topics discussed are: biosynthesis and degradation of amino acids and nucleic acids, protein biosynthesis, and an introduction to molecular biology. Spring.

Prerequisites: FCH 530 and its pre- and co-requisites.

FCH 540. Carbohydrates I: Structure, Reactions and Analysis (2)

Two hours of lecture/discussion on the structure, reactions, and analysis of carbohydrates and polysaccharides. Introduction to carbohydrate structure and nomenclature. Overview of important oligosaccharides and major classes of polysaccharides. Reactions of carbohydrates—derivatization, polymerization, degradation. Analysis of carbohydrate molecules—sequence and linkages size, shape, distribution of functional groups. Fall.

Prerequisite: One year of introductory organic chemistry, or permission of instructor.

FCH 550. Polymer Science: Synthesis and Mechanisms (3)

Introduction to the synthesis of polymers and the mechanism of polymerization processes. Addition homopolymerization and copolymerization by radical, ionic, and coordination type catalysts. Synthesis of block and graft copolymers. Stepwise polymerization, network formation and gelation. Structure of polymers and

stereoregular polymerization. Degradation of polymers, reactions on polymers, polyelectrolytes. Three hours of lecture. Spring.
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; 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. Introduction to physical chemistry, physics, processing and technology of synthetic polymers. Polymer solutions, including molecular weight determinations and chain statistics. Polymer solid states, including rubber elasticity, viscoelasticity, the glassy state and the crystalline state. Properties, processing, and technology of films, fibers, elastomers, and foams. Fall.
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. 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.
Prerequisites: Two semesters each of organic and general chemistry.

FCH 571 Wood Chemistry I: General Wood Chemistry (2)

Two hours of lecture. Introduction to carbohydrate chemistry. Chemistry of cellulose, hemicelluloses, and lignin. Cellulose derivatives. Distribution of polysaccharides and lignin in wood. Wood extractives. Chemistry of bark. Formation of heartwood. Wood as a chemical raw material. Fall.
Prerequisite: One or two semesters of a three-credit undergraduate course in organic chemistry.

FCH 630. Plant Biochemistry (3)

Three hours of lecture and discussion. 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. 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)
(Credit hours arranged according to nature of topic)

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 (Credit hours to be arranged)

Independent research in physical and organic chemistry of synthetic polymers, physical and organic chemistry of natural polymers, organic chemistry of natural products, ecological chemistry and biochemistry. One written report required. Fall, Spring and Summer.

FCH 899. Master's Thesis Research (Credit hours to be arranged)

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 (Credit hours to be arranged)

Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

FEG—FOREST ENGINEERING

FEG 132. Orientation Seminar: Forest Engineering (1)

One hour of lecture, discussion and/or exercises. Introduction to campus resources available to ensure academic success. Introduction to engineering as a design profession. Fall.

FEG 300. Engineering Design (1)

One hour of lecture or three hours of laboratory. 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. Introduction to water resources engineering. Hydraulics processes explored include pipe flow, open-channel flow, flows within control structures, and flow through porous media. Hydrologic processes explored include scaling rainfall across time and space, computing the timing and magnitude of watershed runoff, and routing flood waves through detention basins and streams. Engineering analysis to link hydrologic and hydraulic systems and use probability distributions to access the system failure. Spring.
Pre- or co-requisite: MAE 341 or equivalent.
Note: Credit will not be granted for both FEG 340 and ERE 540.

FEG 350. Introduction to Remote Sensing for Engineers (2)

Two hours of lecture per week. The fundamentals of acquiring, analyzing and utilizing remote sensing data in the performance of natural resource inventories, environmental quality surveys and site development analyses. Oriented for multidisciplinary participation. Spring.
Prerequisite: Junior status.

FEG 352. Introduction to Remote Sensing (3)

Two hours of lecture and three hours of laboratory. Qualitative and quantitative introduction to the fundamentals of acquiring, analyzing and utilizing remote sensing data in the performance of natural resource inventories, environmental quality surveys, site

development studies and land use analyses. Oriented for multidisciplinary participation. Spring.
Prerequisites: Junior status, physics and calculus or permission of instructor.

Note: Credit will not be granted for both FEG 352 and ERE 552.

FEG 363. Photogrammetry I (3)

Two hours of lecture and discussion, three hours of laboratory. Basic photogrammetric and photo interpretation concepts as a means of acquiring reliable data for engineering and management planning. Potentials, limitations, instrumentation and unique requirements are considered. Fall or Spring.

Prerequisite: ERE 371.

Note: Credit will not be granted for both FEG 363 and ERE 563.

FEG 410. Structures (4)

Three hours of lecture, three hours of computation laboratory and discussion. 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.

Prerequisites: ERE 362, scientific computing.

FEG 420. Harvest Systems Analysis (1)

Three hours of discussion, demonstration and/or field exercises. An introduction to mensuration, harvesting operations, methods analysis, mechanization, and interrelationships between the production and silvicultural aspects of harvesting is presented. Fall.

Prerequisites: FOR 321, ERE 362.

FEG 430. Engineering Decision Analysis (3)

Three hours of lecture. 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. Fall.

FEG 437. Transportation Systems (3)

Two hours of lecture and three hours of laboratory. 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. 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 464. Photogrammetry II (3)

Two hours of lecture and three hours of laboratory. General analytic photogrammetry including interior and exterior orientation systems, intersection, space resection and orientation. Correction of photo coordinates for film deformation, lens distortions, atmospheric refraction, and earth curvature. Introduction to photogrammetric plotters. Planning for photogrammetric projects and designing optimum procedures for selected photogrammetric tasks. Fall.

Prerequisite: FEG 363.

Note: Credit will not be granted for both FEG 464 and ERE 664.

FEG 489. Forest Engineering Planning and Design (3)

Two hours of lecture and three hours of laboratory. A curriculum capstone course designed to integrate other coursework with a systematic approach to real life engineering problems. Semester-long laboratory projects are selected to provide experience in dealing not only with technical and economic constraints, but also with environmental, social, legal and political aspects of the planning process. Spring.

Prerequisite: Senior status in forest engineering.

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.

FIA—FINE ARTS

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

FOR—FORESTRY (RESOURCES MANAGEMENT)

FOR 132. Orientation Seminar: Forestry (1)

One hour of lecture/discussion. Jointly taught by ESF Student Affairs staff and in the Faculty of Forestry. Student Affairs provides an introduction to ESF and to skills necessary for success. The Faculty of Forestry briefly describes forestry, what it is, what foresters do, the social contract with the public, the role of forestry and foresters as professionals, and the integration of biophysical, socio-economic and ethical dimensions of forest resource management. Required of freshmen in the Forest Resources Management and the Dual EFB/FOR programs. Fall.

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 interdisciplinary overview of the development and evolution of Western civilization and its relevance to environmental and natural resource issues. Exploration of various defining moments throughout several millennia. Historical and contemporary influences of the Western tradition. Basic timeline and themes of Western civilization in relation to perceptions of the natural world and treatment of the environment. Meets the General Education requirements for Western Civilization. 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 nineteenth and twentieth centuries, with attention to natural resources. Considers

the impact of defining moments in American history on natural resources and analyzes their implications on contemporary resource use, allocation and management. Exposure to historiography, historical research and analysis. Fall.

FOR 207. Introduction to Economics (3)

Three hours of lecture. 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 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 301. Adirondack Forest Ecology and Dendrology (1)

Intensive field study, presented as the first portion of the Summer Program in Field Forestry. Field identification and ecology of common trees and some shrub and herbaceous species of the Adirondack region. Natural and cultural history of the area as it affects the growth and development of forest vegetation. Summer.

FOR 303. Introduction to Forest Resources Measurements (3)

Ten hours of lecture and thirty hours of laboratory per week for approximately three weeks. Summer Program in Field Forestry. Principles and methods used in the measurement of spatial and vegetative attributes of forest landscapes. Course stresses development of field ability in the areas of overland navigation, timber measurements, and habitat measurements. Summer. Prerequisite: FOR 301.

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. Forest Mensuration (3)

Two hours of lecture and three hours of laboratory. 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. Fall. Prerequisites: FOR 303 or equivalent, APM 391 or equivalent.

FOR 323. Forest Biometrics (3)

Three hours lecture. 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 324. Natural Resources Information Systems (3)

Two hours of lecture and three hours of laboratory per week. Introduction to, and foundation in the use of, the concepts and

principles of geographic information systems, remote sensing, and global positioning systems, with particular emphasis in forest resource management applications. Spring.

FOR 332. Forest Ecology (3)

Two hours of lecture and three hours of lab per week. Introduction to principles of ecology as they relate to forest ecosystems. Autecology and tree physiology from a whole plant perspective. Synecology presented from an applied perspective including the role of human activities and management interventions on ecosystem function from local to global levels. Fall. Prerequisite: EFB 226 (General Botany).

FOR 333. Managerial Economics for Environmental Professionals (3)

Three hours of lecture with class discussion per week. An introductory class addressing the question of how to use economic information to make business decisions with respect to managing environmental resources. Spring. Prerequisite: FOR 207 or equivalent. Note: Credit will not be granted for both FOR 333 and FOR 533.

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 FOR 334 and FOR 534 (both undergraduate and graduate versions of the same course).

FOR 338. Meteorology (3)

Three hours of lecture/discussion. 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 micro scale 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. Basic principles of physical hydrology, including the movement of water through hydrologic reservoirs on global and watershed scales, measurement and quantification of hydrological data, runoff generation processes and water quality in the natural environment. Course content includes precipitation, evapotranspiration, streamflow generation, and fundamentals of groundwater flow. Fall. Prerequisites or Co-requisites: Soils and/or Introductory Geology. Note: Credit will not be granted for FOR 340 and FOR 540 (both undergraduate and graduate versions of the same course).

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 FOR 345 and FOR 545 (both undergraduate and graduate versions of the same course).

FOR 356. Introduction to Raster GIS Analysis (3)

Two hours of lecture/discussion and three hours of laboratory per week. An application of raster Geographic Information System technology to the solution of spatial problems in the fields of planning, forest management, landscape architecture, biology, ecology, and engineering. Students learn how to obtain raster geographic data, convert it to different spatial coordinates, carry out

series of spatial overlay analyses, produce effective maps, and write effective reports. Spring.

Note: Credit will not be granted for both FOR 356 and FOR 556.

FOR 357. Practical Vector GIS (3)

Two hours of lecture/discussion and three hours of laboratory per week. This course teaches the application of vector Geographic Information System technology to the solution of spatial problems and the analysis of spatial data in the fields of planning, forest management, landscape architecture, biology, ecology, and engineering. Students will learn how to obtain geographic data, convert it to different spatial coordinates, carry out spatial queries and overlay analyses, produce effective maps, and write effective reports. Fall.

Note: Credit will not be granted for both FOR 357 and FOR 557.

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 FOR 360 and FOR 560 (both undergraduate and graduate versions of the same course).

FOR 370. Timber Management (4)

Three hours of lecture and three hours of laboratory. An introduction to methods for organizing and regulating forests for timber production, growth and yield, timber harvest scheduling, timber sale contracts, and the role of timber management in forest management. Spring.

Prerequisites: FOR 322 and FOR 334. Co-requisite: FOR 333.

FOR 372. Fundamentals of Outdoor Recreation (3)

Three hours of lecture 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 and Fall.

FOR 373. Forest Operations (4)

Three 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; and the role of forest operations in the broader context of forest management. Fall.

Prerequisite: FOR 321 or FOR 334.

FOR 415. Forestry Consulting and Wood Procurement (3)

Two hours of lecture, two hours of laboratory, and one hour of independent study per week. This course is designed to provide the skills and professionalism to succeed as forestry consultants and wood procurement foresters. Introduction to the structure of the forest products industry in the United States and more specifically the issues and challenges surrounding wood supply and forest management. Field exercises provide students the opportunity to assume the role of both a forestry consultant and wood procurement forester. Fall.

Note: Credit will not be granted for FOR 415 and FOR 615 (both undergraduate and graduate versions of the same course).

FOR 430. Agroforestry (3)

Two hours of lecture and three hours of laboratory per week. The productivity of stands of trees as well as aggregations of agricultural and forest tree crops in tropical and temperate agroforestry systems are examined from an ecophysiological perspective with an emphasis

upon species and species-site interactions. Quantitative techniques and local agroforestry field trips are integrated with lecture material to develop an ecological understanding of the basis for sound agroforestry as well as plantation management. Fall, odd years. Prerequisites: FOR 332, FOR 323 or equivalent.

Note: Credit will not be granted for FOR 430 and FOR 630 (both undergraduate and graduate versions of the same course).

FOR 433. Advanced Silviculture (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 443. Forest Hydrology (3)

Three hours of lecture per week and occasional field trips. Fundamental hydrological processes relevant to forested watersheds, including the occurrence, distribution and movement of water through the hydrologic cycle as precipitation, evapotranspiration and runoff. The focus will be on scientific hydrology, with critical examination of research techniques as applied to the study of forested catchments. Students will conceptualize, execute and interpret hydrologic investigations. Linkages to biogeochemistry will also be explored. Fall.

Prerequisites: FOR 340 or equivalent, with permission of instructor.

Note: Credit will not be granted for FOR 443 and FOR 643 (both undergraduate and graduate versions of the same course).

FOR 455. Forest Genetics and Tree Improvement (3)

Two hours of lecture and three hours of lab per week. General principles of genetics as applied to conservation and utilization of genetic diversity of forest tree species. Topics include selection of elite trees, pollen testing, tissue culture and seed propagation, field-test design, and germplasm conservation and utilization. Spring. Prerequisite: EFB 307, or FOR 334, or FOR 321 or permission.

Note: Credit will not be granted for FOR 455 and FOR 655 (both undergraduate and graduate versions of the same course).

FOR 465. Natural Resources and Environmental Policy (3)

Three hours of lecture per week. Working principles for governance of natural resources and the environment. Includes institutions, processes and models of policy-making and analysis. Focuses on forests, wildlife and water at the federal and state level. Fall. Prerequisite: senior standing and a course in economics.

FOR 473. Planning and Management of Outdoor Recreation Areas (3)

Two hours of lecture, two hours of lab, and one hour of independent study per week. Planning, designing, and managing outdoor recreation facilities such as trails and campgrounds within forest and other natural resource recreation areas. This service-learning course provides an outdoor recreation area planning experience through community and/or organizational service. Emphasis is on the functional relationship between facility design and unit management planning. Spring.

Prerequisite: FOR 372.

Note: Credit will not be granted for FOR 473 and FOR 673 (both undergraduate and graduate versions of the same course).

FOR 475. Human Behavior and Recreation Visitor 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 practices, and 5) recreation planning decisions necessary to manage recreation settings and experiences. Students have the opportunity to apply concepts to personal recreation experiences. Spring.

Prerequisite: FOR 372 or equivalent.

Note: Credit will not be granted for FOR 475 and FOR 675 (both undergraduate and graduate versions of the same course).

FOR 476. Tourism and Commercial Recreation (3)

Three hours of lecture per week and a one-day field trip. Overview of concepts related to tourism planning, commercial recreation business planning, and tourism-related non-governmental organization formation. This service-learning course provides a real-world tourism planning experience through community service. The environmental, social, and economic impacts related to ecotourism, nature-based tourism, and heritage tourism are emphasized. Fall.

Prerequisite: FOR 372.

Note: Credit will not be granted for FOR 476 and FOR 676 (both undergraduate and graduate versions of the same course).

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 FOR 478 and FOR 678 (both undergraduate and graduate versions of the same course).

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. Spring.

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 FOR 480 and FOR 680 (both undergraduate and graduate versions of the same course).

FOR 487. Environmental Law and Policy (3)

Three hours of lecture 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 standing and course in American government or American history.

Note: Credit will not be granted for FOR 487 and FOR 687 (both undergraduate and graduate versions of the same course).

FOR 488. Natural Resources Administration Law (3)

Three hours of lecture and discussion per week. Introduction to the law concerning procedures, powers and judicial review of public agencies responsible for the management of natural resources. Analysis of agency rule making, agency adjudication, disclosure of information, political controls over agencies and judicial review of agency action. Examination of natural resource law topics including public lands, wildlife, preservation, recreation, mineral, timber and water law. Spring.

Prerequisite: Course in American government or American history.

Note: Credit will not be granted for both FOR 488 and FOR 688.

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 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. Independent Study/Internship in Forest Resources Management (7-12)

Independent research or study in resource management/forestry for selected undergraduate students; especially designed for internships spent off campus working for a resource management or forestry oriented firm or organization while also pursuing an academically oriented project. The selection of the study topic will be determined by the student in consultation with his/her adviser. Guidance will be provided by a faculty committee. Final written report is required for record. Limited to seniors in forest resources management. Fall, Spring and Summer.

Prerequisite: Must have a cumulative GPA of at least 3.00.

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 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 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.
Prerequisite: EFB 320.

FOR 533. Managerial Economics for Environmental Professionals (3)

Three hours of lecture with class discussion per week. An introductory class addressing the question of how to use economic information to make business decisions with respect to managing environmental resources as well as analyzing critically, using economic analytical tools, policies concerning the natural resource management decisions. Spring.
Pre- or co-requisite(s): FOR 207 or equivalent and calculus, or permission of the instructor.
Note: Credit will not be granted for both FOR 333 and FOR 533.

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 FOR 334 and FOR 534 (both undergraduate and graduate versions of the same course).

FOR 535. Advanced Forest Soils (3)

Three hours of lecture/discussion 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. 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. The course covers basic principles of physical hydrology, including the movement of water through hydrologic reservoirs on global and watershed scales, measurement and quantification of hydrological data, runoff generation processes and water quality in the natural environment. Course content includes precipitation, evapotranspiration, streamflow generation, and fundamentals of groundwater flow. Students are expected to apply course concepts to an independent research project. Fall.
Prerequisite or Co-requisite: Soils and/or Introductory Geology.
Note: Credit will not be granted for FOR 340 and FOR 540 (both undergraduate and graduate versions of the same course).

FOR 542. Watershed Management (2)

Two hours of lecture or equivalent. The impact of the multiple use of forest and range lands on water yield, soil stability, and water quality. Regional and local problems and potential solutions. Fall.
Prerequisite: FOR 340, FOR 443, or permission of instructor.

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 FOR 345 and FOR 545 (both undergraduate and graduate versions of the same course).

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 field work and production of a soil map. Models of soil genesis, application of the US system of Soil Taxonomy, and soil mapping. Spring.
Prerequisite: Introductory course in soil science.

FOR 556. Introduction to Raster GIS Analysis (3)

Two hours of lecture/discussion and three hours of laboratory per week. An application of raster Geographic Information System technology to the solution of spatial problems in the fields of planning, forest management, landscape architecture, biology, ecology, and engineering. Students learn how to obtain raster geographic data, convert it to different spatial coordinates, carry out spatial overlay analyses, produce effective maps, and write effective reports. Students complete a final project, prepare a comprehensive report and present the results to the class. Spring.
Note: Credit will not be granted for both FOR 356 and FOR 556.

FOR 557. Practical Vector GIS (3)

Two hours of lecture/discussion and three hours of laboratory per week. This course teaches the application of vector Geographic Information System technology to the solution of spatial problems and the analysis of spatial data in the fields of planning, forest management, landscape architecture, biology, ecology, and engineering. Students will learn how to obtain geographic data, convert it to different spatial coordinates, carry out spatial queries and overlay analyses, produce effective maps, and write effective reports. Students complete a final project, prepare a comprehensive report and present the results to the class. Fall.
Note: Credit will not be granted for both FOR 357 and FOR 557.

FOR 558. Advanced Topics in GIS (3)

Two hours of lecture/discussion and three hours of laboratory per week. This course builds on knowledge gained in introductory vector GIS courses and provides instruction in data structures, data models, between layer topologies, and geographic editing. Spring.
Prerequisite: FOR 357 or FOR 557 or equivalent experience with vector GIS.

FOR 560. 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. Graduate students lead the discussion of case studies and have a separate recitation section. Fall.
Prerequisite: graduate status.
Note: Credit will not be granted for FOR 360 and FOR 560 (both undergraduate and graduate versions of the same course).

FOR 615. Forestry Consulting and Wood Procurement (3)

Two hours of lecture, two hours of laboratory, and one hour of independent study per week. This course is designed to provide the skills and professionalism to succeed as forestry consultants and wood procurement foresters. Introduction to the structure of the forest products industry in the United States and more specifically the issues and challenges surrounding wood supply and forest

management. Field exercises provide students the opportunity to assume the role of both a forestry consultant and wood procurement forester. Fall.

Note: Credit will not be granted for FOR 415 and FOR 615 (both undergraduate and graduate versions of the same course).

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. 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.

FOR 630. Agroforestry (3)

Two hours of lecture and three hours of laboratory per week. The productivity of stands of trees as well as aggregations of agricultural and forest tree crops in tropical and temperate agroforestry systems are examined from an ecophysiological perspective with an emphasis upon species and species-site interactions. Quantitative techniques and local agroforestry field trips are integrated with lecture material. Critically analyze ecological factors as the basis for sound agroforestry as well as plantation management. Fall, odd years.

Prerequisite: FOR 332 or FOR 323 or equivalent.

Note: Credit will not be granted for FOR 430 and FOR 630 (both undergraduate and graduate versions of the same course).

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. 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 643. Forest Hydrology (3)

Three hours of lecture per week and occasional field trips. Fundamental hydrologic processes relevant to forested watersheds, including the occurrence, distribution and movement of water through the hydrologic cycle as precipitation, evapotranspiration and runoff. The focus will be on scientific hydrology, with critical examination of research techniques as applied to the study of forested catchments. Students will conceptualize, execute, interpret, and synthesize results from hydrologic investigations. Linkages to biogeochemistry will also be explored. Students are expected to develop detailed field investigations. Fall.

Prerequisite: FOR 540 or equivalent, with permission of instructor.

Note: Credit will not be granted for FOR 443 and FOR 643 (both undergraduate and graduate versions of the same course).

FOR 645. Hydrological Techniques (2)

One hour of lecture and three hours of laboratory. Course will provide a hands-on learning experience in current instrument and measuring

techniques in hydrology, meteorology and hydrogeology, necessary for research in the environmental sciences. The objective will be to explore the principles that govern the use of sensors and the operation of data acquisition systems. Spring.

Prerequisite: FOR 643.

Note: Credit will not be granted for both FOR 445 and FOR 645.

FOR 655. Advanced Forest Genetics and Tree Improvement (3)

Two hours of lecture and three hours of laboratory per week. General principles of genetics as applied to conservation and utilization of genetic diversity of forest tree species. Topics include selection of elite trees, pollen testing, tissue culture and seed propagation, field-test design, and germplasm conservation and utilization. An independent research problem will be undertaken by the student. Spring.

Prerequisite: permission of instructor.

Note: Credit will not be granted for FOR 455 and FOR 655 (both undergraduate and graduate versions of the same course).

FOR 665. Natural Resources Policy (3)

Three hours of lecture per week. Applies interest group theory and the policy process model and institutionalism to policy formation, implementation and analysis. Focuses on environmental federalism, land and water resources and conflict management. Fall.

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 673. Planning and Management of Outdoor Recreation Areas (3)

Two hours of lecture, two hours of laboratory, and one hour of independent study per week. Planning, designing, and managing outdoor recreation facilities such as trails and campgrounds within forest and other natural resource recreation areas. This service-learning course provides an outdoor recreation area planning experience through community and/or organizational service. Emphasis is on the functional relationship between facility design and unit management planning, as well as the unit management planning process. Spring.

Prerequisite: FOR 372.

Note: Credit will not be granted for FOR 473 and FOR 673 (both undergraduate and graduate versions of the same course).

FOR 675. Human Behavior and Recreation Visitor 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 practices, and 5) recreation planning decisions necessary to manage recreation settings and experiences. Students have the opportunity to apply concepts to personal recreation experiences. Lectures concurrent with FOR 475, additional lectures, reading, and data analysis required. Spring.

Prerequisite: graduate standing, instructor permission.

Note: Credit will not be granted for FOR 475 and FOR 675 (both undergraduate and graduate versions of the same course).

FOR 676. Tourism and Commercial Recreation (3)

Three hours of lecture per week and one, one-day field trip. Overview of concepts related to tourism planning, commercial recreation business planning, and tourism-related non-governmental organization formation. The environmental, social, and economic impacts related to ecotourism, nature-based tourism, and heritage tourism are emphasized, as are the tourism planning and commercial

recreation business planning processes. Fall.

Prerequisite: FOR 372.

Note: Credit will not be granted for FOR 476 and FOR 676 (both undergraduate and graduate versions of the same course).

FOR 677. Recreation Research Theory and Application (3)

Three hours of lecture per week. The major components of this course are: 1) how to apply a theoretical construct to create operational definitions used in social science, 2) identification of the interdisciplinary approaches/theories used to investigate social/recreation behavior, and 3) a comparison of the various methods used in social research. Students have the opportunity to apply class objectives to their personal research. Fall.

Prerequisite: graduate standing, instructor permission.

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 FOR 478 and FOR 678 (both undergraduate and graduate versions of the same course).

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. Spring.

Prerequisite: Permission of instructor.

Note: Credit will not be granted for FOR 480 and FOR 680 (both undergraduate and graduate versions of the same course).

FOR 687. Environmental Law and Policy (3)

Three hours of lecture 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. Critically analyze common law environmental remedies, Clean Air Act, Clean Water Act, Endangered Species Act, hazardous waste, and other environmental laws. Fall.

Prerequisite: Course in American government or American history.

Note: Credit will not be granted for FOR 487 and FOR 687 (both undergraduate and graduate versions of the same course).

FOR 688. Natural Resources Administration Law (3)

Three hours of lecture and discussion per week. Introduction to the law concerning procedures, powers and judicial review of public agencies responsible for the management of natural resources. Analysis of agency rule making, agency adjudication, disclosure of information, political controls over agencies and judicial review of agency action. Examination of natural resource law topics including public lands, wildlife, preservation, recreation, mineral, timber and water law. Research paper required. Spring.

Prerequisite: Course in American government or American history.

Note: Credit will not be granted for both FOR 488 and FOR 688.

FOR 690. Seminar and Workshop on Natural Resources Policy and Management (3)

Six hours of discussion, seminar and group project laboratory work. Individual and team projects on policy and management to demonstrate the integration of principles and concepts. Oral and written presentations required. Spring.

Pre- or co-requisites: FOR 560, CMN 531.

FOR 694. Writing for Scientific Publication (3)

Three hours of lecture and discussion. 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. Fall and Spring.

Prerequisite: Permission of instructor.

FOR 695. Research Methods for Natural Resources (3)

Three hours of lecture and discussion. The conduct of scientific research in natural resources. Students design research questions and write a feasible research proposal. Issues include researchable questions, scientific literature, theory, practice, design, measurement, and analysis. Fall.

Pre- or co-requisite(s): Graduate student standing.

FOR 720. Theoretical Foundations of Natural Resources and Environmental Policy (3)

Three hours of lecture/discussion per week. Examination of theoretical foundations of the use of reason, the scientific method, and deductive reasoning in advancing human knowledge and understanding. Investigation of theories of scientific progress and scientists' role in testing, refuting, subdividing, and superseding theory. Analysis of major political science, economic, and behavioral foundations of natural resources and environmental policy, such as rational choice theory, game theory, institutionalism, systems theory, and chaos theory. Research papers required. Spring

Prerequisite: A graduate course in public policy, natural resources policy or environmental policy.

FOR 753. Advanced Natural Resource and Environmental Policy (3)

Three hours of lecture and discussion. Course takes a social history approach to examine the working principles forming the foundation for natural resource and environmental policies. These principles will be directed toward an appreciation of the institutional context for the domestic and global natural resource and environmental issues, and an understanding of the values, institutions, policies and rules, which govern societies and their relationship to their environment. Fall.

Note: Highly desired is previous coursework in public policy, natural resource or environmental policy, environmental law, public administration or property law.

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 Forestry (1-6)

Special investigation and analysis of forest resource management topics. A study plan and a final written report are required. Fall and Spring.

FOR 895. Graduate Internship (1-6)

Professional experience which applies, enriches, or complements formal coursework. Restricted to graduate students in Forest Resource Management. Graded on an "S/U" basis. Fall, Spring and Summer.

FOR 898. Professional Experience (6-12)

Professional experience which applies, enriches, or complements formal coursework. Restricted to M.S. students in Option 2. Graded on an "S/U" basis. Fall, Spring and Summer.

FOR 899. Master's Thesis or Project (1-6)

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.

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—FOREST TECHNOLOGY

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 forty-five hours of lecture and forty-five 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)
A study of the distinguishing characteristics, growth features, distribution, site associations, commercial importance, and natural history of the major tree species of North America. Students will learn to identify forest species by both common and scientific names, from leaf, twig, or bark samples. Students learn seasonal field identification skills and see the habitats, associates, and place in succession of the predominant forest tree, shrub and herbaceous species in the Adirondack region. A number of exotic species will also be introduced. Fall.

FTC 202. Introduction to Surveying (4)
An introduction to the theory and practice of plane surveying. Emphasis is on developing individual skills through small crew projects and handling typical surveying equipment in typical field situations. Lecture topics include the theory of measurements and errors, mathematics for plane surveying, introduction to field problems, introduction to map use and preparation, U.S. Public Land Survey System, and concepts of deed descriptions and record-keeping procedures. Students tour the record room at the county courthouse. Field projects include traversing, using forester's and engineer's tools and methods, mapping using field and office methods, and proficiency projects in handling typical surveying instruments. Fall.

FTC 204. Introduction to Forest Measurements and Statistics (4)
A study of the tools and techniques used to measure primary forest products and inventory forest resources. Timber and wildlife habitat measurements are stressed, as is the professional presentation of forest inventory data in the form of technical reports. Various forest sampling and statistical methods are used and compared. Students participate in several field-oriented, hands-on exercises that reinforce the concepts and skills. Fall.
Pre- or co-requisites: FTC 200, FTC 202, FTC 208.

FTC 206. Forest Ecology (4)
Study of climate and soil factors and how these factors affect individual trees and the interaction of both within the forest community and the forest ecosystem. Competition between forest species is covered in detail. The course introduces students to cover type mapping. Students present a detailed analysis of a forest transect in both written and oral form. Fall.

FTC 208. Spatial Analysis of Forest Resources (5)
Sixty-two hours of lecture and sixty-five hours of laboratory/field study. An introduction to computers and computer software commonly used in forestry and surveying. Interpreting ground features from aerial photographs. Making horizontal measurements

from photographs. Producing maps using digital photo mapping software. Reading and interpreting maps and route surveys. Drafting skills are developed. Students must complete each unit within the course. Fall.

FTC 210. Leadership and Forest Technology (4)
Provides students with technical competence and decision-making abilities. Students receive training in the proper use, design, construction and maintenance of forest hand tools, chainsaws, and skidding equipment. Maps and route surveys, trail development, first aid and CPR are covered. 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 industry. Safety hazards and the prevention, classification, and reporting of accidents are covered. A student must satisfactorily complete each unit within the course to receive a passing grade. Fall.

FTC 211. Silviculture (5)
An introduction to silviculture and water resources management. In silviculture students learn about the regeneration and tending of forest stands, study the used various silvicultural treatments used in the Northeast, and are introduced to silvicultural systems in other major forest regions. Lectures and field labs in water resources cover measurements taken at weather stations, snow courses, stream-gauging stations, and other stream sample points. The hydrologic cycle, concept of flow, and the water balance equation are studied in detail. Students learn the forest management practices used to control erosion and water quality. A student must satisfactorily complete both units within the course to receive a passing grade. Spring.

FTC 213. Forest Inventory Practicum (2)
In this course a practical field problem requires students to use professional methods of collecting, analyzing and presenting forest resources inventory data. Inventory of the timber resource and the development of a forest type map are emphasized. Spring.
Pre- or co-requisite: FTC 204.

FTC 215. Timber Harvesting, Transportation, and Utilization (5)
Acquaints the student with the basic harvesting methods and techniques, with emphasis on the Northeast, and explains how harvesting fits in with other forest uses. Students gain technical competence in timber sale contract administration and basic timber appraisal. Students also learn to administer, locate, design, construct and maintain a forest gravel road. Covers the various tissues of forest trees and how their growth and development are affected by internal and external factors. Differences in stem structure of the important commercial tree species are studied in the laboratory and then related to commercial uses of the wood. Spring.
Pre- or co-requisites: FTC 208, FTC 210.

FTC 217. Forest Protection (5)
Sixty-one hours of lecture and 44 hours of field instruction covers insects, tree diseases, and fire. Tree diseases are identified and impacts within the forest community discussed. Tree damaging insects are observed and pest management measures introduced. Fire ecology, behavior, prevention, and control are addressed. DEC-administered Federal Work Capacity Tests certify "Red Card" qualification. Spring.
Prerequisite(s): FTC 200, FTC 204, FTC 206, FTC 208, FTC 210.

FTC 219. Introduction to Wildlife and Recreation Management (4)
Study of forest wildlife and recreation resources, their importance to humans, and the basic history, concepts and principles of wildlife management and forest recreation management. Technical aspects of managing wildlife and recreation resources to be emphasized include the field identification of bird and amphibian sounds, the development of environmental interpretation programs, trail and camp-ground layout and construction, and resource inventory

techniques. Students improve their communication skills by presenting papers and speeches on wildlife and recreation topics. Spring.

FTC 221. Forest Management (3)

Addresses the common problems met in organizing a forest property to best meet the goals of ownership. Techniques of growth and resource monitoring and the gathering and use of forest records are stressed. Examples and case studies of forest management and production activities are presented. A final project involves the application of information from many other FTC courses in a plan of management activities for an assigned forest property. Spring. Pre- or co-requisites: FTC 204, FTC 206.

FTC 223. Introduction to Water Resources (1)

Ten hours of lecture and sixteen hours of laboratory time. An introduction to water resources covering measurements taken at weather stations, snow courses, stream-gauging stations and other stream sample points. The hydrologic cycle, concept of flow and the water balance question are studied in detail. Students learn the management practices used to control erosion and water quality. Spring. Prerequisite: FTC 202.

FTC 251. Advanced Surveying Measurements and Computations (5)

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 programmable calculator and computer. Spring. Pre- or co-requisite: FTC 202.

FTC 253. Survey Law (3)

A study of the methods of record room research, boundary line establishment by written and unwritten methods, case and statute law related to property surveying, registration of surveyors, liability of surveyors and professionalism. Spring. Pre- or co-requisite: FTC 202.

FTC 255. Boundary Surveying (3)

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. Pre- or co-requisite: FTC 253.

FTC 257. Construction and Topographic Surveys (3)

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 will be covered. Layout of various construction projects including buildings, roads, pipelines and bridges will be discussed. Earthwork, slope staking, and cross-section calculations will also be covered. Students complete a topographic mapping project and develop maps both by hand and by computer-aided drafting techniques. Spring.

FTC 259. Advanced Topographic Surveying (1)

A study of the techniques and methods used to conduct topographic surveys and develop topographic maps. Several projects are completed using a variety of survey methods and instruments. Maps are developed both by hand and by computer-aided drafting techniques.

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 of the SFT. A maximum of 6 credit hours may be taken by any student in total. Semesters as arranged. Fall, Spring or Summer.

GEO—GEOGRAPHY

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

GOL—EARTH SCIENCES

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

HST—HISTORY

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

LIN—LINGUISTICS

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

LIT—LITERATURE IN TRANSLATION

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

LSA—LANDSCAPE ARCHITECTURE

(See also courses listed under EIN)

LSA 132. Orientation Seminar: Landscape Architecture (1)

One hour of lecture, discussion and/or exercises. 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. 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 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. Spring.

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. 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. Computer Graphics I (3)

Five hours of lecture and lab per week. Knowledge and skills are developed in basic digital graphic techniques common to visualizing and communicating design ideas. Methods include 2-D graphics (drawing and image processing), 3-D graphics (modeling and rendering), and content assembly and conveyance (desktop publishing, electronic publishing, business presentations and printing). Fall and Spring.

Prerequisite: Undergraduate standing in landscape architecture or permission of instructor.

Note: Credit will not be granted for both LSA 300 and LSA 500.

LSA 301. Computer Graphics II (3)

Three hours of lecture and lab per week. Knowledge and skills are developed in advanced processing techniques for digital photography, photorealistic visual simulation and 3-D modeling. Methods include 2-D drawing and image processing; 3-D modeling, rendering, animation, video and VR; and content assembly and conveyance using electronic publishing and business presentations. Fall and Spring.

Prerequisite: LSA 300 or permission of instructor.

Note: Credit will not be granted for both LSA 301 and LSA 501.

LSA 311. Natural Processes in Design and Planning (3)

Three hours of lecture. 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. Social and Cultural Factors in Design and Planning (3)

Three hours of lecture. Introduction to an interdisciplinary social science analysis of human settlements. The course introduces basic social science concepts, vocabulary, theories and methods of analysis. Focuses upon developing an understanding of the context for the planning and design of human settlements. Course requirements include readings, examinations and reports. Field trips may be scheduled. Spring.

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 on 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 342. Landscape Architectural Construction Technology (4)

Three hours of lecture and three hours of studio/laboratory. 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 405. 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. Spring.

Prerequisites: LSA 205 and LSA 206 and BLA status, or permission of instructor.

LSA 410. Computer-Aided Design and Drafting (3)

One-half hour of lecture, two and one-half hours of laboratory, and a minimum of six hours additional laboratory are 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 this course include completing self-tutorials, creating drawings and the

completion of two major projects. Fall and Spring.
Prerequisite: General knowledge of manual drafting.
Note: Credit will not be granted for both LSA 410 and LSA 610.

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 laboratory/field exercises. This course concentrates on the identification, selection, and spatial design applications of local woody shrubs and vines and herbaceous plant materials. Concepts covered include ecological relationships of local plants; ornamental plant materials use and identification; plant culture, propagation, and maintenance; transplanting; planting plans and specifications; and planting design and composition. Fall.

Note: Credit will not be granted for both LSA 433 and LSA 633.

LSA 451. Comprehensive Land Planning (3)

Three hours of lecture. 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 460. Off-Campus Design Thesis Studio (15)

Forty-five hours per week. The articulation of the study plan, as approved by the Faculty, through research, readings, field study with graphic and written documentation, and group discussion. Academic study in an off-campus location in the area of significance to landscape architecture or environmental studies, as described and delineated in a proposal prepared by the student with approval by the Faculty. Fall and Summer.

Prerequisites: LSA 423 and LSA 425 with a minimum grade of "C" or a proposal, study plan and equivalent instruction approved by Off-Campus Program Director.

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. 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. 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. Selected Readings in Landscape Architecture (1-3)

Exploration of selected readings in depth with individual independent study upon a plan submitted by the student and related to credit hours assigned. Upon approval of the instructor, the student may systematically investigate some subject area encountered in regularly scheduled courses or may initiate research on a variety of subject areas of determined relevance. Fall and Spring.

Prerequisite: Permission of instructor.

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 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 500. Computer Graphics I (3)

Five hours of lecture and lab per week. Knowledge and skills are developed in basic digital graphic techniques common to visualizing and communicating design ideas. Methods include 2-D graphics (drawing and image processing), 3-D graphics (modeling and rendering), and content assembly and conveyance (desktop publishing, electronic publishing, business presentations, and printing). Additional readings and a supplementary research component. Fall and Spring.

Prerequisite: Graduate standing in landscape architecture, or permission of instructor.

Note: Credit will not be granted for both LSA 300 and LSA 500.

LSA 501. Computer Graphics II (3)

Three hours of lecture and lab per week. Knowledge and skills are developed in advanced processing techniques for digital photography, photorealistic visual simulation and 3-D modeling. Methods include 2-D drawing and image processing; 3-D modeling, rendering, animation, video and VR; and content assembly and conveyance using electronic publishing and business presentations. Additional readings and a supplementary research component. Fall and Spring.

Prerequisite: LSA 500 or permission of instructor.

Note: Credit will not be granted for both LSA 301 and LSA 501.

LSA 552. Graphic Communication (3)

Two three-hour studios and one one-hour lecture. 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. 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. 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 610. Computer-Aided Design and Drafting (3)

One-half hour of lecture, two and one-half hours of laboratory, and a minimum of six hours additional laboratory are 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. Fall and Spring.

Prerequisite: General knowledge of manual drafting.

Note: Credit will not be granted for both LSA 410 and LSA 610.

LSA 611. Natural Processes in Planning and Design (3)

Two hours and forty minutes of lecture and one hour of discussion. 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. 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 III—Advanced Site Design (4)

One hour of lecture and nine hours of studio. 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. 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. 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 633. Planting Design and Practice (3)
Three hours of lecture. This course concentrates on woody and herbaceous plant materials used in landscape architecture and their arrangement and composition in spatial design. Concepts covered include ecological relations of plants; ornamental plant materials use and identification; plant culture, propagation and maintenance; transplanting; planting plans and specifications; and planting design and composition. A paper or project is required. Fall.

LSA 640. Research Methodology (3)
Three hours of lecture and discussion. This course focuses on the application of scholarly and scientific methodology to the activity of intellectual inquiry. The purpose is to enable students to identify researchable questions and introduce the methodology necessary to answer these questions in an unambiguous and objective manner. The course addresses issues of theory, research organization, experimental design, sampling theory, data manipulation and communication with respect to proposals, projects, theses and technical papers. Fall and Spring.

LSA 645. Construction Documentation Studio (3)
Six hours of studio and one hour of lecture. 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. 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 and one hour of discussion. The legal and historical basis of planning. 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 community design. Term paper required. 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. 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. 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. 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. 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 undergraduate 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 (1-6)

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. 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 team work, 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 field work 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. 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 (Credit hours to be arranged)

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. 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. 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.

MAT—MATHEMATICS

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

MAX—MAXWELL SCHOOL

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

PAF—PUBLIC AFFAIRS

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

PHI—PHILOSOPHY

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

PHY—PHYSICS

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

PSC—POLITICAL SCIENCE

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

PSE—PAPER SCIENCE AND ENGINEERING**PSE 132. Orientation Seminar: Paper Science and Engineering (1)**

One session per week of lecture, discussion, and/or exercises. Introduction to campus resources available to ensure academic success. Introduction to PSE as a field of inquiry and career path. Fall.

PSE 300. Introduction to Papermaking (3)

Three hours of lecture. Historical and commercial consideration of the paper industry. Technology of papermaking with emphasis on stock furnish, stock preparation and paper machine operation. Introductory discussions of papermaking materials and formation and reactions of a fibrous web. Fall.

PSE 302. Pulp and Paper Laboratory Skills (1)

Three hours of laboratory per week. Introduction to the laboratory skills necessary for subsequent PSE courses as well as necessary "survival" skills for their summer and co-op work experiences. Skills covered include pulp sampling and analysis, freeness, consistency, handsheet preparation, and physical and optical testing. A demonstration run of the pilot paper machine is part of this course. Fall. Pre- or co-requisite: PSE 300 (concurrent registration).

PSE 304. Mill Experience (2)

Twelve weeks full time pulp or paper mill employment approved by the Faculty between the junior and senior years. The student must submit a comprehensive report to fulfill this requirement. Fall, Spring and Summer.

Pre- or co-requisites: PSE 300, PSE 302.

- 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. Pulping and Bleaching Processes** (3)
Three hours of lecture. Technological and chemical consideration of pulping and bleaching of raw materials used in the paper industry. Includes consideration of the pulping and bleaching processes and related chemistry. Discussions of related operations, e.g., chemical recovery, are included. Spring.
Pre- or co-requisites: PSE 300, FCH 221, FCH 223.
- PSE 351. Pulping and Bleaching Laboratory** (2)
One hour lecture and three hours laboratory. Discussion of: pulping and bleaching processes, effect of chemical and physical variables on the wood components and pulp properties, and the chemistry involved. Experiments in pulping, bleaching and pulp evaluation. Spring.
Pre- or co-requisites: FCH 223, FCH 360, PSE 350.
- 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 PSE 361 and ERE 561 (both undergraduate and graduate versions of the same course).
- PSE 370. Principles of Mass and Energy Balance** (3)
Three hours of lecture. 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 (pulps, black liquor, etc.). Filtration and sedimentation of fibrous and particulate suspensions. Characteristics of pumps. Flow systems with economic considerations. Fall.
Prerequisites: PHY 211, MAT 296, FCH 152.
Note: Credit will not be granted for PSE 371 and ERE 571 (both undergraduate and graduate versions of the same course).
- PSE 372. Heat Transfer** (3)
Two hours of lecture and/or demonstration. The study of heat transfer including conduction, convection, radiation and their applications in industry. Heater and heat exchanger design and selection, and industrial evaporation. Spring.
Prerequisites: PSE 370, PSE 371.
- 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 456. Management in the Paper Industry** (3)
Three hours of lecture. Provides the student with interactive contact with active executives in the paper and allied industries. The student will develop and present studies of business cases in discussion forum to the class. An understanding of how general managers operate to manage an entire organization will be presented by visiting experts, class participation, group presentations, written papers and examinations. Spring.
Note: Credit will not be granted for both PSE 456 and ERE 676.
- PSE 465. Paper Properties** (4)
Three hours of lecture, three hours of laboratory and discussion. Evaluation and study of the physical, optical, and chemical properties of paper and the interrelationships existing among paper manufacturing methods, papermaking additives test results and the ultimate properties desired in the finished paper. Fall.
Prerequisite: PSE 300.
Note: Credit will not be granted for both PSE 465 and ERE 677.
- PSE 466. Paper Coating and Converting** (3)
Three hours of lecture per week. Evaluation and study of various coating materials and processes used by the paper industry. Introduction to polymers and their use in converting operations. Study of materials and equipment used in converting operations, fundamentals and parameters which control their use, effects on final properties of papers. Spring.
Prerequisite: PSE 465.
Note: Credit will not be granted for PSE 466 and ERE 678 (both undergraduate and graduate versions of the same course).
- PSE 467. Papermaking Wet End Chemistry** (3)
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.
Prerequisite: Senior status in paper science and engineering program or permission of instructor.
- PSE 468. Papermaking Processes** (3)
One hour of lecture, six hours of laboratory. Laboratory study of the papermaking process, with emphasis on operation of the semi-commercial Fourdrinier paper machine. Emphasis is on the fundamentals of 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 ERE 679.
- PSE 473. Mass Transfer** (3)
Three hours of lecture. The study of mass transfer, humidification, air conditioning, drying, gas absorption, distillation, leaching, washing and extraction. Fall.
Prerequisites: PSE 370, PSE 371, PSE 372.
- PSE 477. Process Control** (3)
Three hours of lecture. 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 ERE 667.

PSE 480. Engineering Design Economics (3)
Engineering analysis of modern plant practice in the pulp and paper, chemical and related industries. Operating costs, profitability criteria, optimization techniques and evaluation of alternatives. Modeling and computer simulation of process units and systems; use of typical software. Design exercises and case studies. Spring. Prerequisites: PSE 370, MAT 296.

PSE 481. Engineering Design (3)
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: PSE 473.

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.

REL—RELIGION

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

SOC—SOCIOLOGY

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at www.syr.edu/publications/undergradcat.

WPE—WOOD PRODUCTS ENGINEERING

WPE 132. Orientation Seminar: Construction Management and Wood Products Engineering (1)
One hour of lecture and discussion. Introduction to campus resources available to ensure academic success. Fall.

WPE 303. Construction Management and Wood Products 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. Pre-requisite: Upper-division status.

WPE 322. Mechanical Processing (3)
Two hours of lecture and three hours of laboratory. 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.

WPE 326. Fluid Treatment of Wood (3)
Two hours of lecture, three hours of laboratory. 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: WPE 387 or permission of instructor. Note: Credit will not be granted for both WPE 326 and ERE 682.

WPE 330. Building Codes and Zoning Practices (3)
This course shall introduce the student to the New York State Building Code and local fire, zoning and administrative ordinances pertaining to the construction and maintenance of buildings. The student shall be introduced to building system classification; systems components including mechanical, electrical, fire and structural elements; and the need for safety regulations governing construction and occupancy of buildings. Emphasis shall be placed on construction plans review and code enforcement administration. Fall or Spring.

WPE 331. Construction Safety (3)
Three hours of lecture/discussion. 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. Fall. Note: Credit will not be granted for both WPE 331 and ERE 531.

WPE 332. Mechanical and Electrical Equipment (3)
This course shall introduce the basic concepts of mechanical systems design and construction for residential and commercial buildings. Systems design and equipment selection are performed for heating, cooling, plumbing, sanitation, electrical, lighting, and acoustics. Emphasis is placed on the use of the New York State Building Code, the New York State Energy Conservation Code, the National Electrical Code and the American Society of Heating, Refrigeration and Air Conditioning Engineering Manual. Spring.

WPE 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 WPE 335 and ERE 535.

WPE 342. Light Construction (3)
Three hours of lecture. Elements of structural design, light-frame construction, blueprint reading and estimating. Fall or Spring.

WPE 343. Construction Estimating (3)
Three hours of lecture/discussion. Basic estimating/bidding theory and process. The processes for reviewing and interpreting contracts, specifications and blueprints and their role in the estimating or 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: WPE 342 or permission of instructor. Note: Credit will not be granted for both WPE 343 and ERE 543.

WPE 350. Construction Methods and Equipment (3)
Three hours of lecture/discussion. The study of production, methods of operation and costs of heavy construction equipment. Analysis of heavy construction operations. Economics of equipment use. 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. Fall.

Note: Credit will not be granted for both WPE 350 and ERE 525.

WPE 376. Decay of Wood Products (3)

Two hours of lecture and one hour of demonstration/discussion. Degradation of wood by fungi and other biological agents. Emphasis on the effects of decay on wood properties and methods of decay prevention. Spring.

Pre- or co-requisite: WPE 386 or WPE 387.

WPE 386. Structure and Properties of Wood (2)

Two hours of lecture. Structure of wood in relation to defects, properties and uses. The variability of wood. Spring.

WPE 387. Wood Structure and Properties (3)

Three hours of lecture. Structure of wood and its relation to physical properties and uses. The normal variability of wood, abnormal growth, defects, deterioration of wood and their influence on properties and uses. Fall.

WPE 388. Wood and Fiber Identification Laboratory (2)

Six hours of laboratory. Wood and papermaking fiber identification using both gross and microscopic features. Fall.

Prerequisite: WPE 387 to be taken concurrently or previously.

WPE 389. Wood Identification Laboratory (1)

Three hours of laboratory. Identification of principal commercial timbers of United States on gross characteristics. Spring.

Prerequisite: WPE 387.

WPE 390. Fiber Identification Laboratory (1)

Three hours of laboratory. Identification of woody and nonwoody papermaking fibers. Spring.

Prerequisite: WPE 387.

WPE 400. Introduction to Forest Products (3)

Three hours of lecture. Characteristics of the products of the forest tree and manufacture of wood products. Spring.

WPE 404. Timber Design Project (3)

Lectures, discussion, and laboratory. Mechanical testing of wood, development of working stresses, design of a model structure, and construction and testing of the structure. Spring.

Prerequisites: ERE 362, CIE 325, or permission of instructor.

WPE 410. Computer-Aided Design and Drafting (3)

One-half hour lecture, two-and-one-half hours laboratory, and a minimum of six hours additional laboratory 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.

Prerequisite: General knowledge of manual drafting.

Note: Credit will not be granted for both WPE 410 and ERE 610.

WPE 413. Computer-Aided Senior Project (3)

Open-ended real-life design projects with microcomputer aids. Systems approach is emphasized. Project requirements, system selection, approximate design, value engineering and final design are among design aspects considered. Analytical and model analysis. Spring.

Prerequisite: FEG 410.

WPE 414. Computer Applications in Engineering (3)

Microcomputer applications in a broad spectrum of selected topics in engineering sciences and practice. Hands-on experience is emphasized. Coursework is directed toward solving real-life

engineering problems. Software is provided and used. No computer programming or skills are required. Spring.

Prerequisite: FEG 410.

WPE 420. Adhesives, Sealants, and Coatings (3)

Two hours of lecture and three hours of laboratory. An introduction to adhesives, sealants and coatings used in the wood products and building construction industries. All three types of materials, based upon polymers, will be evaluated in terms of their properties and respective technologies. Emphasis will be placed on knowing how to apply this knowledge to understand current practice and problem solving. Laboratory demonstrations to identify materials, methods of application, and methods of evaluating these materials. Fall.

Prerequisite: Junior status.

WPE 422. Composite Materials (3)

Two hours of lecture, three hours of laboratory. Proper use of plywood, particleboard, oriented strandboard, waferboard, fiberboard, laminated veneer lumber, parallel strand lumber, laminated beams, wood polymer composites in building construction and/or furniture based upon physical and strength properties of these materials. Design considerations include: allowable design loads; applications such as beams, trusses and sheathing; screw, nail and bolt connections. Laboratory exercises will be patterned after ASTM standard tests to evaluate the physical and mechanical properties of these materials with written reports to be submitted by each student. Spring.

Prerequisite: WPE 387.

Note: Concurrent or prior completion of ERE 362 is desirable.

WPE 430. Computer Applications in Construction Management (1-3)

Guided individual study. Projects are estimated, scheduled and/or managed exclusively by industry standard construction-related software, including Timberline Precision Estimating, Quest Earthworks, Quest for Contractors, Primavera Project Planner, SureTrak Project Manager by Primavera and Expedition by Primavera. Final report covers entire project. Fall and Spring.

Prerequisite: Senior standing or permission of instructor.

Note: Credit will not be granted for both WPE 430 and ERE 630.

WPE 444. Wood Products Marketing (3)

Three hours of lecture and discussion. Fundamentals of forest products industry markets, products, distribution channels, market segmentation, pricing, promotion and sales. Fall.

Prerequisite: Microeconomics.

WPE 453. Construction Planning and Scheduling (3)

Three hours of lecture/discussion. 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): WPE 343 and/or estimating experience or equivalent scheduling experience.

Note: Credit will not be granted for both WPE 453 and ERE 653.

WPE 454. Construction Project Management (3)

Three hours of lecture/discussion. 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: WPE 343, WPE 453, senior standing or permission of instructor.

Note: Credit will not be granted for both WPE 454 and ERE 654.

WPE 455. Construction Contracts and Specifications (3)

Three hours of lecture/discussion. 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.

Note: Credit will not be granted for both WPE 455 and ERE 658.

WPE 497. Senior Seminar for Wood Products

Engineering Majors (3)

Discussions and oral presentations on professional issues of current interest in the construction and wood products industries.

Preparation for entrance into the job market. Guest speakers from, and visits to, industry sites of significance in the wood products and construction fields. Fall.

WPE 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.

NOTES

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