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State University of New York College of Environmental Science and Forestry

ANNOUNCEMENT OF COURSES -
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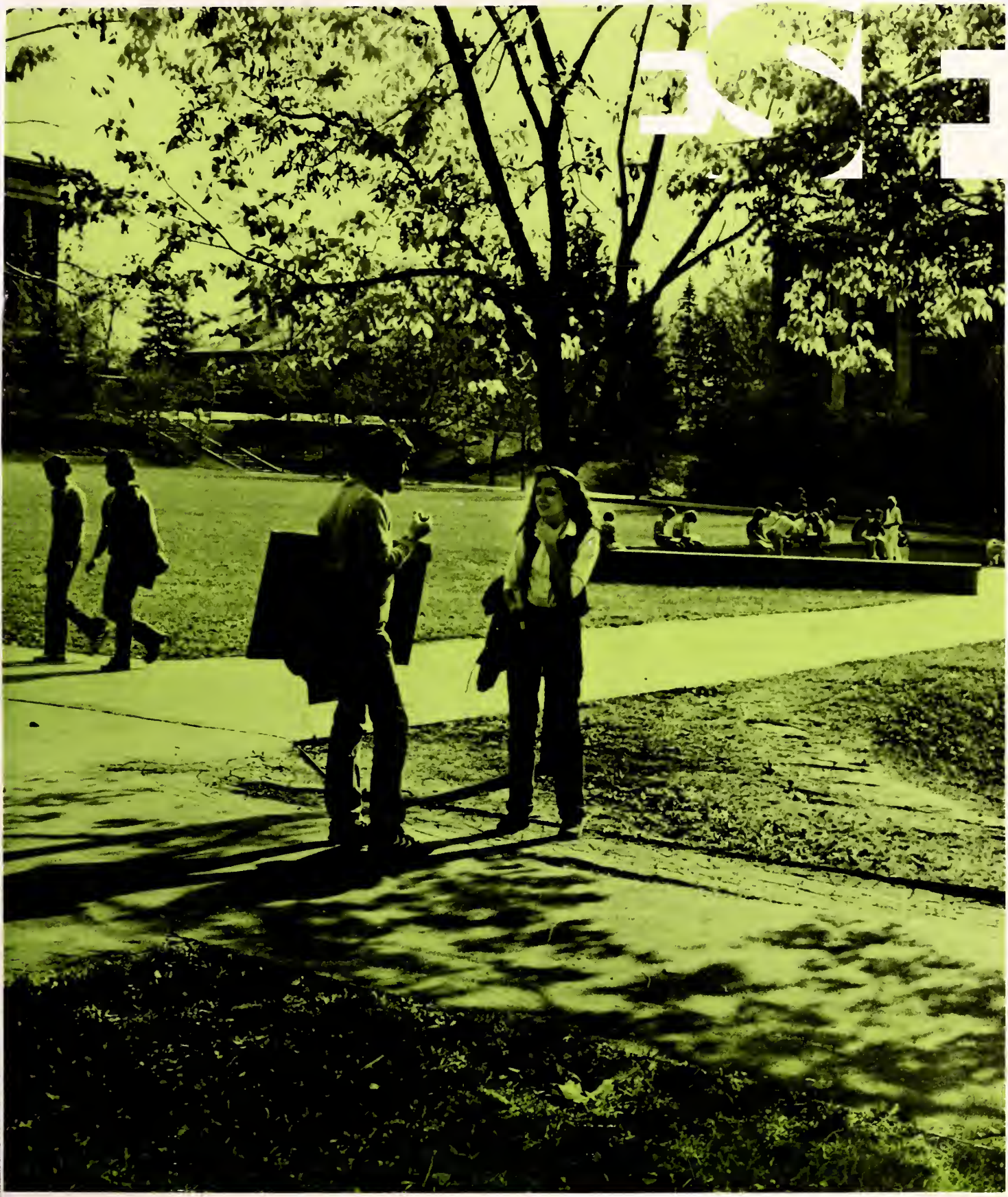
VOL. 11
1984-85
TO
1986-87

State University of New York

COLLEGE OF

ENVIRONMENTAL SCIENCE AND FORESTRY

1984—85 CATALOG



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The State University of New York College of Environmental Science and Forestry is accredited by the Middle States Association of Colleges and Secondary Schools: the B.S. degree program in Forestry is accredited 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; and the B.S. degree program in forest engineering is accredited by the Accreditation Board for Engineering and Technology.

Additional information is available upon request from any of the above addresses. This undergraduate/graduate catalog was published by the College of Environmental Science and Forestry, June 1984.

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 College of Environmental Science and Forestry.

State University of New York

COLLEGE OF

ENVIRONMENTAL SCIENCE AND FORESTRY

1984-85 General Catalog

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Academic Calendar

SYRACUSE CAMPUS

FALL 1984

New Student Orientation Program	Sept. 2, 3	Sunday, Monday
Academic Advising	Sept. 3, 4	Monday, Tuesday
Registration for New Students	Sept. 3, 4	Monday, Tuesday
Classes Begin	Sept. 5	Wednesday
Graduate Student Registration	Nov. 14, 15	Wednesday, Thursday
Thanksgiving Recess	Nov. 21—25	Wednesday—Sunday
Early Registration	Nov. 26—Dec. 7	Monday—Friday
Last Day of Classes	Dec. 14	Friday
Exam Period	Dec. 17—21	Monday—Friday

SPRING 1985

Orientation and Advising for New Students	Jan. 14	Monday
Registration for New Students	Jan. 14	Monday
Classes Begin	Jan. 15	Tuesday
Spring Recess	Mar. 9—17	Saturday—Sunday
Early Registration	Apr. 1—11	Monday—Thursday
Last Day of Classes	May 1	Wednesday
Reading Day	May 2	Thursday
Exam Period	May 3—9	Friday—Thursday
Commencement	May 11	Saturday

ESF: What's In A Name?

1911. Governor John A. Dix signed a bill establishing the New York State College of Forestry at Syracuse University.

1948. Legislative action incorporated into State University of New York all state-supported higher education. Thus, the State University College of Forestry at Syracuse University.

1972. By special legislative act, the College was renamed the State University of New York College of Environmental Science and Forestry.

Why, in the first place, all the name changes? And, secondly, what difference do they make? What, really, is in our name?

ESTABLISHING A TRADITION

The beginnings and early development of the New York State College of Forestry were largely due to James R. Day, chancellor of Syracuse University, and community leaders who were attuned to the growing national sentiment favoring forest conservation and who sensed the need for a professional school of forestry. The legislative act which created the College instructed that the institution "conduct such special research in state-wide investigations in forestry as will throw light upon and help in the solution of forestry problems..." and that it be "the institution for educational work in forestry in the State."

From the very first years of its existence under the first dean, Hugh P. Baker, the College responded to the broad needs of environmental professionalism. While other schools and colleges of forestry became more specialized, the College at Syracuse broadened to include the essentials of environmental science: design, engineering, and the life sciences, as well as resource management.

With the formation of the State University of New York in 1948, coordination and systematization came to higher education in the state. The University, according to its charter, was to "supplement, not supplant, the great network of private colleges and universities." The College of Forestry, which from its beginning had been state-supported and governed by a Board of Trustees currently made up of nine members appointed by the Governor and six *ex officio* members, was recognized as a specialized college within the State University system.

Stemming from Chancellor Day's early sponsorship of the College, Syracuse University and ESF have long been engaged in numerous fruitful devices of institutional cooperation. This relationship is probably the most outstanding example in this country of collaboration between public and private institutions of higher education. Even as a part of State University, the College maintains this unique position. The major character of the relationship stems from the fact that since its beginning, the College purchased from Syracuse University the major portion of its supportive and enrichment instruction, thus allowing the College to more fully develop its professional upper division and graduate level instruction.

Other cooperative areas are living centers and dining facilities, athletic programs, the use of the University's infirmary and health counseling services, the bookstore facilities, the University library system, joint Commencement ceremonies held in the Carrier Dome, and participation in numerous social activities including the elaborate religious, dramatic, and cultural benefits of a large university.

ESF TODAY

The third phase in the evolvement of the College's name came in 1972 when it was rechartered as the State University of New York College of Environmental Science and Forestry. Thus, the name reflects more deeply the traditional grounding and concern of forestry in the environment; it illuminates more clearly the capabilities of its program.

The College of Environmental Science and Forestry has completed a plan, conceived more than a dozen years ago, to achieve complete upper division/graduate status. Undergraduate students wishing to embark upon a career in the environmental sciences and forestry will enroll for two years at a junior college or four-year institution, studying an ESF prescribed program and transfer to this college as juniors. The move to upper division/graduate college status marks another step in the College's long-standing commitment to educate professionals capable of facing the complex environmental problems of today and of the future.

For more than 73 years, the full thrust of the State University of New York College of Environmental Science and Forestry has been focused on the environment on all of its six campuses and in each of its three mission areas—instruction, research, and public service. The College has been, and continues to be, devoted to the advancement of environmental science and forestry.

The Mission: Instruction, Research, and Public Service

INSTRUCTION

In the fall of 1983, student enrollment reached 1,591. Of this number, 1,084 were undergraduates and 507 were graduate students. In addition, there were 11 students engaged in postdoctoral work.

Undergraduate Education

At the baccalaureate level, the College offers professional study in eight areas: *chemistry; environmental and forest biology; environmental studies; forest engineering; paper science and engineering; wood products engineering; resource management;* and *landscape architecture.* These programs are registered with the New York State Education Department.

Each of these curricula leads to the bachelor of science degree. In the case of landscape architecture, an additional year of study results in a bachelor of landscape architecture degree, and in the forest engineering program, a fifth year leading to a bachelor's degree in civil engineering can be taken at Syracuse University or State University at Buffalo.

Graduate Education

The College awarded its first graduate degree in 1913. Today the College offers advanced degrees in seven major program areas: *environmental and forest biology; chemistry; resource management and policy; silviculture and forest influences; environmental and resource engineering; landscape architecture; and environmental* science. These programs are registered with the New York State Education Department.

Graduate study leads to the master of science degree, the master of landscape architecture degree, and the doctor of philosophy degree. A postdoctoral study program, closely related to the College's research effort, is also available.

In addition to these degrees, the College and Syracuse University provide the opportunity for graduate students to complete concurrently a degree at ESF and, at Syracuse University, either the J.D. degree in the College of Law, the M.P.A. degree in the Maxwell School of Citizenship and Public Affairs, the M.A. or M.S. degree in the S.I. Newhouse School of Public Communications, or the M.B.A. degree in the School of Management. Students must complete at least one semester of graduate level coursework at ESF before being considered for a concurrent degree program at Syracuse University.

Technical Education

At the paraprofessional level, the College has been training forest technicians since 1912 at its Wanakena Campus in the Adirondack Mountains. It is the oldest Ranger School in the United States and offers a two-year *forest technology* curriculum. Graduates are awarded an associate in applied science degree. In this curriculum, students take their first year of general education at a two- or four-year college. The second year, with its emphasis on practical field training in the relationships between forest technology and managerial needs, is taken at Wanakena with its 2,800 acres of forested land. Graduates of this degree program in practical forestry are prepared for positions as forest rangers; federal, state, and private industry forest technicians and forestry aides; district forest supervisors; timber inventory specialists; timber sales supervisors; forest surveyors and engineering aides; and forest protection technicians.

Continuing Education

The philosophy that education is a lifelong pursuit is an ancient one and was written into the law creating the College. This concept is doubly important to the sciences and professions in this technological age when, with knowledge expanding in all directions, major environmental problems still remain to be resolved. The informational needs of New York's citizens also are undergoing change. The increasing urban character of our population; the changing pattern of agricultural and forest land ownership and use; the rise in level of education and sophistication in a more efficient society; and the increase in leisure time, travel mobility and need for recreational facilities and pursuits all contribute to a growing need for educational opportunities in environmental science and forestry for adult audiences.

The College has, over the years, succeeded in communicating knowledge on forest resources management, utilization, and conservation to a variety of off-campus publics. The entire College faculty has contributed to these programs. To reinforce this commitment,

the College established a School of Continuing Education upon which to base expanded educational opportunities at both the undergraduate and graduate course levels.

Conferences, symposia, seminars, and shortcourses on various aspects of forestry and the related sciences are conducted at both the basic and applied levels. Audiences include forest owners, managers, and operators; wood engineers and forest industries personnel; academic and scientific groups; conservation and recreation personnel from local and other public and private planning groups; and citizen-action committees. Upon request, continuing education programs can be designed to meet specific needs of professional organizations, agencies, and industry. Credit or noncredit courses, at campus or off-campus sites, can be arranged.

Expansion of in-service training courses, establishment of environmental learning centers on College forest properties, and production of media materials for public information and education are examples of activities directed toward updating and upgrading professional clients and broadening the public's awareness and appreciation of New York's forestlands and other natural resources.

For information on specific continuing education projects, inquiries should be sent to Director, School of Continuing Education.

RESEARCH

The College's commitment to scientific inquiry stretches far back to its second year of existence. In 1912, Dean Hugh P. Baker initiated the first research project of the College by joining forces with the U.S. Forest Service in an industry study designed to show what kinds of firms were using wood in New York State and the species and quantities used.

In the 1980's, the College's research program has attracted a worldwide clientele of industrial, governmental, professional and scientific groups, and through liaison with them, the program maintains its vigor and relevancy to the important environmental issues. Support from this clientele amounts to more than $4 million a year, a two-fold increase in the last decade.

Students and faculty from across the College contribute to the depth and diversity of the research program. Findings from these studies are applied to a host of issues and problems through various demonstrations and information devices. Recent examples include studies of limestone quarry reclamation; the development of polymeric materials for artificial human organs; nonchemical control measures for insect pests, e.g., the gypsy moth; studies of the ecology of Antarctic birds; new wood pulping processes leading to pollution-free water and air effluents; and the ecological effects of winter navigation in the Great Lakes and the St. Lawrence River.

Institute of Environmental Program Affairs

Research and public service programs at the College of Environmental Science and Forestry are given additional emphasis through the Institute of Environmental Program Affairs (IEPA). This Collegewide coordination vehicle was initiated in 1972 in recognition of the College's traditionally broad and integrated approach to natural resources science and in response to new perceptions of the relationship between human endeavors and environmental quality. The Institute, which is staffed by the Office of Research Programs, functions to bring together groups of faculty scientists to explore research and public service needs and opportunities which transcend the programs of the schools, departments, and organized research centers and institutes of the College.

Study teams of scientists and graduate students from many disciplines have collaborated with external program cooperators from governmental agencies, citizens' groups, and private industry to pursue multidisciplinary research and public service programming as part of the IEPA program. Early efforts were focused on regional natural resource and environmental studies conducted at the request of New York State agencies such as the St. Lawrence-Eastern Ontario Commission, the Tug Hill Commission, the Catskill Study Commission, and the Adirondack Park Agency. Other studies which transcend regional problems and issues have been conducted with diverse sponsorship, including environmental service systems, leisure time and recreational activities appropriate to the Hudson River Basin; solid waste processing and heavy metals recovery from processing residues from the forest products industry; wetlands evaluation studies; remote sensing techniques to facilitate environmental monitoring of coastal water quality and land use patterns; reclamation of open pit limestone quarries; the siting of nuclear power generation facilities; and environmental assessment studies associated with proposals for extended season navigation in Lake Ontario and the St. Lawrence River.

More recently, IEPA has provided a focus for faculty interested in pursuing research and public service programming through diverse sponsorships in particular areas of high public concern. Three task forces are currently operating in these areas to develop new project activity and coordinate the Collegewide research focus in bioenergy projects, acid precipitation and atmospheric deposition, and sludge and sludge management concerns.

Empire State Paper Research Institute

The Empire State Paper Research Institute (ESPRI) is the only worldwide basic research organization in the pulp and paper field. It performs investigations in cooperation with the Empire State Paper Research Association (ESPRA), which is comprised of 78 pulp and paper companies in 14 countries. The Institute was

established in 1945 when the members of ESPRA recognized the need for new scientific and technical knowledge and methods, and since then ESPRI has been able to maintain an efficient balance between the practical and theoretical bases of the pulp and paper industry.

Housed in the modern J. Henry Walters Hall with its own pilot paper mill, and staffed by scientists who are internationally recognized for their accomplishments, ESPRI provides a research base for long-range industry development. Its program has widened in scope to cover almost all aspects pulping and papermaking, including additive retention, oxygen pulping and bleaching, effluent control, sheet drying, printability, and energy efficiencies.

Polymer Research Institute

Scientists at the College have made many original contributions to the field of pure and applied polymer chemistry, including the development of living polymers, the study of anionic polymerization and electron-transfer initiation, and work on the permeation of gases and films through polymeric films.

College faculty members specializing in polymer chemistry have trained several hundred graduates and postdoctoral researchers, many of whom now hold leading positions in universities and industrial and governmental laboratories.

Nelson Courtlandt Brown Laboratory for Ultrastructure Studies

This Center, located in Baker Laboratory, is a teaching, research, and service facility of the College. It is equipped to handle virtually every type of modern microscopy. This includes light, scanning electron, and transmission electron microscopy. Among the major items of equipment are: two RCA EMU-3 transmission electron microscopes; an RCA EMU-4, an ETEC Autoscan scanning electron microscope, energy dispersive X-ray analyzer, several types of light microscopes, high vacuum evaporators, microtomes and ultramicrotomes. The laboratory resources include specimen preparation rooms, several photographic darkrooms, three electron microscope laboratories and other supporting facilities.

The primary service of the Center is teaching; course offerings include photomicrography, scanning electron microscopy, and interpretation of cellular ultrastructure. Research is a second major activity since support is provided for students, faculty, and research staff who have projects involving structural studies. Public service is extended to local high school groups, medical facilities, other regional colleges and universities, and industry.

Adirondack Ecological Center

The Adirondack Ecological Center (AEC) is located on the College's Newcomb Campus in the center of the Adirondack Mountains. Staffed by resident scientists, technicians, and support staff, the AEC conducts studies of the Adirondack region year-round. Research includes studies of managed and unmanaged forest lands, wildlife populations and habitats, terrestrial and aquatic ecology, and wilderness management. Work is carried on in close collaboration with the New York State Department of Environmental Conservation, the U.S. Fish and Wildlife Service, the U.S. Department of Agriculture, and forest industries.

The vigorous research program of the Center provides excellent opportunities for collaboration by Syracuse-based faculty and students. Several graduate students are regularly in residence at Newcomb pursuing their thesis research.

Renewable Materials Institute

The Renewable Materials Institute (RMI) has as its principal goal research on wood and other renewable materials such as agricultural waste products, which would include straw, rice hulls, and bagasse. To meet its mission, research on the characterization of the material itself is primary. Closely related with it is the determination of physical properties which control the behavior of the material during utilization as well as in use in consumer products. In exploring renewable materials, strong emphasis is placed on energy considerations. This can be in terms of energy savings during production or economies of energy because of the use of the end product in housing or in some other application. Also included are related studies in the combustion of wood, the efficiency of heating with wood and the emissions resulting from wood combustion.

The principal facilities for the materials characterization are found in the Center for Ultrastructure Studies and include the transmission electron microscopes, a scanning electron microscope with EDXA and rapid particle analysis. All of the facilities of the Department of Wood Products Engineering are also available, including a sawmill, veneer and plywood manufacturing facility, dry kilns, wood machining equipment, and timber testing laboratory. The facilities of other research institutes and Departments in the College are also available for special projects.

Tropical Timber Information Center

The Tropical Timber Information Center (TTIC) provides identifications of wood samples and information about tropical woods for both general characteristics and technical properties. These services are oriented toward importers and users of tropical woods. The Center began operation in 1975 as part of the Department of Wood Products Engineering and is one of only two such sources of information in the western hemisphere. The Center also carries out special studies under contract for production of data that is not available in the literature. The technical base for operation of the

Center is a large, worldwide collection of authenticated wood samples and an extensive collection of reference materials in Moon Library and the Department of Wood Products Engineering. Both of these resources have been built up over the past 60 years by close cooperation with institutions throughout the world. Activity of the Center is oriented toward requests for services from importers and users of tropical woods and to expanding the collections.

Cellulose Research Institute

Research at the Cellulose Research Institute is at present centered on the fine structure of native cellulose and its transformations into other commercially important forms of cellulose. For example, the structural differences between native and regenerated celluloses have been determined, for the first time, through x-ray crystallographic studies. The same techniques are now being used to study the structural aspects of cellulose mercerization, an important commercial process in cellulose chemistry. Other recent research has been concerned with the organization, chemical composition, and function of the vascular cambium in trees, the ultimate source of all wood and bark produced in nature.

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

The Northeast Forest Experiment Station of the U.S. Department of Agriculture-Forest Service maintains a research center at the College. Until 1977, this unit pursued studies of forest-centered recreation with the aim of developing methods for integrating recreation and other uses of forests.

Beginning in 1978, the Cooperative Research Unit was re-oriented to research on urban environmental forestry problems. This provides increased opportunities for faculty and students to collaborate with Forest Service scientists in studies of urban and environmental problems.

PUBLIC SERVICE

The College, throughout its 73-year history, has continued to respond to its specific legislative mission prescribing major responsibilities in the area of public service. Public education and information, technical advice and guidance to cooperating local, state, and federal agencies and organizations, and technical assistance to the forest and wood-using industries constitute the principal formal public service activities. The Institute of Environmental Program Affairs (described in the Research section) coordinates the College's public service activities on the professional level.

While the list of public service contributions is lengthy, a few examples include: the College's Film Library; the Tree Pest and Disease Service, which provides technical advice to private citizens and to governmental agencies; and the participation of ESF faculty members in Central New York's Poison Control Center. Altogether, the public service programs of the College reach approximately one million New York State residents each year.

The Campuses

The College operates a multiple campus system with regional campuses and field stations located at Syracuse, Tully, Wanakena, Warrensburg, Cranberry Lake, Newcomb, and Clayton. This system, composed of about one million square feet of facilities in 186 buildings and 25,000 acres of land, represents the largest fully-utilized campus in the world.

THE SYRACUSE CAMPUS

The main campus is in Syracuse and lies on 12 acres adjacent to Syracuse University in an area that traditionally has been known as "The Hill." Located here are the Schools of Biology, Chemistry, and Ecology; Environmental and Resource Engineering; Forestry; Landscape Architecture; and Continuing Education. In addition, the main campus houses the Institute of Environmental Program Affairs, the Empire State Paper Research Institute, the Polymer Research Institute, a cooperative research unit of the USDA Forest Service, the Ultrastructure Center, the Graduate Program in Environmental Science, and the Renewable Materials Institute.

These program units are housed in five major academic buildings (Baker Laboratory, and Walters, Bray, Marshall, and Illick Halls). The main campus also includes Moon Memorial Library, the Maintenance Building, and several other small service and storage facilities.

Specialized facilities at the Syracuse campus include electron microscopes, plant growth chambers, air-conditioned greenhouses, a bio-acoustical laboratory, a 1,000-curie cobalt-60 radiation source, radioisotope laboratory, computing center, and specialized instrumentation including nuclear magnetic resonance spectrometers, electron spin resonance spectrometer, gas chromotography, mass spectrometer, ultracentrifuge, and X-ray and infrared spectrophotometer. Photogrammetric and geodetic facilities of the forest engineering department include one of the most extensive arrays of equipment in the United States, with a Nistri TA-3 stereocomparator, Mann comparator, computerized Nistri photocartograph, and nine other varieties of plotters. The paper science and engineering laboratory has a semicommercial paper mill with accessory equipment. The wood products engineering department has a complete strength-of-materials laboratory as well as a pilot scale plywood laboratory and a machining laboratory. The greenhouses and forest insectary are used to produce plant and insect material for classroom and laboratory. Extensive collections are available for study, including wood samples from all over the world, botanical materials, insects, birds, mammals, and fishes.

The **F. Franklin Moon Library** contains more than 90,000 cataloged items and over 900 journals are currently received. The collection constitutes a specialized information source for the forestry, environmental science, and landscape architecture programs of the college, and it 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 and engineering, photogrammetry, silviculture soil science, water resources, world forestry, wildlife biology, wood products engineering, and zoology.

The collections of Syracuse University libraries (SU's Science and Technology Library is immediately adjacent to the ESF campus), and SUNY Upstate Medical Center are within walking distance. These libraries may be used by all members of the College of Environmental Science and Forestry. Other collections located throughout New York State and the United States are readily accessible through Inter-library loan. All Syracuse University collections may be searched by using the SULIRS on-line catalog located in Moon Library.

The library building, opened for service in 1968, can accommodate 132,000 volumes and can seat 575 persons. The main reading areas are located on the upper level adjacent to the open stacks and are divided by the card catalog and reference service area. The library contains a current periodical room, a bibliographic center containing indexes and abstracts, individual study carrels and library faculty offices. The Hoverter Archives and special collections, conference room, audio tutorial center, Directed Studies Center and the computer terminal room are located on the lower level.

Leisure reading material is not housed separately but is distributed throughout the collection. This collection contains books on national and world social problems, humanities, education, and popular books concerned with the environment. The archives consists of historical items relevant to the college and forestry development in New York State. The special collections area of the archives contains rare, scarce, and valuable books, and folios as well as the Fletcher Steele collection on landscape architecture, and the Thomas Cook collection on papermaking.

Public services provided by the library faculty includes a credit course, orientation, class lectures, study guides,

user aids, and reference desk service. Moon Library is a member of the SUNY OCLC network.

The **Educational Communications** unit directly supports the program areas of the College through development and application of media materials and methods for the classroom, for the presentation of research findings, and for public service endeavors. These include television programming, slide/tape and motion picture production and photographic services. Other services to the College community include engineering, audio-visual equipment distribution, and maintenance and support functions. The Educational Communications staff also participates directly and actively in instructional programs in environmental communication at both the undergraduate and graduate levels, as well as through the School of Continuing Education.

The College provides *academic computer services* in several forms. Remote communication facilities are available for both batch and interactive processing on the Syracuse University systems, and local/stand-alone facilities are available in the form of micro-computers dispersed about the ESF campus. Syracuse University operates an academic computer center consisting of two IBM 4341's and one DEC-KL10, all of which are accessible via terminals (20 public access and 60 restricted access) on the ESF campus. Clusters of micro-computers have been established by each of the academic divisions of ESF for purposes of faculty-staff-student use and education. Computer applications take advantage of extensive software on the Syracuse University systems including packages for statistics, graphics, text editing, and general mathematical functions as well as most of the major programming languages—FORTRAN, APL, BASIC and PASCAL finding the heaviest usage. In addition, a color graphics facility is being developed at ESF to satisfy the many needs for graphics analysis, design, and communication.

THE TULLY CAMPUS

Located about 25 miles south of Syracuse is the Tully Campus which is composed of the Heiberg Memorial Forest and the Genetic Field Station.

Heiberg Memorial Forest is located on the northern escarpment of the Allegheny Plateau. It includes 3,800 acres of diverse terrain and forest growth. The Forest is utilized both as an extensive outdoor teaching laboratory and as a site for intensive research. The **Forest Ecosystem Lab**, which is a highly instrumented outdoor teaching laboratory, a large complex of all-weather classrooms, many experimental plantings from throughout the world, a commercial-scale maple syrup operation, and an experimental deer research area are among the developments on this forest. Each fall the Heiberg Memorial Forest is the site of an intensive program for environmental and resource management students in a total ecosystem approach to forest community management instruction.

THE WANAKENA CAMPUS

The Wanakena Campus, located on the Oswegatchie River, 65 miles northeast of Watertown and 35 miles west of Tupper Lake, is the site of the **James F. Dubuar Forest** and the **School of Forestry's Forest Technician Program**. This campus, with its large instructional and demonstration forest, supports the College's associate degree program for the training of forest technicians. This is the oldest forest technician school in the country. This campus is situated on the western plateau of the "lakes region" of the Adirondacks.

In addition to its full academic program, this campus hosts various summer short courses in forest biology and forest technology.

THE WARRENSBURG CAMPUS

The Warrensburg Campus is located in the southeastern Adirondack region and encompasses the **Charles Lathrop Pack Demonstration Forest**, an area of roughly 2,500 acres of heavily forested land noted for its white pine. The Forest has been under intensive management since 1927 for the combined purpose of instruction, research, and demonstration in forestry and allied fields.

Each year this campus hosts the Summer Session in Field Forestry, a seven-week course devoted to introductory instruction in field forestry principles and techniques. The course is required of all entering students in Environmental and Resource Management and is open to election by students in Environmental and Forest Biology.

Formal offerings in Continuing Education and various meetings and conferences are also held here for practicing professionals and organizations directly associated with forestry and allied environmental fields.

THE CRANBERRY LAKE CAMPUS

The Cranberry Lake Campus, approximately 1,000 acres of forested property situated in the northwestern section of the Adirondack Mountains of northern New York State, is the site of the College's **Biological Station** where the College operates a ten-week summer field program in environmental biology. The campus is bounded by 150,000 acres of New York State forest preserve lands, by Cranberry Lake and by isolated forest bogs and beaver meadows.

The extensive facilities are intensely utilized in a comprehensive curriculum of upper-level and graduate courses.

Use of this campus before and after the summer session program varies to include individual research projects, cooperative studies with other agencies and visits by large groups from both the College and outside institutions.

THE NEWCOMB CAMPUS

Located in the central Adirondack Mountains, Newcomb is the largest of the regional campuses and home to the **Adirondack Ecological Center** where extensive studies of animal biology and ecology are carried out. Also located there is **The Archer and Anna Huntington Wildlife Forest** which is about 15,000 acres in size.

This campus is of mountainous terrain and contains a variety of vegetative types and wildlife. The campus is used year round for a general research and forest management program participated in by faculty, graduate students, and visiting scientists.

THE FIELD STATIONS

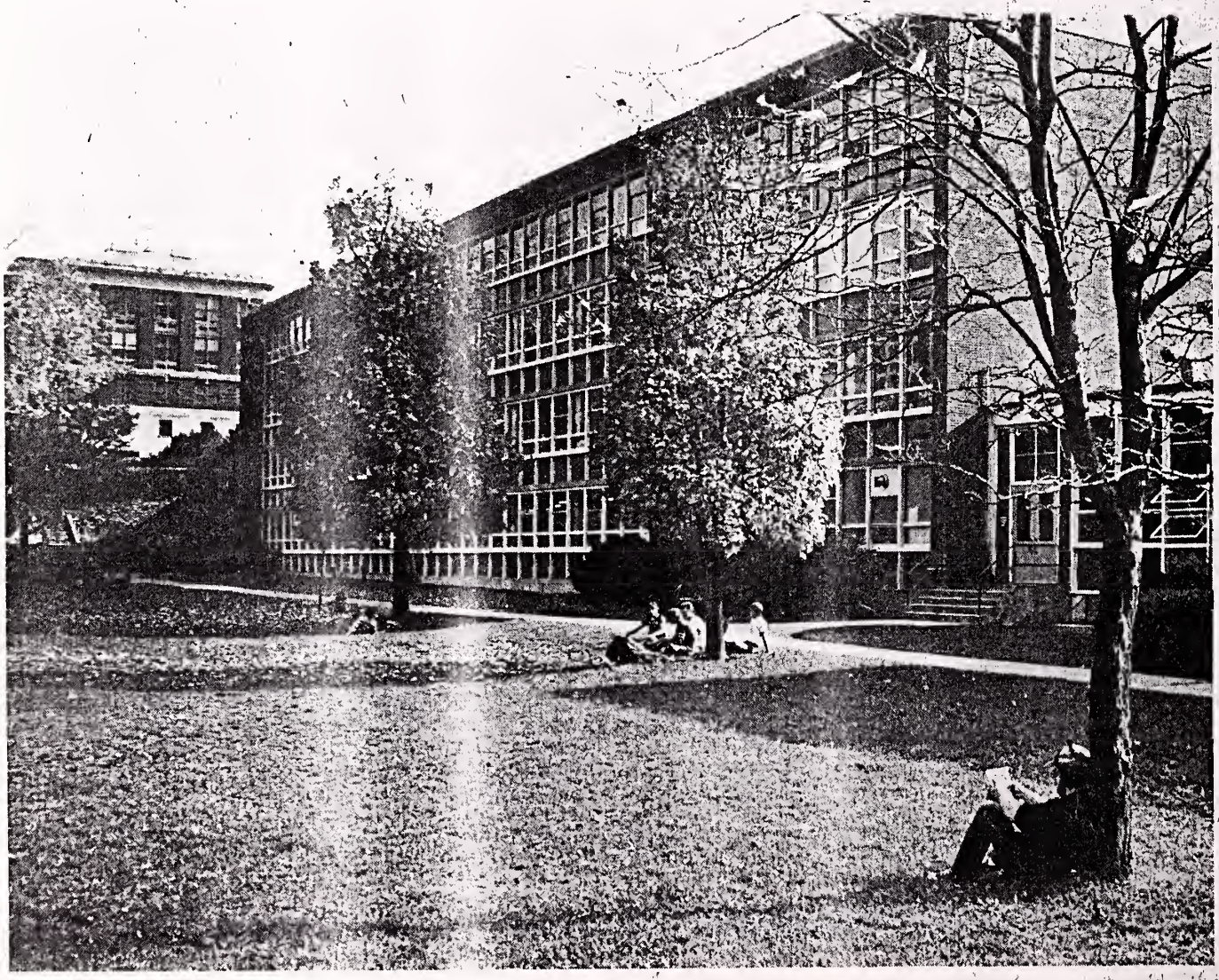
In addition to its regional campus system, the College operates several field stations which directly support the instruction, research, and public service programs of the institution. The 44-acre **Forest Experiment Station**, located only a few minutes drive from the main campus in Syracuse, is used to support main campus academic programs. Located at the Station are a large arboretum, tree nursery, and experimental greenhouse facility. Adjacent to the Tully Campus is the College's **Genetic Field Station**. It is a 59-acre area devoted to relatively short-term outplantings of plant materials developed in the various genetic research projects of the College. With its irrigation system and layout of level blocks, it is an excellent facility for developing hybrids, for grafting, doing experiments, and for research in heritability. A magnificent island, the **Ellis International Laboratory**, is situated in the heart of the Thousand Islands—St. Lawrence River area off the village of Clayton. Accessible only by boat, this laboratory is an unusually appropriate site for the Collegewide, cooperative and international, environmental monitoring and research activities of the St. Lawrence Seaway area. The College's most recent acquisition is a 15.2-acre facility on **Wellesley Island**. This island property, formerly a Coast Guard Station, has shore frontage on the American channel of the St. Lawrence Seaway. It is ideally suited for aquatic studies of many types.

The Syracuse Metropolitan Area

The College of Environmental Science and Forestry is located on one of several hills that overlook Syracuse, a growing metropolitan area of nearly 500,000. Known as the "Salt City" because of the great salt industry which was centered here for more than seventy years, Syracuse is today a city of diversified industry and commerce. The area is a leader in the manufacture of china, quality shoes, air conditioning equipment, medical diagnostic equipment, drugs, automotive parts, and lighting equipment.

The City of Syracuse offers students many cultural, recreational, and educational opportunities, including a symphony orchestra, several museums, live theater, and historical points of interest.

Called the "Crossroads of New York State," Syracuse is one of the few cities in the nation situated at the crossing point of two major superhighways. It is located at the intersection of the 500-mile east-west New York State Thruway and the north-south Penn-Can Highway. Driving time from New York City, Philadelphia, Boston, Toronto, and Montreal is about five hours; from Buffalo and Albany about three hours. The city is served also by a modern international airport and major bus and rail lines.



Academic Life

Society is increasingly in the hands of those who have broad foresight and a balance of judgment in applying scientific, sociological, and technical knowledge to guide human and environmental forces. Modern civilization—with its compelling demands from industry, government, and educational institutions—requires people who think objectively and constructively, and who act creatively and responsibly.

From its beginnings in 1911, the State University of New York College of Environmental Science and Forestry has served New York State and the nation in meeting the needs of its citizens in regard to the environment through education, research, and public service. The faculty and students of the institution are committed to the resolution of immediate environmental problems, the development of the knowledge necessary to predict occurrences in the future, and the presentation of public policy alternatives that will both protect the environment and accommodate the real needs of society.

At the undergraduate level, ESF offers curricula in the general areas of resource management, engineering, environmental design, and the physical and life sciences that prepare graduates to enter and contribute to the professional world or to continuing their education at the graduate level, at ESF or elsewhere.

Graduate years are a time of discovery and excitement, a time of answers and new insights, a time of personal productivity and contributions to scholarship. It is during graduate education that the student sharpens the ability to think critically and analytically, to plan research, to design experiments, to work effectively with the basic research tools as well as specialized equipment, and to undertake the discipline of purposeful study toward a specific goal.

The College currently supports significant graduate degree programs in six discipline areas and in its broad program in Environmental Science, which encourages multidisciplinary study. Both undergraduate and graduate programs of the College reflect the work of its faculty and their student colleagues, who, together, utilizing some of the most modern facilities and laboratories in the country, maintain a long-standing tradition of academic and professional excellence.

This catalog provides an introduction to the College and its programs of undergraduate and graduate study and research. It only begins to suggest the diversity and depth of the existing and potential programs that make environmental science the challenge of the 1980's and beyond.

UNDERGRADUATE ADMISSION

The College of Environmental Science and Forestry is an upper division/graduate center, enrolling at the undergraduate level transfer students who have completed at least two years of postsecondary coursework. Outstanding high school seniors can assure their acceptance by the College as junior transfers by applying to the Advanced Early Admission program.

Freshman and sophomore level courses may be taken at any two- or four-year college or university; all students considering transfer to ESF as juniors should follow the prescribed program appropriate to their intended major at the College. Each curriculum offered at the College of Environmental Science and Forestry and listed in this catalog defines the required lower division courses necessary for admission. These requirements are listed in the Areas of Study section of the catalog.

Students who are certain they intend to transfer to ESF may enroll in established pre-environmental science programs organized by the College in cooperation with a number of two- and four-year colleges in and out of New York State. Students who attend these colleges will find a smooth articulation has been established and upon successful completion of these prerequisites will generally gain admission to the college with full junior status. It is not required to specifically attend one of these colleges; a student may obtain the necessary lower division courses at almost any college or university in the country.

Application to ESF's associate degree program in Forest Technology at the Wanakena Campus must be made one year in advance. Therefore, high school students desiring to attend the Wanakena program in 1986 must apply this year. For further information on ESF's School of Forestry's Forest Technician Program, see page 56, or contact the Office of Admissions.

ADVANCED EARLY ADMISSION PROGRAM

High school students who are strongly motivated toward attending ESF may apply to the College of Environmental Science and Forestry during their senior year under the *Advanced Early Admission Program*.

Those seniors whose academic background is successfully competitive will receive a letter of acceptance to the College for entrance two years later with full junior status, contingent upon successful completion of all prerequisite courses of the first two years of the curriculum to which they have been admitted. The prerequisite

courses will be outlined and described in an enclosure with the acceptance letter.

This early acceptance will alleviate much of the anxiety about admissibility. High school seniors will know prior to graduation if they have been accepted to the College for entrance at the junior level. It affords those accepted students the opportunity to attend any college of their choice that offers the appropriate lower division courses. SUNY applications for the Advanced Early Admission Program may be obtained from high school guidance offices in New York State or directly from the Office of Admissions at ESF.

TRANSFER ADMISSIONS

For those students not accepted under the Advanced Early Admission Program, admission to the College of Environmental Science and Forestry is based on the student's previous college coursework, overall academic aptitude, and interest in the programs offered at this College. Consideration is given to both the quality and appropriateness of the student's prior academic experience. The minimum grade point average for consideration is 2.0 (4.00 = A).

PRE-ESF COOPERATIVE TRANSFER PROGRAMS

The College, working in cooperation with other collegiate institutions, both in and out of New York State, has developed 55 pre-environmental science and forestry programs. The development of these programs illustrates that high school students can look forward to a wide selection of colleges in which they can obtain all the necessary lower division courses and appropriate advisement to transfer to ESF as full juniors.

These colleges represent the total spectrum of higher education (private, public, 4-year, 2-year) and are located in New York, Connecticut, Massachusetts, New Jersey, Pennsylvania, Rhode Island, Iowa, and Maryland. Students who attend these colleges will find a smooth articulation has been established and once they transfer to ESF will share a common academic background with other transfer students.

Currently, the list of cooperating colleges includes:

New York State Colleges

Adirondack Community College, Glens Falls
Broome Community College, Binghamton
Canisius College, Buffalo
Cayuga County Community College, Auburn
Columbia-Greene Community College, Hudson
Community College of Finger Lakes, Canandaigua
Corning Community College, Corning
Dutchess Community College, Poughkeepsie
Erie Community College, Buffalo
Genesee Community College, Batavia
Herbert H. Lehman College, Bronx
Herkimer Community College, Herkimer
Hudson Valley Community College, Troy
Jamestown Community College, Jamestown
Jefferson Community College, Watertown
LeMoyne College, Syracuse
Mohawk Valley Community College, Utica
Monroe Community College, Rochester
Nassau Community College, Garden City
Niagara County Community College, Sanborn
North Country Community College, Saranac Lake
Onondaga Community College, Syracuse
Orange Community College, Middletown
Paul Smith's College, Paul Smiths
Rockland Community College, Suffern
Siena College, Loudonville
Suffolk County Community College, Selden
Sullivan County Community College, Loch Sheldrake
SUNY Alfred Agricultural and Technical College, Alfred
SUNY Canton Agricultural and Technical College, Canton
SUNY Cobleskill Agricultural and Technical College, Cobleskill
SUNY College at Cortland, Cortland
SUNY Delhi Agricultural and Technical Collage, Delhi
SUNY College at Geneseo, Geneseo
SUNY Morrisville Agricultural and Technical College, Morrisville
SUNY College at New Paltz, New Paltz
SUNY College at Oneonta, Oneonta
SUNY College at Oswego, Oswego
Syracuse University, Syracuse
Tompkins Cortland Community College, Dryden
Ulster County Community College, Stone Ridge
Westchester Community College, Valhalla

Out-of-State Colleges

Allegany Community College, Cumberland, MD
Berkshire Community College, Pittsfield, MA
Camden County College, Blackwood, NJ
Garrett Community College, McHenry, MD
Holyoke Community College, Holyoke, MA
Housatonic Community College, Bridgeport, CT
Keystone Junior Colleger, LaPlume, PA
Kirkwood Community College, Cedar Rapids, IA
Mercer County Community College, Trenton, NJ
Middlesex Community College, Edison, NJ
Ocean County College, Toms River, NJ
Roger Williams College, Bristol, RI
Union College, Cranford, NJ

TRANSFER CREDIT

Courses transferred for credit must be appropriate to the student's curriculum choice. Credit will be awarded for all such courses completed with a passing grade of "D" or better.

Furthermore, courses to be transferred as required courses in a curriculum must be acceptable in content. Course credit hours are transferred, but grades and grade points are not.

No transfer credit will be awarded until all final transcripts are received. It is the student's responsibility to see that this is done.

COLLEGE PROFICIENCY EXAMINATIONS

The College recognizes that an increasing number of students are obtaining college-level credit through examination and/or completion of College credit while in high school. The College's policy on this, and other forms of nontraditional credit, is to grant the same amount of credit in parallel courses as the student's previous collegiate institution granted. It becomes the student's responsibility to be sure that *all* earned credits are on the previous college transcript and clearly identified by academic discipline.

EDUCATIONAL OPPORTUNITY PROGRAM

The basic goal of the Educational Opportunity Program at the College is to provide qualified students with a college education—the opportunity for personal growth and professional development. Upon completion of the program, graduates will be provided access to jobs in professional fields. The program is not designed for students who need only financial assistance. It serves students who ordinarily would not be able to attend college because of a lack of financial resources and insufficient academic preparation. To qualify, students must be New York State residents and demonstrate the potential to successfully complete the courses of study at the College.

Further information regarding the Educational Opportunity Program may be obtained by contacting the Office of Admissions.

INTERNATIONAL STUDENTS

The College accepts international students on the undergraduate level if they can satisfy all regular admission requirements. It is recommended, however, that students from foreign countries obtain their baccalaureate degree in their home country, and apply to the College as graduate students. Experience has shown that this arrangement provides for greater academic achievement and more efficient use of the student's time and funds. International students applying for admission must satisfy all of the course prerequisites for their intended major. In addition they must:

1. Demonstrate proficiency in the English language through acceptable performance on the Test of English as a Foreign Language (TOEFL) and/or the College Entrance Examination Board (CEEB) Achievement Text in English, and
2. Produce evidence of their ability to meet all their financial obligations.

Undergraduate international students must file official State University of New York foreign student admission forms. Prior to international student acceptance, adequate financial resources must be demonstrated, and after acceptance health and accident insurance must be obtained before the student will be allowed to register at the College.

International students who are currently at an American college may apply for transfer to the College. They must meet all entrance requirements of international students plus those of a transfer student as listed above. Permission to transfer must be obtained from the U.S. Immigration and Naturalization Service district office having jurisdiction over the college in which the student is currently enrolled.

HEALTH EXAMINATION BOARD

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

GRADUATE ADMISSION

Admission to graduate study may be granted only to applicants with at least a bachelor's degree from a recognized institution and whose preparation has been suitable in quality and content for the proposed field of major study. Applicants will be evaluated on the basis of the following: (1) their academic record should show at least a B or 80 percent average for the junior and senior years; (2) Graduate Record Examination aptitude scores, and, in some cases, subject matter (advanced) tests indicative of graduate study ability (see below); (3) supporting letters of recommendation; (4) a statement of specific educational and professional goals which describes the choice of degree program and the students' plan for the pursuit of the objectives in the program; and (5) other evidence of scholarly achievement and potential. Admission is selective with priority given to applicants who have high scholastic standing.

ADVANCED TESTS

Subject matter (advanced) test scores are required by the following programs:

Graduate Programs	*Advanced Test*
Chemistry	Chemistry
Environmental and Forest Biology	Biology

PROCEDURE

All applicants are required to submit Graduate Record Examination aptitude scores. This examination is offered several times each year in major cities of the world. For information on registration and scheduling write to the Educational Testing Service, Princeton, New Jersey 08540. Test scores should be sent to the Office of Academic Programs (Institutional number R2530).

The College provides a special application form for graduate work. Requests for information and applications should be addressed to the Office of Academic Programs.

INTERNATIONAL STUDENTS

Citizens of other countries with special educational objectives are accepted for graduate study in all programs. They must show satisfactory evidence that they have completed studies in their major field equivalent to those at a recognized American institution with a scholastic record equivalent to a B average in their junior and senior years. They must submit Graduate Record Examination scores as explained in the section on Admission Requirements. Also, applicants whose native language is other than English must submit scores on the Test of English as a Foreign Language (TOEFL). This requirement may be waived if the student has received a degree from an American institution. This examination is offered several times each year in major cities of the world.

For information on registration and scheduling, write to the Educational Testing Service, Princeton, New Jersey 08540, U.S.A. In submitting test scores, request that they be sent to the Office of Academic Programs.

EXPENSES

APPLICATION FEE

When a student applies for admission to an undergraduate program at any of the State University of New York units, a nonrefundable application fee is required. More information about fee and guidelines for exemptions is provided in the "Application Guidebook" for the State University of New York. There is a $35 application fee for those applying for graduate study.

ADVANCED PAYMENT FEE

All admitted undergraduate students pay a fee of $50, which is credited to the student's first semester tuition. This payment should be sent to the College Business Office accompanied by the form provided by the Office of Admissions. The payment is required prior to May 1, or 30 days after acceptance, whichever is later. It is refundable up to May 1, or within that 30-day period. There is no advanced payment fee required for those accepted for graduate study.

TUITION AND FEES (Effective Fall 1984)

The tuition and fee structure of the College of Environmental Science and Forestry covers usage of library, infirmary, physical education facilities, ROTC, special testing, and other services, as well as an assessment for student activities and charges for expendable supplies and equipment.

Tuition is charged in the following rate per semester:

Tuition Type	NYS Resident Students	Out-of-State Students
Undergraduate Matriculated		
Full-Time	$ 675.00	$1,600.00
Part-Time	$ 45.00/credit hour	$ 107.00/credit hour
Graduate Matriculated		
Full-Time	$1,075.00	$1,867.50
Part-Time	$ 90.00/credit hour	$ 156.00/credit hour
Continuing Education—Non-Degree		
Students who do not hold a Baccalaureate Degree		
Course Nos. 0-599	$ 45.00/credit hour	$ 107.00/credit hour
Course Nos. 600-999	$ 90.00/credit hour	$ 156.00/credit hour
Students who do not hold a Baccalaureate Degree		
Course Nos. 0-499	$ 45.00/credit hour	$ 107.00/credit hour
Course Nos. 500-999	$ 90.00/credit hour	$ 156.00/credit hour
Maximum Total Tuition for 12 credit hours or more	$1,075.00	$1,867.50

RESIDENCY

'Residence' for purposes of this (tuition payment) question refers to the principal or permanent home to which the student returns. If the principal or permanent home has not been located in New York State for a twelve-month period prior to the date of registration for the academic term for which this application is made, the student will be presumed to be an Out-of-State resident for purposes of tuition.

STUDENT ACTIVITY FEES

In addition to tuition, the student body has voted to assess each full-time undergraduate student $38 per year year to cover the cost of student activities. Full-time, non-matriculated students are charged a fee of $19 per semester, and part-time matriculated students $1.50 per credit hour. Full-time graduate students likewise have a mandatory activity fee of $15. ESF students also pay an activity fee to Syracuse University to cover SU-sponsored activities and services available to ESF students, not duplicated by College organizations. These fees are $26.75 for full-time undergraduate and $15 for full-time graduate students. Part-time matriculated students are charged $17.50 per year payable at fall registration; part-time matriculated graduate students are charged $10 per year.

COLLEGE FEE

There is a State University of New York general college fee of $25 per year for all full-time students. Part-time student fee is $.85 per credit hour.

COMMENCEMENT FEE

A commencement fee of $13 is required at the beginning of the semester in which the degree is expected. Additional costs are incurred by graduate students for the binding, abstracting, and microfilming of theses.

TERMS OF PAYMENT

A check or money order for tuition and fees should be made payable to State University of New York College of Environmental Science and Forestry. This payment is required by the last day of the registration period and can be paid at the College's Business Office either prior to registration or during registration. A fee of $10 or $20 may be assessed for payment later than the established date.

HOUSING AND BOARD COSTS

ESF does not operate student residences or dining halls. These facilities are offered by Syracuse University. Specific information about available housing and board plans is available from the Office of Residence and Dining Services, Syracuse University, Syracuse, New York 13210.

In general, housing costs at SU range from $1,790 to $2,500 for an academic year, reflecting the diversity of available accommodations for graduate or undergraduate, single or married students. Most dormitory rooms accommodate two students and are furnished with beds, mattresses, desks, chairs, study lamps and dressers. A commercial linen service is available to those who order it. Separate dormitories are maintained for graduate students.

Furnished and unfurnished apartments are also available for both single and married students. These are located in a housing complex approximately two miles from the main campus, and are regularly serviced by a free shuttle-bus.

A variety of options on board offerings are available for all students, whether or not they reside in University dormitories. Costs range from $1,000 to $1,700 for an academic year.

In addition, a wide variety of living arrangements in private homes and apartment complexes is available in the Syracuse metropolitan area.

Payment for housing and board is made directly to Syracuse University.

OTHER COSTS

Students majoring in resource management attend a seven-week Summer Session in Field Forestry at the Warrensburg Campus between the sophomore and junior years. Forest biology majors have the option of attending this session or the Summer Session in Environmental Biology at the Cranberry Lake Biological Station at the end of the junior year. Cost for the Warrensburg session is $675 and $550 for the four-week program at Cranberry Lake, plus travel and personal expenses.

An extended field trip of up to two weeks at the end of the junior year costs approximately $250 for Wood Products Engineering students.

Field trips for Landscape Architecture students range between $125 and $150. In addition, students enrolled in the five-year Landscape Architecture program are required to spend one semester off campus. **This is a self-described 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.**

The cost of books and supplies is approximately $300 a year. Additional costs for personal expenses, recreation, clothes and travel depend on the individual, and they may range from $600 to $800 a year.

REFUNDS

The following policies apply to tuition liability and refunds for students canceling their registration.

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%

Application for refund must be made within one year after the end of term for which the tuition was paid to State University. The first day of class session is considered the first day of the semester, and Saturday of the week in which this first session occurs is considered the end of the first week for refund purposes. It is interpreted that a student who does not attend any class sessions after Saturday of the first week and who notifies the College of his intent to cancel registration on or before the second Saturday following the first day of classes will be considered to have canceled his registration during the first week.

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

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

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

Notwithstanding any other provisions for refund, when a student has withdrawn through circumstances beyond the student's control, under conditions in which the denial of refund would cause undue hardship, the Chief Administrative Officer of the unit may, at his discretion, determine that no liability for tuition has been incurred by the student, provided the student has not completed more than one half of the term and has not received or will not receive academic credit for the term. Such action, including the reason for withdrawal, must be in writing.

FINANCIAL ASSISTANCE

The College of Environmental Science and Forestry offers four basic forms of student financial assistance: scholarships or grants, part-time employment, long-term loans, and assistantships for graduate students. These 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 *Financial Assistance at ESF*, a separate publication which is mailed to all applicants, and is available to the public by contacting the Office of Financial Aid.

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 student problems. All students are encouraged to apply for financial aid.

HOW TO APPLY

Each year students interested in receiving financial assistance, *except for graduate assistantships*, must complete the application process. (Graduate students who wish to be considered for a graduate assistantship refer to page 25, and follow those instructions.) *Two forms are necessary to apply:*

1. The candidate must complete a College Aid Application and Financial Aid Transcript and return it to the Office of Financial Aid by MARCH 15. The application is included in the publication, *Financial Assistance at ESF*. Applications will be accepted after March 15; it should be noted, however, that available funds may already be committed to other students. Applicants need not wait for notification of acceptance to the College before applying for financial aid.

2. The candidate must also complete and submit by February 15 the Family Financial Statement (FFS) to the American College Testing Co., Iowa City, Iowa. The FFS is available in the College's Office of Financial Aid, high school guidance offices, and most college financial aid offices.

Students are invited to discuss with the professionals in the Financial Aid Office any problems in financing their education.

This application information is based on current requirements, and financial aid systems and forms are undergoing constant change. Applicants are urged to contact the Office of Financial Aid for the latest information and requirements.

SELECTION OF RECIPIENTS

In making award decisions, consideration is given primarily to comparative financial need; however, scholastic standing, character, and potential contribution to the College community are also factors in making certain awards.

Retention of Awards—State

All students who are awarded financial assistance will be required to maintain satisfactory academic progress each semester in order to keep their awards. Satisfactory academic progress for all programs, *except New York State* (TAP, Regents, etc.), is defined on page 23 of this catalog.

Recipients of a New York State award must adhere to the following State requirements:

(1) Academic Progress—A student will need to read the stated minimums on the following charts to be eligible for the next semester award.

Standard of Satisfactory Academic Progress for Purpose of Determining Eligibility for State Student Aid
All Campuses—State University of New York

Calendar: Semester — Programs: Associate Degrees and Certificate Programs

Before being certified for this payment,	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
a student must have accrued at least this many credits,	0	3	9	18	30	45	60	75
with at least this grade point average.	.0	.5	.75	1.3	1.5	1.7	2.0	2.0

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.

Calendar: Semester — Program: Baccalaureate Degree

Before being certified for this payment,										
a student must have accrued at least this many credits,	0	3	9	18	30	45	60	75	90	105
with at least this grade point average	0	.5	.75	1.20	1.40	1.50	1.60	1.70	1.80	1.90

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.

Calendar: Semester — Programs: All Graduate Level Programs except Professional

Before being certified for this payment,	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
a student must have accrued at least this many credits,	0	6	12	21	30	45	60	75
with at least this grade point average.	0	2.0	2.5	2.75	3.00	3.00	3.00	3.00

(2) Program Pursuit—Students must complete a minimum number of semester hours each semester. *For A.A.S. Degree students*, they are required to complete 75 percent of the full-time load. Full-time is defined as 12 credit hours. Therefore, .75 × 12 = 9. Nine credit hours must be completed each semester.

For Bachelor, Master, and Ph.D. students, they must complete 100 percent of full-time load each term. Full-time is 12 credit hours. Therefore, students must register for and complete at least a minimum of 12 credit hours each term.

Waivers

Should a student fall below the requirement, he/she may apply for a waiver. Students are allowed *only one* waiver during undergraduate work and *only one* during graduate work. The issuance of the waiver will be granted only after the student and the institutional waiver designee have mutually concurred that such issuance is in the best interest of the student. Request for a waiver is made through the Vice President of Student Affairs.

Calendar: Academic Year — Program: Associate Degree

Academic years completed at ESF	2	3
A student must have successfully completed this number of credit hours	45	76
with at least this cumulative grade point average	2.000	2.000

Calendar: Academic Year — Program: Baccalaureate Degree

Academic years completed at ESF	3	4	5	6
A student must have successfully completed this number of credit hours	70	100	130	160
with at least this cumulative grade point average	2.000	2.000	2.000	2.000

Calendar: Academic Year — Program: All Master Level Programs

Academic year completed at ESF	1	2	3
A student must have successfully completed this number of credit hours	15	27	42
with at least this cumulative grade point average	3.00	3.00	3.00

Calendar: Academic Year — Program: All Ph.D. Level Programs

Academic year completed at ESF	1	2	3	4	5	6	7
A student must have successfully completed this number of credit hours	15	27	42	54	66	75	90
with at least this cumulative grade point average	3.000	3.000	3.000	3.000	3.000	3.000	3.000

Retention of Awards—Title IV

In order for students to be eligible for Title IV Federal Student Assistance (Pell Grants, Supplemental Educational Opportunity Grant, National Direct Student Loan, College Work-Study Program, PLUS), both undergraduate and graduate students must meet specified criteria.

The criteria that students must meet to be eligible for Title IV student aid is the same criteria *all ESF* students must adhere to with regards to institutional academic policies, and specifically academic progress towards their degree. The evaluation criteria are:

(1) Appropriate grade point average for satisfactory academic progress.
(2) Successfully accumulate credits towards their degree.
(3) Obtain their degree within the prescribed degree time limit. Time limits vary for individual programs and are illustrated on the adjacent charts.

Appeal/Probation/Reinstatement

Students who fall beneath the minimum standards may appeal through the College Academic Affairs Committee to retain their eligibility for receipt of Title IV Federal Student Assistance. (See Academic Dismissal p.26.)

These appeals should be evaluated for mitigating circumstances such as injury, illness, etc., and the reasonableness of the student's ability to move back up to the appropriate standard. If the College Academic Affairs Committee places a student on "academic probation," the student is still eligible for Title IV aid as defined by the statement of "Good Academic Standing" (p.26).

Notification

Students will be notified via certified mail of their individual circumstances if they fall below the standards, appeal loss of eligibility, or reinstatement of eligibility.

SCHOLARSHIP AND GRANT PROGRAMS (SEOG)

Supplemental Educational Opportunity Grants

The College is the recipient of funds authorized under Title IV-A of the Higher Education Act of 1965, as amended. These funds enable the College to award grants to undergraduate students who have financial need. Grants range from $200 to $2,000 per year.

ESF Educational Opportunity Grant Program (EOP)

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

Prospective Educational Opportunity Program students must apply for financial aid when submitting their admissions applications.

Pell Grants (Formerly Basic Educational Opportunity Grants)

The Pell (BEOG) Program was authorized in the Education Amendments of 1972. Grants are available to eligible full-time and half-time undergraduate students. The amount of the award can vary from $225 to $1,900.

Applications are available from high school guidance offices or any college office of financial aid. Students should submit the Student Aid Report (SAR) to the Office of Financial Aid as soon as it is received from the processor.

Regents Programs

Additional information and applications for the following programs are available from the College or:

New York Higher Education Services Corporation
Tower Building
Empire State Plaza
Albany, New York 12255

REGENTS COLLEGE SCHOLARSHIPS

High school students who are New York State residents may qualify for a $250 annual scholarship by taking a competitive exam during their senior year.

TUITION ASSISTANCE PROGRAM

These awards are available to New York State residents who are enrolled in full-time degree programs. Based on income, awards range from $300 to full tuition. Separate application is necessary.

REGENTS GRANTS OR CHILDREN OF DECEASED OR DISABLED VETERANS

These 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 award entitles a New York State resident to $450 per year.

Vocational Rehabilitation Grants

Financial assistance and program counseling are provided by New York State for students with disabling handicaps. Information is available from any Office of Vocational Rehabilitation.

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.

Additional information and counseling are available from the Veterans' Affairs Counselor at the College. Local veterans' administration offices, or the State

Regional Office, 111 West Huron Street, Buffalo, New York 14202, can provide information and application forms.

Social Security Benefits

The 1965 amendments to the Social Security Act extended the age limit for a child's benefits from 18 to 22, providing the child is a full-time student. Local Social Security offices have additional information. These benefits are slated to expire in 1985.

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 about the programs, students should contact the Bureau of Indian Affairs, 1951 Constitution Avénue NW, Washington, D.C., or the Native American Education Unit, State Education Department, Education Building Annex, Albany, New York 12234.

Private Fellowships, Scholarships, and Grants

The College administers a number of programs which have been established by private individuals, companies, organizations and foundations. These scholarships and grant programs have varying eligibility requirements and are awarded to students according to their respective guidelines which are described in more detail in *Financial Assistance at ESF*. The following is a list of the programs: Alumni Memorial Awards; Alumni Educational Grants; Nelson Courtlandt Brown Scholarship Fund; Henry H. Buckley Student Aid Award; Simeon H. Bornt III Scholarhip Award; Eugene C. Reichard Scholarship Award; Walter Tarbox Memorial Scholarship; Warren Bennett Memorial Award; Wilford A. Dence Memorial Award; Meyer Environmental Chemistry Scholarship Award; Meyer Wood-Plastic Scholarship Award; Edward Aalbue Memorial Scholarship; Lt. Gary Scott Memorial Scholarship; Gerald H. Williams Scholarship; Mary E. Palmer Memorial Scholarship; Portia Farrell Morgan Scholarship; Phyllis Roskin Memorial Award; and Student Association grants.

Syracuse Pulp and Paper Foundation, Inc. Scholarships

Scholarships from this foundation are awarded to United States citizens who are students in paper science and engineering. The scholarship may amount to $100 more than the recipient's annual tuition charge. Incoming transfer students entering the program may ascertain the award amounts currently being offered and request a Pulp and Paper Scholarship application from the Office of Financial Aid. It is necessary to reapply each year for the scholarship.

State University Supplemental Tuition Assistance

A limited number of small grant awards are determined annually by the College for students with financial need.

EMPLOYMENT OPPORTUNITIES

College Work-Study Program (CW-SP)

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 minimum wage and increase as duties and responsibilities increase.

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.

A part-time employment program is available to qualified veterans. More information is available from the Veterans' counselor at the College.

LOANS

National Direct Student Loans

These loans are available to students with financial need who are enrolled at least half-time. Amounts which can be borrowed are $3,000 for 2 years and $6,000 for 4 years with a maximum of $12,000, including graduate study. Repayment and 5 percent interest begin 6 months after leaving college. Deferment and cancellation benefits are available for certain situations.

Guaranteed Student Loans

This program is administered by the New York Higher Education Services Corporation (NYHESC) for New York State residents. These loans are available from a bank or other lending agent to students who are registered at least half-time. Undergraduates can borrow an aggregate of $12,500 for their undergraduate studies, and a graduate student can borrow an aggregate of $25,000. Repayment and 8 percent interest begin 6 months after leaving college (an additional 1 percent interest is paid at the time the loan is received). Applications are available at local banks.

Parent's Loan (PLUS)

Parents of students may borrow up to $3,000 annually and $15,000 overall, at an interest rate of 12 percent. Loan repayment begins 60 days after receipt of the loan. Total loans to parents and students cannot exceed total cost of education. Applications are available at local lending institutions.

Emergency Loans

The College is able to provide registered students interest-free, short-term loans (30 days). These loans are available because of the interest and support of the following donors: Alumni Association Short-term Loan Fund; David B. Schorer Memorial Fund; and Edward Vail Emergency Fund.

Students should contact the Office of Financial Aid when need arises for a short-term loan.

GRADUATE ASSISTANTSHIPS

Assistantships are awarded to students of demonstrated scholarship and whose education and experience enable them to assist in laboratory instruction and research. The amounts of the assistantships range from $4,800 to $9,000 per year. In addition, tuition may be waived. Students who hold an assistantship must be enrolled for full-time study.

Beginning graduate students may apply for assistantships on their application for admission, and continuing graduate students should consult with their major professors.

ACADEMIC POLICIES

The following academic policies are extracted from the complete undergraduate and graduate policies which are contained in the *Student Handbook*. The *Student Handbook* is available from the Office of Student Affairs, 105 Bray Hall.

UNDERGRADUATE AND GRADUATE POLICIES

Published Requirement

Students must satisfy the requirements for graduation in effect at the time of their first matriculation as a student. Students may graduate under the requirements stated subsequent to those in effect at their matriculation, but they may not use prior ones.

Attendance

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

Education 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:

"1. No person shall be expelled from or be refused admission as a student to an institution of higher education for the reason that he is unable, because of his religious beliefs, to attend classes or to participate in any examination, study or work requirements on a particular day or days.

"2. Any student in an institution of higher education who is unable, because of his 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.

"3. 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 his religious beliefs, an equivalent opportunity to make up any examination, study or work requirements which he may have 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.

"4. 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.

"5. 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 his availing himself of the provisions of this section.

"6. 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 his rights under this section."

Audits

Students may informally audit ESF courses 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 formally audit courses with the permission of their major professor and the course instructor. They may not be used to satisfy any graduation requirements. Formally audited courses will appear on the 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.

Withdrawal from ESF

Students who withdraw on or before the "drop date" for a semester will have their records marked "(date): Withdrawal." Courses will appear for that semester with the grade of "W."

Students who withdraw after the "drop date" for a semester, but before the semester ends, will have either "WP" (withdraw passing) or "WF" (withdraw failing) listed after each such course.

Students who withdraw from the College 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.

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 merely as an educational device designed to encourage greater effort on the part of students who appear to be having difficulty in meeting certain academic standards. 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 College Academic Affairs Committee.

UNDERGRADUATE POLICIES

Credit Hour Load

To be classified as full-time, an undergraduate 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.

Evaluation

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

Grade	*Definition*	*Grade Points*
A		4.0
A-	Excellent	3.7
B+		3.3
B	Good	3.0
B-		2.7
C+		2.3
C	Passing	2.0
C-		1.7
D	Minimum Passing	1.0
F	Failure	0
I/F	Unresolved Incomplete	0

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
SAU	Audit (Satisfactory)
UAU	Audit (Unsatisfactory)
I	Incomplete

Grade Point Averages

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

Academic Honors

PRESIDENT'S LIST

Students who carried 12 or more credits of coursework graded "A - F" and earned a minimum grade point average of 3.00 will be placed on the President's List for that semester.

Graduation Honors

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

A minimum of 30 credits of ESF and Syracuse University courses have been completed as a matriculated, upper-division student.

A grade point average of: 3.00 - 3.33, *cum laude*; 3.34 - 3.82, *magna cum laude*, 3.83 - 4.00, *summa cum laude*.

Academic Dismissal

Undergraduate students who earn less than a 2.00 cumulative grade point average shall have their records reviewed by the appropriate Collegewide faculty committee which may delegate this authority. Based upon this review, students with less than this minimum cumulative grade point average will be placed on either academic probation or dismissed from ESF. The decision on probation or dismissal will be based upon an overview of the total academic record and the mathematical possibility for attaining a 2.00 cumulative average by the projected graduation date.

When extraordinary conditions contributed to the academic dismissal of students, such students may submit a written appeal to the dismissal decision to the Office of Academic Programs. These appeals will be reviewed by the appropriate faculty committee which will decide either to sustain the dismissal or place the students on probation. There is no appeal beyond this committee.

Students who have been dismissed for academic performance may not reapply until at least one semester has elapsed.

Students dismissed a second time for academic performance may not again be considered for readmission.

Graduation Requirements

Undergraduate students are responsible for meeting the following requirements for graduation:

A. Matriculated status as an undergraduate student.
B. All course requirements must be satisfied.
C. A minimum cumulative grade point average of 2.00 (4.00 = A) for all courses taken as a matriculated student at ESF.
D. At least 24 of the last 30 credits must be registered through ESF.
E. Consistent with the State Education Department requirements, a total of at least 120 credits from courses accepted as transfer credit by ESF and courses successfully completed while a matriculated student at ESF.

Graduation Rate

Of the transfer students who began their studies in the fall of 1979 at ESF, over 78 percent received their degree, or continued in a five-year program, after four semesters of study. For those who began in the fall of 1980, approximately 80 percent received their degree, or are continuing in a five-year program, after four semesters of study. Further information on student retention is available from the Office of Academic Programs at ESF.

GRADUATE POLICIES

Master's Credit Hours

A minimum of 30 credit hours of graduate level work is required for the master's degree. This degree shall represent completion of at least one academic year of graduate-level study or an equivalent that can be shown to accomplish the same goals.

Doctoral Credit Hours

For the doctorate, credit hour requirements vary depending on the student's background and specific degree program. Early in a student's program the coursework requirement will be established which is intended to provide the student with the required level of competency to satisfactorily complete the doctoral candidacy examination. The doctorate shall represent completion of at least three full-time academic years of graduate study beyond the baccalaureate degree or an equivalent that can be shown to accomplish the same goals.

Doctoral Research Tool Requirement

There is no Collegewide requirement for languages or other tools of research for doctoral students. However, the faculty of any program may establish such requirements.

Time Limit

Students must complete all requirements for the master's degree within three years of the first date of matriculation. For the doctoral degree, students must complete all requirements for their degree within three years of satisfactory completion of the doctoral candidacy examination or they will be required to retake the candidacy examination.

Credit Hour Load

A graduate student must be registered for at least one credit each semester, excluding summers, from the first date of matriculation until all degree requirements have been completed. Failure to register will indicate the student no longer wishes to pursue a graduate degree.

Although there is no full-time requirement for degree purposes, there is such a requirement for those who qualify for a tuition waiver and for some other forms of financial support. For these students the following definition applies:

With a master's degree, or the completion of 24 or more credits after the bachelor's degree, students holding an assistantship are considered full-time if they are registered for nine or more credits. All other students are considered full-time if they carry 12 or more credits. All graduate students in landscape architecture must carry 12 or more credits to be considered full-time.

Evaluation

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

Grade	*Definition*	*Grade Points*
A		4.0
A-	Excellent	3.7
B+		3.3
B	Passing	3.0
B-		2.7
C+		2.3
C	Minimum Passing	2.0
C-		1.7
F	Failure	0
I/F, I/U	Unresolved Incomplete	0

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
U	Unsatisfactory
SAU	Audit (Satisfactory)
UAU	Audit (Unsatisfactory)
I	Incomplete

Grade Point Averages

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, i.e., all courses graded "A - F."

Master's Study Integration

Students enrolled in a master's degree program are required to demonstrate the ability:

A. to critically evaluate, organize, analyze, and synthesize the coursework and other components of their program of study;
B. to relate these components to current concepts and issues in their chosen field and associated disciplines;
C. to work logically and independently; and
D. to communicate effectively.

Master's study integration requirements may be met by successful completion of one of the following three options. The faculty of any program may limit the number of permissible options for its students. As permitted by their program, students will choose and follow one option with the approval of their major professor and with the guidance of their steering committee. Each option must be designed to satisfy the above requirements.

OPTION 1. THESIS OR PROJECT AND DEFENSE

Scope. Under this option, in addition to completion of necessary coursework, students must prepare either:

1. a research-oriented thesis which investigates a problem that expands or clarifies knowledge in the field, with generalizable results, or
2. an application-oriented project which applies skills or techniques from the field to a specific problem.

Whichever is chosen, students are required to define an appropriate problem for investigation; review relevant information sources; develop a study design; collect, organize, analyze, and interpret data; and draw conclusions.

Product. The thesis or project must be documented in a thorough and appropriate format and style. It must be in a permanent form, which may consist of print or nonprint materials.

Credits. Students must satisfactorily complete 6 to 12 credits for the investigation leading up to completion of the document. These credits will be graded on an "S/U" basis. Students must register for the approved number of credits for their investigation sometime during the three-year limit for the master's degree. They may register for more than the approved number of credits for their investigation, but the excess credits may not be used to fulfill the minimum 30 credits required for the master's degree.

Defense Examination. The thesis or project must be successfully defended.

OPTION 2. ACADEMIC OR PROFESSIONAL EXPERIENCE AND MASTER'S COMPREHENSIVE EXAMINATION

Scope. Under this option, in addition to completion of necessary coursework, students must engage in an academic or professional experience which applies, enriches, and/or complements the more formal coursework of their plan of study. This option might include, but not be limited to, an internship or an independent study experience. Whatever the form of the option, its objectives, organization, procedure, and manner of documentation must be submitted in writing and be approved by the student's major professor and steering committee before the experience is begun.

Product. This experience must be reported in a thorough and appropriate format and style. It need not be in a permanent form.

Credits. Students must satisfactorily complete 6 to 12 credits for this experience. These credits will be graded on an "S/U" basis. Students must register for the approved number of credits for their experience sometime during the three-year time limit for the master's degree. They may register for more than the approved number of credits for their experience, but the excess credits may not be used to fulfill the minimum 30 credits required for the master's degree.

Master's Comprehensive Examination. At the completion of their plan, students must successfully pass a comprehensive examination covering the major field, allied fields, and the content of their completed experience.

OPTION 3. COURSEWORK AND MASTER'S COMPREHENSIVE EXAMINATION

Scope. Under this option, students must satisfactorily complete a minimum of 42 hours of graduate level coursework appropriate to their field of study. As in other options, the design and sequencing of the coursework plan must be conducted with the guidance and approval of the student's major professor and steering committee.

Product. No product is required beyond that required for individual courses.

Credits. Students must satisfactorily complete a minimum of 42 credits of graduate level coursework. Students must complete these required credits sometime during the three-year time limit for the master's degree.

Master's Comprehensive Examination. At the completion of their plan, students must successfully pass a comprehensive examination covering the major field and allied fields.

Doctoral Thesis

Nature and Purpose

A thesis must be completed and successfully defended in order for the doctoral degree to be awarded. The doctoral thesis is the final and most important component of the series of academic experiences which culminate in the awarding of the Ph.D. degree. Three major functions are fulfilled by the thesis experience: (1) It is a work of original research or scholarship which makes a contribution to existing knowledge; (2) It is an educational experience which demonstrates the candidate's mastery of research methods and tools of the specialized field; and (3) It demonstrates the student's ability to address a major intellectual problem and arrive at a successful conclusion.

Examinations

Doctoral Preliminary Examination

An examination may be required of those admitted into a doctoral program to ascertain their level of understanding of the basic principles and techniques necessary to function effectively in that program. The results of the preliminary examination will be used to guide the major professor and the student in determining the appropriate coursework necessary to complete that requirement for the doctorate.

The format for the examination will be determined by the faculty in the program involved. It is recommended that the examination be primarily written with a supplemental oral presentation. When a preliminary examination is required, it should be conducted as early as possible in a student's program, at least before the completion of the student's second semester.

Doctoral Candidacy Examination

A student admitted into a doctoral program must satisfactorily complete a candidacy examination covering the major field and, in a broader manner, allied fields in order to be advanced into the status of doctoral candidate.

The purposes of the doctoral candidacy examination are to determine the student's knowledge of factual material and ability to use this knowledge creatively and intelligently.

The doctoral candidacy examination must be taken when the majority of coursework is completed but before the student begins serious thesis investigation. The candidacy examination must be passed at least one year before the student may present a thesis for defense.

Defense Examination for Thesis or Project

All graduate students who are required to complete a thesis or project must successfully defend it and have it accepted by the College.

The purposes of the defense examination are to determine the validity and significance of the data; and evaluate the student's understanding of investigative methods, ability to critically analyze data, and ability to relate the study results to the appropriate field and to more general scientific principles and knowledge.

Academic Dismissal

Graduate students who earn less than a 3.00 cumulative grade point average or who earn two grades of "U" shall have their records reviewed by the College Academic Affairs Committee, which may delegate this authority. Based upon this review, students either will be placed on academic probation or will be dismissed from ESF. The decision on probation or dismissal will be based upon an overview of the total academic record, the mathematical possibility for attaining a 3.00 cumulative average by the projected graduation date, and the recommendation from the major professor, program coordinator, and school dean or program director.

When extraordinary conditions contributed to the academic dismissal of students, such students may submit a written appeal to the dismissal decision to the Office of Academic Programs. These appeals will be reviewed by the College Academic Affairs Committee, which will decide either to sustain the dismissal or place the students on probation. There is no appeal beyond this committee.

Students who have been dismissed for academic performance may not reapply until at least one semester has elapsed.

Students dismissed a second time for academic performance may not again be considered for readmission.

Graduation Requirements

Graduate students are responsible for meeting the following requirements for graduation:

A. The student must be in a matriculated status as a graduate student.
B. The approved academic plan for each student must be completed within the applicable time limit.
C. For the doctoral degree, the student must be admitted to candidacy and a thesis completed and successfully defended.
D. A minimum cumulative grade point average of 3.00 (4.00 = A) for all graduate level courses taken during the program of study at ESF must be achieved.
E. Consistent with the State Education Department requirements, a total of at least 30 graduate credits is required for the master's degree and, for the doctorate, at least three full-time academic years of graduate study beyond the baccalaureate degree or an equivalent that can be shown to accomplish the same goals.

STUDENT LIFE

HOUSING

The College of Environmental Science and Forestry does not operate its own residence facilities or food service. Students enter into a Room and Board Contract with Syracuse University, which has housing facilities available adjacent to the State-operated College. Contracts for room and board made with Syracuse cover a *full academic year* (both fall and spring semesters) and are not normally renegotiable during that time period.

Students have a choice of living centers at Syracuse University—large halls, apartment houses, cottages, fraternities and sorority houses, or cooperative units. Student resident advisors live on each floor or in each unit and are available for counseling, advisement, and referral services.

Syracuse University also has housing units available for married students and their families. While veterans are given preference, nonveterans can usually find housing.

Students who wish to live off campus may contact Alternative Action Services (ALTERACTS), a student-run housing organization at Syracuse University. An extensive listing of available housing in the Syracuse area is provided free of charge.

FOOD SERVICE

Syracuse University offers different meal plans to help meet the varying nutritional needs and interests of individual students. Students living in University apartments, co-ops, fraternities and sororities or off-campus can take advantage of the board plans available. Students living in dormitories and area housing without full kitchen services are required to subscribe to a board plan.

The College does not provide a food service program. However, a snack bar, located in the basement of Marshall Hall, is open 8 a.m. to 3:30 p.m. weekdays during the academic year.

EXTRACURRICULAR ACTIVITIES

Students at the College of Environmental Science and Forestry have many extracurricular activities to choose from, both on campus and in the community.

At the College

The *Undergraduate Student Association* (USA) and the *Graduate Student Association* (GSA) are the official representative bodies on campus governing student activities. Undergraduate and graduate students elect representatives from each school to manage the affairs of their respective organizations and the concerns of their constituents.

Campus organizations offer students an opportunity to broaden their knowledge and meet other students with similar personal and academic interests. These include: the *Basketball Club*; *Bob Marshall Club*, an organization of students concerned about the future of the Adirondack Mountains; the *Forestry Club*, the traditional sponsor of the intercollegiate Woodsmen's Team; *Botany Club*; *Forest Engineers Club*; *Mollet Club*, an organization of landscape architecture students; *Papyrus Club*; the *Recycling Club*; and the *Zoology Club*, which sponsors lectures, films, and field trips.

Other groups on campus include *Saengerbund*, the College singing group; and *Alpha Xi Sigma*, senior honorary society. There are also student chapters of the *Wildlife Society*, the *Society of American Foresters*, the *American Chemical Society*, the *American Fisheries Society*, the *American Water Resources Association*, the *Forest Products Research Society*, the *American Society of Landscape Architects*, the *Associated General Contractors*, *Society of Wood Science and Technology*, and the *Technical Association of Pulp and Paper Industries (TAPPI)*.

The two major student publications at ESF are the *Knothole*, a weekly newspaper, and the *Empire Forester*, an annual yearbook which has won many awards in past years.

Recent GSA-sponsored activities include a lecture series, a traditional fall picnic, and various social functions designed to encourage interaction between graduate students and College faculty.

At Syracuse University

Students at the College of Environmental Science and Forestry have all the privileges of Syracuse University students: participation in student government, organizations, sports, and other extracurricular activities.

Men and women at the College participate in all Syracuse University intercollegiate sports, club sports, and intramurals. Archbold Gymnasium on the Syracuse University campus is the center of athletics and physical education. Additional indoor facilities are provided through Manley Field House and the Carrier Dome which is the site of Syracuse University home football and basketball games. Facilities at Skytop recreation area include a lodge, and 22 tennis courts. The Women's Building offers instructional, social, and recreational facilities. All full-time undergraduate women are eligible to participate in intercollegiate competition in tennis, field hockey, volleyball, basketball, swimming, and diving.

Students are provided with many opportunities for acquiring musical training and performing experience through the Syracuse University Band, (Symphonic Band, Wind Ensemble, Stage Band, Concert Band and Jazz Workshops), the Syracuse University Orchestra, and the Syracuse University Chorus.

Membership is allowed in all Syracuse University student groups, including a wide variety of clubs, the International Student Association, religious and military organizations, and professional and honor societies.

In the Syracuse Area

The City of Syracuse and its surrounding countryside offer many cultural, educational, and recreational opportunities. The city has several fine museums, including the Everson with its outstanding collection of works by local, regional, and international artists; a local repertory theater; several points of historical interest; a professional symphony orchestra; and a Civic Center which attracts artists from around the world.

Eight parks lie within the city limits, numerous county and state parks, including Beaver Lake Nature Center and Montezuma National Wildlife Refuge are within a short drive.

COLLEGE SERVICES

Career and Counseling Services

The Office of Career and Counseling Services is available throughout the students' college career as a place where at any time they may seek the advice of experienced counselors. This office should be the first contact when questions or personal problems arise. Most student problems can be dealt with in one or two brief contacts. Severe problems requiring extensive assistance are referred to the cooperative facilities at Syracuse University and/or specialized agencies in Syracuse.

The Office is designed to provide additional assistance to students throughout the year to help them adjust to and successfully graduate from ESF. Through various presentations, counseling sessions, group activities and workshops, students are given the opportunity to further develop such skills as decisionmaking, reading, studying, and test taking. Additional programs deal with coping with adjustments related to transferring colleges and exploring relationships between academic pursuits and career objectives.

Special efforts are made to assist students identified as having academic difficulties or adjustment problems. Often personal and academic problems are associated with career decisions. A key component of this office is to provide a variety of opportunities through resource materials, presentations, job development, and counseling to meet the individual needs of each student at his/her various stages of career readiness. Some career services offered through this Office are skills development workshops; list of full-time, part-time, and summer jobs; on campus recruiting; company literature; career newsletters; reference information; a library outreach program; and an alumni job list.

Each year this office conducts a Placement Survey to monitor the success and progress of our college graduates. The reports are shared with the college community and made available to the public upon request.

Since 1978, placement statistics for ESF graduates, 6-9 months past graduation, have not varied significantly. On the average 75 percent of the graduates are employed, 18 percent are continuing their education, and 7 percent are available for employment.

More detailed information is available in the Office of Counseling and Career Placement in Room 108, Bray Hall.

Services for the Handicapped

Students who experience short-term handicaps and/or incapacitating injuries that need special transport or classroom assistance should contact the Office of Student Affairs.

The Office of Administration and Services, assisted by Student Affairs, also provides specialized support services and adapts general resources to assist more permanently handicapped students to obtain maximum academic, social, and cultural benefits within the College community. Some of the specific services provided or made available include: pre-admissions guidance, orientation, mobility training, reader recruitment, preferential housing assignments, tutoring and other supportive services as required to meet individual living/learning needs. The College is also prepared to respond to handicapped students' needs for personal and career counseling and job placement assistance.

For further information, contact the ESF 504 Coordinator, Mr. David G. Anderson, Office of Administration and Services, Room 209, Bray Hall (315) 470-6622. The College maintains liaison relationships with rehabilitation agencies within the local community and the state, including the Office of Vocational Rehabilitation and the Commission for the Visually Handicapped. For specific information regarding their own eligibility, students should contact the respective agency directly.

Health and Medical Facilities

Students may consult a physician for medical care or health advice at the Syracuse University Student Health Service. Full-time students are entitled to unlimited visits to the out-patient clinic and also 10 days of confinement per college year with ordinary medical care in the infirmary. Infirmary usage over 10 days will be at prevailing infirmary rates. Some laboratory examinations, if necessary for treatment or diagnosis of common illness, are provided without cost. Most common legal drugs are provided at a minimal charge.

A student accident or sickness insurance plan, available at fall registration, not only supplements the usual infirmary privileges, but is also a health protection plan during the summer months when students are not under the care of the Health Service. Married students with dependents who are not covered by Health Service privileges are strongly urged to provide themselves and their families with special insurance made available to University students. *All international students are required to carry health and accident insurance.*

SU Speech and Hearing Clinics

The Gebbie Speech and Hearing Clinics provide remedial assistance to all regularly enrolled students who may be handicapped by hearing, speech, and voice disorders. This service is free to students.

SU Psychological Services and Research Center

Students desiring an analysis of their aptitudes, abilities and interests may secure special testing programs at the Testing and Evaluation Service Center on the Syracuse University campus.

SU ROTC Opportunities

Students attending the College are eligible to participate in the Army or Air Force ROTC Program at Syracuse University.

ROTC at Syracuse University consists of both 4- and 2-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 six-week and four-week camps and on-campus programs are available to suit individual needs.

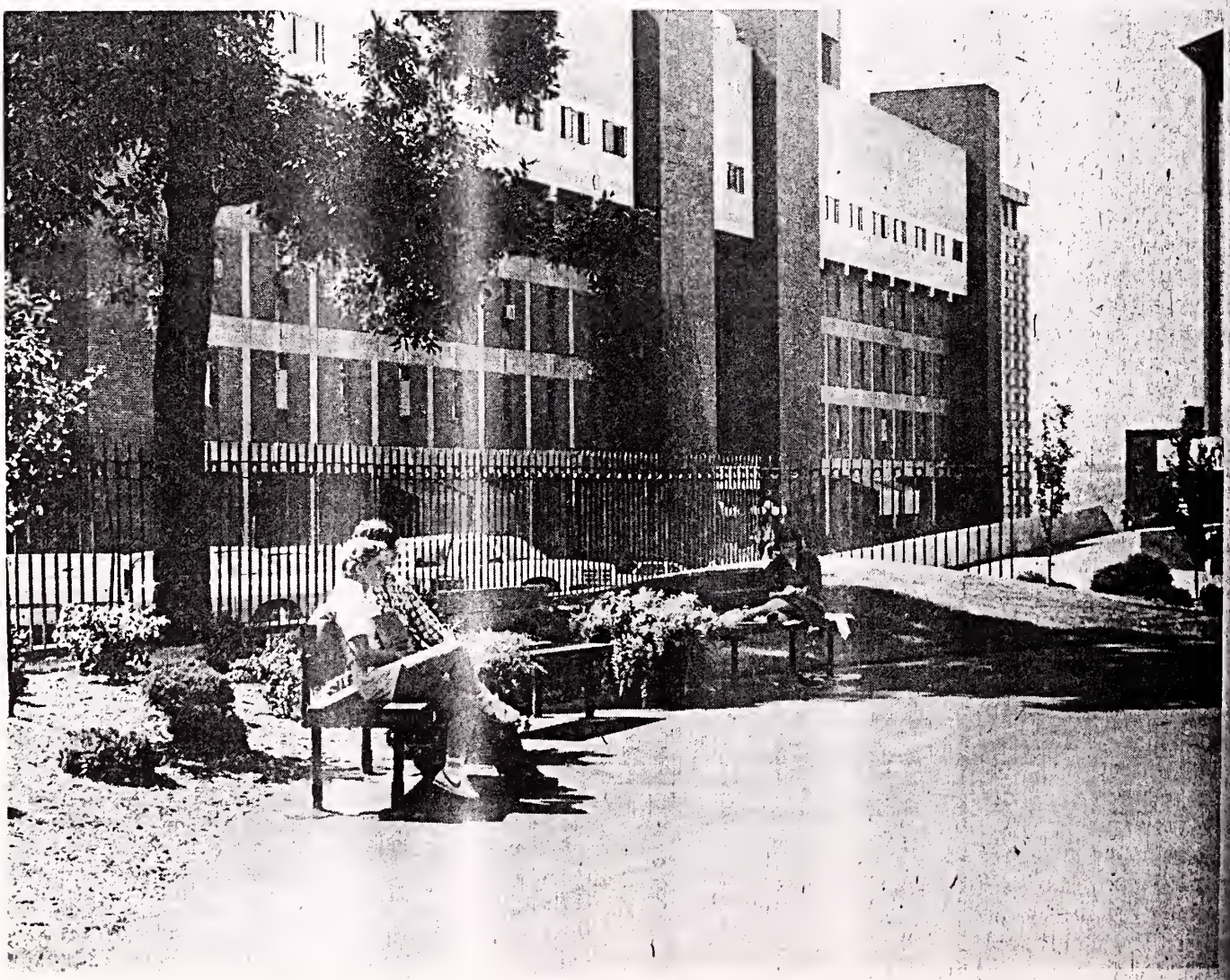
The ROTC programs offer academic instruction, alternate and supplementary career opportunities, leadership experience and financial aid.

ESF Alumni Association

The Alumni Office serves as the liaison between the College, the Alumni Association Board of Directors and more than 9,000 alumni. The Association supports education programs through scholarships, publishes a quarterly newsletter and represents alumni concerns.

ESF Student Rules and Regulations

The complete listing of guidelines for all students attending ESF is found in a separate publication, the *Student Handbook*, which is distributed at registration. "Rules and Regulations of Conduct and Behavior" which pertains to all students is included in the *Handbook*. It is the student's responsibility to be familiar with these regulations and abide by them.



Degree Programs and Areas of Study

The College is authorized to award degrees in the following programs. Enrollment in other than registered or otherwise approved programs may jeopardize a student's eligibility for certain financial aid programs.

School of Biology, Chemistry and Ecology

Chemistry; B.S., with areas of study in biochemistry, natural products chemistry, environmental chemistry, or natural and synthetic polymer chemistry. (HEGIS CODE 1905)

Forest Chemistry; M.S., Ph.D., with areas of study in biochemistry, natural products chemistry, environmental chemistry, or natural and synthetic polymer chemistry. (HEGIS Code 1905)

Environmental and Forest Biology; B.S., M.S., Ph.D., with areas of study in ecology, entomology, environmental physiology, fish and wildlife biology and management, pathology and mycology, pest management, plant science, soil ecology, or zoology. (HEGIS Code 0499)

Interdepartmental area of study in chemical ecology; M.S., Ph.D.

School of Forestry

Forest Technician Program; A.A.S. (HEGIS Code 5403)

Resource Management—General Forestry; B.S. (HEGIS CODE 0115)

Forest Resources Management; M.S. Ph.D., with areas of study in policy and administration, forestry economics, forest management, recreation management, silviculture, silvics, forest soil science, tree improvement, forest influences, international forestry, urban forestry, and quantitative methods. (HEGIS Code 0115)

School of Environmental and Resource Engineering

Forest Engineering; B.S. (HEGIS Code 0999)

Paper Science and Engineering; B.S. (HEGIS Code 0999)

Wood Products Engineering; B.S., with options in building construction, or forest products in which emphasis may be chosen in marketing, production systems engineering, or wood science. (HEGIS Code 0999)

Environmental and Resource Engineering; M.S., Ph.D., with areas of study in forest engineering, paper science and engineering, or wood products engineering. (HEGIS Code 0999)

School of Landscape Architecture

Environmental Studies; B.S. (HEGIS Code 0201)

Landscape Architecture; B.L.A. (HEGIS Code 0204)

Landscape Architecture; M.L.A., with areas of study in social/behavioral studies, natural/physical applied sciences, or design process, methods and management. (HEGIS Code 0204)

Collegewide Program

Graduate Program in Environmental Science; M.S., Ph.D., with areas of study in energy, environmental communications, land use, urban ecosystems, waste management, and water resources. (HEGIS Code 0420)

THE SCHOOL OF BIOLOGY, CHEMISTRY AND ECOLOGY

STUART W. TANENBAUM, *Dean*

The School of Biology, Chemistry and Ecology offers two curricula in environmental science and forestry through the Department of Environmental and Forest Biology and the Department of Chemistry.

ENVIRONMENTAL AND FOREST BIOLOGY

ROBERT L. BURGESS, *Chairman*

The Department of Environmental and Forest Biology provides students with a firm foundation in basic biology in association with the principles of forest ecosystem dynamics and environmental science. It encompasses a variety of interconnected disciplines concerned with living systems, and treats 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.

Effective management and protection of forests and related natural resources are increasingly dependent upon the understanding of living systems relative to productivity and tolerance to environmental impacts caused by the activities of man. Therefore, basic knowledge of biology is prerequisite to desirable practices and sound regulations for optimizing both the development and use of natural resources while avoiding deleterious impacts.

The critical importance modern society places upon the utilization of natural resources and the quality of our environment adds new and increasingly diverse dimensions to the services a well-trained biologist can render. The department is committed to meet this dynamically changing array of opportunity through diverse courses enriched by an active program of research that focuses upon upper-level undergraduate and graduate study. Through the addition of selected electives to a required core, undergraduates may focus their program toward a special biological field (see p. 35) or toward future graduate study. Graduate students may develop a course of study under the guidance of a major professor and graduate committee within any of several study concentrations (see p. 36).

The academic programs stimulate interest in the recognition and understanding of plants, animals, and protists, and deal with an understanding of the

dynamic changes in biological systems in the context of the broad fields of ecology, physiology, evolution, and genetics. This understanding is accomplished by an integration of coursework with a strong research program, much of which is concerned with natural resource management and improvement of the quality of our environment.

Undergraduate Program

The curriculum for the Bachelor of Science degree is built around a core of required courses which provide the student with a general education, a basic background in the principles of the biological and the physical sciences, and an orientation to forestry. Its design develops breadth in biology as well as depth in a selected biological field. Thus, although individual course selections may vary, all students major in environmental and forest biology and each, with an assigned advisor, develops a special plan of study.

A dual-major program is available that meets the undergraduate requirements of both the School of Forestry and the School of Biology, Chemistry and Ecology (see p. 64).

A total of 125 credit hours, 60 of them prior to matriculation, is required for the Bachelor of Science degree. In addition to the core courses specified below, at least 21 hours in biology must be completed and, of these, at least 15 are to be from courses given in the College of Environmental Science and Forestry. These courses should be compatible with the intended concentration of study and must be at the 300 level or above. Six of the 21 credit hours must involve subject matter in plant science and six in animal science, both exclusive of the five-hour summer field requirement. The balance of the required hours is chosen in consultation with the advisor.

Lower Division Courses

The curriculum facilitates transfer of freshman and sophomore credits from other institutions. To assume training in residence at the junior level, entering students must have successfully completed a minimum of 60 credits which include:

Course Area	*Credit Hours*
General Chemistry with Laboratory	8
Organic Chemistry with Laboratory	8
General Physics with Laboratory	8
Mathematics proficiency, through Integral Calculus	4-8
English	6
*Social Sciences—Humanities	9-12
General Botany and Zoology **OR** General Biology with Laboratory	8
Biology Electives	3-6
TOTAL MINIMUM LOWER DIVISION CREDITS	60

*A course in technical writing and/or speech is recommended as part of the Social Science—Humanities group.

Upper Division Courses

Junior Year			*Credit Hours*
First Semester	EFB 336	Dendrology I	3
	EFB 320	General Ecology	3
	EFB 352	Elements of Forest Entomology	3
	Electives		6
			15
Second Semester	APM 491	Introduction to Probability and Statistics	3
	FOR 345	Soils **OR** GOL 105 Earth Science	3
	EFB 325	Cell Physiology	3
	Electives		6
			15
SUMMER FIELD EXPERIENCE—Must be met as described on page 34			5

Senior Year			*Credit Hours*
First Semester	Electives		15
Second Semester	EFB 407	Principles of Genetics	3
	EFB 408	Genetics Laboratory	1
	Electives		11
			15
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

A total of 125 credit hours is required to complete the B.S. degree in Environmental and Forest Biology.

SUMMER FIELD EXPERIENCE

The curriculum requires that between the junior and senior year each student completes a minimum of five semester credit hours or its equivalent during residence in an approved academic program in field biology. This requirement can be met by the appropriate selection of courses at the Cranberry Lake Biological Station (CLBS) where courses are offered during each of two sessions (see p. 35). Earning five credits at one session satisfies the requirement; any additional courses taken in the other session count as elective credits.

One of the following alternatives to the CLBS program may be selected to fulfill the summer field requirement:

Alternative 1

Students desiring an experience in the principles and practices of professional forestry may attend the Summer Session in Field Forestry at the Pack Forest, Warrensburg Campus. Field instruction at this Campus emphasizes subject matter in forestry, surveying, mensuration, and cartography.

Alternative 2

Other biological field stations may be attended to earn the minimum five semester hours credit or its equivalent. Petitions requesting this alternative must include course descriptions and the program contemplated and be submitted no later than one month prior to the end of the spring semester preceding the summer program. A current file of alternative stations and course descriptions is maintained by the director of the Cranberry Lake Biological Station.

Alternative 3

EFB 420, Field Experience-Internship, may be authorized by petition when

containing a major field-learning component and when thoroughly planned and well documented. It must be related to and supportive of the indicated career goal. The student must receive advance agreement from a member of the Department of Environmental and Forest Biology faculty to guide, collaborate, evaluate a work plan for the summer, and later assign a grade and credits to the internship. The plan must be submitted at least one month prior to the end of the spring semester and must be approved by the Curriculum Director.

Electives

General requirements for graduate study and a wide range of federal, state, municipal, and private biology positions are met by the curriculum. Through skillful selection of electives, the student may prepare for special biological fields related to natural resources or the environment. Those training for biological positions in federal and state service should review Civil Service publications and become familiar with specific course requirements early enough to make timely elective choices. Students planning to meet special requirements for Federal Civil Service positions in forestry may do so by electing 10 credits in forestry courses and attending the Summer Session in Field Forestry at the Warrensburg Campus. Students are urged to use some elective time to enhance their communications skills. Courses in technical writing, applied communications or a language (as approved by their faculty advisor) are useful.

Special Biological Fields

Animal Physiology. Without further specialization, job opportunities in this field are limited, but those at the bachelor level include technician work in a laboratory, medical school, hospital, or in a liberal arts college; clerical work in government information agencies such as at the National Medical Library, and the Smithsonian Institution; and sales opportunities with the pharmaceutical and chemical industries.

Entomology. Insects play significant roles, both beneficial and detrimental, in their interactions with man, his resources, and his environment. Several courses are available on insect life and functions that enable a student to fulfill requirements of Civil Service and a variety of other employers. Program strengths are in forest entomology, medical entomology, pest management, and environmental toxicology.

Environmental Microbiology. Microbiology is a dynamic and exciting science—vital in the world today and for the future. This science deals with bacteria, molds, algae, yeasts, protozoa, rickettsiae, and viruses: their roles in industry, disease, the environment, and everyday life. Careers in microbiology are available throughout the public and private sectors, and related to many different professions and industries.

Fish and Wildlife Biology and Management. A basic and applied program in fish and wildlife biology, including management and behavior, is provided for the student whose objectives are to develop professional skills in the biology and management of these natural resources.

Forest Pathology and Mycology. Protection of vascular plants and wood products from invading organisms, such as fungi, is basic to forest productivity, effective wood product use, and the maintenance of environmental quality. Program strength is in the ecological, physiological, genetic, and environmental aspects of disease. Students may train for positions in forest pathology, mycology, pest management, plant quarantine, or diagnostic laboratories. Opportunities for employment exist with federal, state, and private agencies.

Pest Management. Modern control of insects and disease dictates practices appropriate to maintaining an acceptable environmental quality. Through proper selection of courses, a student is able to achieve training that will result in wise selections of methods for an integrated approach to pest management. Training is more than adequate to prepare students for state examinations required for pesticide applicator's certification.

Plant Physiology. Plant physiology, part of the broader science of botany, attempts to understand the life processes that occur in plants. Career opportunities are available through federal, state, and local governments through their extensive testing and monitoring programs. Additionally, positions are available in agriculture and forestry concerning pathogenic microorganisms and physiological mechanisms of infection.

Plant Science. Students may prepare for a wide variety of opportunities in the botanically oriented professions. Essential to understanding plants are their biochemical and physiological processes; their interactions with the environment and with one another; with animals and other organisms; their genetic makeup, evolution and classification. Requirements may be satisfied for technical positions in areas such as botany, plant ecology, tree genetics, plant physiology, horticulture, tree maintenance, or plant quarantine.

Zoology. A basic and broad program is provided for the student whose objectives are to go on for graduate study or to further training in such subjects as physiology, soil invertebrate ecology, animal behavior, or animal ecology. Some opportunities with federal and state agencies are available at the baccalaureate level.

Cranberry Lake Biological Station

Students in the Environmental and Forest Biology curriculum generally satisfy their summer requirement by attending either session at the Cranberry Lake Biological Station. Courses at the Station are senior-level offerings designed to come after the junior year spent on the Syracuse Campus. Students elect courses during one session for a total of five semester-hours. Extra credits earned by attending both sessions count toward elective hours in biology. Students from other institutions are welcome.

Cranberry Lake and its environs are ideally suited for an advanced biology summer program. The surrounding topography is rolling hill and lake country dotted with numerous small ponds, closed bogs, and stream drainages. The lake itself is the third largest body of water in the Adirondacks. Because 80 percent of the shoreline is in State ownership, the lake remains relatively unspoiled by recreational developments and is free of pollution problems. Much of the original forest cover in the region was harvested years ago; today a rich variety of community types occupy those sites as the vegetation reverts to natural conditions. The remaining virgin forests also provide the student with many examples of stable forests, each

type reflecting the particular environmental conditions controlling forest development. A wealth of wildlife parallels the variety of cover types over the region. The area provides easy access to a wide range of additional ecosystems ranging from bog to alpine types.

Facilities include four classroom-laboratories; dining facilities capable of serving 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 from mid-June into mid-August and is divided into two sessions. Courses are designed to emphasize and effectively utilize the unique nature of this Adirondack setting, and all involve field trips each day into the surrounding forest and aquatic ecosystems.

Students wishing more information about the Summer Program, including courses and fees, may write to the Director, Cranberry Lake Biological Station, State University of New York College of Environmental Science and Forestry, Syracuse, New York 13210.

Graduate Program

The graduate program in Environmental and Forest Biology is organized in nine interdependent biological study concentrations that provide comprehensive coverage within specific interest areas. Each concentration is governed by indicated faculty who define the scope of subject matter, recommend acceptance of students and guide them in a course of study. Some of these concentrations follow taxonomic lines while others are broad unifying areas basic to all taxa. Students choosing to emphasize a taxonomiccategory should explore the desirability of engaging to some extent in the broader interdisciplinary areas. Similarly, it is often opportune for students enrolled in the latter to develop a degree of specialization in at least one taxon as a means of assuring a useful mix of talents. Those students whose interests are not served by the designated areas of concentration should explore the feasibility of alternate routes of study, provided the needed expertise is available, and they may be guided by faculty listed in the concentration nearest the student's interest.

Most students seeking the M.S. degree include in their study plan a research thesis and its defense (see p. 27). There also is an option to earn the degree with 42 hours of coursework, the latter specified by the student's advising faculty according to concentration core requirements. All who seek the Ph.D. must include original research and dissertation or its equivalent in the form of refereed publications.

The major center of activity is Illick Hall, with the laboratories, classrooms, controlled spaces, and equipment that one would expect in a modern building in which 85,000 square feet of working space is available for graduate study and research. Laboratories, many of them temperature and temperature-humidity controlled, and one sound-controlled, are provided for study and research in plant development, physiology, tissue culture, biochemistry and toxicology, ecology, and animal behavior. An herbarium, mycological collections, insect and other arthropod collections, and the Roosevelt Wildlife Collection of vertebrates are maintained in archival condition as useful 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.

Also available to the Department's students and faculty is a variety of sophisticated instrumentation: convenient access to a computer center; radioisotope counting equipment, including liquid scintillation spectrometer and Cobalt-60 source; diverse analytical equipment and measuring devices; gas-liquid chromatography; and, in collaboration with the Chemistry Department, a comprehensive analytical expertise. The Nelson C. Brown Center for Ultrastructure offers scanning and transmission electron microscopy capability.

Supportive to the program are the academic resources, including courses, of Syracuse University, SUNY's Upstate Medical Center and the several campus facilities described elsewhere in this catalog. Our students participate as well in courses and utilize faculty and facilities at Cornell University in cooperative exchanges.

Excellent field sites and facilities are available for research in all aspects of the program in nearby or moderately distant locations from the Syracuse campus. 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 that collectively offer a variety of habitat diversity from highlands to aquatic-terrestrial zones. The ponds, streams, and lakes in Central New York and the St. Lawrence River are regularly used by graduate students in wetlands and aquatic ecology and fishery biology.

Further academic advantages stem from the urban setting of the Syracuse campus. The Greater Syracuse area provides a convenient laboratory for studies basic to urban forestry: the growth and protection of woody vegetation, green-space 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 pollutants and wastes require 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 study-in-depth of many elements of basic biology offering substantial assistance toward the solution of pressing human problems.

Of the nine available study concentrations, eight are contained within the department: *Ecology, Entomology, Environmental Physiology, Fish and Wildlife Biology and Management, Pathology and Mycology, Plant Science, Soil Ecology, and Zoology*. One concentration, *Chemical Ecology*, is shared with faculty of the Chemistry Department.

Ecology

ALEXANDER (Vertebrates, Wetlands), ALLEN (Forest Insects), BEHREND (Wildlife), BRANDT (Fisheries Biology), BROCKE (Wildlife, Bioenergetics), BURGESS (Forest Ecology), CHAMBERS (Wildlife), DINDAL (Invertebrates), GEIS (Plants, Wetlands), KETCHLEDGE (Dendrology, Bryology), KURCZEWSKI (Insect Behavior), MITCHELL (Invertebrates, Bioenergetics), MÜLLER-SCHWARZE (Vertebrates, Behavior), NAKAS (Microbiology), PORTER (Vertebrate Ecology), RAYNAL (Higher Plants, Taxonomy), RINGLER (Aquatic Ecology), SCHAEDLE (Plant Nutrition), SHIELDS (Vertebrate Behavior), SIMEONE (Forest and Wood-boring Insects), VANDRUFF (Wildlife), WERNER (Limnology).

Understanding relationships between living organisms and their abiotic and biotic environment is fundamental to environmental science which also encompasses man's role in ecological systems. Ecology is an integrative science which depends on an understanding of ecological theory, habitat characteristics, and the basic biological attributes of organisms. This concentration area encourages the incorporation of this knowledge into those areas of practical concern. Specific research may entail the study of: distribution and abundance of organisms; community structure including trophic relationships, diversity or succession; and ecosystem properties such as patterns of energy transfer and biogeochemical cycling.

Entomology

ABRAHAMSON (Forest Insects, Pest Management), ALLEN (Forest Insects, Population Ecology), BREZNER (Physiology), CASTELLO (Virology, Insect Vectors), KURCZEWSKI (Morphology, Taxonomy, Behavior), LANIER (Forest Insects, Pheromones, Cytotaxonomy), MILLER (Pest Management), MITCHELL (Population Ecology), NAKATSUGAWA (Toxicology), NORTON (Spiders and Mites, Insect Larval Taxonomy), RINGLER (Aquatic Entomology), SIMEONE (Forest and Wood-inhabiting Insects).

Adjunct Faculty

HOWARD (Medical Entomology).

Graduate study opportunities prepare students in the basic aspects of insect life and the role of insects in relation to man and his 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 man and those playing key roles as parasites and predators of pest species. Current research areas include population dynamics of forest defoliators, pheromone communications among beetles and moths, speciation of insects as understood through behavioral and cytogenetic study, natural control of insects in forest systems and basic biochemistry of insect detoxification mechanisms.

Environmental Physiology

BREZNER (Insect Physiology), CASTELLO (Plant Virology), GRIFFIN (Fungus Physiology), HARTENSTEIN (Invertebrate Physiology), MITCHELL (Environmental Energetics), NAKAS (Microbial Physiology), NAKATSUGAWA (Insect and Vertebrate Toxicology), SCHAEDLE (Plant Physiology), WALTON (Plant Physiology), WILCOX (Plant Physiology).

The Environmental Physiology Concentration provides students with advanced training to develop an understanding of the nature and control of biological processes. Programs are developed according to chosen academic goals and research opportunities available. Current interests include mechanisms of action of plant growth hormones; biochemical regulation of seed germination; plant and microbial enzymology; virology; toxicity and disposition of insecticides and environmental toxicants in vertebrates; production and action of plant phytoalexins and antibiotics; plant defenses against phytophagous invertebrates; mycorrhizae, ion transport; mineral nutrition, cambial physiology and photosynthesis.

Fish and Wildlife Biology and Management

ALEXANDER (Vertebrates, Herpetology), BEHREND (Vertebrates), BRANDT (Fisheries Management), BROCKE (Vertebrates), CHAMBERS (Vertebrates), MÜLLER-SCHWARZE (Vertebrate Behavior), PAYNE (Ornithology), PORTER (Vertebrate Ecology), RINGLER (Fisheries, Aquatic Ecology), SHIELDS (Vertebrate Behavior), VANDRUFF (Vertebrates, Ornithology), WERNER (Limnolgy, Fisheries).

Adjunct Faculty

MATTFELD (Wildlife Biology), NOON (Wildlife Biology), SCHACHTE (Fisheries Biology), SUGATT (Aquatic Toxicology).

Study in this area provides students with advanced preparation in biological concepts of fish and wildlife populations, particularly as they relate to the proper management of these important resources. Widespread and increasing concern for management of these wild animal resources has been matched by strong student interest in educational programs which prepare them for careers in the fish and wildlife professions. Graduate education, such as is available through this study area, is rapidly becoming a universal prerequisite to employment as a professional fisheries or wildlife biologist.

Areas of research include wetland ecology and management of wetland species, population-habitat relationships, predator ecology, urban wildlife relationships, endangered species studies, feeding ecology of fishes, stream ecology, ecology of larval fishes and homing behavior of fishes.

Forest Pathology and Mycology

ABRAHAMSON (Forest Pathology, Entomology), CASTELLO (Forest Pathology), GRIFFIN (Fungus Physiology), MANION (Forest Pathology), NAKAS (Microbiology), VALENTINE (Genetics), WANG (Mycology), WILCOX (Mycorrhizae), ZABAEL (Forest Pathology and Wood Deterioration).

The study area in Forest Pathology and Mycology trains students interested in developing an expertise responsive to the increasing pressures on forest and shade tree systems for wood fiber, public services, and amenities. This requires new sophisticated levels of disease understanding, disease control, a broad knowledge of fungi, bacteria and viruses, their environmental impacts and their roles in biodeterioration. Areas of staff interest and expertise appropriate for graduate student research emphasis include: environmental, fungal and viral tree diseases; mycorrhizae; wood decay and biodegradation processes; monitoring and impact assessment of disease in forest and urban tree systems; chemical and biological control of tree diseases; epidemiology of tree diseases and the genetics of resistance to tree diseases and to pathogen variability; physiology

of fungus growth and development; taxonomy and biology of decay and imperfect fungi; and fungus ultrastructure.

Plant Science

BURGESS (Ecology), CASTELLO (Virology), GEIS (Ecology), GRIFFIN (Mycology, Fungus Physiology), KETCHLEDGE (Ecology, Bryology), LOWE (Mycology), MANION (Pathology), NAKAS (Microbiology), RAYNAL (Ecology, Taxonomy), SCHAEDLE (Physiology), SILVERBORG (Pathology), TEPPER (Anatomy, Morphogenesis), VALENTINE (Genetics), WALTON (Physiology), WANG (Mycology), WILCOX (Physiology, Mycorrhizae), ZABEL (Pathology, Wood Deterioration).

Adjunct Faculty

AMES (Physiology), FAUST (Taxonomy), ZABLOTOWICZ (Microbiology).

Plants, as the principal energy source for ecological food chains, serve as the structural and functional foundation of natural and managed ecosystems. The plant science concentration provides opportunity for study in a broad range of specialties fundamental to the understanding of plants and their interaction with other organisms, emphasizing both forest and related plant systems. Current faculty and student 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; decay, discoloration and biomodification of wood; taxonomy, physiology, growth and ultrastructure of fungi; heritability of wood properties and disease resistance of trees; biochemistry and physiology of plant growth regulators; photosynthesis; mineral nutrition; mycorrhizae; bryoecology; morphogenesis in shoot and root systems; and plant tissue culture.

Soil Ecology

DINDAL (Invertebrates), HARTENSTEIN (Invertebrates, Physiology), MITCHELL (Invertebrates, Energetics), NAKAS (Microbiology), NORTON (Invertebrates, Taxonomy), WANG (Mycology), WILCOX (Mycorrhizae), ZABEL (Wood Biodegradation).

Soil ecology includes the study of interrelationships of soil-inhabiting organisms (as individuals, populations and communities) with their biotic, chemical, and physical environments. This field can be considered to be a frontier of science because of the myriad of undescribed species of soil-dwelling arthropods, nematodes and annelids, and the wealth of incompletely understood symbiotic relationships that can be readily discovered by students in this concentration. Soil ecology deals with fundamental aspects of biodegradation and nutrient cycling and is therefore important for improvements in crop culture and enlightened waste disposal.

The soil ecology concentration is supported by courses in physical aspects of soils, plant and animal taxonomy and general ecology.

Zoology

ALEXANDER (Vertebrates, Wetlands), BROCKE (Vertebrates), CHAMBERS (Wildlife Ecology, Management), DINDAL (Invertebrates), HARTENSTEIN (Physiology, Invertebrates), MITCHELL (Invertebrates, Bioenergetics), MÜLLER-SCHWARZE (Vertebrate Behavior), NORTON (Arachnology), PORTER (Wildlife Biology), RINGLER (Fish Behavior), VANDRUFF (Vertebrates, Wildlife Biology), WERNER (Limnology, Aquatic Ecology).

Adjunct Faculty

BENZO (Vertebrate Physiology), DEGENNARO (Vertebrate Physiology, Embryology).

Zoology provides opportunity for in-depth coursework and fundamental research in morphology, physiology, taxonomy, and behavior of invertebrate and vertebrate animals. As one of the basic areas in the Department of Environmental and Forest Biology, Zoology is supportive of other concentrations such as Ecology, Fish and Wildlife Biology and Management, and Soil Ecology. Graduate studies in Zoology include both basic and applied research on animals of our natural ecosystems, including their associated soils and waters.

FOREST CHEMISTRY

KENNETH J. SMITH, *Chairman*—(Physical and Polymer Chemistry), CABASSO (Polymer Chemistry), CALUWE (Organic Polymer Chemistry), CAMPBELL (Phytoenzymology), HASSETT (Environmental Chemistry), JOHNSON (Environmental Chemistry), LALONDE (Organic and Natural Products Chemistry), SARKO (Physical and Polymer Chemistry), SILVERSTEIN (Ecological Chemistry), SMID (Physical and Polymer Chemistry), TIMELL (Wood Chemistry).

The academic program in forest chemistry enables the student to develop not only an understanding of chemical phenomena, but also an appreciation for chemistry that can link it to the biological and applied sciences. Programs include courses in traditional areas of chemistry, with additional study in those fields pertaining to environmental science and forestry. This broad spectrum of academic offerings is possible through close cooperation with Syracuse University, where a wealth of accessory courses at both the undergraduate and graduate levels are available. Emphasis on the investigative function of chemical science is manifest in the wide array of ongoing research projects within the department.

The Department of Chemistry offers the following areas of concentration leading to the Bachelor of Science degree:

Biochemistry and Natural Products Chemistry

Environmental Chemistry

Natural and Synthetic Polymer Chemistry

Students in all options, by selecting proper electives, may be certified on graduation as having completed an American Chemical Society approved curriculum. All options are excellent grounding for professional work at the B.S. level or for advanced graduate study.

Undergraduate Program

Lower Division Courses

For students transferring into the College as juniors, recommended courses consist of 68 credits or an associate degree and include:

Course Area	*Credit Hours*
Biology with Laboratory	8
General Chemistry with Laboratory	8
Organic Chemistry with Laboratory	8
Physics with Laboratory	8
Economics	3
English	6
Language, Literature or Communication	6
Electives	12-15
*Mathematics	6-9
TOTAL MINIMUM LOWER DIVISION CREDITS	68

*Mathematics through integral calculus. An additional mathematics course beyond integral calculus is required for the B.S. degree.

Upper Division Courses

Junior Year			*Credit Hours*
First Semester	FCH 325	Organic Chemistry III	4
	[3]CHE 332	Quantitative Analysis	2
	CHE 333	Quantitative Analysis Laboratory	1
	FCH 360	Physical Chemistry	3
	[1]Professional Elective		2-4
	Elective		3
			15-17
Second Semester	[2]Math or Elective		3
	FCH 380	Instrumental Methods	3
	FCH 361	Physical Chemistry	3
	CHE 357	Physical Chemistry Laboratory	2
	FCH 384	Spectrometric Identification of Organic Compounds	2
	[1]Professional Elective		2-3
	Elective		3
			18-19

[1]A sequence of professional electives should be chosen in the junior year. In addition to the freshman biology courses, a student whose emphasis is in biochemistry must take 3 semester hours of genetics and at least one other 3-semester-hour biology course. A student whose emphasis is in natural products must take 3 semester hours of biology in addition to the freshman biology courses and an additional hour of organic chemistry laboratory (FCH 496) and a second hour of FCH 384.

[2]One course of mathematics or applied mathematics beyond MAT 397, or equivalent, is required.

[3]CHE designations refer to courses offered at Syracuse University.

Biochemistry and Natural Products Chemistry Option

This option is designed for students who wish to approach problems in the life sciences with the tools and point of view of the chemist. In addition to a major concentration in the several branches of chemistry, the student obtains a solid grounding in the fundamentals of physics, mathematics, and biology. Professional electives can provide a minor concentration in botany, ecology, entomology, zoology, or physiology. Collaborative efforts of chemists and biologists are providing new solutions to problems of environment, natural resources, and health.

Senior Year			*Credit Hours*
First Semester	LIB 300	Library Research	1
	FCH 495	Introduction to Professional Chemistry	1
	FCH 571	Wood Chemistry I	2
	FCH 574	Wood Chemistry Laboratory	1
	FCH 530	Biochemistry I	3
	FCH 531	Biochemistry Laboratory	2
	[1]Elective		3
	Elective		3
			16
Second Semester	[2]FCH 498	Introduction to Research	5
	FCH 497	Undergraduate Seminar	1
	FCH 532	Biochemistry II	3
	FCH 573	Wood Chemistry III	2
	Elective		3
	Elective		3
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

[1]Introduction to Polymer Science, FCH 550 (3 credit hours) is suggested.
[2]Petition by student to Department for replacement of this requirement will be considered to allow time for special interest.

A total of 134 credit hours is required to complete the B.S. degree in Chemistry with the Biochemistry and Natural Products option.

Environmental Chemistry Option

The environmental chemistry option is designed for those students who wish to obtain a solid fundamental background in chemistry which will enable them to make a strong contribution towards the identification and solution of problems in the areas of pollution, air and water quality, analysis and basic research in environmental chemistry. A large number of professional electives, available through course offerings of other departments such as biology and engineering, provide the important interface with other disciplines necessary for a working understanding of the complex problems inherent in environmental studies.

Senior Year			*Credit Hours*
First Semester	LIB 300	Library Research	1
	FCH 495	Introduction to Professional Chemistry	1
	FCH 510	Environmental Chemistry I	3
	FCH 515	Methods of Environmental Chemical Analysis	3
	Chemistry Elective		3
	[1]Elective		3
	Elective		3
			17
Second Semester	[2]FCH 498	Introduction to Research	5
	FCH 511	Environmental Chemistry II	3
	FCH 497	Undergraduate Seminar	1
	FCH 519	Environmental Chemistry Seminar	1
	Electives		6
			16
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

[1]Biochemistry I, FCH 530, (3 credit hours) is suggested.
[2]Petition by student to Department for replacement of this requirement will be considered to allow time for special interest.

A total of 134 credit hours is required to complete the B.S. degree in Chemistry with the Environmental Chemistry option.

Natural and Synthetic Polymer Chemistry Option

This option is designed for students interested in the structure and physical properties of man-made and natural materials, the giant molecules of wood, plastics, polysaccharides, proteins, rubbers, and fibers. The recently discovered chemistry of these materials constitutes one-half the concern of the chemical industry and is the origin of a major revolution in our way of life and our understanding of nature. This special subject area is an advanced core of studies beyond the basic courses of the classical undergraduate chemistry curriculum.

Senior Year

			Credit Hours
First Semester	LIB 300	Library Research	1
	FCH 495	Introduction to Professional Chemistry	1
	FCH 550	Introduction to Polymer Science I	3
	FCH 551	Polymer Techniques	2
	FCH 571	Wood Chemistry I	2
	FCH 574	Wood Chemistry Laboratory	1
	[1]Elective		3
	Elective		3
			16
Second Semester	[2]FCH 498	Introduction to Research	5
	FCH 552	Introduction to Polymer Science II	3
	FCH 497	Undergraduate Seminar	1
	FCH 573	Wood Chemistry III	2
	Electives		6
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

[1]Biochemistry I, FCH 530 (3 credit hours) is suggested.
[2]Petition by the student to Department for replacement of this requirement will be considered to allow time for special interest.

A total of 134 credit hours is required to complete the B.S. degree in Chemistry with the Natural and Synthetic Polymer option.

Graduate Program

Recent years have seen profound advances in the fundamental knowledge of chemical areas which have special significance for forestry and the environment. The following research areas have received active attention by both faculty and graduate students in the programs: polymer chemistry and physics; wood chemistry; environmental chemistry; biochemistry; chemistry of natural products, including ecological chemistry; and materials sciences.

Requirements for a master of science or doctor of philosophy degree in chemistry include a research project and thesis, along with an appropriate program of courses at the College and at Syracuse University.

Specific projects may vary from year to year, since they reflect the current interests of the faculty. Current research projects with *physiochemical* emphasis are: the chemistry, physics, solid-state and solution properties of natural and synthetic polymers, including studies in thermodynamics, statistical mechanics, crystallization, morphology, elasticity, conformation of macromolecules, optical properties, polymer catalysis, mechanism of polymerizations, polyelectrolytes, ion binding to macromolecules and ion pairing; chemistry of free radicals, radical ions and charge transfer processes; structure and properties of ionic solutions in nonaqueous media; crystal structure and morphology of cell wall constituents; membrane properties and technology; and heavy metal speciation. Current *organic* chemistry programs deal with synthesis of special polymers such as high temperature aromatic block, stereoregular vinyl polymers, and polysaccharides, various aspects of natural products chemistry, but especially alkaloids and terpenes, isolation and characterization of insect and mammalian attractants. An active program on the structure and topochemistry of the *polymeric* wood components, hemicelluloses, lignins and celluloses is underway. In *biochemistry*, department members are studying mechanisms of action of plant growth

hormones, biochemical regulation of seed germination, plant enzymology, and ultrastructural plant cytology.

Graduate research laboratories in the Hugh P. Baker Laboratory are well equipped for polymer studies, chemical, and biochemical research. Instrumentation includes analytical and preparative ultracentrifuges, Warburg respirometer, recording infrared and ultraviolet spectrophotometers, mass spectrometer, differential refractometer, electron spin resonance spectrometer, nuclear magnetic resonance spectrometers, automatic membrane osmometers, solid- and solution-state light scattering photometers, recording polarimeter and optical dispersion spectrometer, analytical and preparative high performance liquid chromatographs, combined gas chromatographs—mass spectrometry center, spectrofluorimeter, several ultramicrotomes, electron microscopes, X-ray diffraction, instrumentation chromatography and cold laboratories, and radiochemical laboratories with counters for solids, liquids, and gases.

INTERDEPARTMENTAL AREA OF STUDY

The following concentration in chemical ecology is offered in collaboration with faculties of the Department of Environmental and Forest Biology and the Department of Chemistry. Interested students should apply to the department of major interest, which will have prime responsibility for setting requirements. Faculty from both departments can aid in 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 to grapple with problems requiring an understanding of both.

Chemical Ecology

LANIER (Insect Pheromones), MÜLLER-SCHWARZE (Vertebrate Pheromones), SILVERSTEIN (Pheromone Chemistry), SIMEONE (Insect Pheromones), TANENBAUM (Microbial Chemistry).

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 occur at all taxonomic levels: between uni- and multicellular organisms, microbes and plants, plants and plants, plants and animals, microbes and animals, animals and animals. Study of such interactions has been accelerated in recent years through joint efforts of biologists and chemists in meaningful research accompanied by a growing body of literature.

THE SCHOOL OF ENVIRONMENTAL AND RESOURCE ENGINEERING

WILLIAM P. TULLY, *Dean*

The School of Environmental and Resource Engineering offers three undergraduate curricula and one graduate program which support the engineering aspects of environmental science and forestry through the Departments of Forest Engineering, Paper Science and Engineering and Wood Products Engineering. A Bachelor of Science degree is awarded in each of these fields while advanced degrees (M.S. and Ph.D.) are offered through the graduate program in Environmental and Resource Engineering.

The undergraduate curricula provide students with a broad base of study and specialized education in engineering, science, and technology. Students learn to apply their education to improve the economic use of forest and rural resources, to enhance environmental quality and to increase the efficiency of processes and the wise use of water and timber, wood, paper, and related fibrous material products. Graduates are prepared for a variety of careers in industry and government service in these fields.

The specific requirements for entering each curriculum at the junior level and for completing the coursework residency requirements for the B.S. degree are described with the individual departmental programs which follow. During late May the School offers a Summer Institute for pre-ESF students preparing to enroll in these curricula one or two years hence. Participants receive detailed academic guidance and learn about career opportunities.

Qualified applicants with associate degrees in engineering science or an appropriate blend of science and mathematics usually gain full admission at the junior level. Graduates of two-year technology programs also may qualify for junior standing in certain curricula if their previous studies included the courses appropriate to departmental requirements.

Graduate Program

The Graduate Program in Environmental and Resource Engineering is based on a synthesis of the professional activities of the three curricular areas described above. Both the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees are offered. The program provides students with a balanced understanding of scientific research, engineering measurement, and engineering analysis and design, and with specialized depth and appropriate interdisciplinary breadth of knowledge in environmental and resource engineering. Its graduates are prepared for professional careers as leaders in the private and public sectors of research, engineering, technology, teaching and administration in the industries and professions served by this program.

In its broadest sense this program is concerned with the application of science and engineering to the development and improved utilization of the natural environment and its forest-related resources. Thus, graduate education is understood to involve a wide range of scientific and engineering abilities and attitudes.

Specialized areas of study have been delineated to serve student interests. Within these areas of study, an individually-designed study program is developed for and with each student. A partial listing of specialized areas of graduate study and research include: wood science and technology, composite materials and wood treatments, design of timber structures, tropical timbers, anatomy and ultrastructure, pulp and paper technology, fiber and paper mechanics, chemistry of pulping and bleaching, colloid chemistry and fiber flocculation, chemical process engineering, pollution abatement engineering, forest engineering, water resources engineering, transportation and soils, energy and environmental quality, and remote sensing and photogrammetry.

Applicants to the graduate program in Environmental and Resource Engineering must meet general Collegewide requirements, have prior education or experience suitable for beginning advanced study in their chosen area of specialization and have a deep commitment to the advancement of the academic and professional aspects of their career goals. Some coursework deficiencies may be corrected within individual study programs.

Candidates for the Master of Science degree must complete a program of study totaling at least 30 hours of credit earned through graduate level coursework. Six to 12 of these credits shall be given for a master's thesis or project. Up to six credit hours of graduate level coursework may be transferred from another institution.

The Ph.D. program usually builds upon a master's degree and demands further advanced mastery of material in the area of study and the dissertation topic. This includes additional graduate level coursework beyond the M.S. degree as determined with the student's committee.

Candidates for the Ph.D. must demonstrate competence in at least two tools of research (statistics, computer programming or foreign language), pass a doctoral candidacy examination, and write and defend a dissertation.

Students are able to draw on the combined resources of the three academic departments in the School. In addition, courses and facilities of other schools of the College as well as Syracuse University complement those of the School of Environmental and Resource Engineering.

Prospective students who desire more information than is presented for each of the departmental descriptions and specialties described should contact the Dean, School of Environmental and Resource Engineering.

FOREST ENGINEERING

ROBERT H. BROCK, *Chairman* (Photogrammetric and Geodetic Engineering, Mapping Systems)

DUGGIN (Agricultural Assessment, Remote Sensing, Physics), HASSETT (Environmental Engineering, Water Resources), HENNIGAN (Water Resources, Environmental and Water Quality Management and Policy), HOPKINS (Surveying, Site Assessment, Remote Sensing), LEE (Computers and Systems Engineering, Transportation and Equipment, Soil Mechanics), MCCLIMANS (Soils, Hydrology, Site Engineering), PALMER Engineering Economics, Energy, Production and Harvesting Systems), TULLY (Structure, Engineering Hydrology, Water Resources).

A large portion of our nation's resources exists on forested and rural lands. These include: the increasingly valued renewable resources of timber, biomass and wildlife; the sustaining resources of water, soil and nutrients; and the derivative resources of paper, wood, and fibrous products and recreation and amenity values. Forest engineering is a unique field of engineering which is concerned with the design of systems and facilities to improve the sustained high quality yield of resources and multiple use benefits of goods and services from forested and rural lands.

The undergraduate curriculum in Forest Engineering provides a broad base of study and specialized education in engineering with an emphasis on site development for improved resource use and conservation. Instruction focuses on: locating and quantifying resources; designing harvesting, conveyance and transportation systems and networks for water and timber; designing structures, facilities and pollution abatement systems; and engineering planning for the development of sites and regions for multiple use.

Programs of advanced studies toward an M.S. or Ph.D. degree in environmental and resource engineering are offered. Individually designed programs provide graduates with sufficient understanding of the methodologies of scientific research and of the principles of engineering analysis or design to work with competence in resource related research, engineering design and management. There are opportunities for individuals who seek advanced education in such areas as water resources engineering, photogrammetry and remote sensing, transportation and soils, energy and environmental quality as well as forest engineering.

Because of the special importance of continual measurement and evaluation of the broad scaled parameters which affect the resource base, unique opportunities for study are available for students aiming toward professional careers involving the conceptualization, design, and maintenance of geographically referenced resource information systems. This includes elements of surveying, photogrammetry, remote sensing, and resource information systems design.

Undergraduate Program

The primary objective of this curriculum is to prepare qualified engineering graduates to operate with professional competence within the context of forest and natural resources development. The curriculum includes basic, forest, and engineering sciences. It utilizes elements of traditional engineering disciplines and develops its unique aspects from interweaving engineering design with an understanding of the natural environment and its renewable resource base including water, soil, timber, wildlife, and amenity values. Studies in the humanities and social and economic sciences are integrated throughout the curriculum to help achieve a broad and balanced perspective of professional practice in forest engineering.

Qualified graduates in search of advanced degree education enjoy ready acceptance to engineering graduate schools throughout the country. Graduates of the Forest Engineering curriculum may enter an established five-year program in either civil, industrial, or mechanical engineering at Syracuse University. A bachelor of science degree in engineering will be awarded by Syracuse University upon completion of the requirements of the fifth year.

To enter the Forest Engineering curriculum at the junior level, a transferring student must have acceptable college credit in the following coursework areas or be able to have suitable coursework substitutions for courses listed in the junior and senior years.

The curriculum in Forest Engineering is accredited by the Accreditation Board for Engineering and Technology (ABET).

Students must meet these minimum requirements, and they are encouraged to exceed the minima in the elective areas, to facilitate scheduling during the upper division years.

Lower Division Courses

Course Area	*Credit Hours*
Biology (Botany preferred)	3
General Chemistry with Laboratory	8
Engineering Physics with Laboratory	8
Calculus through Differential Equations	15
English	6
Economics (Macro- and Microeconomics)	6
Engineering Drawing (Graphics)	1
Computer Programming	3
Engineering Mechanics (Statics and Dynamics)	4
Electrical Science	3
Humanities or Social Science Electives	3
TOTAL MINIMUM LOWER DIVISION CREDITS	60

Upper Division Courses

Junior Year			*Credit Hours*
First Semester	ERE 362	Mechanics of Materials	3
	ERE 371	Surveying for Engineers	3
	FOR 321	General Silviculture	3
	CIE 327	Principles of Fluid Mechanics	4
	FBO 305	Dendrology	2
	Elective		3
			18
Second Semester	FEG 340	Engineering Hydrology and Flow Controls	4
	FEG 350	Introduction to Remote Sensing	2
	FEG 363	Photogrammetry I	3
	MEE 285	Design of Mechanical Equipment	3
	IOR 326	Statistics for Engineers	3
	ERE 351	Basic Engineering Thermodynamics	2
			17

Senior Year			*Credit Hours*
First Semester	FEG 410	Structures I	4
	FEG 420	Harvest Systems Analysis	1
	FEG 430	Engineering Decision Analysis	3
	CIE 437	Soil Mechanics and Foundations I	4
	FOR 477	Resource Policy and Management	3
	Elective		3
			18
Second Semester	FEG 454	Tractive Power Systems	2
	FEG 437	Transportation Systems	3
	ERE 440	Water Pollution Engineering	3
	FEG 489	Forest Engineering Planning and Design	3
	Elective in Engineering Design Sequence		3
	Elective		3
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	70

TOTAL UPPER AND LOWER DIVISION ELECTIVE REQUIREMENTS

Humanities or Social Sciences: At least 9 credit hours must be elected in social sciences or humanities, at least 6 of which are recommended to be upper division. (If lower division English coursework does not include at least 3 credit hours of humanities coverage, then an additional 3 credit hours of humanities are required.) Humanities coursework deals with branches of knowledge concerned with man and his culture, while social sciences coursework concerns individual relationships in and to society. Traditional subjects in these areas are philosophy, religion, history, literature, fine arts, sociology, psychology, anthropology, economics, and modern languages beyond the introductory skills courses, while modern nontraditional subjects are exemplified by courses such as technology and human affairs, history of technology, and professional ethics and social responsibility. Subjects such as accounting, industrial management, finance, personnel administration, ROTC studies, and skills courses, such as public speaking and technical report writing, do not fulfull the humanities and social science content.

Engineering Sciences: Electrical Science and coverage of Dynamics (separately or in combination with Statics) are required.

Engineering Design: At least 3 credit hours are required in upper division engineering coursework as part of an advisor approved sequence which complements other forest engineering coursework and provides the equivalent of at least 1 credit hour of depth in the design and synthesis component of the program, such as:

- Design of Wood Structural Elements
- Structures II
- Soil Mechanics II
- Air Pollution Engineering
- Introduction to Design
- Synthesis of Mechanical Systems

A total of 130 credit hours is required to complete the B.S. degree in Forest Engineering.

Graduate Program

Graduate studies and research are primarily concerned with environmental and resource related programs. Individual study programs leading to the master of science and doctor of philosophy degrees are available to meet the student's needs and interests in graduate study. Successful programs of graduate study may be efficiently designed by students with bachelor of science degrees in engineering or in forestry, natural sciences, physics, or mathematics.

Study programs with emphasis on environmental and resource engineering measurements may be designed in remote sensing, photo interpretation, geodetic engineering, analytical photogrammetry and photogrammetric systems. Programs emphasizing engineering analysis and design are available in water resources, environmental engineering, water quality management engineering, energy, transportation, harvesting and site engineering systems. Included are the monitoring, measurement and evaluation of physical parameters affecting water, soil, timber, vegetation, and wildlife.

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 Schools at both ESF and at Syracuse University. Exceptional departmental support exists for programs in environmental engineering measurements in the form of remote sensing and photogrammetric laboratories and the extensive forest properties owned by the College at which research may be conducted.

External support comes from several active sources, including industrial, commercial and governmental. Over the past two decades, close cooperation has developed special study and research opportunities with these sources.

PAPER SCIENCE AND ENGINEERING

BENGT LEOPOLD, *Chairman* (Organic Chemistry and Mechanical Properties of Fibers and Paper)

BAMBACHT (Pulping, Papermaking, Paper Machine Operation), BRITT (Chemistry of Paper Formation), DENCE (Organic Chemistry, Pulping, Bleaching), GORBATSEVICH (Pulping, Bleaching, Paper Technology and Paper Properties), HOLM (Water and Air Pollution Abatement, Computer Simulation), JELINEK (Computer Applications, Process Engineering, Thermodynamics), LAI (Organic Chemistry, Pulping), LUNER (Surface and Colloid Chemistry of Papermaking Systems), MARK (Mechanical Properties of Fibers and Paper), MARTON (Mechanical and High-Yield Pulping), ROTHENBERG (Pulping, Bleaching), STENUF (Chemical Engineering, Instrumentation, Thermodynamics, Flow Phenomena, Process Control, Corrosion), THORPE (Fiber Physics, Paper Physics and Mechanics).

Outstanding for its vigorous growth and diversity of products, the pulp and paper industry is the fifth largest in the nation and exceptionally strong worldwide. Its need for professional men and women with training in science, engineering and technology is increasing even more rapidly than the industry itself. The College pioneered instruction in this area in 1920 with the organization of the paper science and engineering department, which has maintained a singularly high position in professional education for the continuing development of the pulp, paper and allied industries. Its graduates, who are in constant demand, occupy positions of leadership throughout the world.

The curriculum in Paper Science and Engineering is designed to provide a broad base of study and to prepare students for a variety of careers in the paper and related industries. Excellent opportunities are provided for men and women qualified to fill positions as research chemists, process engineers, technical service representatives, line management personnel, and many others.

The program provides education in the physical sciences and chemical engineering, with specific emphasis on those aspects of these disciplines which relate to the manufacture of pulp and paper. This includes the chemistry and anatomy of wood, the conversion of wood to pulp and paper, and the chemistry and physics of paper and paper formation. Instruction in chemical engineering includes a foundation of unit operations basic to the pulp and paper industry, as well as specialized courses, such as water and air pollution engineering.

The department is located in Walters Hall, opened in 1969. This facility is devoted exclusively to education and research in the field of pulp and paper. In addition to a large number of special purpose laboratories and highly sophisticated scientific equipment, the department maintains an experimental pulp and paper mill equipped with machinery and instrumentation for studies of pulping, pulp purification, reuse of secondary fibers, refining, paper additives, and papermaking. This facility includes one 12-inch and one 48-inch fourdrinier paper machine, one pressurized and several atmospheric disk refiners, one pressurized grinder for mechanical pulping, and auxiliary equipment. In addition, the Department maintains an environmental engineering laboratory designed to demonstrate various methods used for the recycling of waste paper and the treatment of waste water. Also included is a modern chemical engineering laboratory, used for studies in all phases of unit operations and processes, process control, and analog simulation.

Undergraduate Program

The curriculum is entered at the junior level. Students with an associate degree in engineering science, science and mathematics, or chemical technology usually qualify for admission if their studies have included 8 credit hours of organic chemistry with laboratory. Other applicants with two years of college study may also gain admission if their curriculum includes the appropriate courses. Minor deficiencies can usually be made up during the junior year.

The Paper Science and Engineering curriculum consists primarily of chemical engineering courses and specialized courses relating to the manufacture of pulp and paper products.

Lower Division Courses

Course Area	*Credit Hours*
Botany or Biology with Laboratory	4
General Chemistry with Laboratory	8
Organic Chemistry with Laboratory	8
Quantitative Analysis	3
Physics with Laboratory	8
Mathematics—Analytic Geometry and Calculus, Differential Equations	12
Computer Science	3
Economics	3
English	6
Engineering Drawing	1
Humanities or Social Science Electives	8
TOTAL MINIMUM LOWER DIVISION CREDITS	64

Upper Division Courses

Junior Year			Credit Hours
First Semester	FCH 572	Wood Chemistry II	3
	FCH 360	Physical Chemistry	3
	PSE 300	Introduction to Papermaking	3
	WPE 387	Wood Structure and Properties	3
	PSE 370	Principles of Mass and Energy Balance	3
	PSE 371	Fluid Mechanics	3
			18
Second Semester	PSE 372	Heat Transfer	2
	FCH 361	Physical Chemistry	3
	WPE 390	Wood and Fiber Identification Laboratory	1
	PSE 301	Pulp and Paper Processes	3
	PSE 302	Pulp and Paper Processes Laboratory	1
	ERE 377	Process Control	3
	LIB 300	Library Research Methods	1
	*Elective		3
			17

SUMMER MILL EXPERIENCE: PSE 304 Mill Experience 2
(Twelve weeks of full-time pulp or paper mill employment approved by the Department between the junior and senior years.)

Senior Year			Credit Hours
First Semester	PSE 461	Pulping Technology	3
	PSE 465	Paper Properties	4
	PSE 473	Mass Transfer	3
	PSE 491	Paper Science and Engineering Project	1
	*Electives		6
			17
Second Semester	PSE 466	Paper Coating and Converting	2
	PSE 468	Papermaking Processes	3
	ERE 440	Water Pollution Engineering	3
	*Electives		6
			14
		TOTAL MINIMUM UPPER DIVISION CREDITS	68

*At least 9 hours of electives must be selected from an advisor-approved sequence of technical courses. Examples of suggested areas are shown below.

TECHNICAL ELECTIVES

Colloid and Surface Chemistry	Applied Mathematics
Instrumental Analysis	Computer Modeling
Polymer Chemistry	Principles of Management
Pollution Abatement	Mechanics
Independent Research Project	Engineering Design
Thermodynamics	Materials Science

A total of 132 credit hours is required to complete the B.S. degree in Paper Science and Engineering.

Graduate Program

Graduate studies reflect the strong trend toward diversification in the industry and offer opportunities for obtaining master of science and doctor of philosophy degrees in a variety of subjects related to the manufacture of pulp and paper. Individual study programs are designed to meet specific personal needs. Typical areas of study range from the development of new pulping processes, chemical interactions on the paper machine and the disposal of pulping and papermaking effluents, to the fluid dynamics of fiber suspensions, the colloid chemistry of papermaking constituents, and the physical properties of fiber networks.

An important component of the graduate program is thesis research under direction of a graduate advisor. Much of this research is carried out under the auspices of one of the outstanding research facilities in the world, the Empire State Paper Research Institute (ESPRI), an integral part of the department. Its research activities aim to generate new information regarding the fundamentals, the science, the engineering and the technology of the papermaking process, utilizing advanced techniques such as electron microscopy, specialized spectrophotometry, nuclear magnetic and electron spin resonance and nuclear tracer methods. Recent work has been directed to fundamental investigations of pulping, bleaching, additives, paper recycling, effluent disposal, the papermaking process, the properties of paper, reactions of wood components during mechanical and chemical treatments, the structure of wood and wood fibers, evaporation, fluid dynamics, heat transfer, and chemical recovery.

Many research projects are carried out in cooperation with other College departments. Examples of such projects include a wide-ranging study of the toxicity of paper industry effluents in cooperation with the Department 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 Wood Products Engineering, as well as the Department of Aerospace and Mechanical Engineering at Syracuse University.

The department enjoys excellent external support in the form of graduate fellowships and grants from ESPRI, the Syracuse Pulp and Paper Foundation, and other industry sources, as well as a number of government granting agencies.

WOOD PRODUCTS ENGINEERING

GEORGE H. KYANKA, *Chairman* (Applied Mechanics, Structures) CÔTÉ (Cellular Ultrastructure, Light and Electron Microscopy), DAVIDSON (Physical Properties of Wood), HANNA (Ultrastructure and Microscopy), R. MEYER (Wood Properties and Anatomy), MOORE (Wood Materials Processing and Technology), SIAU (Protective Treatments, Transport Processes), SMITH (Adhesives, Coatings, Wood-based Composites).

While wood is one of the oldest structural materials known to man, it occupies a position of major economic importance today with the annual tonnage of wood produced in the United States exceeding that of any other

major structural material. This fact becomes even more important in this age of environmental and ecological concern because wood is the only major structural material that comes from a renewable natural resource, and demand is growing for more efficient utilization of available material. Improved efficiency must be based on solid scientific and engineering information. The Department of Wood Products Engineering provides undergraduate instruction in basic wood science and technology and stresses the application of science and engineering to building construction and the production, design, and utilization of wood-based materials. At the graduate level, the Department provides guidance via advanced courses and research opportunities in wood science and timber engineering.

Undergraduate Program

The Department of Wood Products Engineering prepares students for a wide variety of professional occupations concerned with the use of wood as a material. Two curriculum options are available: Building Construction and Forest Products. Both options have elective courses which permit tailoring the program to serve the needs of individual students from a wide variety of two-year preparatory programs. The Forest Products option is individualized to serve students that wish to emphasize Marketing, Production Systems Engineering, or Wood Science and Technology.

As the only major engineering material derived from a renewable natural resource, wood is receiving increased attention as an alternative to other materials which originate from the depleted nonrenewable resources. Thus, a principal aim of the departmental program is to teach students the fundamental properties of wood as a material to promote efficient wood processing, product design, and final use, whether as a piece of furniture or as a complete building.

To enter either option at the junior level, a transferring student must have acceptable college credit in the following coursework areas. Individuals not meeting the basic outline shown are encouraged to contact the Admissions Office to work out special arrangements and/or additional study requirements.

Lower Division Courses

Course Areo	*Credit Hours*
*General Chemistry with Laboratory	4
*General Physics with Laboratory	8
Mathematics—Analytical Geometry and Calculus	8-9
English	6
Computer Programming	3
Recommended Additionol Courses	
Accounting	6
Biology or Botany	3-4
Economics (Micro- and Macroeconomics)	6
Engineering Drawing (Graphics)	2
Organic Chemistry	3
Electives	16-18
TOTAL MINIMUM LOWER DIVISION CREDITS	62

*Four credits of physics are required, although 8 hours are recommended. However, students who wish to emphasize wood science and technology in the forest products option must have: general chemistry with laboratory (8); general physics with laboratory (8); and general botany with laboratory (4); organic chemistry (3).

Upper Division Courses

Junior Year			*Credit Hours*
First Semester	WPE 387	Wood Structure & Properties	3
	WPE 361	Engineering Mechanics-Statics	3
	ERE 371	Surveying for Engineers	3
	ACC-204	Financial Accounting Systems	3
	Elective		3
			15
Second Semester	ERE 362	Mechanics of Materials	3
	ERE 364	Engineering Materials	3
	ACC 252	Introduction to Managerial Accounting	3
	Management Elective		3
	Elective		3
			15
INDUSTRIAL FIELD TRIP (a two-week field trip immediately following final exam period): WPE 399 Field Trip			2

Senior Year			*Credit Hours*
First Semester	WPE 420	Adhesives, Sealants, and Coatings	3
	WPE 454	Construction Management	3
	FEG 410	Structures	4
	CIE 437	Soil Mechanics & Foundations I	4
		Statistical Analysis	3
			17
Second Semester	WPE 326	Fluid Treatments	2
	WPE 327	Fluid Treatments Laboratory	1
	WPE 450	Construction Equipment	3
	WPE 422	Composite Materials	3
	WPE 497	Senior Seminar	2
	WPE 404	Design of Wood Structural Elements	3
	Elective		3
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	66

NOTE: Computer Programming required for entrance to program.

A total of 128 credit hours is required to complete the B.S. degree in Wood Products Engineering with the Building Construction option.

The A.S. or A.A.S. degree in Architectural, Civil, Construction, or Mechanical Technology may also fulfill the requirements for admission. Students who lack the above background courses are nevertheless encouraged to consult the Admissions Office and the faculty of the department for an evaluation of their academic records.

Building Construction Option

Current economic pressures are dictating that the construction industry become more efficient in the design and construction of new facilities and structures. These structures range in size from residential structures to massive power generation stations. Consequently, the industry has increased its demand for technically trained professionals who have the skills to manage construction projects. These professionals must be prepared to develop new and innovative construction techniques, deal with a highly organized union work force, prepare competent cost estimates, and manage entire projects from start through completion.

Although the Building Construction curriculum emphasizes the use of wood as a building material, it allows the students an opportunity to develop a broad educational background in construction which will prepare them for a wide range of job positions in the construction industry and related fields. The program has a certain degree of flexibility which allows the student to specialize in a particular area of interest.

Illustrative electives are listed below:

Engineering

Structural Analysis
Foundation Design
Building Systems
Energy Systems
Engineering Design

Management

Marketing
Business Law
Accounting
Finance
Operations Research

Environmental

Air Pollution Engineering
Solid Waste Disposal
Waste Water Treatment
Environmental Sanitation
Land Use Planning

The following are some of the position titles past graduates now hold:

Assistant Project Superintendent
Project Supervisor
Construction Manager
Cost Engineer
Resource Scheduler
Timber Engineer
Truss Design Engineer
Research Engineer
Construction Consultant
Technical Sales Representative

Forest Products Option

The forest products option prepares students for employment in the wood products industry. A forest products graduate should be able to walk into any wood products manufacturing operation and, after observing the process be able to fully understand what is going on. Instruction is individualized by selecting emphasis courses that are combined with required core courses designed to develop a comprehensive knowledge and understanding of wood as a raw material. The forest products option trains wood technologists, utilizing an individualized program with a series of emphasis courses to develop additional background in manufacturing, marketing, or specialization in wood science and technology.

Students wishing to enter graduate school can plan a series of electives to meet entrance requirements of major graduate institutions, whether in wood science and technology, business administration, or another branch of the sciences.

Marketing Emphasis

A special knowledge of the material properties of wood and the suitability of specific wood species for use in various products or processes enable a graduate with marketing emphasis to assist a customer in selection of the right wood product for the intended end use or makes possible the procurement of the best wood raw material for some manufacturing operation. These situations include considering the correct species of wood, treatments to prolong the useful life of a wood product, or selection of the most suitable manufactured product, such as medium density fiberboard or plywood, for a specific application. In some cases market research surveys or economic analyses may be required. Complete understanding of the employer's products, the material properties of wood, and the customer's special needs and problems are necessary for the marketing specialist to function efficiently. In addition to many sales-related or purchasing-related positions are other employment possibilities such as those requiring analysis of economic and trade conditions or relating engineering properties of wood to established or new product lines.

Job titles of recent graduates include:

Veneer Sales Manager
Technical Sales Representative
Applications Engineer
Regional Sales Manager
Export Trade Analyst
Product Development Engineer
Marketing Research Analyst

Production Systems Engineering Emphasis

Numerous manufacturing methods are used to produce the over 5,000 products that use wood in one form or another. By studying various production systems and ways to modify wood properties, a wood production systems engineer is prepared for a career in the manufacture of forest products (veneer, plywood, particleboard, etc.). These careers deal with product and process development, quality control, production control, design engineering, personnel relations, and management.

Job titles of recent graduates include:

Production Coordinator
Quality Control Supervisor
Plywood Production Manager
Systems Analyst
Plant Engineer
Supervisor of Operations
Production Supervisor
Production Planner

Wood Science and Technology Emphasis

Wood science and technology deals with materials science and engineering. Graduates that have stressed the science and technology of wood are prepared to utilize their knowledge of wood in numerous ways: to increase the efficiency of wood use, apply existing or new knowledge to wood product manufacture or utilization, or to do the research and development required for the new products, processes, and treatments necessary to meet the

increasing demands made on our limited forest resources for wood commodities. Such research projects could be either basic, in which case the frontiers of wood science are extended, or applied, in which case existing knowledge is applied to current technological problems. Much of the work that needs to be done is technology transfer, so that known techniques of wood science and technology can be applied to the manufacturing or utilization environment. A wood science and technology graduate who has a good background in wood as a material can adapt the present state of knowledge to a broad range of utilization, research, or manufacturing operation, research, or manufacturing operations. Employment opportunities include corporations, trade associations, government research institutes, and universities. An M.S. degree is highly recommended for those wishing to formally enter the research field, and a Bachelor's degree for those wishing to work in technical service or manufacturing.

Job titles of recent graduates include:

Forest Products Specialist
Materials Research Associate
Wood Products Technologist
Forestry Specialist (Wood Products)
Research Associate in Wood Science
Product Development Engineer

Emphasis Courses

Students desiring to emphasize Marketing, Production Systems Engineering, or Wood Science and Technology should select 24 credit hours of emphasis courses. These courses are defined upon consultation with the academic advisor. Typical concentration areas might be as follows:

Marketing

Finance
Accounting
Marketing
Materials Science

Production Systems Engineering

Operations Management
Quality Control
Engineering Economics
Computer Applications

Wood Science

Tropical Timbers
Wood Chemistry
Physiology and Pathology
Independent Research

Graduate Program

Recent research projects in wood ultrastructure have dealt with the interaction of coatings and adhesives with the wood substrate, with cell wall development, with the effectiveness of wood preservatives, and with the identification of natural inclusions in wood. Projects in tropical wood identification and structure-property relations in foreign and domestic timbers are examples of work in the field of systematic wood anatomy. The field of wood physics has had active projects in the permeability of wood and the mechanics of fluid transport. Current projects in the field of mechanics are focused on the elastic behavior of wood and wood-base composites, fracture mechanics of wood, the behavior of new structural designs such as truss systems, and the mechanical properties of laminated-veneer-lumber. In addition, there is growing interest in studying the physical properties of wood-based composite materials and the chemical modification of wood, as well as wood finishing systems.

Laboratory facilities include a mechanical testing laboratory with a wide range of testing machines, a physics laboratory with electronic instrumentation, and complete wood processing facilities including a sawmill, plywood mill, dry kilns, and wood preservation equipment. One of the United States' largest foreign wood collections is used for graduate research and to support the program of the Tropical Timber Information Center (TTIC).

In addition, the College has available a complete microscopy laboratory, containing transmission electron microscopes, scanning electron microscope with energy dispersive x-ray analysis and particulate analysis accessories, a wide variety of light microscopes, and related equipment. Extensive equipment for chemical analysis and nuclear chemical techniques also serve the research program.

The program works closely and cooperates with the Renewable Materials Institute. Students use this unique opportunity to investigate the properties of wood and related renewable engineering materials.

Upper Division Courses

Junior Year			Credit Hours
First Semester	FBO 305	Dendrology	2
	WPE 361	Engineering Mechanics-Statics	3
	WPE 387	Wood Structure & Properties	3
	WPE 388	Wood & Fiber Identification Laboratory	2
	*Electives		6
			16
Second Semester	WPE 326	Fluid Treatments	2
	WPE 327	Fluid Treatments Laboratory	1
	ERE 362	Mechanics of Materials	3
	WPE 322	Mechanical Processing	3
	*Emphasis Course		3
	*Electives		3
			15
INDUSTRIAL FIELD TRIP (a two-week field trip immediately following final exam period): WPE 399 Field Trip			2

Senior Year			Credit Hours
First Semester	WPE 420	Adhesives, Sealants, and Coatings	3
		Statistical Analysis	3
	*Emphasis Courses		6
	*Electives		3
			15
Second Semester	WPE 497	Senior Seminar	2
	WPE 422	Composite Materials	3
	FOR 404	Economics of Wood-Using Industries	3
	WPE 404	Design of Wood Structural Elements	3
	*Emphasis Course		3
	*Electives		3
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

*Specific courses selected for these requirements must have the advisor's approval.

A total of 127 credit hours is required to complete the B.S. degree in Wood Products Engineering with the Forest Products option.

THE SCHOOL OF FORESTRY

JOHN V. BERGLUND, *Dean (Silvics, Silviculture)*

Syracuse Campus

ABRAHAMSON (Entomology, Pathology, Pesticides), BENNETT (Economic Theory, Economic Thought in Forestry), BICKELHAUPT (Nursery Soils, Forest Soils), BLACK (Water and Related Land Resources), BURRY (Forestry Extension, Wood Utilization), CANHAM (Forestry Economics, Economics, Economics of Natural Resources), COUFAL (Silviculture), CRAUL (Forest Soils), CUNIA (Operations Research, Biometry), DALL (Environmental Law and Policy), DREW (Tree Physiology, Physiological Ecology), ESCHNER (Forest Influences, Forest Hydrology), GRANT (Micrometeorology), GRATZER (Forest Recreation, Forest Management), GRAVES (Forest Resource Policy, Planning and Management), HALLIGAN (Silviculture), HERRINGTON (Meteorology, Urban Forestry), HORN (Mensuration, Law), HOWARD (Silvics, Forest Management), KOTEN (Forest Management, Management Science and Planning), LEA* (Silviculture, Timber Harvesting), MAYNARD (Tree Improvement), MONTEITH (Forestry Economics, Land Use), MORRISON (Forest Recreation, Forestry Extension), NYLAND (Silviculture, Forestry Practice), PETRICEKS (Resource Economics, International Forestry Economics), RICHARDS (Silviculture, Urban Forestry), STITELER (Statistics), WHITE (Forest Soils, Silviculture), YAVORSKY (International Forestry).

* On leave 1983-85

Forest Technician Program—Wanakena Campus

WESLEY E. SUHR, Director (Dendrology, Soil and Water Measurements). JAHNKE (Ecology, Silviculture, Forest Management, Fire Management, Systems Analysis), MARTIN (Mensuration, Tree Physiology and Morphology, Wildlilfe Ecology), MILLER (Forest Roads, Installations, Aerial Photogrammetry, Graphics, Recreation) REMELE (Ecology, Silviculture, Surveying, Personnel Management).

Adjunct Faculty

CZAPOWSKYJ (Forest Soil Science), HEISLER (Meteorology), HORSLEY (Silvics), MARQUIS (Silviculture), ROWNTREE (Urban Forestry), SLOAN (Policy), YAWNEY (Silviculture).

Undergraduate Program in Resources Management

The School of Forestry prepares students for the critical role of managing forests and related resources and their environments for human benefit. Management here embraces the integration of basic ecological and social principles into comprehensive plans for the manipulation and use of forest and open lands for the sustained production of timber, forage, water, wildlife, and recreational values consistent with current and future national needs, and with the protection and enhancement of environmental quality. It also includes the effective implementation of these programs technically and via the administrative process, in accordance with established policies and goals and in cooperation with individuals and organizations, both public and private.

The successful management of forests and related resources involves many different people working together as teams to bring their special expertise to bear on problems created by society's demands upon these basic resources. The School of Forestry presently offers three undergraduate degree programs designed to help students fit into different parts of the interdisciplinary multi-level teams mentioned:

1. A professional forestry and resource management degree program, at the bachelor's level, offered at the Syracuse Campus.
2. A forest technician degree program at the associate's level, offered at the Wanakena Campus. For details of this program see p. 56.
3. A dual-major program that meets the bachelor's degree requirements of both the School of Forestry and the Department of Environmental and Forest Biology. For details of this program see p. 64.

Since the dual biology/forestry program and the forest technician program are covered in separate sections, the discussion which follows pertains to the School's professional forestry and resource management program.

Students completing the School's professional forestry program qualify for practice as foresters and environmental managers with public and private organizations or as private consultants serving a wide array of clients. The potential for a meaningful, rewarding career in service to human welfare becomes significant when one recognizes the vast amount of land area covered by forests. About 60 percent of New York State is classified as forest land, while roughly one-third of the land area of both the United States and the world is so classified. The goods and services that flow from this vast resource base are of critical and growing importance to the needs of modern society and influence, in a major way, the quality of the environment.

The professional forestry and resource management program offers opportunity for students to pursue special interests, to prepare for advanced study, or to develop their capabilities for service in a variety of fields pertinent to renewable natural resources and the environment, but not specifically forestry oriented. Though it represents the oldest area of professional instruction in the College, the current curriculum was implemented with the entering class of 1973, with some modification made since then. It is accredited by the Society of American Foresters and meets the educational requirements of the U.S. Government Office of Personnel Management for forester employment in Federal agencies. A core of required upper division courses, totaling 41 semester hours, presents the basic principles and practices underlying the purposeful management of forest and related resources for optimum production and use of any one, or combination, of their potential products and services.

Considerable emphasis in the curriculum is placed on field instruction to provide students with intimate knowledge of how the forest ecosystem functions and how it is manipulated and used for a variety of owner objectives. Close to half of the required upper division core courses is conducted wholly or primarily in the forest environment and entail substantial physical activity such as conducting field surveys, inventorying timber and other resources, and thinning forest stands. Attendance at a seven-week, eight-credit hour Summer Session in Field Forestry is required prior to registration for the junior year.

This session emphasizes field skills and techniques and introduces ecological concepts, and serves as the major avenue of entrance into the professional forestry curriculum.

A unique feature of the curriculum in the fall semester of the junior year is a set of team-taught blocked courses emphasizing ecological foundations and applications based on the skills learned at the Summer Program in Field Forestry. This fall semester is largely held at the facilities of the College's 4,000-acre Heiberg Forest, nearby the Syracuse Campus, with all transportation provided by the College. The Summer Program in Field Forestry and the fall semester of the junior year total 23 credit hours of field oriented core courses, and as part of the conditions for admission to this curriculum, applicants must be willing and able to function effectively in the field under a wide range of terrain and weather conditions. Any questions or concerns about this requirement should be directed to the Director of Admissions.

Extensive elective opportunities, totaling about one-fourth of the curriculum, allow students to shape their programs to meet individual needs and interests. In a broad sense, electives may be chosen to provide extensive coverage of either forest resource science or management, and they may be oriented toward immediate employment or as a base for graduate study. More specifically, one student might choose to broaden knowledge of forest resource management or science by distributing electives to cover all of the areas of forestry's multiple-use, while another might choose to enhance depth of understanding of a more specialized area by concentrating electives in areas such as timber, watersheds, forest wildlife, recreation, entomology, pathology, soils, international forestry, or urban forestry. Electives may also be taken at Syracuse University, usually to add to a student's general education or to gain knowledge of an area of business management, communications, geography or other similar topics not offered at ESF. Elective course selections must have the approval of the student's faculty advisor, and it is very important that they be planned early in the student's program.

A significant feature of the elective component of the professional forestry and resource management curriculum is that the spring semester of the senior year consists wholly of electives and thus is available for a variety of independent or group study activities. These may be conducted in whole or in part on any one of the College's several campuses, or off campus at another institution, in cooperation with some resource management agency or firm, or in conjunction with an overseas academic program operated by the College. Proposals for off-campus study must be well planned. They are subject to faculty review and approval and are carried out with varying degrees of faculty guidance to ensure adherence to academic standards. Utilization of the spring senior semester in such a fashion may result in the need for a fifth semester to meet graduation requirements.

A total of 135 credit hours is required to complete the B.S. degree curriculum. For students contemplating entrance to the program, it is required that they have completed at least 64 semester credit hours or have earned an associate degree, and further, that a minimum of 56 of these credits be distributed among specific course areas as outlined below. The maximum number of freshman-sophomore semester credit hours which may be transferred is 64. Students who have completed more than 64 lower division credits may transfer up to 12 additional hours of junior-senior level courses and should seek advice on upper division credits at the time of matriculation. The professional forester must understand both the biological and social influences that affect the use of forest resources. Prospective students should choose lower division elective courses that will serve to broaden and enhance their understanding in the social and political sciences, humanities, and communication skills.

Lower Division Courses

Course Area	*Credit Hours*
Biology (Botany and Zoology preferred) with Laboratory	8
General Chemistry with Laboratory	8
Physics I with Laboratory	4
Calculus I	3
Economics (Microeconomics required)	3
Political Science (U.S. Institutions)	3
Introductory Sociology **OR** Introductory Psychology	3
Computer Programming (Language)	3
*English	6
**Social Science/Business Electives	9
***Mathematics/Physical Science Electives	6
****Free Electives	8
TOTAL MINIMUM LOWER DIVISION CREDITS	64

*Standard freshman English sequences are acceptable, but where possible the student is *strongly* urged to take technical report writing.

**Courses in sociology, psychology, U.S. history, macroeconomics, political science, anthropology, U.S. geography, business, finance, or accounting. *Note*: students *may be* admitted with only 9 credit hours of the required or elective courses in economics, political science, psychology/sociology and social science/business areas. The remaining 9 credit hours of deficiencies must be made up as early as possible in the student's ESF program, including the use of summer sessions.

***Courses in mathematics, physics, chemistry, geology, computer science, meteorology, logic. Math courses must be of a level equivalent to Calculus II or be in some way complementary to Calculus I.

****Free electives and electives in the specified categories should be chosen with the clear idea that they are in preparation for an upper-division, professional program. Courses in the free elective category that have been found to be helpful include personnel management, group dynamics, technical report writing, speech, foreign language, logic, pre-calculus math, first aid and CPR, graphics/drafting, surveying, real estate, marketing, conservation law, ecology, dendrology, plant pathology, philosophy, religion, fine arts or other arts, sciences or business courses. Free electives can also include further courses from the directed elective categories. All electives should be chosen with the particular career goals of a student in mind.

Upper Division Courses

			Credit Hours
Summer:	[1]Summer Program in Field Forestry		
	FOR 301	Field Dendrology	1
	FOR 302	Forest Surveying and Cartography	2½
	FOR 303	Introduction to Forest Mensuration	3½
	FOR 304	Introduction to Forestry	1
			8

[1]SUMMER PROGRAM IN FIELD FORESTRY—7 weeks, 8 credit hours: Required of all students (except Forest Technician Program and Paul Smith's Forest Technician Program graduates) *prior* to registration for junior year.

Junior Year			
First Semester	FOR 322	Forest Mensuration	1
	FOR 331	Introduction to the Physical Environment	6
	FOR 332	Silvics-Silviculture	8
			15
Second Semester	FOR 360	Principles of Management	3
	FOR 370	Management of the Forest Enterprise	3
	APM 391	Introduction to Probability and Statistics	3
	[2]Electives		7
			16
Senior Year			
First Semester	APM 492	Forest Biometrics	3
	FOR 400	The Social Environment of Resource Management	3
	FOR 461	Management Models	3
	[2]Electives		6
			15
Second Semester	[2]Electives		17
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	71

[2]One half of the student's elective hours during the junior and senior years must be in courses taken in no fewer than three of the following schools: Forestry, Environmental and Resource Engineering; Biology, Chemistry and Ecology; Landscape Architecture. The remaining elective hours should be used to round out the professional education of a student. Note: a required course of 2-3 credit hours is under consideration for the Second Semester of the Senior Year.

A total of 135 credit hours is required to complete the B.S. degree in the Professional Forestry and Resource Management Curriculum.

Graduate Education

FOREST RESOURCES MANAGEMENT

Graduate education in the School of Forestry builds upon the basic foundations of knowledge and skill acquired by students in its professional undergraduate curriculum, in similar professional programs at other schools, or in undergraduate programs focused on any of the fields important to Forest Resources Management. Graduate study programs are created to suit the needs of each individual student and are designed to prepare the student for careers in resource administration, management, scientific research, professional education, and a variety of other specialized positions in public and private employment bearing directly or indirectly on forest resources management. Students with nonforestry undergraduate or master's degrees with strong interest in forest resources management are encouraged to apply.

The practice of forestry is based on a number of fields of science ranging from applied physics to sociology. Graduate study in the School of Forestry focuses on one or more of these fields in the context of resources management. Understanding the forest ecosystem as a provider of goods and services and as a modifier of the physical environment is the thrust of silviculture—culture of the forest. The fields of meteorology, soils, hydrology, and silvics (forest ecology) support study and research in silviculture. Tree improvement is the science and practice of improving the forest through genetics. The societal environment in which forests are managed is founded in the study of public and private policy on forestry economics. Forest management provides the bridge between the biological and societal requirements. Recreation management is the management of the forest for recreation. Basic to all these fields is the study of quantitative methods (statistics, mensuration). Urban and international forestry are broad study areas.

POLICY AND ADMINISTRATION—Dall, Graves, Horn
FORESTRY ECONOMICS—Bennett, Canham, Monteith
FOREST MANAGEMENT—Burry, Gratzer, Herrington, Koten
RECREATION MANAGEMENT—Gratzer, Morrison
SILVICULTURE—Abrahamson, Berglund, Coufal, Halligan, Howard, Lea, Richards, Yawney
SILVICS—Berglund, Drew, Horsley, Howard
FOREST SOIL SCIENCE—Bickelhaupt, Czapowskyj, White
TREE IMPROVEMENT—Maynard
FOREST INFLUENCES—Black, Eschner, Grant, Heisler, Herrington

In addition, there are three areas of study which integrate study in the above areas or serve as foundations for study in all areas. These are:

INTERNATIONAL FORESTRY—Petriceks, Yavorsky
URBAN FORESTRY—Herrington, Richards, Rountree, Sanders
QUANTITATIVE METHODS—Cunia, Horn, Stiteler

The description of these areas of study is not intended to infer compartmentalization of study. Indeed, most students in the School have programs of study which encompass two or more of the study areas and are encouraged to develop integrative programs of study by the School faculty.

Master's Degree Program

All three of the College's master's options are available to students in the

School of Forestry. The appropriate option must be selected with the approval of the student's committee.

Doctoral Degree Program

Although a doctoral program is usually built upon a master's degree obtained at the College or elsewhere, the program can be entered directly from a baccalaureate degree.

There is no minimum credit requirement for the doctoral program, but the usual load is 30 credit hours beyond that required for the master's degree. The field work for writing of a dissertation usually takes at least 12 months. In addition, written and oral candidacy examinations, intended to test the student's mastery of subject matter essential to the student's dissertation topic, and an oral defense of thesis examination are required. A preliminary examination may be required prior to the candidacy examination. The student's committee may require languages or other tools be included in the student's program.

The Major Professor and Student's Committee

Each graduate student in the School is assigned, or has selected via the application process, a Major Professor or faculty advisor to act as the director of the student program of study. The student and his/her Major Professor are assisted in planning the student's program and in determining successful completion of the program by the student's committee. Each student's committee and study program are designed to meet the student's specific needs.

Joint Study with Other Schools of the College

In a number of areas, particularly forest biology, close cooperation and joint programs of study can be established with faculty in other schools of the College. If a student is particularly interested in the forestry implications of, say, insect damage, then admission to the School of Forestry programs is indicated. On the other hand, if the student's interest is focused on the insect, then a program centered in the School of Biology, Chemistry and Ecology may be more appropriate.

Joint Degree Programs with Syracuse University

Joint degree programs which provide the student with two master's degrees, one from the College and another from Syracuse University, are available with the following Schools:

- School of Management
- Maxwell School of Public Administration
- College of Law
- Newhouse School of Communication

The joint degree programs usually add an additional year to a normal master's program of study.

POLICY AND ADMINISTRATION

Graduate study in the area of resources policy and administration is designed to prepare students for leadership positions in the broad range of responsibilities at the planning, budgeting, programming, and operating levels of public agencies and businesses. The expanded role of federal and state government oversight over resource use and land management has brought substantially increased need for thorough understanding of policy matters, legal requirements, and governmental and political interactions with resource owners and users. Advanced courses, seminars and special problems structured around these needs and the complex interrelationships of society with resources are offered. A wide array of complex problems of administrative management, resources policy issues, and related legal, financial, and executive needs are included among the topics that may be emphasized.

Students are encouraged to round out their academic programs through the courses offered by other units of the College as well as Syracuse University Graduate School of Citizenship and Public Affairs and the School of Management or other graduate units. Students with undergraduate preparation in forestry, liberal arts, engineering, or other appropriate areas who have strong interest in resource administration and policy can be served through selection of necessary emphases that complement work already taken.

The broad array of possibilities of course selection and the diverse points of view that are available allow the student to build a program to meet specific career objectives. The breadth and diversity also offers the student an opportunity to develop talents for managerial leadership and policy positions in various aspects of enterprises and public agencies whose work is critical to the future of resources management.

FORESTRY ECONOMICS

The program is designed to meet the needs of the student with an undergraduate degree in forestry or forest products. With some additional courses in forestry, the program also serves the graduate in liberal arts, engineering, or business, should interest point toward the economics of forest management. The goals are depth of understanding and familiarity with economic tools contributing to making competent decisions in resource economics, management, and policy.

The core of the program consists of courses in forestry and resource economics as offered by School faculty. In addition, one must be aware of the social and biological environment in which forestry economics is applied. To this end the program is supplemented by courses in general economics, statistics and operations research, resource policy, business administration, and related managerial and biological fields. The course offerings and facilities of the School, the rest of the College, and Syracuse University are actively drawn upon.

Individual programs are tailored to fit the student's particular interest: for example, the economics of timber management, land use economics, economics of natural environments, economic development and forestry. Graduates with the master's degree find employment typically as forest economists or resource analysts with federal and state agencies, and with private industry. Graduates with the Ph.D. usually find careers in teaching or research.

FOREST MANAGEMENT

Forest management focuses on the planning and implementation processes necessary to achieve integrated use of forests and associated natural resources. The educational objective is to develop expertise sufficient for capable, professional resource management under a variety of natural and societal environments.

The study of forest management requires a broad knowledge of both the natural and social environments as the basis for an understanding of the way in which these environments affect or are affected by the development and utilization of forests and associated wildlands. Implementation of plans also requires an understanding of the social environment as well as the managerial process to facilitate working with people both inside and outside of the organization.

Programs are flexible and a student may pursue a special interest in a single product, several products or services, tools and processes of planning for integrated forest use, or in developing managerial skills. The emphasis of the program, however, would be in the application of the skills and knowledge to the management of forest lands. Where appropriate, courses may be taken at Syracuse University's School of Management and the Maxwell School of Public Administration to complement course offerings in the School of Forestry and other Schools of the College. Recent graduates have found employment in all of the diverse areas described above.

RECREATION MANAGEMENT

Graduate study in this area equips students with a broad understanding of the nature and purposes of outdoor recreation and how they relate to natural resources, and builds the skills necessary for capable recreation management.

Individual programs combine study in resources management with relevant studies in the social and political sciences and development of analytical capabilities needed to implement plans and programs. Other schools of the College and of Syracuse University, treating such areas as planning, engineering, design, and education, provide a wide range of supporting courses and facilities.

All program areas in RMP require that each student take a minimum of 12 credits of coursework within the School of Forestry. Courses in Applied Mathematics (APM) can also be used to meet this requirement. If a student's prior preparation is inadequate to meet the graduate program objectives, the major professor and/or committee will suggest appropriate remedial coursework to make up the deficiency.

SILVICULTURE

Classical silviculture can be defined as the theory and practice of the manipulation of forest ecosystems, including the control of vegetation establishment, composition, growth, and quality. The nature of cultural treatments, the theories upon which they are based, and the biological, physical, and social constraints to their implementation are stressed in this area of specialization. Elements of forest vegetation are intensively examined from the dual standpoints of fulfilling management goals for goods and services and maintaining or enhancing biotic productivity for the future.

Management goals are considered to include all the many and varied goods and services that the basic forest resource is capable of supplying. Forest productivity is of basic concern; the student specializing in this area progresses through formal coursework and research toward an understanding of the effect of various treatments on the continuous, balanced, and adequate supplies of wood, water, wildlife, recreation opportunities, and amenity values. One major area of emphasis within this specialization relates to treatment of tree stands for their continued production of wood products and other commodities. Another emphasis centers on the treatment of stands that are managed for several values simultaneously, where the harmonious integration of uses is of concern. A third emphasis focuses on evaluation and manipulation of vegetation systems primarily for their on-site values, such as in wilderness and recreation areas, highway and utility rights-of-way, mining and other wasteland reclamation, and urban greenspace. This involves a broad interpretation of forest ecosystems that includes herbaceous and shrub systems as well as silvics.

The Silviculture graduate specialization is aimed at preparing foresters to understand and evaluate forest ecosystems in whatever depth may be required, and to prescribe treatments or further experimentation to attain management objectives or increase knowledge toward this end.

SILVICS

Silvics has been defined as that branch of forestry which provides the scientific base for the cultural treatment of forest vegetation by (1) studying and defining interrelationships within forest ecosystems and (2) cataloging general intraspecific characteristics of tree species. In a sense, silvics is the ecology of managed forest ecosystems, although unmanaged and natural forests are often studied intensively to provide the benchmark conditions from which the silviculturist begins.

The specialist in silvics must maintain channels of communication with colleagues in the basic disciplines, including those in soil physics, soil chemistry, micro-meteorology and climatology, genetics and tree breeding, plant ecology and physiology, wildlife biology, entomology, and pathology. In addition, certain tools, including a comprehensive knowledge of probability and statistics, the ability to use modern computers effectively, and a familiarity with measurement and sampling theory, are required by specialists in most applied sciences including silvics.

The specialist in silvics is essentially at one focal point of much of what has been called fundamental forest research. His most useful function and worthwhile contribution to the field of forestry may very well depend on the ability to synthesize relevant material and, through experimentation, provide the silviculturist with information and possible techniques for use in the cultural treatment of forest vegetation.

FOREST SOIL SCIENCE

Graduate studies in this area of specialization may be directed toward aspects of soil science related to the quantity and/or quality of goods and services in the management of resources of nonagricultural lands, and the impact of management practices on environmental quality. These include soil moisture, soil temperature, and nutrient element status interrelationships in the evaluation of soil productivity; evaluation of ecosystems to quantify nutrient element balances and cycling; amelioration of soils for increased productivity; and impact of various land-use practices on soil productivity.

Modern well-equipped laboratories are available for graduate student use in

plant, soil, and water chemical analyses; soil water-holding capacity and compaction; infiltration and runoff; and other chemical and physical property investigations. The extensive College properties noted previously permit forest soil research to be conducted under a wide variety of environments and ecological conditions.

Programs are coordinated with other areas of specialization through cooperation among school personnel, with other departments of the College, Syracuse University, and the U.S. Forest Service.

TREE IMPROVEMENT

Tree improvement is an important component of forestry, and as demands on the resource increase, it will become even more vital. The most common objective of a tree improvement program is to develop populations of trees that are well-adapted, rapid growing, and disease-free. Other possible objectives may be to increase the aesthetic or recreational value of forest trees through selection for other traits.

Modern, well-equipped laboratories and greenhouses are available for graduate student use. Many established test plantations are available for collection of materials and field evaluations. Graduate students will take formal coursework in plant biochemistry and physiology, statistical genetics, and plant breeding. This specialization prepares graduates for positions in seed orchard management, tree improvement, and forest genetics with private, state, and federal organizations.

FOREST INFLUENCES

Forest influences as an area of graduate study includes all the effects resulting from the presence of forest trees and associated vegetation on climate, the hydrologic cycle, erosion, floods, and soil productivity. Health considerations and human comfort have often been included in older definitions of forest influences, and are assuming greater importance today with our growing concern for the environment.

Included among the principal studies in this area are energy exchange between forest and atmospheres; moderation of urban environments by vegetation; soil and slope stability; and watershed hydrology, including snow.

Graduates fill a variety of positions in research, teaching, and public and private management as watershed management specialists, hydrologists, environmental officers, meteorologists, and ecologists.

INTERNATIONAL FORESTRY

Graduate education in international forestry is designed to assist individuals who are intent upon pursuing internationally-oriented careers in forestry and related fields.

Instruction is aimed at supplementing and enriching the student's technical forestry knowledge and providing the broad background deemed necessary for effective service in a variety of professional areas. These include forestry advisor, teacher, or research specialist with national and international agencies, private business and industrial firms, philanthropic foundations, and voluntary service organizations whose activities include the development and use of forest resources in other lands.

At the master's level, program emphasis is on the attainment of general competence in research methods, foreign languages, cultural anthropology, world geography, and international affairs, plus a broad understanding of the world forestry situation. At the doctoral level, program concentration is on a specialized discipline area such as forestry economics, forest policy and administration, forest management, or silviculture. Orientation to the world forestry field is achieved in part through the selection of formal coursework, and in part through providing an opportunity for the student to conduct his thesis research in residence abroad.

A wide variety of course offerings are available to support the nonforestry elements of this area of study through Syracuse University. Opportunity for field training and research in tropical forestry and related fields is available to qualified candidates, especially at the doctoral level, under cooperative agreements maintained by the College with the Institute of Tropical Forestry in Puerto Rico and the University of the Andes, Merida, Venezuela.

URBAN FORESTRY

Graduate study in urban forestry allows the student to pursue either of two broad objectives. Professional Urban Forestry skills may be broadened in the many areas of information important to the practice of forestry in urban and urbanizing areas through advanced coursework and applied research. More specialized study may be pursued in scientific disciplines supporting the practice of urban forestry. Active areas of specialized research and study in the School includes soils, greenspace ecology, atmospheric science, tree improvement, forest resource inventory and evaluation, and resource economics and planning. There is strong interaction with other urban-related areas of study within the College, including remote sensing, botany, pathology, entomology, wildlife ecology, and landscape architecture. Academic departments in the Maxwell School of Public Affairs at Syracuse University such as Geography, Economics, Political Science and Sociology, cooperate with teaching and research programs in urban forestry. The U.S. Forest Service Northeastern Forest Experiment Station maintains a permanent staff of scientists in their Urban Forest Research Project on campus who are engaged in studies dealing with the planning and management of urban forest ecosystems. This work complements the College's participation as one of nine universities in the Consortium for Environmental Forestry Studies, an organization of scientists and graduate students studying a wide range of problems in urban forestry.

QUANTITATIVE METHODS

Study in the area of quantitative methods is designed to develop professionals skilled in mathematical and statistical problem solution and equipped to act as biomatricians or mensurationists.

The program is designed primarily for students who have done their undergraduate work in areas such as biological sciences, forestry, wildlife, or agriculture. Others who lack background courses may take this material concurrently. Students may concentrate in statistics, operations research, biometry, or forest mensuration. Syracuse University's computer facility and a wide range of courses in mathematics, statistics, and quantitative methods give strong support to the program.

FOREST TECHNICIAN PROGRAM

History and Description

In 1912, some 1,800 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 Technician Program has trained over 3,000 graduates, most of whom are now working in a variety of forest activities, and it has earned the Wanakena Campus a national reputation for excellence. The Program is administered by and is an integral part of the School of Forestry. This relatively unique model of a single professional School offering all levels of work from the technician through post-doctoral emphasizes the teamwork approach to forest resource science and management espoused by the School.

The two-year curriculum trains students as forest technicians. The degree of Associate in Applied Science in Forest Technology (A.A.S.) is awarded. The objectives of the curriculum are to provide students with a knowledge of the field practice of forestry as related to forestry managerial needs; the ability to work and communicate effectively with professional and paraprofessional forestry personnel; and an understanding of the sciences and practices of forestry with some emphasis on ecological applications.

Graduates 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.

The curriculum is designed to allow graduates immediate job entry at the technician level. Students interested in a professional degree in forestry and resource management should investigate the School of Forestry's bachelor's degree curriculum described on page 57. However, it should be understood that transfer into the School's professional forestry curriculum, and other ESF bachelor's degree programs, is possible upon completion of the A.A.S. degree at Wanakena. There is also a transfer package agreement with the University of Michigan, School of Natural Resources, Forest Resources Program.

If a student feels transfer to a baccalaureate program is a possibility after graduation from the Forest Technician Program, he or she should pay close attention to the footnotes under "Freshman Year" on page 57.

The freshman year forest technology curriculum consists of general studies courses which may be taken at any accredited four-year college, community or junior college, or agricultural and technical institute except Farmingdale or Alfred (although transfer credits from these schools are acceptable otherwise).

The second year of the curriculum is offered at the School of Forestry's Forest Technician Program on 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 relationships between forest technology and managerial needs. Fifty percent of the studies are devoted to field exercises, most of which are held on the School's forest. This managed forest, containing both hardwood and coniferous species, covers an area some 3½ miles long with widths varying up to 2¼ miles. On two sides, the forest is bounded by State Forest Preserve lands. The forest is also adjacent to several square miles of virgin timber within the Adirondack Forest Preserve. This excellent forest backdrop for the technology program provides a diverse laboratory for instructional purposes.

Since the Program is situated within a forest environment, some applicants may mistakenly believe that the forest technology program is one of forest lore and wilderness survival. It is, therefore, strongly emphasized that the forest technician curriculum demands high quality academic achievement. Students cannot complete the program without 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, at no additional expense to the student, are made during the year in connection with courses in dendrology, silviculture, forest management, forest recreation, wildlife ecology, and surveying.

LIFE AT WANAKENA

The Wanakena Campus 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.

The main Program building consists of a central service unit with dormitory wings on either side. The central unit contains classrooms, laboratories, a student lounge, faculty offices, the library, a kitchen, dining room and 47 student rooms, each housing two students.

Faculty houses are nearby on the campus. Other buildings include a maintenance shop, garages, a sugar house, 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 training 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 forest technician curriculum at the Wanakena Campus are required to live in the campus's dormitories. An exception may be made for married students who bring their families and rent their own 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 Wanakena Campus does not maintain an infirmary, nor does it employ a physician or nurse. There are two excellent physicians and a dentist as well as an excellent Community Hospital in nearby Star Lake, New York. In emergency situations, the Program transports sick or injured students to the local physician of their choice or to the hospital. Health and accident poli-

cies for FTP 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 through ESF's Office of Student Affairs.

Because of the comparatively isolated location of the Wanakena Campus, a stock of books and supplies used in connection with the second year of the program is maintained on campus for sale to students.

During the first year of the program, College-enrolled students will be guided by the rules and regulations that govern attendance at their local campus. During the second year of the program, students will be guided by the general rules and regulations for College of Environmental Science and Forestry students and an additional set of Wanakena Campus "house rules."

ADMISSION

Admission Requirements

Requirements for entrance into the forest technician curriculum require a minimum of high school units consisting of: English; history (social science); science (including biology); mathematics (including trigonometry or Math 11); and electives. Mechanical drawing, technical report writing, and computer science are suggested electives.

In addition to the academic requirements, the following must also be met by all applicants:

1. The applicant must be strongly motivated toward a career as a forest technician.
2. The applicant must be willing and able to meet the physical requirements of the program which include pole and tree climbing, walking 2 to 6 miles through forest areas often carrying 15-20 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 full medical examination report must be submitted.

Questions concerning any of these requirements should be referred to the Director of Admissions who may, under special circumstances, waive some of them.

Admission Procedures

The decision to admit any student to the Forest Technician Program rests solely with the College of Environmental Science and Forestry. Most openings in the program are filled by students who received conditional acceptances while still seniors in high school, contingent on successful completion of the first year of college. Remaining openings are filled by transfer students who have already attended college. Therefore, it is suggested that the potential forest technician student apply while still a high school senior.

Here is the procedure:

1. Seniors in high school must submit a regular SUNY freshman application for the College of Environmental Science and Forestry, using a Curriculum Code 620 (Forest Technology). These applicants should indicate entry date to be one year in advance of the current year.

FOREST TECHNOLOGY CURRICULUM
(Associate of Applied Science Degree)

Freshman Year	*Credit Hours*
(Completed at a college of the student's choice)	
[1]General Biology	8
English (A technical report writing course is highly recommended.)	6
[2]Math	6
Economics	3
[3]Electives	7
	30

[1]Courses selected may be in general biology, but at least one course in introductory botany is preferred.
[2]Competency in plane trigonometry and college algebra is required. If demonstrated, credits become electives. If students feel transfer to a baccalaureate program is a possibility, they would be well advised to take calculus.
[3]If a student feels transfer to a baccalaureate program is a possibility, general chemistry and physics should be taken as electives. Otherwise, courses in sociology, psychology, political science, geology, soils, accounting, business, computer science, etc. are desirable electives.

Senior Year (Wanakena Campus)			*Credit Hours*
First Semester	FTC 200	Dendrology I	2
	FTC 202	Plane Surveying I	4
	FTC 204	Forest Mensuration and Statistics I	3½
	FTC 206	Forest Ecology	3
	FTC 207	Aerial Photogrammetry	2
	FTC 208	Forest Installations	3
	FTC 213	Forest Protection I	2
	FTC 223	Graphics	1
			20½
Second Semester	FTC 203	Plane Surveying II	1
	FTC 205	Forest Mensuration and Statistics II	2
	FTC 209	Forest Roads	2
	FTC 211	Silviculture	2½
	FTC 214	Personnel Management	1½
	FTC 215	Timber Harvesting	2
	FTC 217	Forest Management	3½
	FTC 218	Forest Recreation	1½
	FTC 219	Elements of Wildlife Ecology	1½
	FTC 221	Soil and Water Measurements	1½
	FTC 227	Forest Protection II	2
	FTC 228	Structure and Growth of Trees	1½
FTC 229	Silviculture II		
		or	2
	FTC 230	Plane Surveying III	
			24½

A total of 75 credit hours is required. Upon satisfactory completion, an Associate of Applied Science (A.A.S.) degree in Forest Technology will be awarded.

2. Submit a regular application to that school selected for the first year of study, using Curriculum Code 620. It is important that students gain entry on their own for the first year of studies. The College will request information at a later date concerning what institution the student will be attending.

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 studies, and they must be appropriate to those courses and comparable in subject matter, content, and level. All second year courses must be taken at the Wanakena Campus 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

Cost of the first year will vary with the specific institution attended.

Estimated costs of the second year program on the Wanakena Campus are as follows:

N.Y. Resident

Tuition	*Board, Room*	*Books, Supplies*
$1,350	Approx. $2,455	Approx. $700

Nonresident

Tuition	*Board, Room*	*Books, Supplies*
$3,200	Approx. $2,455	Approx. $700

An additional estimated expense of $200 will likely be incurred to cover the cost of laundry and clothing. There is also a $20 graduation fee and a $13 student activity fee, plus a $25 residence deposit and a $25 equipment deposit. The latter two fees are fully or partially refundable, depending on breakage charged to a student during the year.

FINANCIAL ASSISTANCE

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 on pages 20-25 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 School assists in placement of graduates. The reputation of the School of Forestry's Forest Technician Program assists 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.

THE SCHOOL OF LANDSCAPE ARCHITECTURE

RALPH A. SANDERS, *Acting Dean*

FACULTY

GEORGE W. CURRY. *Professional Experience*: The Reimann-Buechner Partnership, Landscape Architects, Syracuse; The Curry-Paulo Partnership; Member, Syracuse Conservation Advisory Council, Syracuse Urban Cultural Parks Advisory Committee, and Chairman, Syracuse Landmark Preservation Board. Licensed Landscape Architect, New York State. *Fields of Specialization*: Site Planning, Urban Analysis and Design, Historic Preservation.

TIMOTHY R. DAY. *Professional Experience*: The Architects Collaborative Inc., Architects and Planners; EDAW, Inc. *Fields of Specialization*: Rural Planning, Solar Energy at the Community Scale, Visual Resource Management, Remote Sensing.

GEORGE F. EARLE. *Professional Experience*: School of Architecture, Syracuse University; Artist; President, World Affairs Council. *Fields of Specialization*: History of Art, Cultural History; Painting, Latin American Art; History of Landscape Architecture; Design; Pre-Colombian Art.

JOHN P. FELLEMAN. *Professional Experience*: Planning Engineer, Monroe County, N.Y.; Urban Planner, NYS Hudson River Valley Commission; Chief Planner, Bruce Howlett, Inc.; Partner, Impact Consultants; Licensed Professional Engineer, New York State; Designated Planner-in-Charge, New York State. *Field of Specialization*: Site Systems Engineering; Route Location; Environmental Simulation.

CLAUDE C. FREEMAN. *Professional Experience*: Russell Bailey and Associates, Landscape Architects and Planners; Alfred Obrist, Landscape Architect and Civil Engineer. *Fields of Specialization*: Site Design, Plant Materials, Graphics.

DAVID L. HANSELMAN. *Professional Experience*: Ohio Department of Education, Ohio Department of Natural Resources, Ohio State University. *Fields of Specialization*: Communications Strategies and Message Design, Non-Print Communications.

RICHARD S. HAWKS. *Professional Experience*: EDAW, Inc., Cambridge Research Institute. *Fields of Specialization*: Regional Planning and Design, Facility Siting and Routing, Geographic Digital Data Banks.

ALLEN R. LEWIS. *Professional Experience*: Bucks County Planning Commission, Pennsylvania. Member, American Institute of Certified Planners. *Fields of Specialization*: Community Planning; Planning Theory; System Dynamics; Modeling and Simulation.

FRANK L. MARAVIGLIA. *Professional Experience*: Senior High School Teacher; Business and Management Consultant; President, Centre of Applied Creativity, Baltimore, Maryland; Faculty, Annual Creative Problem Solving Institute, SUNY Buffalo, Organizational Communication. *Fields of Specialization*: Technical Graphics, Creative Problem Solving, Education, Communication, Video, Management.

JAMES E. PALMER. *Professional Experience*: Research Associate, The Environmental Institute, University of Massachusetts; Associate Social Scientist and Resource Planner, Carlozzi, Sinto & Vilkilis, Inc.; College Planner, Kresge College, University of California at Santa Cruz. *Fields of Specialization*: Landscape Perception, Design Evaluation, Social Impact Assessment, Environment and Behavior Research Methods.

ROBERT G. REIMANN. *Professional Experience*: City of Montreal Department of Public Works, Parks and Playgrounds; Sargent, Webster, Crenshaw and Folly Architects; James E. Glavin and Associates; Principal, Reimann-Buechner Partnership; Director, Professional Practice Institute (ASLA); Director, Landscape Architecture Foundation; Fellow, American Society of Landscape Architects; Member, ASLA Council on Education. *Fields of Specialization*: Environmental Design, Passive Energy Conservation, Site Planning and Design.

HAMID SHIRVANI. *Professional Experience*: University of Southern California; University of California, Los Angeles; Southern California Institute of Architecture; Pennsylvania State University; Shirvani & Associates; The Planning Center; Technokam Regional Development Corporation; London Borough of Barnet, U.K.: Maidment & Brady, U.K.; Devereux and Partners, U.K. *Fields of Specialization*: Urban planning and design, environmental policy development, political economy and developing countries.

RICHARD C. SMARDON. *Professional Experience*: Wallace, Floyd, Ellenzweig, Inc., Cambridge, Mass.; Executive Office of Environmental Affairs, Commonwealth of Massachusetts; Oregon State University Extension Service; Institute for Urban and Regional Development, University of California; USDA Forest Service. *Fields of Specialization*: Landscape and Environmental Planning, Visual Resource Analysis, Environmental Assessment/Administration, Wetland Assessment.

KATHLEEN A. STRIBLEY. *Professional Experience*: Department of Landscape Architecture, The Ohio State University; Anderson-Lesniak and Associates, Inc.; Research Project, University of Michigan; Johnson, Johnson and Roy, Inc.; Colvin-Robinson Associates, Inc.; Dalton•Dalton•Little•Newport, Inc. *Fields of Specialization*: Design and Behavior; Public Participation; Urban Design, Parks and Recreation; Site Planning and Design.

DANIEL A. SUNDQUIST. *Professional Experience*: American Peace Corps; EDAW, Inc., University of New Hampshire. *Fields of Specialization*: Site Planning and Design, Environmental Impact Assessment, Siting and Routing, Synaesthetics.

Introduction

The alteration of the physical environment has been a product of human activity since the earliest times of human settlement. 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 that requiring skilled individual effort and often demanding multidisciplinary attention.

The School of Landscape Architecture offers curricula designed to educate students to contribute in varied ways to the wise use of land and landscape. Each degree program provides a basis for students to establish career directions in landscape architecture or in related disciplines. These curricula are offered at both the undergraduate and graduate levels.

UNDERGRADUATE PROGRAM

The School of Landscape Architecture offers two undergraduate degree programs—the Bachelor of Science with a major in Environmental Studies (B.S./E.S.) and the Bachelor of Landscape Architecture (B.L.A.).

Both degrees share the ultimate purpose of providing senior level education for those concerned with the condition and form of the physical environment. The B.S./E.S. degree is basically designed for those students desiring a general undergraduate degree to be followed by an environmentally related graduate degree. The B.L.A. degree is basically designed for those students desiring to enter the profession of landscape architecture either directly after completing this degree or after completing a graduate degree. Students are urged to seek complete clarification of the two degree programs with regard to their own career goals by arranging an interview with the School.

All students apply for either the B.S./E.S. or B.L.A. degree upon application to the College.

BACHELOR OF SCIENCE IN ENVIRONMENTAL STUDIES

The Bachelor of Science in Environmental Studies (B.S./E.S.) program is primarily concerned with interrelationships among the natural environment, people, and the human environment, including society's institutions. Its focus is on the issues involving the condition and form of the physical environment. The goal of the program is to educate students to be more sensitive, articulate, and knowledgeable about the complex environmental issues facing contemporary society.

The B.S./E.S. degree is granted at the end of four years and requires the successful completion of 125 credit hours. Students typically enter the program with 62 lower division credits. During their junior and senior years, students are required to complete a group of core courses in the humanities, natural, and social sciences. The particular emphasis of an individual student's program is determined by the development of two concentration areas investi-

Lower Division Courses

Course Area	*Credit Hours*
Written Communications Required credit hours in this area should be taken in courses dealing with English comprehension, the basic skills of grammar and composition.	3
Humanities Required credit hours in this area should be taken in coursework in philosophy, literature, art, music, drama, and language.	9
Social Sciences Required credit hours in this area should be taken in coursework in history (preferably U.S.), cultural geography, sociology, psychology, political science (preferably U.S. institutions), social or cultural anthropology, or economics.	9
Natural Sciences Required credit hours in this area must include a course in general biology. Additional hours should be taken from coursework in ecology, physical geography, earth science, geology, biology, chemistry, and physics.	6
Mathematics Required credit hours in this area should be taken in computer programming, statistics, or mathematics at the level of college algebra, trigonometry, and calculus.	3
Electives	32
TOTAL MINIMUM LOWER DIVISION CREDITS	62

gating specific environmental concerns directly related to the student's career purposes and goals. It is recommended that students engage some integrative academic experience during their senior year that provides an opportunity to synthesize their environmental studies education.

The complexity and scope of coursework required in the B.S./E.S. program demands both discipline and commitment from students seeking the degree. A clear sense of purpose and objectives is necessary to beneficially engage the curriculum. To successfully meet each student's objectives, a close-working relationship between faculty and student is also necessary. The program's flexibility makes it especially suited for advanced undergraduates desiring a general environmental background in preparation for either graduate training or environmental careers that may appropriately be entered with a baccalaureate degree.

Students receiving the B.S./E.S. degree have pursued graduate study in the disciplines of planning, landscape architecture, and other environmentally related areas such as business, education, and law. Students with academic standing in the top one-third of their class may apply at the end of their junior year for advanced standing admission to the School's M.L.A. program in community design and planning.

Prerequisites for Entry into the B.S./E.S. Program

Because of the wide range of opportunities available to students who enter the B.S./E.S. program, it is important that they prepare themselves with a broad range of lower division coursework. Understanding the issues involved in the condition and form of the physical environment requires a background in the humanities, natural, and social sciences. The following required and recommended prerequisite coursework will prepare the entering student to engage the B.S./E.S. curriculum.

Each applicant is required to submit a statement of program interest. This statement should describe how study in the B.S./E.S. program will contribute to the student's educational and career goals. It should reflect an understanding of the curriculum and represent the student's preparedness to take advantage of the special nature of the program.

Bachelor of Science in Environmental Studies Curriculum

I. CORE REQUIREMENTS

	Credit Hours
A. *WRITTEN COMMUNICATIONS* ..... Coursework intended to develop a professional-level skill in written communication. Required are three credit hours in report writing or equivalent and one credit hour in library research.	4
B. *METHODS AND TECHNIQUES* ..... Coursework intended to develop methods and techniques useful for analyzing environmental information. Required are six credit hours, including a three-credit-hour course in statistics or computer programming.	6
C. *ENVIRONMENTAL CONCEPTS AND SYSTEMS THINKING* ..... Coursework intended to develop critical facilities and systems thinking useful for an appreciation of the holistic nature of environmental issues. Required are six credit hours, including EIN 300 Introduction to Environmental Studies.	6
D. *NATURAL SCIENCES* ..... Coursework intended to provide a natural science foundation useful for understanding natural phenomena and processes. Required are nine credit hours, including EIN 311 Natural Processes in Planning and Design. It is recommended that the remaining courses have a laboratory or fieldwork component.	9
E. *HUMAN-ENVIRONMENT INTERACTIONS* ..... Coursework intended to provide a foundation for understanding the interaction of humans and the environment from social, institutional, and historical perspectives. Required are nine credits, including EIN 390 Social/Cultural Influences and Environmental Form, EIN 451 Introduction to City and Regional Planning, and either EIN 371 History of American Landscape Attitudes, or EIN 471 History of Landscape Architecture.	9
II. CONCENTRATION REQUIREMENTS ..... This coursework provides an opportunity to develop proficiency in two particular aspects of the interrelationship of the natural environment, people, society's institutions, and their influence on the condition and form of the physical environment. Two concentration areas of nine credit hours each are required. A maximum of three credit hours of independent study may be counted toward each concentration. Internship-type experience may not be counted toward a concentration. Concentrations are proposed by students after consultation with faculty and must be approved by the faculty advisor. Accepted coursework must be of grade C or better.	18
III. DIRECTED ELECTIVES ..... Eleven credit hours of coursework selected with the approval of the faculty advisor to complement core requirements or concentration areas. It may include a senior-year integrative academic experience. It is recommended that some integrative academic experience providing an opportunity to synthesize their environmental studies education be engaged by each student during their senior year. Possible alternatives include independent readings, a research project, an internship, a senior seminar, or an off-campus study. Each option has its own prerequisites and some have limited enrollments.	11
TOTAL MINIMUM UPPER DIVISION CREDITS	63

A total of 125 credit hours is required to complete the B.S. degree in Environmental Studies.

BACHELOR OF LANDSCAPE ARCHITECTURE

The B.L.A. degree 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) as the first professional degree offered at the School. The B.L.A. is granted at the end of five years of study and requires the successful completion of 160 credit hours. Students enter into the third year of the program with a minimum of 62 lower division credit hours and follow the prescribed curriculum.

The B.L.A. degree program consists of a core of courses involving the basic principles and skills of landscape archi-

tecture design, land manipulation and engineering, applied ecology, and communications. Additionally, students are required to participate in an independent study semester of the Off-Campus Program during the fall semester of the fifth year. The major objective of the B.L.A. program is the development of 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 obtain a license to practice landscape architecture. At present, the State of New York requires those holding a 5th-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 a license.

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 in designing the form of the environment.

Students receiving a B.L.A. degree have entered the profession as employees in public agencies 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, energy conservation, environmental policy management and research.

Prerequisites for Entry into the B.L.A. Degree Program

Because of the breadth of concern of the B.L.A. degree, it is imperative that entering students prepare themselves with a broad range of lower division coursework. The environmental efforts with which the students will be involved require a strong background in both the natural and social sciences. In addition, prior skill development in graphics, mathematics, and computer science is required. The following required prerequisite coursework must be met to prepare the entering student to engage the B.L.A. curriculum.

ELECTIVE GUIDELINES

Students planning to transfer to the School of Landscape Architecture should consider the following as guidelines in selecting their 35 credit hours of electives. The subject areas are considered *highly desirable* but are not required. Course areas marked (*) are required following transfer to the School, but can be waived if completed prior to transferring. This will allow a student to take additional electives at ESF.

1. In addition to the required prerequisite credit hours listed, further subject coverage in Written and Oral Communications, Natural Sciences, and Social Sciences as listed above is recommended.
2. Art and Design
   Courses in this category should preferably include Art History* and Studio Art. Studio courses in Drawing or Three-Dimensional Design, i.e., Sculpture, Ceramics, and Photography, are recommended.
3. Analytical Tools
   Courses in this category should preferably include Elementary Plane Surveying*, Air Photo Interpretation*, or Elementary Physics. Additional work in computing technology is highly recommended, particularly in the realm of computer graphics and computer-assisted design (CAD).
   Demonstration of academic excellence in environmental design and design graphics through submission of a portfolio is highly recommended as part of the admission's process to the B.L.A. program.

Lower Division Courses

Course Area	*Credit Hours*
Written and Oral Communication Required credit hours in this area should be taken in courses dealing with English comprehension, the basic skills of grammar and composition, and public speaking.	6
Graphics A minimum of one semester's work preferably in a course in engineering drawing, mechanical drawing, or architectural drafting may be selected.	3
Natural Sciences Required credit hours in this area must include a course in botany or plant biology. Additional hours should be taken from coursework in ecology*, physical geography, earth science, geology, or environmental geology.	6
Social Sciences Required credit hours in this area are to be taken from coursework in U.S. history, sociology, social psychology, social or cultural anthropology, political science, or economics.	3
Mathematics Required coverage of college algebra and trigonometry. Students with prior coverage in math who can demonstrate proficiency at time of admission may substitute elective hours for this prerequisite. More advanced math is desirable but not required.	6
Computer Science Required course must include introduction to programming utilizing BASIC, FORTRAN, APL, or PASCAL.	3
Electives	35
TOTAL MINIMUM LOWER DIVISION CREDITS	62

Bachelor of Landscape Architecture Curriculum

Third Year

			Credit Hours
First Semester	LSA 320	Introduction to Landscape Architecture and Planning	3
	LSA 326	Landscape Architectural Design Studio I	3
	CMN 382	Graphic Communication	2
	EIN 311	Natural Processes in Planning and Design	3
	EFB 320	General Ecology or Elective	3
	Elective		2
			16
Second Semester	LSA 327	Landscape Architecture Design Studio II	3
	LSA 330	Site Research and Analysis	2
	EIN 371	History of American Landscape Attitudes	3
	EIN 390	Social/Cultural Influences and Environmental Form	3
	ERE 306	Elements of Map and Air Photo Interpretation or Elective	1
	ERE 308	Elements of Plane Surveying or Elective	1
	ENG 406	Technical Writing	3
			16

Fourth Year

			Credit Hours
First Semester	LSA 422	Landscape Design Studio III	4
	LSA 433	Plant Materials	2
	LSA 434	Design Materials	1
	LSA 442	Site Grading	2
	LSA 443	Site Drainage Systems	1
	EIN 451	Fundamentals of City and Regional Planning	3
	EIN 471	History of Landscape Architecture	3
			16
Second Semester	LSA 423	Landscape Design Studio IV	4
	LSA 425	Orientation for Experiential Studio	2
	LSA 444	Vehicular Circulation Design	1
	LSA 445	Introduction to Structures	1
	LSA 455	Professional Practice in Landscape Architecture	2
	EIN 470	Art History or Elective	3
	LIB 300	Library Research	1
	Elective		3
			17

Fifth Year

			Credit Hours
Summer	LSA 533	Plant Materials	2
First Semester	LSA 524	Experiential Landscape Design Studio V (Off-Campus Program)	16
Second Semester	LSA 522 or	Landscape Design Studio VI—Urban Design	4
	LSA 525 or	Landscape Design Studio VI—Site Design	4
	LSA 527	Landscape Design Studio VI—Regional Design	4
	LSA 545	Professional Practice Studio	2
	Architecture Elective		3
	Elective		3
	Elective		3
			15

A total of 160 credit hours is required to complete the B.L.A. degree.

NOTE: A number of the courses listed in the B.L.A. curriculum are in the process of being revised. Upon revision, new course descriptions will be available after approval by the College of Environmental Science and Forestry Faculty.

GRADUATE PROGRAM

MASTER OF LANDSCAPE ARCHITECTURE

The master's degree is open to those students who hold an undergraduate degree and meet the prerequisites for admission. The program is accredited by the American Society of Landscape Architects and focuses on community design and planning. The three-year course of study provides a strong foundation of design theory and process while emphasizing mastery of the skills associated with an individually selected area of concentration. The core curricula focus on processes of community design and planning. Students are required to integrate the core coursework with an elected area of concentration. The program requires cross-disciplinary study to prepare students to enter a variety of emerging positions in the public and private sectors. Illustration of these positions may be found in design research, community development, impact analysis, and environmental management. Although these positions require working knowledge of design, they transcend the traditional skills normally associated with project design. Processes related to management, analysis techniques, technological application, and the social and natural sciences are considered necessary to undertake these and other similar positions. Graduates of the program are currently employed by government, educational institutions and private offices practicing environmental design and analysis across a broad and comprehensive scope or purview. The M.L.A. degree is granted upon the completion of 72 credit hours (42 graduate) in a prescribed curriculum.

A variety of joint degree program opportunities exists for applicants wishing to develop a unique career track. Concurrent professional degrees in Law, Public Administration, Public Communication, or Business Management may simultaneously be pursued at Syracuse University. Ph.D. programs for careers in teaching and research are available within the College's Graduate Program in Environmental Science, and with a variety of programs at Syracuse University, such as geography. Applicants interested in dual degree programs are encouraged to contact the College's Graduate Admissions Office at an early date.

M.L.A. DEGREE PROGRAM

The M.L.A. curriculum has four components: a foundation year, a sequence of required core courses, a series of elected courses in an area of concentration, and a terminal experience. The foundation coursework provides the skill and knowledge basis for engaging environmental design. The required core courses have as their focus the development, enhancement, and refinement of understanding of landscape architectural philosophy, theory, skills, and techniques, as focused on community design and planning. Emphasis is placed on the refinement of proficiency in design analysis skills, concepts, and objectives.

Each student is required to select and complete nine credit hours of directed graduate electives in a declared area of concentration within the major of community design and planning. The specific concentration is the responsibility of each student and must be approved by the student's faculty advisor or major professor prior to the end of the first year. Illustrative concentrations include: physical, cultural, communication/public participation, urban design, visual analysis, and environmental simulation.

Three terminal experience options are available: thesis or project, coursework, academic, or professional experience. A project consists of the critical application of professional knowledge and skills to a landscape architectural problem. A thesis consists of research which expands or clarifies basic knowledge related to community environmental design. The coursework option involves selected electives in the designated area of concentration. The academic/professional experience is typically a semester-long internship with a public agency, private firm, or nonprofit institution.

The following describes the broad sequential linkages of the six-semester program:

First Year: Foundation courses in design analysis, physical factors, graphics, history, and theory, and start of graduate elective sequence, or engagement of additional undergraduate technical subjects. The scale focus is human, site, and neighborhood.

Second Year, Fall Semester: The third semester of study is intended to provide an introduction to decision-making processes, including computer applications in community design and planning. An examination of the impact of physical factors on the environment is provided. Scale focus includes municipal and site in rural/suburban scenarios.

Second Year, Spring Semester: The fourth semester of study is intended to investigate community design and planning through a variety of projects focusing on the form and condition of environments supporting human behavior. Methods of research and analysis relevant to social determinants at the scale of an urban district are introduced.

Third Year: This year is individually designed, with the assistance of a major professor, to meet the student's career objectives while satisfying the requirements of the selected concentration area, and terminal experience. Study and research opportunities exist both at the Syracuse Campus and throughout the world. Often, all or a portion of the fall semester involves off-campus pursuits, while the spring semester entails final coursework and project documentation.

Research and community service play a significant role in the graduate pro-

M.L.A. Program Sequence

The M.L.A. program is established as a three-year sequence of courses. The following sequence illustrates a typical three-year program.

First Year		Credit Hours
LSA 520	Design Analysis Studio I	3
CMN 382	Graphic Communication	2
LSA 671	History of Landscape Architecture	3
[1]LSA 697	Topics and Issues of CDP	2
LSA 521	Design Analysis Studio II	3
LSA 330	Site Research and Analysis	2
ERE 306	Air Photo Interpretation	1
LSA 445	Elements of Structures	1
LSA 496	Site Grading	2
[2]Directed Electives		5
		24

Second Year		Credit Hours
LSA 620	Community Design and Planning Studio I	3
LSA 652	Community Development Process	3
LSA 656	Environmental Factors, Community Response, and Form	3
[3]LSA 433	Plant Materials	2
[3]LSA 434	Design Materials	1
LSA 621	Community Design and Planning Studio II	3
LSA 650	Behavioral Factors of Community Design	3
Directed Electives		6
		24

Third Year

[4]*Typical Options for Integrative Experience:*

		Thesis/Project		Academic/ Professional Experience		Coursework	
		Fall	Spring	Fall	Spring	Fall	Spring
LSA 898	Academic/Professional			12			
LSA 899	Thesis/Project	3	6				
LSA 641	Formal Organization		1		1		1
LSA 642	Project and Program Scheduling		1		1		1
LSA 643	Ethical Issues in Community Design and Planning		1		1		1
Directed Electives		9	3		9	12	9
		12	12	12	12	12	12

[1]Also required for students who enter with advanced standing.
[2]Directed electives are selected in consultation with the student's advisor. They are designed to augment the student's undergraduate preparation, to develop the required concentration.
[3]Usually not required for students who enter with advanced standing.
[4]The precise number of credit hours taken by a student during a given semester in LSA 899, LSA 898, or in directed electives is determined in consultation with the student's advisor.

gram, primarily through funded projects and projects/thesis. Not only does research provide new knowledge and applications for the profession, but it enriches the curriculum, enhances faculty expertise and develops student skills in rigorous observation, clear thinking, and lucid writing.

By the nature of a profession which exists on evolving frontiers of human interaction with natural and built environments, much of the research in landscape architecture deals with issues in an exploratory way. Faculty members and graduate students usually work together on research projects in an atmosphere of mutual learning. Approaches may vary from rigorously quantitative analysis of data, to highly qualitative evaluation of broad problems, to application of design and planning methods to specific cases.

The College library and the several libraries on the Syracuse University campus offer reference material to support study programs. Facilities at the School include adequate studio and office space as well as three research laboratories. The School also has reproduction, model making, photographic, audio-visual, micro-computer, video, noise, solar, and visual simulation equipment. The College's Computer Center is fully interfaced with Syracuse University to provide a complete range of academic and research capabilities. The College also has a fully-equipped video tape recording (VTR) studio, photogrammetic labs and micro-computer based image processing capability for LANDSAT tape interpretation.

The School is unique in its location within the College of Environmental Science and Forestry. This situation provides the M.L.A. candidate with the opportunity to draw upon information and knowledge in ecology, natural sciences, resource management, forestry and many other related environmental disciplines. The U.S. Forest Service Urban Forestry unit located at the College provides a unique opportunity to promote interdisciplinary environmental design research. In addition, the relationship with Syracuse University provides the School with an extensive intellectual as well as physical resource basis.

The Syracuse area has the largest concentration of landscape architectural firms in the state, outside New York City. With a metropolitan population of nearly 500,000, the city has many opportunities for urban-oriented study. Also, the city's central location in Upstate New York provides easy access to a rich variety of community design and planning contexts throughout the northeastern U.S. and the major metropolises of Canada.

Students seeking admission to the M.L.A. program may apply to enter in either the first or second year based on education and experience. Admission to the first year requires:

1. An undergraduate degree.
2. Graduate Record Examination scores.
3. Undergraduate transcript.
4. Three letters of recommendation.
5. A completed course in each of three areas:
   a. botany, biology, or ecology;
   b. geology, geomorphology, or earth science;
   c. anthropology, psychology, or sociology;
   d. computer application or programming course.

In addition, students seeking admission to the second year must have:

6. Accredited design degree or equivalent;
7. Design and engineering portfolio;
8. TOEFL scores required for all applicants whose native language is not English. Applications should be made prior to March 1 for the following fall.

DUAL UNDERGRADUATE PROGRAM IN ENVIRONMENTAL AND FOREST BIOLOGY AND RESOURCES MANAGEMENT

This dual curriculum is designed to provide students with a strong background in basic biology and forestry. In doing so it meets the core course requirements in two undergraduate curricula: Environmental and Forest Biology, and Resources Management. The Dual Program is one level in a continuum of Biology and Forestry study opportunities at the College:

Environmental and Forest Biology with Forestry Electives
Dual Program
Resources Management with Biology Electives
Resources Management

Upon completion of the Dual Program, graduates will be highly qualified to work professionally in forested ecosystems. The breadth of training received by students who elect this option will prepare them for a career in forestry and other aspects of environmental science in the federal, state, and private sectors. Exposure to diverse courses and extensive field experience enhances their employment opportunities in multidisciplinary programs that are characteristic of contemporary approaches to forestry management and other environmental problems.

The Dual Program requires a minimum of five semesters at the upper division level. Six semesters may be necessary for those students who lack appropriate lower division courses, or who wish to develop specific interests in forest biology or forestry. A total of 147 credit hours, 62 of them prior to matriculation, is required for this Bachelor of Science degree. In addition to the 58 credit hours of upper division core courses listed below, six of the elective credit hours must be in Plant Science, six in Animal Science, six in

FOR (Forestry) and three in WPE (Wood Products Engineering) or FEG (Forest Engineering), exclusive of the eight-hour summer camp experience.

There is less opportunity to take free electives in the Dual Program than in the two curricula which it combines. It is recommended that elective requirements in plant science and animal science address critical support areas such as forest pathology, plant ecology, fish and wildlife management, and forest entomology. Similarly, forestry electives in silviculture, hydrology, or tree improvement are examples of elective opportunities in important forestry support areas. In all cases, choice of electives depends on the student's professional goals. Course selection is made after consultation with each of two advisors; one from the School of Environmental and Forest Biology and one from the School of Forestry.

To facilitate transfer at the junior level, it is important that students satisfy the lower division course requirements prior to matriculation at the College of Environmental Science and Forestry.

Students entering at the junior level should have successfully completed a minimum of 62 credits which include:

Lower Division Courses

Course Area	*Credit Hours*
General Chemistry with Laboratory	8
Organic Chemistry with Laboratory	8
General Physics with Laboratory	8
Mathematics, through Integral Calculus	6-8
English	6
General Botany and Zoology OR General Biology with Laboratory	8
*Social Sciences	6
*Political Science (U.S. Institutions)	6
*Biology Electives OR Economics (Macro- and Microeconomics)	6
	62

Upper Division Courses

Junior Level			*Credit Hours*
Fall Semester	EFB 320	General Ecology	3
	EFB 336	Dendrology I	3
	**EFB 352	Elements of Forest Entomology	3
	***ECN 201	Microeconomics	3
	****Elective		3
			15
Spring Semester	APM 391	Statistics	3
	EFB 325	Cell Physiology	3
	FOR 360	Principles of Management	3
	****Elective		3
	**ECN 202	Macroeconomics	3
	Computer Application		1
			16
Summer:	FOR 301, 302, 303, 304 Field Forestry Program at Warrensburg		8
Fall Semester	FOR 331	Introduction to Physical Environment	6
	FOR 332	Silvics/Silviculture	8
	FOR 322	Mensuration	1
			15

Senior Level			*Credit Hours*
Spring Semester	FOR 370	Management of Forest Enterprise	3
	EFB 407	Genetics	3
	EFB 408	Genetics Laboratory	1
	****Electives		9
			16
Fall Semester	APM 492	Biometrics	3
	FOR 400	Social Environment of Resource Management	3
	FOR 461	Management Models	3
	****Electives		6
			15

*Students may be admitted with 3 credit hours in each of these subject areas. Deficiencies must be removed as early as possible in the student's program.

**A spring course, EFB 351, may be substituted if scheduling problems conflict with EFB 352. This will open up 3 hours of electives during the fall semester rather than in the spring.

***If the economics requirement is satisfied in the freshman and sophomore years, biology or forestry electives may be substituted and vice versa.

****These electives should include at least 3 credits in WPE or FEG, 6 credits in FOR, 6 credits in plant sciences, and 6 credits in animal science.

GRADUATE PROGRAM IN ENVIRONMENTAL SCIENCE

MOHAN K. WALI, *Director*

The collegewide Graduate Program in Environmental Science (GPES) offers M.S. and Ph.D. degrees in environmental science through a transdisciplinary program which draws upon faculty from across the College as well as selected faculty participants from Syracuse University. Concurrent degree programs are also offered between GPES and Syracuse University's Maxwell School of Citizenship and Public Affairs, S. I. Newhouse School of Public Communications, School of Management, and College of Law.

A PERSPECTIVE

Amid the phenomenal advances in engineering technology in this century, there arose an unprecedented demand for materials and processing. Concomitantly, a burgeoning human population, coupled with increasing demands for food, fiber, and fuel resulted in large scale disturbance of the environment, overexploitation of natural resources and insensitive land use practices. Polluted air and water, land areas made derelict by mining, energy-intensive agricultural practices, increased use of pesticides, large scale industrial growth with its attendant waste products, unprecedented numbers of automobiles, networks of roadways, and expanding urbanization brought to the fore the political, economic, and some recently-acquired social-cultural realities.

The understanding of and solutions to contemporary environmental problems transcend disciplinary boundaries. Hence, environmental science must not only integrate the traditional scientific disciplines but also the problems of technological development, of generated residuals and the risk of environmental hazards, and of associated economic and social choices.

ENVIRONMENTAL SCIENCE is the field of enquiry in which the knowledge and principles of physical, biological, and social sciences flow as systems processes within the contextual framework of unifying policies. These policies, in turn, determine the design, the plan and the regulation seeking mitigation of environmental problems. While the emphasis in some cases may be on immediate environmental problem-solving, understanding the problem must be the key for effective and long-term resolution. Additionally, the study of environmental problems in many cases affords great opportunities for the enrichment of the basic knowledge of traditional disciplines and the testing of some of their basic tenets.

MISSION

The central mission of GPES is transdisciplinary education and research for effective resource use, resource conservation, and environmental enhancement and protection. Future environmental scientists will require sound knowledge of the traditional disciplines, as well as the understanding of a number of ancillary subject areas. Their effectiveness will be demonstrated through technology transfer that brings the science from the experimental to real world situations. The challenge lies in the translation of environmental awareness and concerns into well informed, scientifically-based action. It is here that the central role of a program like GPES resides: *Transdisciplinary education and research to foster the effective use of natural resources while protecting the environmental base from which all resources flow.*

Therefore, the Graduate Program in Environmental Science engenders the following approaches to prepare the student to scientifically deal with environmental problems, and to perform as an effective environmental professional:

(a) *multidisciplinary approach*—recognition of the necessity to approach environmental problems with input from several disciplines and professions:

(b) *holistic philosophy*—awareness of and deference to the interdependence of elements (including physical, biological, and social systems, human behavior, and cultural values) within ecosystems;

(c) *sound grounding in at least one concentration*—competency to understand and apply the principles of an environmental area of study, and with that strength interact with other disciplines;

(d) *realistic experience*—through internships or other focused projects which provide direct interaction in social, economic, political, and social institutions which underlie decisionmaking; and

(e) nontraditional *problem solving* tools to permit a student to go beyond traditional disciplinary paths.

PROGRAM OF STUDY

Within the framework of POLICY, PLANNING, and REGULATION, there are six areas of concentration: ENERGY, LAND USE, WATER RESOURCES, URBAN ECOSYSTEMS, WASTE MANAGEMENT and ENVIRONMENTAL COMMUNICATION. These concentrations are designed to be broad-based; are not mutually exclusive and intergrade into each other to form a continuum; and some areas of pursuit belong to several concentrations, e.g., environmental assessment and impact analysis. Similarly, faculty interests are diverse and encompass more than one area of concentration.

A. Policy, Planning, and Regulation

FACULTY: BEHREND, DALL, FREY, GEIS, GRATZER, GRAVES, HENNIGAN, KARP, LAMBRIGHT, MONTEITH, NAKATSUGAWA, E. PALMER, J. PALMER, PORTER, REIMANN, ROWNTREE, SHIRVANI, SMARDON, WHALEY, YAVORSKY

Policy study, defined as the study of the nature, causes, and effects of alternative public policies, is the integrating force bringing all concentration study areas together in pursuit of the common goal of meaningful and effective research and education in environmental science.

Hence, the examination of policy by decomposition into its components and the design and synthesis of new alternatives, or *policy analysis*, forms a central core of the program. Policies formulated on the basis of contemporary scientific knowledge together with the societal, economic, and cultural values, pave the way for planning and regulation for environmental issues.

Through the study of public policy, students gain an understanding of the causes and consequences of policy decisions which will help integrate environmental knowledge with the scholarship of public administration and

political science. This integration is necessary because the careers of graduates will either be directly in the public sector, or closely linked with government agencies. Second, an understanding of the causes and consequences of public policy assists students to solve practical problems. Such understanding is valuable in developing strategies and tactics to accomplish desired objectives. Third, the knowledge of public policy causes and consequences creates political awareness, a virtual necesssity for any professional irrespective of the sector of employment.

An excellent example wherein policy and scientific knowledge are intended to be brought together for decisionmaking is the National Environmental Policy Act of 1969. By this Act, environmental impact statements which consider alternative courses for every stipulated development that has the potential for adverse environmental impact have become institutionalized. The Act provided for active citizen participation; any decisions that invoked the spirit of the Act could be challenged.

Students can opt to specialize in environmental assessment analyses through studies in any one of the GPES concentrations. In practice, such analyses are team efforts, and the program is intended to ensure that potential team members are conversant with, and operationally adapted to, the language and procedures of the disciplines involved. Starting with students who have an in-depth background in an established discipline or profession (e.g., chemistry, biology, engineering, ecology, forestry), the program seeks to build upon existing strengths while broadening the student's ability to deal effectively with the complex, interdisciplinary problems which arise in studies of environmental impact.

B. Areas of Concentration

LAND USE

FACULTY: M. ALEXANDER, BEHREND, BLACK, BROCKE, BURGESS, CHAMBERS, DALL, DINDAL, ESCHNER, FELLEMAN, GEIS, GRATZER, GRAVES, HARTENSTEIN, JOHN HASSETT, HAWKS, KARP, MCCLIMANS, MONTEITH, J. PALMER, PAYNE, PORTER, RAYNAL, REIMANN, ROWNTREE, SANDERS, SHIRVANI, SMARDON, VANDRUFF

The Land Use Concentration develops an understanding of present and future trends in the magnitude and patterns of land use and estimates future availability of land for multiple uses. It provides opportunity for economic, sociological, political, policy, planning, and ecological foci. It brings together an interdisciplinary mix of coursework, internship experience or research to address land use value conflict situations, ecologically-based land use considerations of carrying capacity, and appropriate means to anticipate and plan for existing and new land development technologies and processes. The following objectives are important: (a) to foster appropriate use of policy, planning, economic and legal devices for encouraging socially responsible use of the land; (b) to clarify the behavioral and perceptual sources of environmental problems and land use decisions; and (c) to develop, test, and refine methods for evaluating land use proposals with important environmental consequences. Options for specialization include: (1) *Land Use Planning*, and (2) *Managemend Land Use Patterns*.

Recommended areas of study include, from (1) physical sciences: energy exchange, soils, remote sensing, visual landscape analysis, meteorology, and soil and water conservation; (2) biological sciences: terrestrial community ecology, wildlife management, and silviculture; (3) social sciences: land use economics, environmental impact, transportation systems, environmental law, and environmental communications.

WATER RESOURCES

FACULTY: M. ALEXANDER, BLACK, BRANDT, BURGESS, ESCHNER, FELLEMAN, JAMES HASSETT, JOHN HASSETT, HENNIGAN, JOHNSON, MCCLIMANS, MITCHELL, MONTEITH, NAKAS, RAYNAL, RINGLER, SCRUDATO, SMARDON, TULLY, WERNER

The Water Resources Concentration develops an understanding of both the technical information and transdisciplinary relationships of various *water-related* issues. Individual programs may emphasize scientific or social subject areas but all students acquire preparation in both areas. Scientific aspects include the basic physical, chemical, and biological interactions occurring in aquatic ecosystems under natural conditions, as well as under modified conditions that result from changes in water quality or quantity. The social aspects are concerned with planning, regulation, law and institutions, and management of water resources. Both as a resource for many human benefits and uses, and as a critical environmental element, water serves as a focus for graduate study in pollution and water quality control, and water and related land resources management. The transdisciplinary nature of the program requires a balance of depth, breadth, and synthesis of studies drawing together many diverse components.

Recommended areas of study include, from (1) physical sciences: civil engineering, geology, geomorphology, hydrology, meteorology, sanitary engineering, soils, and water chemistry; (2) biological sciences: ecology, entomology, fishery biology, forestry, microbiology, water quality, wildlife management, and zoology; (3) social sciences: administration, economics, government, history, law, and policy.

URBAN ECOSYSTEMS

FACULTY: BLACK, BURGESS, HAWKS, HERRINGTON, J. PALMER, RAYNAL, ROWNTREE, SANDERS, SHIRVANI, SMARDON, VANDRUFF

The Urban Ecosystems Concentration focuses on urban system structure and function using both analytic and synthetic techniques. Faculty expertise in soils, meteorology and hydrology, wildlife, energy and reclamation, forestry, design, and human attitudes and behavior combine to facilitate the systemic approach to the study of Urban Ecosystems. Three types of systems are available to the students for field work: (a) the nonmetropolitan community typical of Upstate New York rural areas, (b) the metropolitan central city surrounded by suburbs and agricultural lands, and (c) the megalopolitan seaboard extending from Boston to Washington, D.C.

Recommended areas of study include from (1) physical and engineering sciences: microclimate, water management, soils, remote sensing; (2) biological sciences: urban forestry, wildlife, greenspace silviculture, and botany; (3) social sciences: land economics, geography, human and cultural geography, and ecology.

WASTE MANAGEMENT

FACULTY: J. ALEXANDER, DINDAL, DURKIN, ESCHNER, FREY, HARTENSTEIN, JAMES HASSETT, JOHN HASSETT, HENNIGAN, JOHNSON,

MCCLIMANS, MITCHELL, MONTEITH, NAKAS, NAKATSUGAWA, SCRUDATO, TANENBAUM.

The Waste Management Concentration encompasses three subject areas: (1) *Toxic Waste Disposal*—Research into natural detoxification is an active and valuable component of waste management studies, and the nature, amounts and disposal/destruction in land fills, or by incineration, chemical neutralization, deep well injection, and ocean dumping are considered thoroughly. (2) *Biomass Utilization*—Includes the use of forest and agricultural wastes and other forms of biomass that have a vast potential for energy production and as biochemical feedstock. (3) *Biogeochemical Management of Wastes*—Waste materials may have unique features due to their specific chemical and physical composition, their temporal and spatial location, and their possible contamination by toxic substances. These waste materials may have useful nutrient and energy attributes which make them amenable for use through biogeochemical processes associated both with natural and man-made systems. They include wood product residuals, wastepaper, wastewater effluents, and sewage sludge.

Depending on subject areas chosen, students obtain an understanding of processes that generate waste; of community, chemical and microbial ecology; environmental chemistry including toxicology; wood chemistry; and implementation considerations including engineering and management components.

ENERGY

FACULTY: HAWKS, HERRINGTON, MONTEITH, NAKAS, D. PALMER, REIMANN, TANNENBAUM, YAVORSKY

The Energy Concentration provides for study of fuel energy-environment-economy relationships with a focus in three areas: (1) *Conventional and Alternate Energy Sources*—the distribution, politics, and development of conventionally known sources (gas, oil, hydropower, coal, etc.) together with a search for strategies of exploring alternate sources; (2) *Conservation*—efficient use in industry, public and private sectors; and (3) *Reclamation of Disturbed Lands*—the rehabilitation of land mined for coal, tar sands, oil shales, and other materials and minerals. As an example, surface mining for coal is directly related to the overall energy scenario, and the use of coal will be intensified worldwide. This aspect of study is directly related to land use, water resources, air pollution, and waste management.

Recommended areas of study include, from (1) physical and engineering sciences: geology, chemistry, hydrology, engineering systems; (2) biological sciences: ecology, range management, forestry, agriculture; (3) social sciences: environmental law, sociology, and economics.

ENVIRONMENTAL COMMUNICATION

FACULTY: J. ALEXANDER, M. ALEXANDER, BRANDT, BURGESS, CHAMBERS, DINDAL, EHLING, ELY, HANSELMAN, MONTEITH, NAKATSUGAWA, PAYNE, PORTER, STITELER, VANDRUFF, WEEKS, YAVORSKY

The Environmental Communication Concentration recognizes four general paths; (1) *Environmental Education and and Interpretation*—Effective communication is a necessary element for fulfilling the social contract in democratic societies. A growing concern in the U.S. public for environmental quality reveals a new interest in the historic, cultural, and natural values associated with our environment. Education and interpretation provides a continuum of environmental knowledge from awareness and appreciation to scientific concept understanding. (2) *Environmental Journalism and Media*—Students who choose this path share the same general objective as in (1) above; however, they specialize in presentation through mass media. (3) *Public Participation*—More interactive roles in decisionmaking must emphasize the skills and techniques of public participation. Tasks usually start with soliciting public comprehensions and opinions concerning specific environmental issues, and then employing information dissemination and public interaction. Skills and knowledge in social psychology, public relations, message design and presentation, law and government must be applied. (4) *Environmental Mediation*—The purpose here is to effect conflict resolution by avoiding legal action. The public's growing awareness of environmental values leads to increased conflict concerning their use. This new role of trained individuals is to understand the technical issues that underlie the dispute, identify affected groups, and apply various techniques for conflict resolution and group problem-solving.

Recommended areas of study include, from (1) physical sciences: environmental and organic chemistry, environmental geology, mineral resources, energy systems, and soil and water management and conservation; (2) biological sciences: ecology, entomology, and taxonomy; and (3) social sciences: planning, policy, information systems, and instructional technology, journalism, and law.

REQUIREMENTS

The academic requirements of the Graduate Program in Environmental Science are designed to provide graduates with a thorough preparation to meet the challenges of the field as leading scientists and professionals. General programmatic requirements constitute a framework to ensure that the individual study program will meet the need for depth of knowledge in one chosen area of concentration, breadth across at least two areas, and training in the analysis and synthesis of attributes of environmental issues.

Each student must be adequately prepared for advanced work in environmental science. To demonstrate this, each student is required to have satisfactory coverage of basic sciences, professional training, and experience. Students must also have basic training in quantitative methods and demonstrate competence in them. Where preparation in these areas is found deficient at the time of entrance, admission may be made on a provisional basis pending the successful completion of deficiencies.

Master of Science

1. Core: A minimum of 9 credit hours will be required in general courses designed interactively with the chosen areas of concentration. The distribution of these credits will be as follows:
   (i) Three credit hours in environmental policy to prepare the student's background in environmental science institutions and public decisionmaking as they pertain to natural resources of air,

land and water, to resource economics, to waste management, and related topics.
(ii) Three credit hours each in two areas of concentration supporting the chosen area of concentration in order to gain appreciation and knowledge of the interdependence of the processes and components of ecosystems.

2. Area of concentration: A minimum of 15 credit hours (excluding 898, 899, and 999 numbered courses) to ensure the depth of study in one chosen area supplemented by:
(a) Thesis: Six credit hours of research resulting in a document which clearly demonstrates, the graduate level accomplishments of the student, is of a quality and scope suitable for publication in a scholarly journal; or
(b) Internship: Six credit hours with a public, private or industrial organization, a graduating essay on the internship, and the successful completion of a comprehensive examination (credit hours determined by major professor and the student's advisory committee). Study projects in the past have included paid internships with such organizations as the National Wildlife Federation, New York State (NYS) Legislature, NYS Department of Environmental Conservation, NYS Energy Research and Development Authority, Agway, Inc., and Cablesystems of Syracuse.
(c) Additional coursework: Eighteen credit hours followed by the successful completion of a comprehensive examination may be substituted for the thesis and internship options.

Doctor of Philosophy

Requirements for the doctorate are as follows:

1. Core requirements—coverage as stipulated for the Master of Science degree.
2. Credits—completion of at least three full-time academic years of graduate study beyond the baccalaureate degree or an equivalent that can be shown to accomplish the same goals.
3. Language and tools—as required by advisory committee.
4. Preliminary exam—an examination may be required of those admitted into a doctoral program to ascertain their level of understanding of the basic principles and techniques necessary to function effectively in that program. The results of the preliminary examination will be used to guide the major professor and student in determining the appropriate coursework necessary to complete that requirement for the doctorate.
5. Candidacy exam—must satisfactorily complete a candidacy examination covering the major field and, in a broader manner, allied fields in order to be advanced into the status of doctoral candidate.
6. Doctoral dissertation—a thesis must be completed and successfully defended in order for the doctoral degree to be awarded.

(Please also refer to the College graduate policies on page 29.) Students seeking concurrent degrees with Syracuse University are advised to state that desire clearly in their applications; in such cases, students must also meet the entrance and degree requirements of the appropriate Syracuse Univeristy Colleges and Schools. However, students may not apply for the concurrent degree option until they have completed at least one semester of graduate level coursework and earned grades at a superior level.

Graduate Exchange Programs

INTERCAMPUS DOCTORAL EXCHANGE

There is an opportunity for doctoral students at ESF to study for one or two semesters at the following schools: State University Centers at Albany, Binghamton, Buffalo, or Stony Brook; City University of New York; or New York University.

This exchange program provides students with an opportunity to take advantage of over 160 faculty, specialized research laboratories and equipment, technical libraries, and field study areas which complement the extensive programs and resources at ESF which are discussed throughout this catalog.

This fellowship provides a grant-in-aid of up to $5,000 a year and may include a tuition waiver. For further information, please contact the Office of Academic Programs.

COLLEGE OF AGRICULTURE AND LIFE SCIENCES AT CORNELL UNIVERSITY

The State University of New York College of Environmental Science and Forestry and the New York State College of Agriculture and Life Sciences at Cornell University provide an opportunity to exchange graduate students so they can take advantage of special courses, faculty, and research facilities.

There are a number of programs on both campuses which complement one another. The following research and instructional areas at the College of Agriculture and Life Sciences appear likely to be of greatest interest to ESF students:

Agricultural Economics—Land Economics; Resource Economics; Resource Investment and Environmental Quality; Agricultural Land Policy.

Agricultural Engineering—Physical Analysis of Plant and Animal Materials; Soil and Water Engineering; Environmental Systems Analysis; Drainage Engineering; Soil and Water Conservation.

Agronomy—Identification, Appraisal and Geography of Soils; Soil Fertility Management; Soil and Water Conservation; Aquatic Plant Management; Forest Soils; Soil Microbiology; Microbial Ecology; Use of Soil Information and Maps as Resource Inventories; Soil Organic Matter; Soil Chemistry; Weed Science; Dynamic Climatology; Physics of Clouds, Rain, and Rainmaking.

Natural Resources—Wildlife and Fisheries Management; Environmental Conservation; Resource Analysis and Planning; Woodland Management; Forest Ecology; Maple Syrup Production.

Floriculture—Woody Plant Materials; Herbaceous Plant Materials; Plants and Design.

Entomology—Insect Pest Management; Arthropod Pests of World Importance; Biological Control; Insect Pathology; Environmental Biology; Pesticides in the Environment.

Plant Breeding and Pathology—Plant Cell Genetics; Methods of Plant Breeding; Genetics and Breeding for Disease and Insect Resistance; Plant Pathology; Advanced Disease Control; Dendropathology; Pest Management for Plant Protection; Advanced Mycology; Plant Virology; Plant Nematology; Bacterial Plant Pathogens; Disease Physiology; Philosophy of Plant Pathology; Taxonomy of Fungi; Pathology of Trees and Shrubs.

Pomology—Tree Fruits; Orchard Management; Growth and Development of Woody Plants.

Rural Sociology—Rural Development and Cultural Change; Political Structure and Development; Social Power and Community Change; Political Economy of Rural and Regional Development.

For detailed information please contact the Office of Academic Programs.

Course Offerings

Students at the College of Environmental Science and Forestry have not only the academic and research resources of their own institution, but also the resources of nearby Syracuse University and State University Upstate Medical Center.

COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY 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 cognizant departments or programs, approved by the appropriate academic dean, faculty committee, and the college faculty.

Course Numbering System

Code Levels:

100-299 Lower-division undergraduate courses for which no graduate credit may be given.

300-499 Upper-division undergraduate courses for which no graduate credit may be given.

500-599 Graduate courses designed expressly for areas of specialization in post-baccalaureate programs or in the professional program leading to the Bachelor of Landscape Architecture. Undergraduate students with superior academic records may register for these courses.

600-699 Graduate courses which permit undergraduate students to enroll only by petition with a well-documented justification approved by the undergraduate advisor, curriculum director, and course instructor.

700-999 Graduate courses for which no undergraduate may enroll.

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APM—APPLIED MATHEMATICS

360. Introduction to Computer Programming (3)
The basic course in computer use offered by the College. It is intended to provide the student with the skill and understanding needed to utilize digital computer languages for problem solving. The course will cover instruction in APL, FORTRAN IV, use of operating systems, and some background material in general hardware/software designs. Fall and Spring.

391. Introduction to Probability and Statistics (3)
Two hours of lecture, three hours of laboratory. Elementary probability, theoretical and sampling distributions, hypothesis testing, statistical estimation, analysis of variance, regression and correlation, nonparametrics and sampling concepts. Spring.
Prerequisite: Two semesters of calculus.

492. Forest Biometrics (3)
Two hours of lecture, three hours of laboratory. Analysis of variance including nested and cross-classification. Matrix approach to multiple linear regression and weighted least squares. Nonlinear regression. Sampling methods and design. Applications to forestry problems. Fall.
Prerequisite: APM 391 or equivalent.

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 IV and APL with a discussion of an Assembly Language. Other topics include representation of information, management of files, error control, operational systems and job control. Fall and Spring.

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.

605. Theory of Probability Distributions (1-3)
Three hours of weekly sessions over five to 14 weeks. Statistical problems and mathematical models; random experiments, random variables, probability, frequency and distribution functions of discrete, continuous and mixed random variables; functions of random variables and the probability distributions; mathematical expectation and its applications; discussion of the main theoretical distributions such as binomial, Poisson, negative binomial, normal, Gamma, Beta, exponential and others; applications of this framework to the model construction problem in the statistical, operations research and forest mensuration areas. Fall or Spring.
Prerequisites: Two semesters of differential and integral calculus and an introductory course in statistics, or permission of the instructor. The course can be taken in conjunction with APM 651—Operations Research I (for one credit hour) or independent of it for one to three credit hours.

620. Analysis of Variance (3)
Three hours of lecture and recitation and three hours of laboratory. Multiway 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. Fall.
Prerequisites: Graduate standing and an introductory course in statistics covering material through the one-way analysis of variance.

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 or equivalent.

630. Regression Techniques with Applications to Forestry (3)
Two one and one-half hours of lecture. Review of matrix algebra, probability theory and statistical methods. Basic concepts in regression analysis. Classical linear regression model. Least and weighted least squares method. Dummy variables and their uses in regression and covariance analysis. Applications to problems of statistical prediction and estimation from the field of forestry in general and forest mensuration and inventory in particular. Fall.
Prerequisite: APM 391 or equivalent.

635. Multivariate Statistical Methods (3)
Estimation and inference for the multivariate normal distribution. Multivariate analysis of variances, factor analysis, principal components analysis, canonical correlation, discriminant analysis, cluster analysis. Spring.
Prerequisite: One semester of statistics.

650. Operations Research (3)
Two one and one-half hours of lecture. Deterministic and Stochastic Operations Research models applicable to managerial problems. Linear programming, transportation and allocation models, goal programming, dynamic programming, network analysis, and simulation techniques. Spring.
Prerequisites: APM 391 and MAT 227 or equivalent, or permission of the instructor.

CMN—COMMUNICATIONS (LANDSCAPE ARCHITECTURE)

(See also courses listed below under EIN and LSA.)

380. Technical Drawing I (1)
One three-hour drafting room period. Elements of perspective, isometric, oblique, and orthographic projection. Practice in freehand and instrument drawing. Fall.

381. Technical Drawing II (2)
Two three-hour drafting room periods. Elements of perspective, isometric, oblique, and orthographic projection. Practical applications of these principles in machine and architectural drawing, including piping and electrical drawings. Spring.

382. Graphic Communication (2)
Two three-hour studios with up to one hour of studio per week devoted to group presentation meetings, instruction, and review of new techniques such as diagramming, drafting, perspective, and plan graphics. Drawings, examinations, and a final portfolio constitute the basis for grades. Fall.

482. Advanced Graphic Media (1-3)
Three hours of studio. Discussions, demonstrations, critiques and individual study. Study oriented toward perception and self-expression, use and possibilities of various media, as selected by student and instructor. Fall and Spring.
Prerequisites: Prior art media training or experience and permission of the instructor.

530. Environmental Communications Studio (2)
Three-hour studio and one-hour discussion. For seniors and graduate students, this course offers the opportunity for students to apply communications theory and strategies through the planning, production, and display of media projects developed around the student's area of professional interest. Enrollment limited to 20 students. Fall.
Prerequisite: CMN 531 or permission of the instructor.

531. Environmental Communications (3)
Three hours of lecture/discussion. An introductory course for seniors and graduate students which presents techniques and processes in education and communications applicable in environmental science, management, planning, and design. Topics include basic teaching, learning and communications theory and strategy, working with the press, electronic media, gaming and simulation, public address techniques, slide/tape production and use, film production and use. Spring.

637. Environmental Communications Project (1-3)
This course is designed to give graduate students an opportunity to work as a team in identifying, developing, administering, and evaluating a communications project related to an environmental issue. Typically, a workshop or shortcourse will be developed and offered for some targeted public through the School of Continuing Education. The nature of the topic and format of the project will be determined according to experience background of students enrolled. Task responsibilities and time commitments are correlated with number of hours for which student has registered. Spring.

682. Video Communications (3)
Three hours of studio plus lecture. This course will provide students with instruction and experience in the skills necessary to provide video tape programs. Each student will prepare and develop a video script for production of a program on an assigned topic. Completed programs will be tested and evaluated. Class size is limited. Fall and Spring.
Prerequisite: Permission of the instructor.

738. Environmental Education Programs of Agencies and Institutions (1-3)
One three-hour seminar session. An analysis of contemporary environmental education objectives, methodologies, and philosophies employed by various public and private institutions. Attendance, readings, and short paper required for one-hour credit. For two or three hours credit, an individual investigation of the environmental education and communications activity of an agency or organization is also required. Fall.

EFB—ENVIRONMENTAL AND FOREST BIOLOGY

The Department 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. In the following list, courses numbered from ( )00 - ( )25 (at each level) are General Biology offerings; those from ( )26 - ( )50 are Plant Sciences, those from ( )51 - ( )75 are Entomology; and those from ( )76 - ( )95 are Animal Science courses.

NOTE: All EFB courses require a minimum prerequisite of one year of college biology or equivalent. A course at an appropriate level may be taken with permission of the instructor.

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.

320. General Ecology (3)
Two hours of lecture, three hours of field trips during the first half of the semester. Three hours of lecture during the second half of the semester. Introduction to ecosystem ecology stressing the dynamic interrelationships of plant and animal communities with their environments, ecological factors, energy flow and trophic levels in natural communities, plant responses and animal behavior, population dynamics, biogeography, and representative ecosystems. The ecological impact of man is reviewed. Fall.

325. Cell Physiology (3)
Three hours of lecture. Introduction to the dynamics of living systems with emphasis on the universality of the biological world. Spring.
Prerequisite: One semester of organic chemistry.

326. Plant Structure, Function and Morphology (4)
Three hours of lecture and three hours of laboratory. An exposition of plant biology with emphasis on the structure and function of the life forms, reproduction, and adaptations of major groups of plants. Fall and Spring.

330. Plant Nutrition (3)
Three hours of lecture. Descriptive aspects of the fundamental activities of plants. Subjects covered include cell structure, water and mineral metabolism, organic nutrition, and a brief introduction to biological control mechanisms. Spring.
Prerequisite: EFB 326 or equivalent.

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. Open only to students in the Forest Engineering curriculum. Fall.

336. Dendrology I (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.

340. Forest and Shade Tree Pathology (3)
Two hours of lecture and three hours of autotutorial 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.

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 Resources Management. Spring.

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.

382. Wildlife Conservation (3)
Two hours of lecture, one hour of recitation. Introduction to the biological principles of conservation including the relationship of natural resources to modern society. The wildlife resource and its conservation will be emphasized. It is not designed for students concentrating in the area of Forest Wildlife Management. Fall.

385. Comparative Vertebrate Anatomy (4)
Three hours of lecture and three hours of laboratory per week. Analysis of vertebrate structure, with emphasis on comparative study of organ systems. Includes evolution of form and function, major adaptive patterns, and phylogenetic relationships in vertebrates. Spring.

386. Vertebrate Histology (3)
Two hours of lecture and three hours of laboratory. A study of tissues from protochordates, fishes, amphibians, reptiles, birds, and mammals, with emphasis on evolution, environment, and function, and with introduction to histopathologies. Spring.

387. Vertebrate Physiology (3)
Three hours of lecture. A study of functional responses of vertebrates to internal and external environmental conditions. Fall.

405. History of Natural Science (1)
One hour of lecture. A review of the history of western science from pre-Ionian times to Darwin, with evaluation of the impact of culture and religion on scientific progress. Spring.

407. Principles of Genetics (3)
Three hours of lecture and discussion. A general course covering concepts of genetics and evolution base 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, the genetic structure of populations and their evolution. Numerical methods for characterizing and analyzing genetic data are introduced. Spring.

408. Principles of Genetics Laboratory (1)
Three hours of autotutorial laboratory. Experiments with plants and animals and computer simulation exercises demonstrate the basic principles of inheritance of Mendelian and quantitative 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. Spring.
Co-requisite: EFB 407.

409. Introduction to Quantitative and Population Genetics (1)
Ten lecture-discussions and four autotutorial laboratories the second half of the semester (incl. Lecture-Lab Modules 5 and 6 of FBL 470 and 471). Basic genetic concepts of quantitative inheritance, the structure of populations and evolution. Laboratory experiments and computer simulations are used to demonstrate these concepts. Numerical methods for characterizing and analyzing genetic data are introduced. Spring.
Prerequisite: An introductory genetic lecture-laboratory course deficient in these areas of genetics and permission of the instructor.
Note: Not open to students taking EFB 407 and 408.

420. Field Experience—Internship (5)
Full-time for at least five weeks, or equivalent, of employment with an agency or professional involved in field activity. A resident faculty member is required to serve as course evaluator. Approval of curriculum director is necessary. See advisor for detailed procedural information. Summer.

421. Ecology of Freshwaters (2)
Half-time for four weeks. Cranberry Lake Biological Station. Experimental and observational studies of environmental and biotic interactions influencing productivity of freshwaters. Basic concepts at the organismic, population, and community level. Summer.

426. Plant Propagation (1)
One combined lecture-demonstration laboratory plus supervised greenhouse assignments. Instruction in principles and practices of plant propagation and in related greenhouse operations. Fall and Spring.
Prerequisite: Senior status in Environmental and Forest Biology curriculum.
Note: Cannot be used to satisfy the 6-hour biology curriculum requirement in the plant sciences.

430. Fungal Physiology (3)
Three hours of lecture and discussion. Principles of growth, morphogenesis, and reproduction of the fungi emphasizing the role of the environment in controlling fungal processes. Spring.
Prerequisite: EFB 325 or equivalent.

431. Fungal Physiology Laboratory (1)
Three hours of laboratory. Selected experiments in the quantitative study of fungal growth, nutrition, sporulation, and spore germination. Spring.
Co-requisite: EFB 430.

435. Adirondack Flora (2)
Half-time for four weeks. Cranberry Lake Biological Station. Field study of the summer flora of the Adirondack Mountains. Summer.

436. Dendrology II (1)
One three-hour field trip/laboratory. A continuation of Dendrology I emphasizing trees and shrubs ecologically important in the Central New York region and economically important in North America. Fall.

440. Principles of Forest Pathology (3)
Three hours of lecture, discussion or laboratory. Concepts and principles of tree diseases in relation to forest practices and practical experience in disease diagnosis and impact evaluation. Fall.
Prerequisite: EFB 340.

441. Field Problems in Forest Pathology (1)
Full-time for one week. Cranberry Lake Biological Station. Field study of important tree diseases in the Adirondacks, including heart-rots, root-rots, cankers, rusts, foliage diseases, mistletoe, and physiological diseases. Also field study of mycorrhizae and other tree-root mutualisms. Summer.

442. Field Mycology (2)
Half-time for four weeks. Cranberry Lake Biological Station. An introduction to the collection and identification of the Adirondack fungal flora. Field techniques and laboratory identification of the major fungi found in selected ecosystems. Summer.

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.

446. Bryoecology (3)
Two hours of lecture and one three-hour laboratory or field trip. A study of the taxonomic diversity and ecological adaptations of Bryophytes in regional ecosystems. Spring.

447. Wetland Plant Ecology (1-2)
Full-time for one week. Cranberry Lake Biological Station. Study of wetland plant community dynamics and environmental relationships in the Adirondack Mountain Region. Summer.

448. Physiological Ecology of Plants (3)
Three hours of lecture. Examination of the interactions between plants and their environment. Emphasis will be given to the physiology of plants as it is modified by fluctuating external conditions and the mechanisms of plant adaptation. Students completing EFB 448 should not enroll in EFB 330. Fall.
Prerequisites: An introductory course in physics, EFB 320, and EFB 326.

451. Pest Management—Theory and Practice (2)
Two hours of lecture for nine weeks; then one lecture hour and one three-hour laboratory for four weeks. A review of history and governmental policy of pest management, as well as basic instruction in theory and practicum. Spring.
Prerequisite: EFB 352 or equivalent.

452. Principles of Chemical Control (3)
Two hours of lecture; one three-hour laboratory. A study of the chemistry, toxicology, handling and application of chemicals used to manage pest populations. A primer for the State Pesticide Application examinations. Fall.
Prerequisite: EFB 451.

453. Forest and Aquatic Insects (2)
Half-time for four weeks. Cranberry Lake Biological Station. The forest and aquatic insects of Cranberry Lake Region and their role in these environments and habitats. Insect collection required. Summer.

454. Wood Deterioration by Insects (3)
Three hours of lecture, discussion, and demonstration. Biology, identification, ecology of insect and wood interrelations; prevention of injury and control of insects injurious to forest products and wood in use. Spring.
Prerequisite: EFB 352 or equivalent.

460. Insect Behavior and Ecology (2)
Half-time for four weeks. Cranberry Lake Biological Station. Descriptive, comparative, and experimental behavior of aquatic and terrestrial insect species of the Cranberry Lake Region. Field project, involving field study and paper required. Ecology of forest insects and field techniques used in their study. Emphasis on functional roles played by insects in forest ecosystems. Summer.
Prerequisites: EFB 320 and EFB 352 or equivalents.

476. Vertebrate Ecology (2)
Half-time for four weeks. Cranberry Lake Biological Station. Utilization of unique Adirondack forms and communities to study population dynamics, behavior, systematics, and ecological role of vertebrates; standard field and laboratory technlques. Summer.

478. Microcommunity Ecology (2)
Half-time for four weeks. Cranberry Lake Biological Station. Study of terrestrial invertebrate microcommunities; descriptive and comparative assay of microhabitats incorporating experimental and field techniques. Summer.

479. Field Ornithology (2)
Half-time for four weeks. Cranberry Lake Biological Station. Field study of the ecology, distribution and behavior of birds of the Adirondack region. Techniques used in conducting field studies in avian biology will be emphasized. Summer.

480. Principles of Animal Behavior (4)
Three hours of lecture, one hour of recitation per week. A study of the basic principles of animal behavior, stressing exogenous and endogenous mechanisms of control, with emphasis on the evolution of behavior. Spring.

481. Behavioral Ecology (2)
Half-time for four weeks. Cranberry Lake Biological Station. Study of the behavioral adaptations of animals to their environment. Emphasis will be placed on animal orientation and social behavior. Habitat selection and interspecific interactions will also be considered. Summer.
Prerequisite: EFB 480.

482. Invertebrate Zoology (4)
Three hours of lecture, three hours of laboratory. Structure, function, classification, and evolution of invertebrates. Emphasis on ecological role of invertebrates in specific habitats. Fall.

483. Biology of Birds and Mammals (4)
A course surveying the taxonomy, anatomical-behavioral-physiological adaptations and natural history of birds and mammals. Techniques for the field study of a vertebrate species will be discussed. Fall.

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. Spring.

486. Ichthyology (3)
Two hours of lecture, three hours of laboratory. An introduction to the anatomy, physiology, ecology, behavior, and taxonomy of fishes. Spring.

487. Fishery Biology (4)
Three hours of lecture and three hours of laboratory. Introduction to models of growth, mortality, production, and exploitation; aspects of fish ecology and behavior related to the dynamics and management of fish populations. Fall.
Prerequisite: EFB 486 or equivalent.

488. Ecology of Adirondack Fishes (2)
Half-time for four weeks. Cranberry Lake Biological Station. Study of the ecology of fishes, with detailed individual investigation of the ecology of Adirondack fishes. Summer.

490. Wildlife Ecology and Management (3)
Three hours of lecture. A study of the ecological principles governing wild animal populations and their habitats and the relationship of these principles to management programs and decisions. Spring.
Prerequisites: EFB 320 or equivalent.

491. Wildlife Ecology and Management Practicum (2)
One hour discussion, 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:* LIB 300.

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.

497. Seminar in Environmental and Forest Biology (1)
Literature surveys and seminars on topics of biological interest and importance. Subject to be generated by faculty and students and to be announced prior to registration. Fall and Spring.

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.

500. Forest Biology Field Trip (1-3)
A five- to ten-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. Estimated student expense, $75. Fall or Spring.

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.

512. Chemical Ecology (3)
Two hours of lecture and one hour of discussion. A treatment of biological phenomena incorporating elements of ecology, physiology, and chemistry as a basis for development, behavior, and survival. Emphasis is on the intra- and inter-specific relationships involving chemical messengers at the organismal, population, and community levels. Spring.
Prerequisites: Organic chemistry, EFB 320, EFB 325.
Note: Also listed as FCH 540.

515. Population Ecology (3)
Two hours of lecture and three hours of laboratory. Description, analysis, evolution, interactions and stability of natural and experimental populations. Spring.
Prerequisite: EFB 320 or equivalent.

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.

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.
Co- or Prerequisite: EFB 524.

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.

531. Plant Physiology Laboratory (1)
One laboratory session. Introduction to methods and procedures of physiological research. Spring.
Co-requisite: EFB 530.

532. Plant Anatomy (3)
Two hours of lecture and three hours of laboratory. An introductory course in plant anatomy designed to familiarize the student with the organization and development of the primary and secondary plant body of higher plants. Spring.
Prerequisite: EFB 326.

533. Chemical Defenses of Plants (3)
Three hours of lecture/discussion about the ways in which plants defend themselves chemically against microorganisms, insects, herbivores, and other plants. Fall.
Prerequisite: A course in physiology or biochemistry.

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.
Prerequisites: EFB 326, EFB 327.

540. Mycology (3)
Two hours of lecture and three hours of laboratory. Fundamentals of the morphology, taxonomy, cytology, life histories, and ecology of fungi. Fall.

541. Wood Microbiology (3)
Two hours of lecture and three hours of laboratory/field trip. Major types of fungus defects of wood and its products and principles of control. Special emphasis on chemistry of wood decay, wood durability, toxicants, lumber discolorations, heart-rots and decay in forest products. Fall.
Prerequisites: Organic chemistry, EFB 340.

551. Forest and Shade Tree Entomology (2)
Two hours of lecture. Important forest and shade tree insects, detection, evaluation, prevention, and control of their damage; their relation to silviculture and management of forests and shade trees. Spring.
Prerequisite: EFB 352 or equivalent.

552. Forest and Shade Tree Entomology Laboratory (1)
Three hours of laboratory/field trip. Identification of important forest and shade tree insects and their damage. Spring.
Pre- or Co-requisite: EFB 551.

553. Biological Control (2)
Two hours of lecture. Theory and practice of biological control of insect pests and weeds. Emphasis on the ecology and utilization of major groups of predators, parasitoids, and pathogens used in pest management and interpretation of mortality. Fall.
Prerequisite: EFB 352 or equivalent.

554. Aquatic Entomology (3)
Two hours of lecture and three hours of laboratory. The biology, ecology, and identification of fresh water insects, with emphasis on the role of aquatic insects in the hydrobiome. Fall.
Prerequisite: EFB 352 or equivalent.

555. Arachnology (3)
Two hours of lecture and discussion and three hours of laboratory. Introduction to biology and ecology of spiders, mites, scorpions, and other arachnid groups. Laboratories emphasize classification and identification of specimens. Spring (even years).
Prerequisite: EFB 352 or EFB 482 or equivalent.

560. Environmental Toxicology of Insecticides (2)
Two hours of lecture. Basis of action of insecticides in living systems, behavior of insecticides and microtoxicants in environment, interaction of insecticides and biological systems. Fall.
Prerequisite: EFB 325 or equivalent course in physiology or biochemistry.

561. Medical Entomology (3)
Three hours of lecture and recitation. Study of arthropods affecting man, domestic animals, and wildlife with emphasis on their biology, control, and relationship to vertebrate disease. Spring (even years).
Prerequisite: EFB 352 or equivalent.

565. Insect Morphology (3)
Two hours of lecture and three hours of laboratory. A comparative study of the external morphology of insects emphasizing evolutionary trends, especially modifications of homologous structures. Topics of special importance include intersegmental relationships, feeding, sensory mechanisms, locomotion, and reproduction. Spring.
Prerequisite: EFB 352.

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.

578. Terrestrial Community Ecology (3)
Three hours of lecture. Relation of terrestrial vertebrates and invertebrates to their physical, chemical, and biological environment. Emphasis on community principles, structural quantification, and evolutionary processes of terrestrial animals. Fall.
Prerequisite: EFB 320 or equivalent.

590. Wilderness Wildlife Management (2)
Two hours of lecture followed by one hour of group discussion. Students will participate in a two-day field trip at Huntington Forest. Completion of a term paper will be required for graduate credit. Fall.

610. Ecological Energetics (3)
Two hours of lecture and three hours of laboratory or one hour of discussion. Investigation of the principles of energy flow in biological systems. Emphasizing understanding of energy transformations, energy budgets and energy structures of individual organisms, populations, and ecosystems. Spring.
Prerequisite: EFB 320 or equivalent.

620. Wetland Ecology (2)
One hour of lecture and one field trip or discussion session. A study of the status, ecology, value, use and regulation of wetlands in the Northeast and emphasis on freshwater areas. Fall.
Prerequisite: EFB 320 or equivalent.

625. Membranes and Biological Transport (3)
Two hours of lecture and one hour of discussion. Composition, structure, and physical properties of membranes. Membrane functions including transport, bioelectricity, and cell compartmentalization. Specific transport processes in biological systems. Fall (even years).
Prerequisites: One semester of biochemistry and an advanced physiology course.

630. Fungus Physiology (3)
Two hours of lecture and one hour of discussion. Principles of growth, reproduction, and differentiation of the fungi emphasizing the role of the environment in controlling fungal processes. Spring.
Prerequisite: Two semesters of physiology or biochemistry.

632. Plant Growth Regulation (3)
Three hours of lecture/discussion on topics concerned with the biochemistry and physiology of plant hormones and synthetic growth regulators. Fall.
Prerequisite: A course in plant physiology or biochemistry.

635. Topics in Plant Nutrition (2)
Two hours of lecture, discussion, and seminars. Advanced course dealing with selected topics of mineral and organic nutrition of plants. Fall (odd years).
Prerequisites: Completion of one or more physiologically-oriented plant science courses.

640. Principles of Forest Pathology (3)
Four hours of lecture, discussion, and laboratory. Concepts and principles of tree diseases in relation to forest practices and practical experience in disease diagnosis and impact evaluation. Fall.
Prerequisites: EFB 340, EFB 641.

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.

642. Principles and Practices of Tree Disease Control (3)
Two hours of lecture and three hours of laboratory or discussion. An advanced course considering the major chemical, cultural, and biological practices and integrated disease management strategies for tree disease control. Spring.
Prerequisites: EFB 440, EFB 540.

643. Plant Virology (3)
Three hours of lecture. The structure function, and replication of virus particles. Transmission mechanisms, vector relationships, symptomatology, and disease control strategies are covered in detail. Spring.
Prerequisite: Organic chemistry.

644. Plant Virology Laboratory (2)
Four hours of laboratory. Methodologies necessary to manipulate viruses and to identify and fully characterize virus unknowns will be presented. Spring (even years).
Prerequisite: EFB 643.

645. Plant Ecology (3)
Two hours of lecture and discussion and one laboratory/discussion. 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: EFB 320 or equivalent.

651. General Insect Taxonomy (3)
Two hours of lecture and three hours of laboratory. Identification and classification of the important orders and families of insects; acquaintance with pertinent taxonomic literature and use of keys; and understanding of evolutionary principles and concepts and a knowledge of systematic theory and practice. Insect collection required. Fall.
Prerequisite: EFB 565.

660. Insecticide Toxicology Laboratory (2)
One hour of discussion and three hours of laboratory. Laboratory experiments in mode of action and behavior of insecticides, biological and instrumental analysis of insecticides including tracer analyses. Spring (odd years).
Prerequisites: EFB 560 or equivalent and permission of the instructor.

678. Practicum in Terrestrial Community Ecology (3)
One hour of lecture, one hour TBS, and three hours of laboratory. Intensive practical application of ecological principles to the study of terrestrial animal communities. Includes experimental and field collection of data, quantifications, synthesis, and final reporting. Fall.
Pre- or Co-requisite: EFB 578 or equivalent.

680. Behavioral and Physiological Ecology (3)
Two hours of lecture and one hour of discussion. An examination of the concepts of animal adaptations to ecological change from a behavioral point of view. Particular emphasis will be placed on the role the environment plays in shaping the behavior of a given species. Behav-

ioral and physiological responses to environmental conditions will be treated as a continuum. Spring (odd years).
Prerequisites: One course in ecology, behavior, and physiology.

682. Invertebrate Symbiosis (3)
Two hours of lecture and one three-hour laboratory. An introduction to the ecology and evolution of interspecific relationships of invertebrates. Spring (even years).
Prerequisites: EFB 320, EFB 482.

690. Management of Wildlife Habitats and Populations (4)
Three hours of lecture and three hours of laboratory; some weekend field trips. For graduate students intending to enter professions in natural resource management, especially fish and wildlife and forestry. Focus is on the application of ecological principles and management techniques in the planning of habitat and harvest management programs for wildlife. Extensive independent work required. Fall.
Prerequisite: EFB 491.

691. Habitat Inventory and Evaluation (3)
Four hours of lecture and discussion. For students intent on careers in natural resource management, environmental planning or environmental impact analysis. Focus is on methods for investigation of species-habitat relationships, and construction of models for the inventory and evaluation of habitat. State-of-the-art habitat evaluation procedures are explored. Spring.
Pre- or Co-requisite: Multivariate Statistics.

692. Biology and Management of Waterfowl (2)
A consideration of the identification, life history, ecology, and economic importance of waterfowl of the Atlantic Flyway. The management of local, flyway, and continental waterfowl populations, including the establishment of hunting seasons, will be discussed. One Saturday field trip. Fall (odd years).

695. Urban Wildlife (2)
Three hours of lecture and discussion with field trips. A study of the occurrence, adaptations, and values of wildlife in urbanized areas, with emphasis on current research and agency programs. Spring (even years).

720. Topics in Soil Invertebrate Ecology (3)
Two one-hour lecture and discussion periods and a three-hour laboratory. Study of literature relating to soil invertebrate microcommunities; taxonomy, culturing, and collection methods of soil fauna; student will conduct an individual research problem. Spring (odd years).

724. Seminar in Aquatic Ecology (1)
Two hours of lecture and discussion. A seminar to explore in some depth areas of current research in aquatic ecology. Fall (even years).
Prerequisite: Six credits in aquatic ecology.

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 and Spring.
Prerequisites: EFB 531 or equivalent, biochemistry with laboratory.

740. Mycorrhizae (3)
Two hours of lecture and three hours of laboratory/discussion. A basic background course covering structural, functional, and ecological aspects of mycorrhizae; their methods of field and laboratory study; and applications in forestry practice. Fall (odd years).

741. Topics in Phytopathology (3)
Two two-hour lectures and discussions. Discussions of specific subjects in phytopathology and wood microbiology. Topic selection is based on availability of expertise and will be announced in advance. This course may be repeated for credit in different specialties. Fall or Spring.

745. Topics in Plant Ecology (2)
Two hours of seminar and discussion. An advanced course dealing with current research in plant community dynamics. May be repeated for additional credit. Fall.
Prerequisite: EFB 445 or EFB 645.

790. Topics in Wildlife Biology (1-3)
Hours to be arranged. Group study of a wildlife management topic. Fall or Spring.
Prerequisite: Six credits of wildlife management courses.

796. Topics in Environmental and Forest Biology (1-3)
Special instruction, conference, advanced study, and research in selected subject areas. Typewritten report required. Check *Schedule of Courses* for details. Fall and Spring.

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.

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. Typewritten report required. Fall and Spring.

830. Physiology of Growth and Development (2)
Lecture. A study of the growth and development of plants and the physiological and biochemical processes that influence the development of form and structure in higher plants. Fall (even years).
Prerequisites: EFB 530, EFB 532, and organic chemistry.

840. Advanced Mycology, Homobasidiomycetes (3)
Review of selected literature as well as laboratory training in identification and research techniques. Fall.
Prerequisite: EFB 540.

841. Advanced Mycology, Heterobasidiomycetes (3)
Review of selected literature as well as laboratory training in identification and research techniques. Spring (even years).
Prerequisite: EFB 540.

842. Advanced Mycology, Ascomycetes (3)
Review of selected literature as well as laboratory training in identification and research techniques. Spring (odd years).
Prerequisite: EFB 540.

843. Advanced Mycology, Deuteromycetes (3)
Review of selected literature as well as laboratory training in identification and research techniques. Fall (even years).
Prerequisite: EFB 540.

851. Advanced Insect Taxonomy (3)
Two hours of lecture and three hours of laboratory. Methods, procedures, and concepts of systematics. Examples and material will be drawn from among important groups of forest insects. Fall.
Prerequisite: EFB 651.

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.

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.

980. Topics in Animal Behavior (2)
Two hours of lecture and discussion. A seminar-type course designed to explore in depth selected and controversial subject areas in animal behavior. Fall or Spring.

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.

EIN—ENVIRONMENTAL INFLUENCES (LANDSCAPE ARCHITECTURE)

(See also courses listed under CMN and LSA.)

300. Introduction to Environmental Studies (3)
Three hours of lecture and discussion per week on the interrelationships among the natural environment, people, and the human environment. Emphasis is placed on developing critical facilities and systems thinking useful for assessing environmental issues. Fall.
Prerequisite: Permission of the instructor.

311. Natural Processes in Planning and Design (3)
Section 1: Landform and Soils
Section 2: Hydrology, Climate and Energy
Section 3: Plant, Animal, and Human Ecology
Three hours of lecture. This course presents an overview of the basic principles governing the dynamics of natural resources and processes which should be understood in planning and designing the human landscape. In each section, sources of reference data application to planning and project scale design will be discussed. Occasional local field trips will be utilized. Fall.
Prerequisite: Permission of the instructor.

371. History of American Landscape Attitudes (3)
Three hours of lecture-discussion. This course presents, through lectures, readings, and slides, uniquely American historical attitudes toward land and nature as shown through various cultural activities and disciplines, such as painting, architecture, landscape architecture, religion, philosophy, utopianism, exploration and recreation, land development and economics, and certain technological developments. Cultural expressions of the 19th century will be of primary interest, but formative attitudes from the Colonial period and certain 20th century results will be included. One-third to one-half of lecture periods are given over to student reports, criticism, and discussion. Spring.
Prerequisite: Permission of the instructor.

390. Social/Cultural Influences and Environmental Form (3)
Three hours of lecture. This course provides an introduction to an interdisciplinary social science analysis of human settlements. The course introduces the basic concepts, vocabulary, theories, and units of analysis for an interdisciplinary social perspective of the environmental form of human settlements. As such, it 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.

451. Fundamentals of City and Regional Planning (3)
Three hours of lecture. An introductory survey course in planning. The historical development of American City and Regional Planning, theories of the planning process, the role of planning in public decision-making, landmark legislation and judicial decision related to planning, and approaches to controlling land use will be presented. Fall.

452. Simulated Planning in Metropolitan Systems: Theory and Practice (3)
Three hours of laboratory, two hours of lecture/discussion. A computerized simulation designed to provide an understanding of the decisionmaking environment of metropolitan planning. Each participant is assigned a role consistent with his/her background. Lectures provide a theoretical framework for the activities in the simulation; a discussion section provides for evaluation. Computer experience is not necessary. Spring.

470. Art History (3)
Three hours of lecture. Informal lectures will emphasize and review assigned text and other readings and handout notes. Slides will be shown regularly; reports, quizzes and examinations. Evolutionary nature of the main cultural periods of Western man and fine art as man's selected environment will be the course emphasis. Spring.
Prerequisite: Permission of the instructor.

471. History of Landscape Architecture (3)
Three hours of lecture. Informal lectures and class participation, reports, assigned text and assigned reserve shelf reading, optional text and handout notes, quizzes and exams. Slides. Historical study and style analysis of Western man's efforts to design his environment and his changing attitudes and relationships to environment. Also, non-Western coverage where significant or influential on Western Man. Study of historical personalities as well as periods that are of environmental concern up into the modern period. Fall.
Prerequisite: Permission of the instructor.

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 the instructor.

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 the instructor.

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 the instructor.

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.
Prerequisite: Environmental Studies senior standing and written approval of an internship contract by faculty sponsor, curriculum director, and field supervisor.

510. Creative Problem Solving Seminar (3)
Three hours of lecture and discussion. A course designed to extend the student's understanding and application of creative problem solving processes. One requirement will be to select and carry out an application of the techniques to a particular problem, with consultation and guidance from the instructor. Critique and survey of the literature on creativity, in-depth analysis of the synectics process, and various procedures which have been developed for nurturing creative behavior comprise the essence of the program. Spring.
Prerequisite: Undergraduate degree or permission of the instructor.

ENS—ENVIRONMENTAL SCIENCE

796. Special Topics in Environmental Science and Policy (1-3)
Lectures and discussion, seminars, conferences and group research on topics of special or current interest, in fields related to environmental science and policy. See schedule of classes for current offerings. Fall and Spring.

797. Environmental Science Seminar (1-2)
Discussion of current topics and research related to environmental science. Fall and Spring.

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.

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.

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.

999. Doctoral Thesis Research
(Credit hours to be arranged)
Research and independent study for the doctoral degree and dissertation. Fall, Spring, and Summer.

When choosing courses, students must consult their advisors/major professors.

ERE—ENGINEERING (ENVIRONMENTAL AND RESOURCE ENGINEERING)

306. Elements of Map and Air Photo Interpretation (1)
Two hours of lecture and three hours of laboratory per week for five weeks of a semester. Introduction to map and photograph interpretation to extract information useful to site inventory, analysis, planning, and design activities. The physical and geometric properties of maps and photographs, the characteristics of information contained in them, and the principles and procedures of interpretation are discussed. Spring.
Prerequisite: Junior standing in Landscape Architecture.

308. Elements of Plane Surveying (1)
Two hours of lecture and three hours of laboratory per week for the last five weeks of the semester. Introduction to the principles and procedures of plane surveying for mapping and construction layout purposes. Topics briefly discussed include the basic mathematical principles of surveying, the types and uses of surveying, horizontal and vertical distance measurement, angle measurement, traversing and computations, construction layout, tacheometry, and surveying errors (and their treatment). Spring.
Prerequisites: Junior standing in Landscape Architecture and college level plane trigonometry.

320. APL for Engineers and Scientists (2 or 3)
Programming and operation of time-sharing digital computer systems via the APL language. Analysis, modeling, and solution of basic problems in environmental science and engineering. Students desiring three credits will complete an original, substantial term project. Spring.
Prerequisites: Calculus and physics or permission of the instructor.

321. Analog Computation for Engineers and Scientists(1 or 2)
Programming and operation of electronic analog computers. Analysis, modeling, and simulation of dynamic phenomena and systems in environmental science and engineering. Students desiring two credits will complete an original term project. Fall or Spring.
Prerequisites: Calculus and physics or permission of the instructor.

342. Hydraulics in Construction (4)
Three hours of lecture, three hours of laboratory. The physical, mechanical, thermal, and hydraulic properites of fluids relevant to the construction industry. A study of solutions to hydraulic problems in contemporary construction activities. Not open for credit to forest engineering students. Spring.
Prerequisites: Physics and differential calculus.

350. Wood Preservation (2)
Two hours of lecture with some demonstrations. A survey of basic wood-water relationships, shrinking and swelling, elementary wood structure, wood permeability, capillary forces, heat transmission, agencies of wood deterioration, wood preservation processes, wood fire performance, fire tests, and fire retardant treatments. Not open to WPE students. Fall.

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 open for credit to students who have completed successfully FCH 360 or equivalent.

352. Applied Engineering Thermodynamics (2)
Classical principles applied to devices and systems. Emphasis on efficient design of manufacturing equipment and processes. Power and refrigeration cycles; energy conversion; materials recovery. Environmental case studies and design project. Computer-aided data correlation and system simulation. Spring.
Prerequisites: ERE 351, FCH 360, or equivalent.

362. Mechanics of Materials (3)
Three hours of lecture. Theories of stress, deformation, and stability of common structural materials subjected to various force systems. Fall.
Prerequisites: Integral calculus and statics.

364. Engineering Materials (3)
Two hours of lecture and one three-hour laboratory per week. An introduction to the study of materials science emphasizing the structure and properties of materials used in the construction industry in general. Lab work includes fabrication, testing, and evaluation of actual systems. Spring.
Prerequisites: Junior standing, physics, chemistry, and engineering mechanics.

371. Surveying for Engineers (3)
Two hours of lecture and recitation and three hours of laboratory. The principles of plane surveying for engineers. Subject matter areas include introduction to the theory of measurement and errors. Linear and angular measurements in both the horizontal and vertical planes, traversing and computations, horizontal and vertical control and associated computations, areal and volumetric computation, circular and parabolic curves, state plane coordinates, public land surveys, and the analysis and treatment of systematic and random errors. Laboratory field work and computations culminate in a topographic map. Fall.
Prerequisites: Differential and integral calculus.

375. Elementary Corrosion (1)
One hour of lecture. Basic electro-chemistry, film formation and passivation, galvanic corrosion and pitting, cathodic and anodic protection, protective coatings and inhibitors. Application of the above in the home, car, field, at sea, and in industrial plants. Spring.

377. Process Control (3)
Three hours of lecture. The study of the principles of process control both with and without electronic computers. The emphasis is on sensing and control elements, signal transmission, non-computerized controllers, conversion of signals to digital input for computer programs, control problems such as lag and errors, and applications with emphasis on the paper industry. Spring.
Prerequisite: College level physics.

420. Computer Applications in Science and Engineering (3)
Principles and methods of mathematical modeling for analog and digital computer solution. Applications to data reduction and correlation, statistical analysis, process and equipment simulation, optimization and control, and computer-assisted instruction. Typical examples, class problems and student projects. Current status and future projection of computation equipment, software and operating techniques. Fall.
Prerequisites: Calculus and computer programming, or permission of the instructor.

422. Process Design and Simulation (3)
Two hours of lecture/discussion and three hours of design laboratory per week. Mathematical modeling of process units and systems. Consideration of energy requirements, operating costs, and optimization techniques. Steady-state and dynamic simulation via computer programs. Use of data sources and software, applied to design exercises and case studies. Spring.
Prerequisites: Unit operations and computer programming, or permission of the instructor.

440. Water Pollution Engineering (3)
Two hours of lecture and three hours of laboratory. Introduction to the physical, chemical, and biological parameters of waste water treatment processes and to the principles of the unit operations involved. Study of the design parameters and design procedures of waste water treatment systems. Spring.
Prerequisites: Physics and CHE 356 or equivalent.

441. Air Pollution Engineering (3)
Three hours of lecture and discussions. 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 equivalent.

488. Engineering Economics (1)
One hour of lecture and three hours of laboratory; first half of semester. This course provides students with the tools to understand the economic aspects of engineering and to evaluate engineering proposals in terms of worth and cost. Coverage extends through alternatives analysis, using rate of return, present worth, average annual cost and other methods, and evaluation of public activities, focusing on benefit-cost analysis. Spring.

496. Special Topics (1-3)
Lectures, readings, problems, and discussions. Topics as announced in the areas of environmental or resource engineering. Fall and/or Spring.

510. Energy: Alternate Systems (3)
Three hours of lecture. An introduction to alternate energy resources and conversion processes. Focus is on relatively small-capacity, decentralized systems and means for judging appropriateness, costs, and impacts of application under varying conditions and needs. Instruction modules on passive and active solar heating, wind energy system, biomass resources and conversion, including ethanol production, methane recovery and wood gasification, and internal combustion cogeneration.

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. Fall and Spring.
Prerequisite: ERE 371 or equivalent.

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. Introduction to scanning and transmission electron microscopy. Fall.
Prerequisite: Permission of the instructor.

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.

611. Energy: Production and Conservation (3)
Three hours of lecture. An introduction to the technology, impacts, hazards, and costs of large-scale, centralized power generation, with emphasis on opportunities for resource conservation. Spring.

640. Water Resource Systems (3)
Three hours of lecture and discussion. Fundamentals of the systems approach to complex water resource problems. Characteristics of water resource systems, related to systems engineering methodologies. Quantitative and qualitative subsystems are considered in a technical nature which exposes the socio-legal-political interfaces of water resource decisionmaking. Spring.
Prerequisite: FEG 340 or equivalent.

642. Water Quality Modeling (3)
Two hours of lecture and three hours of laboratory per week. An analysis of the biological, chemical, and physical factors of receiving waters governing the action of wastes and their reactions in receiving waters. Introduction to modeling techniques applicable to water quality management issues. Fall.
Prerequisite: ERE 440 or equivalent as evaluated by the instructor.

643. Water Pollution Engineering (3)
Two hours of lecture and three hours of laboratory. Introduction to the physical, chemical, and biological parameters of waste water treatment processes and to the principles of the unit operations involved. Study of the design parameters and design procedures of waste water treatment systems. Spring.
Prerequisites: Physics and CHE 356 or permission of the instructor.
Note: A student may not enroll in or receive credit for both ERE 440 and ERE 643.

652. Remote Sensing Interpretation (3)
Two hours of lecture and three hours of laboratory. Introduction with a qualitative emphasis on 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. Fall and/or Spring.
Prerequisites: Physics and calculus or permission of the instructor.
Note: Not open to students having previous credit for FEG 352.

655. Remote Sensing Measurements (3)
Two hours of lecture comprising an in-depth coverage of the theory, design, and application of remote sensing systems and techniques employed to obtain precise spectroradiometric measurements to map and monitor natural resources. Photographic and non-photographic systems are considered. Laboratory experiments in the form of an assignment using remote sensing data. Fall or Spring.
Prerequisites: ERE 572 and FEG 363 or ERE 563 or consent of the instructor.

658. Geometric Geodesy (3)
An introductory graduate level course for those without previous background in theoretical geodesy. Topics covered include position determination for short and long lines on the ellipsoid, the ellipsoidal triangle, the parametric equations, three-dimensional geodesy, and mappings of the ellipsoid. Fall.
Prerequisite: Permission of the instructor.

659. Astronomic and Gravimetric Geodesy (3)
An introductory graduate level course in geodetic astronomy and the gravity field of the earth. Topics covered include updating star positions; precise time keeping; position determination by natural and artificial satellites; the fundamental concepts of gravimetric geodesy, including the potential function; attraction; undulations of the geoid and deflections of the vertical. Fall.
Prerequisite: ERE 658.

660. Theory of Errors and Adjustments (3)
The theory of errors and adjustments, of observations oriented toward geodesy and photogrammetry. Topics include error definitions, weighted observations, method of least squares, matrix algebra in adjustments, variance-covariance matrix, the error ellipse and the general case of adjustment. Fall or Spring.
Prerequisites: Calculus and a beginning course in statistics.

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 or equivalent.

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. Fall.
Prerequisites: Organic, physical, and analytic chemistry.
Note: A student may not enroll in or receive credit for both PSE 461 and ERE 670.

671. Chemistry of Pulping and Bleaching (3)
Three hours of lecture. Discussion of the chemistry underlying the commercial pulping and bleaching processes, designed to assist in interpreting the phenomena observed in these operations. Emphasis is placed on those reactions which contribute to delignification and the removal of chromophoric groups in lignin and extractives. Spring.
Prerequisite: FCH 572 or permission of the instructor.

672. Selected Topics in Colloid and Surface Science I (3)
Three hours of lecture, discussions, and problem solving. The following topics will be covered: 1) viscosity of dilute dispersions, 2) osmotic and equilibrium, 3) light scattering, and 4) surface tension. Fall.
Prerequisites: Two semesters of physical chemistry and permission of the instructor.

673. Selected Topics in Colloid and Surface Science II (3)
Three hours of lecture, discussions, and problem solving. The following topics will be covered: 1) absorption from solution and at Gas-Solid interface, 2) electrical double layer, 3) Van der Waals attraction and flocculation, and 4) electrophoresis, zeta potential, and electroosmosis. Fall.
Prerequisites: Two semesters of physical chemistry and permission of the instructor.

675. Principles of Unit Operations (4)
Three hours of lecture and discussion and one two-hour computation period. Fundamentals of fluid dynamics, heat and mass transfer, appropriate analogies and process applications. Stage operations and computation methods. Application to distillation, extraction, gas absorption, evaporation, crystallization and drying. Design, operation, and computer simulation of equipment. Fall.
Prerequisites: Calculus and physical chemistry or permission of the instructor.

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 between paper manufacturing methods, papermaking additives, test results and the ultimate properties desired in the finished paper. Fall.
Prerequisite: Permission of the instructor.
Note: A student may not enroll in or receive credit for both PSE 465 and ERE 677.

678. Paper Coating and Converting (2)
Two hours of lecture plus evaluation of literature, independent project planning, and/or laboratory study. Evaluation and study of the 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 or permission of the instructor.
Note: A student may not enroll in or receive credit for both PSE 466 and ERE 678.

680. The Anatomy and Ultrastructure of Wood (2)
Two hours of lecture and/or demonstration and discussion. The gross, microscopic and submicroscopic structure of wood including organization of the cell wall, distribution of chemical constituents and abnormalities in wood. Fall.

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: Permission of the instructor.
Note: A student may not enroll in or receive credit for WPE 326 or WPE 327 and ERE 682.

683. Structure and Properties of Engineering Materials (3)
Three hours of lecture and discussion. Study of the mechanical, thermal, electronic, and magnetic behavior of metals, ceramics, polymers, and composite materials relating internal structure and engineering properties. "Internal structure" may range from subatomic, atomic, and molecular levels through the structure of crystals and amorphous solids up to the macro-structure of multiphase and composite materials. Spring.
Prerequisite: Permission of the instructor.

684. Mechanical Properties of Wood (3)
Two hours of lecture and three hours of laboratory. The effect of the anatomical and chemical nature of wood on its response to static and dynamic force systems. The theory of elasticity as applied to wood and wood-based composites. Spring.
Prerequisite: Permission of the instructor.

685. Applied 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. Fall.
Prerequisite: Consultation with the instructor.

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 the instructor.

688. Tropical Timbers in Commerce (2)
Two hours of lecture. Introduction to the commercial use of tropical timbers; the factors of forest conditions, stand types and wood qualities influencing their utilization and the development of trade. Sources of information. Spring.
Prerequisite: Permission of the instructor.

689. Tropical Wood Anatomy (1)
Anatomical characters, identification and taxonomy of tropical woods important in commerce. Spring.
Prerequisite: WPE 387 or ERE 360. Recommended that ERE 688 be taken concurrently or previously.

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 the instructor.
Note: A student may not enroll in or receive credit for both ERE 441 and ERE 691.

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 or equivalent.

762. Instrumental Photogrammetry I (3)
Two hours of lecture and three hours of laboratory. The theory and practice of extracting information from photographs with the aid of photogrammetric plotters. Fall or Spring.
Prerequisite: FEG 363 or equivalent.

775. Applied Thermodynamics (3)
The study and application of thermodynamics, including the first and second law, phase relationships, thermochemistry, the production of work and equilibrium relationships. Spring.
Prerequisites: FCH 360, FCH 361 or equivalent.

785. Scanning Electron Microscopy (3)
Two hours of lecture, demonstration and laboratory. Six hours of independent laboratory experience. The theory and operation of the scanning electron microscope including specimen preparation, photographic technique, and interpretation of micrographs. Spring.
Prerequisite: Permission of the instructor.

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 the instructor.

797. Seminar (1-3)
I. Forest Engineering topics. II. Paper Science and Engineering topics. III. Wood Products Engineering topics. Fall and Spring.

798. Research in Environmental and Resource Engineering (Credit hours to be arranged)
I. Independent research topics in Forest Engineering. II. Independent research topics in Paper Science and Engineering. III. Independent research topics in Wood Products Engineering. Fall, Spring, and Summer.

880. Interpretation of Cellular Ultrastructure (2)
One hour of lecture and two hours of demonstration and discussion. The organization and sculpturing of the walls of plant cells; the cellulose microfibril, matrix and incrusting substances, and the warty layer. The ultrastructure and function of cytoplastic organelles in cells. The nucleus, the mitochondrion, the chloroplast, the endoplasmic reticulum, microtubules, the gap junction and the tight junction. The tools and techniques used for light and electron microscopic study of cells, and the interpretation of structural evidence. Directed study and discussion of the latest (current) literature on pertinent topics. Spring.
Prerequisite: Permission of the instructor.

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.

999. Doctoral Thesis Research (Credit hours to be arranged)
Research and independent study for the doctoral degree and dissertation. Fall, Spring, and Summer.

ESF—NONDEPARTMENTAL

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.

FCH—FOREST CHEMISTRY

221. Organic Chemistry I (3)
Two hours of lecture, one hour of recitation. A survey of representative classes of carbon compounds with emphasis on structure, fundamental reactivity, and other important properties and characteristics relevant to biological systems. Fall.

222. Organic Chemistry Laboratory I (1)
One three-hour laboratory. Laboratory techniques in organic chemistry. Melting points, distillation, recrystallization, extraction, column and thin layer chromatography, natural product isolation. Qualitative functional group analysis. Fall.

223. Organic Chemistry II (3)
Three hours of lecture and discussion. The structure and reactivity of organic compounds, utilizing natural products as examples, will be studied in order to develop an organic chemical background for further study of biological chemistry. Spring.
Prerequisite: FCH 225 or equivalent.

224. Organic Chemistry Laboratory II (1)
One three-hour laboratory. Continuation of FCH 222. Simple physical, quantitative, and instrumental techniques applied to organic chemistry. Gas chromatography, polarimetry, kinetics. Introduction to synthesis. Spring.
Prerequisite: FCH 222 or equivalent.
Co-requisite: FCH 223 or equivalent.

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.

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.

361. Physical Chemistry II (3)
Three hours of lecture. Includes discussion on the structure of matter, principles of quantum mechanics, spectroscopy, and chemical kinetics. Spring.
Prerequisite: Physical Chemistry FCH 360 or the equivalent.

380. Instrumental Methods of Analysis (3)
Two hours of lecture and one three-hour laboratory. Lecture includes theory, applicability, and limitations of a number of current methods of instrumental analysis. Laboratory sessions provide practice with several of these techniques. Spring.
Prerequisites: General chemistry and quantitative analysis.

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.

495. Introduction to Professional Chemistry (1)
The professional chemist and his relationships 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.

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. Evidence of competence and appropriate effort is required for credit. A written report will be expected. Fall and Spring.
Prerequisite: Upper division status.

497. Undergraduate Seminar (1)
One hour per week. Literature surveys and seminars on topics of current research interest and recent advances in chemistry. Spring.

498. Introduction to Research (5)
Eighteen hours of laboratory, library search and report writing. Solution of a selected research problem using special laboratory techniques. Typewritten report on data, procedures, results, and conclusions. Spring.

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. Fall.
Prerequisites: An introductory course in physical chemistry is required and a shortcourse in computer programming is recommended.

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. Spring.
Prerequisite: Chemistry through physical chemistry, or consent of the instructor.

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.

519. Environmental Chemistry Seminar (1)
One hour of lecture. Seminars on current research and issues in environmental chemistry and related areas. Spring.

520. Nuclear and Radiation Chemistry (2)
The two one-hour lectures will cover the information required for the basic understanding of nuclear reactions, the types of radiation emitted, the instrumentation necessary to detect and measure this radiation, the principles of radioisotope tracer techniques, and radiation chemistry which is the effect of radiation on organic systems. Visits to the Cornell Reactor and the Nuclear Medicine Department of the Upstate Medical Center will be arranged. Spring.
Prerequisites: Physical, organic and inorganic chemistry or by permission of the instructor.
Note: This course can be taken independently of FCH 521.

521. Nuclear Chemical Techniques (1)
The laboratory will consist of one four-hour laboratory class every two weeks, with one hour to be made up at the student's discretion to accommodate counting periods which extend over several weeks. A short movie by the AEC each week will be required for the sixth hour. The laboratory will give each student the opportunity to use the individual counting instruments, gain experience in the handling and preparation of radioactive samples and the use of the 1000-curie-cobalt source in radiation chemistry. Spring.
Prerequisite: Physical, organic, and inorganic chemistry or permission of the instructor. Advanced tentative registration is required.
Co-requisite: FCH 520.

524. Topics in Natural Product Chemistry (3)
Three hours of lecture and discussion each week. A course intended to introduce the student to various types of secondary metabolites including several of past and current interest because of their pronounced biological activities. Modes of chemical reactivity and means of structure determination and syntheses are covered. Spring.

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.
Prerequisites: One year of organic chemistry and one year of physical chemistry.

531. Biochemistry Laboratory (2)
Six hours of laboratory. This course will stress techniques used in biochemical research. Techniques used include various types of chromatography, electrophoresis, and spectrophotometry and methods involved in the isolation, purification, and assay of enzymes. Fall.
Prerequisite: One semester of quantitative analysis with laboratory.

532. Biochemistry II (3)
Three hours of lecture. Topics discussed are: application of tracer techniques to biochemistry, the chemical and biochemical properties of lipids, theories on the origin of life, photosynthesis and the biosynthesis of steroids and terpenes, plant aromatics, amino acids, porphyrins and other aspects of nitrogen metabolism. Spring.
Prerequisites: FCH 530 and its prerequisites.

539. Principles of Biological Chemistry (3)
Three hours of lecture. Principles of biochemistry with emphasis on their relationship to biology. Topics include basic metabolic pathways, structure, and function of proteins, enzymes, and nucleic acids, energy relationships and biochemical control mechanisms. Nonchemistry majors. Fall.
Prerequisite: A two-semester course in organic chemistry is desirable, but a one-semester course is acceptable.

540 Chemical Ecology
This course is the same as EFB 512. Refer to description on page 75.
Note: Credit cannot be received for both FCH 540 and EFB 512.

550. Introduction to Polymer Science I: Polymer Synthesis and Mechanisms (3)
Three hours of lecture. 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, reaction on polymers, polyelectrolytes. Fall.
Prerequisites: One year of organic chemistry and one year of physical chemistry.

551. Polymer Techniques (2)
One hour of lecture and discussion and three hours of laboratory; lab reports. Techniques of polymer preparation: free radical solution and emulsion polymerization, gel permeation. Molecular weight determination by light scattering, osmometry, viscosity, gel chromatography. Structure characterization by X-ray diffraction, electron microscopy, nuclear magnetic polarized microscopy, stress-strain and swelling equilibrium and thermal analysis. Fall.
Prerequisites: One year of organic and one year of physical chemistry.

552. Introduction to Polymer Science II: Polymer Properties and Technology (3)
Three hours of lecture. Introduction to the 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. Spring.
Prerequisites: One year of organic chemistry and one year of physical chemistry.

555. Natural and Synthetic Polymers: An Overview (2)
Two hours of lecture. A series of 24 introductory lectures on all aspects of polymer science. The material covered will include: types of

natural and synthetic polymers; molecular size and shape; molecular weight determinations; chemical synthesis and reactions; polymer type vs. properties; properties in the liquid state; properties in the solid state; rubber and elastomers; crystallinity and morphology; mechanical and thermal characteristics; manufacturing and polymer technology. Fall.

Prerequisites: Organic chemistry. Some knowledge of physical chemistry is helpful, although not required.

571. Wood Chemistry I: General Wood Chemistry (2)
Two hours of lectures. 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.

572. Wood Chemistry II: Wood and Pulping Chemistry (3)
Three hours of lectures. 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. Chemistry of the industrial pulping processes with emphasis on sulfite and kraft pulping of wood. Chemistry of the major bleaching agents. Chemical byproducts in the pulping industry. Complete tree utilization in the manufacture of pulp and paper. Fall.

Prerequisite: One or two semesters of a three-credit undergraduate course in organic chemistry.

573. Wood Chemistry III: Biosynthesis of Wood (2)
Two hours of lecture. Chemistry of pectin and starch. Photosynthesis with emphasis on the chemical phase. Chemistry of the primary cell wall in plants. Biosynthesis of cellulose, hemicelluloses, pectin, and starch. Biosynthesis of aromatics, including lignin. Biodegradation of wood. Fall.

Prerequisite: FCH 571 or an equivalent course in general wood chemistry.

574. Wood Chemistry IV: Wood Chemistry Laboratory (1)
Three hours of laboratory. Reports. Gravimetric and spectrophotometric determinations of lignin. Determination of the number-average molecular weight of ethylcellulose by osmometry. Estimation of the weight-average molecular weight of ethylcellulose by viscometry. Calibration of a gel permeation chromatography (GPC) column. Separation and characterization of larch arabinogalactans A and B by GPC. Fall.

Prerequisite: FCH 571 Wood Chemistry I or an equivalent course in general wood chemistry.

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—532 or FCH 539 or equivalent.

650. Physical Chemistry of Polymers I (3)
Three hours of lecture. Includes: thermodynamics of polymer solutions, phase equilibria, fractionation, structure-property relationships, elementary chain statistics, molecular geometry, network elasticity, polyelectrolyte theory, and viscosity. Fall.

Prerequisites: One year of organic chemistry and one year of physical chemistry.

651. Physical Chemistry of Polymers II (3)
Three hours of lecture. Viscoelasticity. The glassy state and glass transition temperature. The crystalline state and crystallization kinetics. Characterization of structure and morphology of polymer solid states. Survey of structure and properties of native polymers. Spring.

Prerequisites: One year of organic and one year of physical chemistry.

652. Organic Chemistry of Polymers I (3)
Three hours of lecture. A broad survey of the chemistry of polyfunctional molecules and methods for their conversion to high molecular weight materials. Synthesis of a variety of specialty polymers and chemical reactions on natural and synthetic polymers. Some relations between molecular structure and useful properties. Spring.

Prerequisite: One year of organic chemistry.

653. Organic Chemistry of Polymers II (3)
Three hours of lecture. Kinetics and mechanism of polymerization processes, with emphasis on addition polymerization reactions initiated by radical, cationic and anionic initiators. Mechanism of stereospecific polymerization. Structure of polymers. Reactions on polymers and their modification for specific end uses. Block and graft polymers. Spring.

Prerequisites: One year of organic chemistry and one year of physical chemistry.

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.

798. Research in Chemistry
(Credit hours arranged according to nature of problem)
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 typewritten report required. Fall, Spring, and Summer.

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.

997. Seminar (1)
Seminars scheduled weekly; an average of twenty to thirty seminars are given annually. Discussion of recent advances in chemistry. Credit is given only once to a student. Fall and Spring.

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

300. Introduction to Forest Engineering and Design (2)
One hour of lecture and three hours of laboratory. An introduction to the design process with emphasis on the application of engineering fundamentals to the analysis and design of systems useful in resource manipulation and development. Fall.

340. Engineering Hydrology, and Flow Controls (4)
Three hours of lecture and three hours of laboratory and discussion. Analysis of the waters of the earth, their occurrence, circulation, and distribution; physical properties and their interaction with their environment. Principles of hydrologic budgeting and routing; and basic hydraulics of open channel, conduit, groundwater and overland flow. Applications of probability as a basis for the design of solutions to groundwater, surface runoff, flooding and water supply problems. Spring.

Prerequisites: CIE 327, IOR 326, and APM 360.

350. Introduction to Remote Sensing for Engineers (2)
Two hours of lecture. 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 standing and FEG 363 (which may be taken concurrently with FEG 350).

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: Physics and calculus or permission of the instructor.

363. Photogrammetry (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 and Spring.
Prerequisite: ERE 371 or equivalent.

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 concrete 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, APL Computing.

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. A context is developed for the application of other Forest Engineering courses.
Prerequisites: EFB 315, FOR 321.

422. Production Systems Engineering (4)
Four hours of lecture. An introduction to concepts and procedures for planning, designing, and managing production and large-scale physical systems with focus on forest resources and products. Systems analysis and quantitative techniques are introduced as design tools. Fall.
Prerequisites: IOR 326 and senior standing in forest engineering.

430. Engineering Decision Analysis (3)
An introduction to the design process as a decision model, with emphasis on techniques for determining economic attractiveness of engineering alternatives, and analyzing construction and production operations. Includes a survey of mathematical models useful for operations planning and analysis. Fall.
Prerequisite: IOR 326.

437. Transportation Systems (4)
Three hours of lecture and three hours of laboratory. Interrelationships among natural features, transportation types, design, and management objectives to provide the most effective system within the 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: CIE 437, FEG 422.

447. Hydrologic and Quality Controls (3)
Two hours of lecture and three hours of laboratory. A continuation of FEG 340 coupled with principles and practices of water quality control for forested sites and low density areas. Design of facilities and systems for water, sewerage and waste water treatment and for the abatement of pollution from nonpoint sources. Planning and analysis for water resources development. Spring.
Prerequisites: FEG 340, ERE 488 and CIE 437 or equivalent as evaluated by the instructor.

454. Tractive Power Systems (2)
Two hours of lecture per week. An introduction to analysis and design of tractive power systems used in timber extraction and other forestry, agriculture, and construction applications. Spring.
Prerequisites: MEE 285, ERE 351, FEG 420.

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 photogrammetric projects and designing optimum procedures for selected photogrammetric tasks. Fall.
Prerequisite: FEG 363.

477. Survey Systems Design (3)
Three hours of lecture and discussion. Land survey systems including the U.S. Public Land System, plane coordinate systems, and land use and resource systems—Specifications for Surveying and Mapping Projects. The design of future systems. Spring.
Prerequisites: FEG 371 and FEG 363.

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 standing in forest engineering.

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 the instructor.

FOR—FORESTRY (RESOURCES MANAGEMENT)

301. Field Dendrology (1)
Approximately one half-day lecture, five eight-hour field study, presented as the first portion of the Summer Program in Field Forestry held at Pack Demonstration Forest, Warrensburg, N.Y. Field Identification and ecology of common woody species of the southeastern Adirondack area. Natural and cultural history of the area as it affects the growth and development of these species. Summer.

302. Forest Surveying and Cartography (2½)
Course consists of approximately thirteen, eight-hour class days, combining lectures and practical field applications. The course stresses development of functional ability in the areas of cartography, overland navigation, and land measurement. It is part of the Summer Program in Field Forestry held at Pack Demonstration Forest, Warrensburg, N.Y. Summer prerequisite for FOR 303, 322, 332.
Prerequisite: FOR 301.

303. Introduction to Forest Mensuration (3½)
Lecture and field practice on methods and procedures for measuring trees, forest stands, and forest products. Descriptive statistics and sampling are introduced as they relate to the measuring process. Emphasis is placed upon field procedures and performance. The course is part of the Summer Program in Field Forestry held at Pack Demonstration Forest, Warrensburg, N.Y. Summer.
Prerequisites: FOR 301 and FOR 302.

304. Introduction to Forestry (1)
Approximately one day of lecture and at least four all day field trips, presented as an integral part of the Summer Program in Field Forestry. Students will be introduced to the diversity of forestry and the activities of a professional forester, and will visit forestry field operations and wood-using industries. Summer.

305. Introduction to Forestry II (1)
Lectures and some labs will be used to extend the introduction to forestry (FOR 304) begun during the Summer Program in Field Forestry. Students will explore the breadth of forestry and the

diversity of forest values and uses available. Topics include consideration of many disciplines related to forest resources management and use, and will provide an application of career opportunities within the broad field of forestry.

321. General Silviculture (3)
Two hours of lecture and one three-hour laboratory first half of semester, three hours of lecture last half of semester. Survey of silvical principles and concepts and practice of silviculture for the production of goods and services from the forest. Designed for students in curricula other than resources management. Not available for resources management majors. Fall.

322. Forest Mensuration (1)
Lecture, field, and laboratory work blocked in time and subject matter with FOR 331 and 332. Principles and methods used in the measurement of the trees and forest stands, the use of aerial photos for mapping and inventory, and the theory and application of compound interest to forestry decisions. Fall.

331. Introduction to the Physical Environment (6)
Lectures, discussions, field, and laboratory work blocked in time and subject matter with FOR 332 and 322. Study of the environmental media: air, soil, and water, through examination of the flow of energy and matter within and between these components of the environment. Drawing together information from geology, physical geology, soil science, water science, and meteorology, this course provides understanding of these areas, their interactions, and the interface with the biological system. Fall.
Prerequisite: Junior year standing in FOR curriculum or equivalent. Course should be taken concurrently with FOR 332 Silvics-Silviculture, because of the blocking of these two courses.

332. Silvics-Silviculture (8)
Three one-hour lectures and five three-hour labs or field trips. Fundamentals of silvics and practices of silviculture enabling manipulation of forests to attain objectives of the forest owner. Emphasis is placed on the biological interrelationships within the forest community, including site factors and forest stand dynamics, and the consideration of these in silvicultural operations. Fall.
Prerequisites: Summer Program in Field Forestry, and FOR 331 (taken concurrently) or permission of the instructor.

335. Regional Silviculture (3)
Three hours of classroom study. Topics cover regional factors that influence silvicultural methods commonly used in different forest types. Provides study of various silvicultural systems used in operating forest properties in various regions, with attention to geographical differences in land use, market opportunities, species characteristics, and economic conditions. Spring.
Prerequisite: FOR 332 or FOR 321.

345. Soils (3)
Two hours of lecture and three hours of laboratory. Introduction to the fundamentals of soil science with particular reference to forestry, but including other land uses. Spring.

351. Meteorology and Fire Behavior (3)
Lectures and recitations in atmospheric physics and the physics and chemistry of combustion lead to discussions of fire behavior and the strategy and tactics of fire suppression. Fall.
Prerequisites: PHY 103 and 104 (Calculus helpful but not required).

360. Principles of Management (3)
Three hours of lecture and recitation. Basic principles and concepts of management which are universally applicable to any organization, business enterprise, or public agency. The various approaches to management including the classical, behavioral and quantitative concepts with emphasis upon the integrative approach, now required to meet modern society's changing life styles and values and the new awareness of the public regarding environmental matters and natural resources management. Spring.

364. Soil and Water Conservation Policy (3)
Three hours of lecture. An integrated, historical survey of water and related land resource conservation in the United States. Interrelationships of governments and private organizations in their functions of policy-setting and planning, administration of programs, and evaluation of projects. Three lectures per week. Spring.

370. Management of the Forest Enterprise (3)
Two hours of lecture and one hour of discussion and laboratory. This course is concerned with the management alternatives, both of a technical and social nature, that are available in the planning for and the production of timber, recreation, wildlife, forage, and water from the forest and with the criteria for choice to meet management objectives. Spring.

371. Range Management (3)
Three hours of lecture and discussion covering range ecology, inventory and evaluation; animal husbandry and grazing management; multiple-use of rangelands; range improvement practices; and range policy and administration. Spring.
Prerequisite: Upper division status in Resource Management or Biology, or by permission of the instructor.

373. Timber Harvesting (3)
Two hours of lecture and one three-hour laboratory and discussion. Harvesting as a production system including equipment, equipment mixes, costs and manpower in serving and logmaking and primary and secondary transportation. Evaluation of various systems as to environmental impacts. Wood as a raw material to the primary processing system and trees as inputs to the harvesting system. Spring.

400. The Social Environment of Resource Management (3)
Three hours of lecture and discussion. This course describes the institutional framework within which the resource manager practices his profession. It intends to show how economics, law, public policy, pressure groups and financial considerations constrain the professional judgment of the resource manager and the goals and objectives of the institution employing him. Fall.
Prerequisites: FOR 332, 360, 461, 322 and one hour of computer science; Senior standing.

404. Economics of Wood-Using Industries (3)
Three hours of lecture and discussion. Structure and organization of selected wood-using industries. Analysis of decisionmaking by the firm. Principles of production and marketing including demand and cost analysis and pricing. Special issues and current problems of the industries, and introduction to the newer mathematical and statistical tools for meeting them. Spring.
Prerequisite: Microeconomics.

405. World Forestry Resources: Problems and Prospects (3)
Three hours of lecture and discussion plus guided readings, pertaining to world forest resources and the problems and opportunities associated with their use and development. Major topics include: world forest resources; production and trade; principal wood-producing countries; forestry and the problems of underdevelopment; and special areas and topics of interest to world forestry. Spring.
Prerequisite: Senior status preferred.

433. Commodity Production Silviculture (3)
Six hours of lecture and study, or field work classroom instruction and exercises will introduce topics, followed by field exercises stressing application of silvicultural methods for growing wood products, mostly in hardwood stands. Topics will cover concepts, techniques, diagnostic methods, and field application of silvicultural prescriptions in both even- and uneven-aged management. Offered one day per week as a block of instruction and exercise. Spring.
Prerequisites: FOR 331-332, and one mensuration course beyond Summer Program in Field Forestry; Senior standing.

434. Greenspace Silviculture (3)
Two hours of lecture, one to three hours seminar or field trip. Concepts, techniques, and field practice of evaluating and manipulating vegetation systems, including site conditions, woody and herbaceous vegetation, and use impacts, primarily for on-site values in park, recreation, wildlife and multiple-use lands, roadsides, utility rights-of-way, protection areas, etc. Fall.
Prerequisites: At least one silviculture course and senior status or permission of the instructor.

435. Integrated Use Silviculture (3)
Four hours of lecture and seminar during first half of semester; six hours of field practice thereafter each week. Development of silvicultural decisions in management of woodlands to achieve results under various integrated use objectives. Trips to forest areas. Several technical reports and a cultural plan prepared prescribing treatment to attain various ownership objectives. Spring.
Prerequisites: FOR 331 and 332 or permission of the instructor. Senior standing.

446. Forest Soil Classification, Survey, and Interpretation (3)
Two hours of lecture and discussion, one three-hour laboratory. Detailed examination of soil-genesis and classification, and the survey and description of the soilscape. Interpretations are made for various land uses, especially forestry. Fall.
Prerequisites: FOR 331 or 345 or an introductory soils course.

452. General Meteorology (3)
Three hours of lecture. Examination of the physical processes of the atmosphere as they relate to the exchange of heat, moisture, and momentum in the earth-atmosphere system. Emphasis on the meteorological and micrometeorological basis of climate and its interaction with the biological world. Spring.

455. Forest Tree Improvement (3)
Two hours of lecture, three hours of laboratory or field work. General principles and methods of tree improvement practiced in this country and abroad. Tree selection, techniques of vegetative propagation, hybridization, polyploidy, establishment of seed orchards, clonal and offspring testing and other problems. Spring.
Prerequisites: FBL 470, or Introduction to Mendelian Genetics or Population Genetics.

456. Management of the Forest Business (3)
Three hours of discussion. Overview of major business management principles and methods of operation in forestry enterprises. Emphasis is on general business concepts which forest managers must use. Actual case studies are basis of instruction. Complementary to RMP 611. Fall or Spring.

461. Management Models (3)
Three hours of lecture. Introduction to the various models used in managerial decisionmaking. Emphasis is on the characteristics of the various models: their formulation, assumptions, uses, and limitations. The major topics covered will include: the role of models in management; simple optimization; constrained optimization; multi-valued choices; time adjustment of value; simulation; and models in nondeliberated decisions. Integration of the deliberative and intuitive models is stressed. Fall.

465. Managerial Economics (3)
Three hours of lecture and discussion. Analysis of decisionmaking by the firm. Review of principles employed in modeling, predicting, risk assessment, evaluation and selection of alternative actions. Emphasis on economic and financial decisions and on the delineation of systematic processes of decision. Spring.
Prerequisite: Not available to Resource Management undergraduates except with permission of the instructor.

472. Fundamentals of Outdoor Recreation (3)
Three hours of lecture. 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 on major recreational issues and conflicts faced by area managers, and how they integrate solutions into their plans. Spring.

473. Planning and Development of Forest Recreation Areas (3)
Three hours of lectures or equivalent laboratory and assignments. Planning and designing forest recreation areas, structures, and facilities. Development of construction plans for camp and picnic sites, for waterfront areas and for trails. Emphasis is on the functional relationship between planning and design, management, and maintenance. Field trips required. Fall.
Prerequisite: FOR 472.

475. Sociology and Psychology of Leisure Behavior (3)
Three hours of lecture and discussion. Introduction to theory and research findings dealing with the sociological and psychological aspects of leisure behavior; field work and lectures demonstrate applications, particularly with regard to leisure behavior. Spring.
Prerequisites: FOR 472, and an introductory course in sociology or psychology, or permission of the instructor.

477. Resource Policy and Management (3)
Three hours of lecture supplemented by one hour of discussion and/or lecture. Public and private forest policy formation; principles of modern management; overall management and operation of a productive forest property. Primarily for forest engineers. Not available to Resource Management undergraduates. Fall.
Prerequisites: Mensuration and silviculture, senior standing in Forest Engineering, or by permission of the instructor.

480. Urban Forestry (3)
Two hours lecture and three hours of laboratory or field trip. Introduction to urban forestry: its professional status and potentials. Elements of urban physical geography. Nature and functions of various kinds of urban greenspace; their physical and social interactions as an integrated system, and management within the broader context of urban processes. Field practice in evaluating urban greenspace resources. Spring.
Prerequisites: Senior status. FOR core courses or permission of the instructor. For students in other schools FOR 434 is desirable.

496. Special Topics in Environmental and Resource Management (1-3)
Guided readings, lectures, discussions, tutorial conferences, or special coursework designed to help the undergraduate student apply scientific analysis of a social, biological, or physical nature to questions within his area of interest. Questions and analyses would include those dealing with forest resources management and administration; forest cultural practices; land use and land use planning; hydrology and watershed management; outdoor recreation; resource economics; world forestry; and others. Fall and Spring.
Prerequisite: Permission of the instructor.

498. Special Studies in Environmental and Resource Management (1-6)
Independent research in environmental and resource management for selected undergraduate students. Selection of subject areas determined by the student in conference with appropriate faculty member. Final written report is required for departmental record. Fall, Spring, and Summer.
Prerequisite: Cumulative G.P.A. of at least 2.50 and approval of the instructor and advisor.

499. Independent Study in Resources Management (7-12)
Independent study of some significant aspect of environmental and resources management. The selection of the topic will be determined by the student in consultation with his advisor. Guidance will be provided by a faculty committee. Limited to seniors in Resources Management. Fall or Spring.
Prerequisite: Must have cumulative G.P.A. of at least 3.00.

FTC—FOREST TECHNOLOGY

200. Dendrology I (2)
Twenty-five hours of lecture and 34 hours of field time. A study of the distinguishing characteristics, growth features, distribution, associates and importance of the major tree species of North America. Seasonal

field identification and on-the-spot discussion of habitats, associates, and the place in succession of the predominant forest trees and shrubs as found in the Adirondack area of the Northeast, plus a limited number of introduced species. Fall.

202. Plane Surveying I **(4)**
Fifty-four hours of lecture and 100 hours of field and laboratory time. An introduction to the theory and practice of plane surveying. Emphasis is on individual skill development through small crew projects, 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 and introduction to map use and preparation. Field projects include traversing, methods, and proficiency projects in handling typical surveying instruments. Fall.

203. Plane Surveying II **(1)**
Twelve hours of lecture and 32 hours of field time. A continuation of FTC 202 with emphasis on small crew field projects introducing the use of the engineer's level and the theodolite. Classroom work is directed at explaining the United States Public Land Survey system and introducing the concepts of modern deed descriptions and recordkeeping procedures. A trip to the County Court House is scheduled for a first hand look at a modern deed and record keeping operation. Spring.
Prerequisite: FTC 202.

204. Forest Mensuration and Statistics I **(3½)**
Sixty-seven hours of lecture and 36 hours of field time. A classroom and field study of the basic principles and skills required for timber measurements. Volume tables, their use and construction are studied. Cruise reports are required in which the student presents cruise results. Various methods of forest sampling are studied including methods of calculating necessary sampling intensities and sampling errors. Fall.

205. Forest Mensuration and Statistics II **(2)**
Four hours of lecture and 44 hours of field and laboratory time. A field problem of practical nature utilizing methods for collecting, analyzing, and presenting data dealing with timber volumes. Spring.
Prerequisite: FTC 204.

206. Forest Ecology **(3)**
Forty-one hours of lecture and 52 hours of field time. Study of weather and weather data collection; students manning a forest weather station. Study of climate and soil factors, how they affect trees and forests and the interactions both within the forest community and within the forest ecosystem. Introduction to cover type mapping. Final field problem and written and oral report on the detailed analysis of a forest transect. Fall.

207. Aerial Photogrammetry **(2)**
Fourteen hours of lecture and 48 hours of laboratory. Development of the ability to interpret important ground features by viewing aerial photos singly and in pairs, using stereoscopic techniques and equipment. Work scale problems and make reliable horizontal and vertical measurements. Use radial line plotter and zoom transfer scope for transfer of detail to base map. Forest type mapping and forest inventory using photos. Fall.

208. Forest Installations **(3)**
Thirty-six hours of lecture and 60 hours of field time. This course provides the student with the technical competence necessary to use, plan, construct, and maintain such typical forest improvements as telephone lines, radio systems, trails, and light frame structures. Fall.

209. Forest Roads **(2)**
Twenty-two hours of lecture and 32 hours of laboratory time. This course provides the student with the technical competence necessary to administer, locate, and design the construction and maintenance of a typical forest gravel road. Spring.
Prerequisite: FTC 202.

211. Silviculture **(2½)**
Thirty hours of lecture and 40 hours of laboratory and field work blocked with forest management. Lectures based on text study cover orientation, terminology and present a framework of the various treatments used in many common stand conditions to bring the forest into a more productive state in accord with the objectives of management. Emphasis on thinning in computer simulation and field practice. Exercises in planting and pruning. Demonstrations in chemical silviculture. Spring.
Prerequisite: FTC 206.

213. Forest Protection I **(2)**
Thirty-eight hours of lecture and 36 hours of laboratory/field time. A study of the insect and disease agents that damage trees and their role in the total forest community. The course covers identification of local forest insects and disease-causing organisms, study of the major pest groups of other forest regions, and control measures including the effects of pesticides on the environment. Field trips cover local pests and the damage caused, while laboratory work covers major groups of pests likely to be encountered elsewhere. Fall.

214. Personnel Management **(1½)**
Fourteen hours of lecture and 12 hours of laboratory. A study of company and agency organization functions, including selection of and placement of personnel, training of personnel and performance evaluations, planning for and administering crew responsibilities, human relations in the working situation and special personnel problems of the forest are covered. Techniques of foremanship are applied in various field exercises in other courses, along with the duty of safety hazards, accident prevention, accident classification and accident reporting. Spring.

215. Timber Harvesting **(2)**
Sixteen hours of lecture and 36 hours of field time. This course acquaints the student with the basic harvesting methods and techniques, with emphasis on the Northeast, along with the knowledge of how and where harvesting fits in with other forest uses. Students gain technical competence in timber sale contract administration and basic timber appraising. Spring.

217. Forest Management **(3½)**
Thirty-seven hours of lecture and 68 hours of lab and field work blocked with silviculture. Coverage of the common problems met in organizing a forest property to approach the goals of ownership. Study and practice in techniques of growth measurement and the gathering and use of forest records in general. Review actual examples and case studies of forest management and production activities. Summary application of pertinent information from many other courses in a work plan involving management decisions for an assigned forest property. Spring.
Prerequiste: FTC 206.

218. Forest Recreation **(1½)**
Fifteen hours of lecture and 32 hours of laboratory or field time. This course acquaints the student with the forest recreational resources—its present and future needs. Principles of recreation development and management are discussed with special emphasis placed on the technical aspects. Spring.

219. Elements of Wildlife Ecology **(1½)**
Twenty-four hours of lecture and four hours of field time. A study of the principles of wildlife ecology with fundamentals related to the actions of the preservationist, conservationist, and particularly those of the forest manager. Spring.

221. Soil and Water Measurements **(1½)**
Sixteen hours of lecture and 32 hours of laboratory and field time. A basic introduction to precipitation and streamflow measurements taken at weather stations, snow courses, streamgaging stations, and other sample points. Includes introduction to physical properties of soils related to land management. Discusses forest management practices commonly used to control erosion and water quality. Spring.
Prerequisite: FTC 206.

223. Graphics **(1)**
Sixteen hours of lecture. An introduction to lettering and drafting with emphasis on the skills needed by the forest or surveying technician. Individual skill development is achieved through several projects.

The concept behind each project is explained in handout material and lecture, and each student is then expected to complete the project on his/her own time. Freehand and mechanical lettering plates are produced in addition to precision and map drawings. Fall.

227. Forest Protection II (2)
Twenty-three hours of lecture and 24 hours of field and laboratory time. The basic principles of fire ecology, forest fire behavior, fire danger and fire danger rating, forest fire prevention and control, and prescribed burning are covered. Handtool fire suppression techniques are demonstrated and practiced. Spring.
Prerequisite: FTC 213.

228. Structure and Growth of Trees (1½)
Nineteen hours of lecture and twelve hours of laboratory. A study of the various tissues of forest trees and how their growth and development are affected by internal and external factors. Differences in stem structures of some of the more important commercial tree species of the United States are studied in the laboratory, and these differences are related to the commercial uses of these species. Spring.
Prerequisite: An introductory course in general botany or biology.

229. Silviculture II (2)
Twenty-six hours of lecture and 28 hours of field and laboratory. Continuation of FTC 211 dealing mainly with the handling of the more complex hardwood and mixed stands common to the Northeast. Special coverages will be offered on current practices of regional importance beyond the Northeast where graduates are likely to be employed. Spring.

230. Plane Surveying III (2)
Twenty-six hours of lecture and 28 hours of field time. A continuation of FTC 202 and FTC 203 with emphasis on small crew projects using the theodolite. Advanced field techniques are discussed and practiced, such as the determination of the true meridian by the method of direct solar observation, layout of highway curves and simple triangulation procedures. Each topic is developed in detail in the classroom before each field project is completed. Spring.
Prerequisites: FTC 202 and FTC 203.

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 that of the SFT. A maximum of 6 credit hours may be taken by any student in total. Semesters as arranged. Fall, Spring, or Summer.

LIB—LIBRARY (COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY COURSE)

300. Library Research (1)
Fifteen hours of class time per semester (usually the first five weeks). Introduction for students at all levels to basic library material and the research process leading to preparation of a bibliography. Fall and Spring.

LSA—LANDSCAPE ARCHITECTURE
(See also courses listed under EIN and CMN.)

320. Introduction to Landscape Architecture and Planning (3)
Three hours of lecture. The course presents an overview of the professions of landscape architecture and planning. It surveys the historic and contemporary situations of environmental design and planning. The course introduces the socio-cultural and natural factors which influence the form and condition of the physical environment. It will introduce issues, personality, and projects. Fall.

326. Landscape Architecture Design Studio I (3)
Six hours of studio and one hour of lecture. The first in a sequence of studios focusing on the concepts, skills, and methods of design. This course introduces students to the basic vocabulary, concepts, and principles of design; the application and operation of these in the physical environment, development of three-dimensional spatial concepts. The requirements for this course include readings, examinations, field trips, design exercises, and projects. (Student field trip expense $125-$150.) Fall.
Prerequisite: Permission of the instructor.

327. Landscape Design Studio II (3)
One hour of lecture and six hours of studio. The second in a sequence of studios focusing on the concepts, skills, and methods of design. This course continued the development of design abilities through study of the interrelationship between the requirements of a design established in a program, the visual character of the site and the development of a designed result. The development of spatial concepts which meet principles of composition organization and a given set of requirements. The requirements for this course include readings, examinations, field trips, design exercises, and projects. (Student field trip expense $125-$150.) Spring.
Prerequisites: LSA 326, with a minimum grade of C, and CMN 382.

330. Site Research and Analysis (2)
One hour of lecture and three hours of studio. This course will require those enrolled to apply principles of natural resources and processes to assess the land use and development potentials and limitation of a site. The principles will include landforms, soils, hydrology, climate, energy, and plant, animal, and human ecology. A variety of manual and computer techniques for data collection, analysis and synthesis of natural systems information will be explored. The course will concentrate on the comparison of synthesis techniques and their implications for land use and design decisionmaking. Occasional local field trips will be utilized. Spring.
Prerequisite: EIN 311 or permission of the instructor.

422. Landscape Design Studio III (4)
Twelve hours of studio. This course is a continuation of skill development, theory, and strategies as they relate to design issues and process. Emphasis is placed on in-depth investigation on projects of a direct scale illustrating form derivation and the man-made and natural form. Occasional field trips to illustrate various design solution. Fall.
Prerequisites: LSA 327, with a minimum grade of C, and LSA 330.

423. Landscape Design Studio IV (4)
Twelve hours of studio. This course emphasizes skill development, theory, and strategy as they relate to large-scale site design situations. Continues prior courses emphasis on design process and form manipulation. Occasional field trips to illustrate and inspect design form. Spring.
Prerequisite: LSA 422, with a minimum grade of C.

425. Orientation for Experiential Studio (2)
Three hours of lecture and recitation. Investigation and documentation of an area of specialty, discussion, readings, and research. Fall and Spring.
Prerequisite: Permission of the instructor.

433. Plant Materials (2)
Three hours of lecture and field work for first one-third of semester. Two hours of lecture for second one-third of semester. This course concentrates on woody plant materials used in landscape architecture, the ecological relationships of plants, ornamental plant materials use and identification, plant culture propagation, transplanting, planting plans and specifications. Fall.
Prerequisite: Permission of instructor.

434. Design Materials (1)
Three hours of lecture for last one-third of semester. An introduction to wood, concrete, masonry, asphalt, stone, and synthetic materials intended to provide students with an understanding of the basic visual, structural, and maintenance principles of each, in order to both use the materials in design and prepare written specifications. Fall.

442. Site Grading (2)
Two hours of lecture and three hours of studio during first two-thirds of semester. Lectures, projects, and assigned readings. The study of grading as the primary means of landform modification in landscape architectural design. Primary emphasis will be given to principles of grading, including contour manipulation, sections, profiles, and computations. Concepts of establishing acceptable slopes and positive surface drainage will be introduced. Enrollment limited to BLA or MLA students. Fall.
Prerequisite: LSA 330, Site Research and Analysis.

443. Site Drainage Systems (1)
Three hours of lecture for last one-third of semester. Lectures, projects, and assigned readings. Provides a basis for the design of drainage systems. Coverage includes concepts relevant to understanding precipitation, methods of run-off quantification, open channel flow, systematic pipe network analysis. Enrollment limited to BLA or MLA students. Fall.
Prerequisite: LSA 330, Site Research and Analysis.

444. Vehicular Circulation Design (1)
Three hours of lecture for first one-third of semester. Lectures, projects, and assigned readings. Must be taken concurrently with LSA 423. Introduces the circular geometry of horizontal curves and the parabolic geometry of vertical curves, curve coordination based on safety and aesthetic relationships, road grading. Enrollment limited to BLA or MLA students. Spring.
Prerequisites: Computer Programming and Surveying.

445. Elements of Structures (1)
Three hours of lecture during the second one-third of the semester. Lectures, projects, and examinations. An introduction to the concepts of assembling engineering materials into structure. All common building systems will be surveyed and emphasis will be placed on fundamentals rather than on detailed mathematical design procedures.
Prerequisite: Non-School of Landscape Architecture students by permission of the instructor. Not open to engineering majors. Spring.

455. Professional Practice in Landscape Architecture (2)
Two 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. Occasional field trips will be utilized. Spring.
Prerequisites: Senior status in landscape architecture or permission of the instructor.

456. Introduction to Design Implementation (2)
Two credit hours. One hour of lecture and three hours of laboratory per week. Introduction to drawing, grading, layout, planting, details, specifications, and estimating. Spring.
Prerequisite: Permission of the instructor and concurrent enrollment in LSA 521.

495. Selected Readings in Environmental Studies (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 the instructor.

496. Special Topics in Landscape Architecture (1-3)
One to three hours of class meetings. 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 the instructor.

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 the instructor.

520. Design Analysis Studio I (3)
Six 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.
Prerequisites: First-year MLA standing or permission of the instructor. Not open to BLA students.

521. Design Analysis Studio II (3)
Six hours of studio and one hour of lecture. The second in a sequence of studio 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 in the ordering of a variety of land use activities, with special emphasis on the functional and spatial quality of built environments. The requirements for this course include readings, examinations, field trips, design exercises, and projects. Spring.
Prerequisites: LSA 520, CMN 382, or permission of the instructor.

522. Landscape Design Studio VI (4)
Twelve hours of studio. Studio problems, research, drafting and field trips. Concentration on complex urban problems. Concern for social and psychological considerations of the individual and large groups of people, their interaction and resultant forms of the environment. Spring.
Prerequisite: Permission of the instructor.

524. Experiential Landscape Studio Design (16)
Forty-eight hours per week. The articulation of the study proposal established in LSA 425, as approved by faculty, through research, readings, field study with graphic and written documentation, and group discussion. Academic study in an off-campus location in an area of landscape architectural significance, as described and delineated in a student-prepared proposal approved by the faculty. Fall or Spring.
Prerequisites: LSA 425 and LSA 423, with a minimum grade of C.

525. Landscape Design Studio VI (4)
Twelve hours of studio. Investigation of a problem in landscape architecture as proposed by the student and conducted in conjunction with faculty advisor. Spring.
Prerequisite: Permission of the instructor.

527. Landscape Design Studio VI (4)
Twelve hours of studio. Studio problems, research, reports, and field trips. Concentration on regional landscape problems, the techniques of their analysis and derivation of their significance to the practice of landscape design. Spring.
Prerequisite: Permission of the instructor.

529. The Major Elements of Environmental Design (3)
Lectures, readings, discussions, and studios. The course presents an introductory survey of environmental design methods and associated skills and techniques. While studio work is part of the course, no design background is required. Fall.

533. Plant Materials (2)
Field trips and discussion. Ornamental woody plant identification. Observation and sketches of outstanding examples of planting design. Two weeks. Summer.
Prerequisite: Permission of the instructor.

545. Professional Practice Studio II (2)
Three hours of studio, one hour of recitation. Studio problems, research, discussion and recitation sessions on the processes and methods of office practice. Emphasis on all aspects of site development. Spring.
Prerequisite: Permission of the instructor.

547. Principles of Professional Practice (2)
Two hours of lecture. Lectures, assigned readings, reports, cost estimates, specifications, contracts, professional ethics, registration laws, professional practice. Spring.

595. 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: Fifth-year status or permission of the instructor.

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 the instructor.

598. Research Problem (1-3)
Independent study of selected areas of environmental interest. Emphasis on a self-disciplined study, development of procedures and techniques to be employed in environmental design and planning. Engagement with specific sites and problems as proposed for study by individual communities. Enrollment at periodic intervals throughout the semester. Fall, Spring, and Summer.
Prerequisite: Permission of the instructor.

620. Community Design Studio I (3)
Six hours of studio and one lecture-seminar hour. An examination and evaluation of the landscape architectural design process with an emphasis on the methodological variations which occur in its definition and application. A variety of projects, scales, and programs are employed as a vehicle for study of the design process. Fall or Spring.
Prerequisite: Permission of the instructor.

621. Community Design Studio II (3)
Six hours of studio and one lecture-seminar hour. An examination and evaluation of the landscape architectural design process with an emphasis on the methodological variations which occur in its definition and application. A variety of projects, scales, and programs are employed as a vehicle for study of the design process. Fall or Spring.
Prerequisite: Permission of the instructor.

641. Formal Organizations (1)
Three hours of lecture-discussion for one-third of semester. This course presents basic functional concepts of formal organizations for landscape architects who intend to work at the community scale. Three types of organization arenas are presented: private, public, and nonprofit organizational characteristics of division of work, hierarchy, authority, and communications are introduced. Comparisons are made between traditional bureaucracies and interdisciplinary teams. Each student will prepare an organizational description. Fall or Spring.
Prerequisites: MLA status or permission of the instructor.

642. Project and Program Scheduling (1)
Three hours of lecture-discussion for one-third of semester. The course presents an introduction to alternative scheduling methods for design projects, including bar charts, critical path, and program evaluation review techniques. Fall or Spring.
Prerequisites: MLA status or permission of the instructor.

643. Ethical Issues in Community Design and Planning (1)
Three hours of lecture-discussion for one-third of a semester. Status and role of the profession in society, standards of professional conduct and responsibility, ethical responses to a variety of professional situations is the focus of the course. Fall or Spring.
Prerequisites: MLA status or permission of the instructor.

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 to familiarize the student with basic behavioral science methods including questionnaires, observations, and interviews. A final project provides an opportunity to synthesize course materials. Fall.
Prerequisites: MLA status or permission of the instructor.

651. Process of City/Regional Planning (3)
Three hours of seminar. The purpose of this course is the introduction of planning as a process of decisionmaking and to familiarize graduate students with its scope and content. The course relies upon lectures and readings to develop introductory knowledge as well as seminars and discussions to cover the constitutional basis, tools, and techniques and the current directions of planning. Fall or Spring.
Prerequisite: Permission of the instructor.

652. Community Development Process (3)
Discussion and analysis of the elements of community development process: private sector development, public sector initiatives and programs aimed at community development; and role of planning design in coordinating public and private sector initiatives.

653. Visual Landscape Analysis (2-3)
Three hours of lecture and discussion weekly during the first three quarters of the semester will cover aspects of landscape perception; introduction to methods of visual landscape inventory and evaluation, visibility determination, psychometric assessment, and visual impact assessment; and visual resource management strategies. Problems and exams will be required. Optional third credit entails four hours weekly of laboratory or field projects applying analysis methods and techniques during last quarter of semester.

656. Environmental Factors, Community Response, and Form (3)
Two and one-half hours of lecture and six studios per semester. The course presents an introduction to a comprehensive process for the integration of environmental phenomena, such as solar access, visual access, noise, and wind into community design. The process includes data gathering and analysis, prediction methods, objective criteria, and implementation. Fall.
Prerequisites: Second year MLA status, or permission of the instructor.

671. History of Landscape Architecture (3)
Three hours of lecture-seminar. Regular use of slides and other projected lecture material; assigned texts as a basis for lecture; supplemental readings, assigned and individually researched; class discussion from readings and lecture; and student presentations and term paper. Historical study and style analysis of Western man's efforts to design his environment and his changing attitudes and relationships to environment. Also, non-Western coverage where significant or influential on Western man. Study of historical personalities as well as periods that are of environmental concern up into the modern periods. Fall.
Prerequisites: MLA standing or permission of the instructor.

696. 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 the instructor.

697. Topics and Issues of Community Design and Planning(2)
Two hours of lecture and discussion. Topics for discussion are selected to acquaint the entering graduate student with a generalized view of current issues facing landscape architects in community design and planning. Readings and papers are regularly assigned. Fall.
Prerequisites: MLA students or permission of the instructor.

752. Urban and Regional System Dynamics (3)
Lectures and workshop. The major concerns of this course are application of system dynamics; basic principles of system dynamics; and system dynamics modeling. This method is investigated as a useful tool in modeling many landscape architectural and planning problems. No prior computer experience is necessary. Spring.
Prerequisite: Permission of the instructor.

796. Special Topics in Landscape Architecture (1-3)
One to three hours of class meetings. 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. Fall and Spring.
Prerequisite: Permission of the instructor.

797. Seminar (2)
Two hours of seminar. Discussion of current topics, trends, and, research related to landscape architecture, planning, and management. Fall and Spring.
Prerequisite: Permission of the instructor.

798. Research Problem
(Credit hours to be arranged according to nature of problem)
Special study of assigned problems relating to landscape architecture or planning, with emphasis on critical thinking. Fall, Spring, and Summer.
Prerequisite: Permission of the instructor.

799. Thesis Project Proposal Development (1)
One hour of lecture and workshop. During this course, a student will prepare a proposal for a thesis/project in the MLA program. Fall.
Prerequisites: LSA 699 and permission of the instructor.

898. Professional Experience (1-12)
A supervised external professional work experience which satisfies Option 2 of the master's study integration requirement. Graded on an "5/4" basis. Fall, Spring, and Summer.
Prerequisite: Formation of committee, approval of proposed experience by committee, and the sponsor of the professional experience.

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.

PSE—PAPER SCIENCE AND ENGINEERING

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.

301. Pulp and Paper Processes (3)
Three hours of lecture. Technological consideration of pulping and bleaching of woody raw material. Includes consideration of wood procurement and preparation, pulping and bleaching processes, recovery of secondary fibers, pollution abatement and other ancillary operations. Spring.
Prerequisites: FCH 571 and 572, PSE 300 (or concurrent).

302. Pulp and Paper Processes Laboratory (1)
One three-hour laboratory. Study and practice in the techniques of laboratory procedures normally encountered in the pulp and paper industry. Laboratory exercises selecting and using standard testing methods. Field trips to observe commercial equipment of the pulp and paper industry. Spring.
Prerequisite: PSE 301 (or concurrent).

304. Mill Experience (2)
Twelve weeks full-time pulp or paper mill employment approved by the department between the junior and senior years. The student must submit a comprehensive report to fulfill this requirement. Summer.

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.
Prerequisites: Calculus, physics, and FCH 360 (or concurrent).

371. Fluid Mechanics (3)
Three hours of lecture and/or demonstrations. The study of momentum transfer. Steady and unsteady flow of liquids and gases in pipelines, ducts, open channels, and porous media. Movement of particles in fluid media. Newtonian and non-Newtonian flow and flow of suspensions. Filtration, sedimentation, centrifugation, agitation and mixing. Characteristics and selection of pumps, blowers, agitators and other equipment. Flow measurement and flow system design with economic considerations. Fall.
Prerequisites: College level physics and chemistry, calculus.

372. Heat Transfer (2)
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 and 371 or equivalent.

461. Pulping Technology (3)
One hour of lecture and six hours of laboratory. Discussion of pulping and bleaching processes: effect of chemical and physical variables on the wood components and pulp properties; chemistry involved. Experiments in pulping and bleaching, and pulp evaluation. Fall.
Prerequisites: PSE 301, CHE 346 and CHE 356.
Note: A student may not enroll in or receive credit for both PSE 461 and ERE 671.

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 between paper manufacturing methods, papermaking additives, test results and the ultimate properties desired in the finished paper. Fall.
Prerequisites: PSE 301 and PSE 302.
Note: A student may not enroll in or receive credit for both PSE 465 and ERE 677.

466. Paper Coating and Converting (2)
Two hours of lecture. 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: A student may not enroll in or receive credit for both PSE 466 and ERE 678.

468. Papermaking Processes (3)
Two hours of lecture and three hours of laboratory. Study of the papermaking process, featuring operation of the pilot 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 balance. Results of each paper machine run are evaluated in seminar-type discussions. Spring.
Prerequisites: PSE 461 and PSE 465.

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, 371, and 372 or equivalent.

491. Paper Science and Engineering Project I (1)
Student makes a systematic survey of all available literature on the problem assigned him and incorporates it in a formal, typewritten report. An essential part of this report is a detailed outline of a research project which the student proposes to undertake during the next semester (PSE 492). Fall.
Prerequisites: PSE 300 and PSE 301.

492. Paper Science and Engineering Project II (3)
The analysis of a problem, the synthesis of a solution and the basic design of the facilities needed to solve a problem. Laboratory research, field work, and consulting as needed in addition to the literature survey

completed in PSE 491. Progress reports and a final report and seminar-style presentation. Spring.
Prerequisite: PSE 491.

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.

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.
Prerequisite: PSE 461 and PSE 465.

RMP—RESOURCE MANAGEMENT AND POLICY

529. Environmental Impact: Principles and Strategies (3)
Three hours of lecture and discussion. Principles and theory of environmental impact and statements of impact as required by federal law. Administrative procedures for review and evaluation. Procedural strategy and effective constitution of statements for various governmental levels. Means of obtaining sources of authoritative information. Fall.
Prerequisite: Senior standing.

560. Nonindustrial Private Forest Management (3)
Three hours of lecture and discussion. Resource conditions and management issues associated with private nonindustrial private forest lands. Special attention is given to owner characteristics and objectives, public and private programs which directly or indirectly influence management decisions and the role of foresters in relation to the above. Spring.
Prerequisite: Senior or graduate student standing in forestry.

561. Land Use Economics (3)
Three hours of lecture-discussion. Study of the theory and methods of land use economics and the application of economic analysis to open space and regional planning. Emphasis is on understanding basic concepts; development of operational methods and data sources. Case studies, outside readings, and guest speakers are utilized. Spring.
Prerequisites: One course in macroeconomics and one in microeconomics and permission of the instructor.

562. International Timber Trade (3)
Three hours of lecture. Basic principles of international trade. Structure and procedures of international timber trade. Major trade regions and their relationships. Economic context of timber trade. Emphasis is placed upon methods of analyses for understanding both opportunities and limitations of timber products exports and imports. Fall.
Prerequisites: Two semesters of undergraduate economics, and senior standing in forestry or wood products engineering.

587. Environmental Law (3)
Three hours of lecture and discussion. Studies in Environmental Law designed for resource managers. Review of structure and processes of American legal system, constitutional framework of environmental law, The National Environmental Policy Act, legal framework for management of federal lands, focus on legal aspects of common property resource management, land, water, and air. Fall.

588. The Law of Natural Resource Administration (3)
Three hours of lecture and discussion. An introduction to the law concerning the procedures, powers, and judicial review of public agencies responsible for the management of natural resources. Topics will include the extent of an agency's rule-making power and the rights of aggrieved parties to appeal from agency decisions. Spring.
Prerequisite: FOR 360 or equivalent course in public administration.

602. Resource Economics (3)
Three hours of lecture and discussion. Economic theory and analysis in resource management and use decisions. Study and application of economic models to land, water, forest, wildlife, and recreational resources. Relationships and interactions of public and private sector in resource management. Fall.
Prerequisite: Two semesters of undergraduate economics.

603. Research Methods in Resource Management and Policy (3)
Three hours of lecture and discussion. Study of the elements of research methodology including statistics and their application to analyzing and resolving problems both basic and applied in the managerial and policy sciences. Fall.
Prerequisite: Undergraduate statistics course.

664. Soil and Water Conservation Policy (3)
One three-hour meeting per week. An integrated, historical survey of water and related land resource conservation in the United States. Interrelationships of governments and private organizations in their functions of policy-setting and planning, administration of programs, and evaluation of projects. Fall.

670. Economics of Nonmarket Goods (3)
Group discussion, lectures, guided readings, case studies, and student projects on the economic aspects of watershed management, fish and wildlife management, and outdoor recreation. Major topics include theories of valuation and application to nonmarket goods, cost analysis for nonmarket goods, and measurement of regional impacts. Spring.
Prerequisites: Microeconomics, knowledge of basic statistical analysis, and six hours or more of resource management coursework.

672. Open Space Planning (Recreation) (3)
Three hours of lecture and discussion; one overnight field trip required. Study of methods and techniques applicable to open space planning in nonurban areas. Survey of literature and current research. Open space standards, classification systems, and inventory methods. Development of plans for large scale recreation areas, and inclusion of recreation into regional plans. The interrelationship and conflicts between resource utilization/development and recreation/aesthetics reviewed through case studies. Fall (odd years).

675. Psychology of Leisure Behavior (3)
Three hours of lecture and discussion. Introduction to theory and research findings dealing with the sociological and psychological of leisure behavior: field work and lectures demonstrate applications, particularly in outdoor recreation. Fall.

751. World Forestry (3)
Three hours of lecture and discussion. World forest distribution and types; regional production and consumption of forest products; international trade in timber and related products; the role of forest resources in development; and special topics; tropical forestry, comparative forest policies and programs, forestry education, the problems of developing countries, international cooperation in forestry development, the role of the United States in world forestry, etc. Spring.

753. Resources Policy (3)
Three hours of lecture and seminar. Evaluation of basic environmental and resource issues and their evolvement in public and institutional policies. Exploration of alternative resource goals, policies, and program approaches and their implications. Analysis of processes for policy delineation and modification. Fall.

754. Advanced Forest Administration (3)
Critical appraisal of existing public, semipublic and private forestry agencies in the United States, and the comparative study of major administrative organizations and practices. Occasional inspection trips to forestry headquarters and field units and discussion of internal administrative problems with forest officers. Fall or Spring.
Prerequisite: FOR 360 or equivalent.

796. Special Topics in Resource Management and Policy (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.

797. Seminar (1)
Group discussion and individual conference concerning current topics, trends, and research in management. Fall and Spring.

798. Research Problems in Resources Management and Policy (1-12)
(Credit hours arranged according to nature of problem)
Special investigation and analysis of resources management problems where integrative relationships of several subject aspects of forestry are a major consideration. Fall, Spring, and Summer.

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.

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.

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.

SCE—SCHOOL OF CONTINUING EDUCATION

510. Creative Problem Solving Seminar (3)
Three hours of lecture and discussion. A course designed to extend the students' understanding and application of creative problem solving processes. One requirement will be to select and carry out an application of the techniques to a particular problem, with consultation and guidance from the instructor. Critique and survey of the literature on creativity, in-depth analysis of the synetics process and various procedures which have been developed for nurturing creative behavior comprise the essence of the program. Fall.
Prerequisite: Undergraduate degree or permission of the instructor.
Note: Also listed as EIN 510.

576. Special Topics Course: Environmental Education Processes and Strategies (1-3)
Lectures, discussions, field problems, and structured outdoor laboratory assignments in environmental education processes and strategies for professional educators in elementary and secondary schools who are part-time, nonmatriculated at ESF. Summer.
Prerequisite: Permission of the instructor. Not acceptable for credit in graduate programs of the School of Forestry.

596. Special Topics in Resource Management (1-3)
Lectures, field exercises, guided readings and discussions, in a short-course format. The study of recent developments and applications in resource management. Illustrative topics include management of forest stands, resource economics, land planning or recreation planning and site development. Not acceptable for credit in graduate programs of the School of Forestry. Summer.
Prerequisite: Permission of the instructor.

SIL—SILVICULTURE

520. Application of Ecology (3)
Two hours of lecture and discussion and one to three hours seminar, workshop, or field trip. Exploration of use and implications of ecological concepts for practices modifying terrestrial ecosystems for human benefit. Discussion of ecological writings in relation to applied problems; workshops, field trips and student presentations exploring ecological implications of specific situations. Course designed for interdisciplinary participation. Spring (even years).

535. Advanced Forest Soils (3)
Three hours of lecture-discussions 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 331, 332 or beginning courses in soils and silviculture.

540. Forest Hydrology (3)
Two hours of lecture and three hours of laboratory. The relation of forest and range vegetation to its environment, and its effect upon soil and water. Measurement of precipitation, runoff, erosion, and other variables. Fall and Spring.

542. Practice of Watershed Management (3)
Two hours of lecture and three hours of laboratory. The impact of the multiple use of forest and range lands on water yield and soil stability. Regional problems and potential solutions. Spring.
Prerequisite: SIL 540.

553. Energy Exchange at the Earth's Surface (3)
Two hours of lecture and three hours of laboratory. A comprehensive study of the physical processes taking place in the lowest layer of the atmosphere. Primary emphasis on the turbulent transfer of heat, momentum, and water vapor and the expression of these fluxes in the microclimate. Spring.
Prerequisites: FOR 452, physics, and calculus.

620. Silvicultural Concepts and Applications (3)
Six hours of lecture, study, or field work. Classroom instruction and exercises introduce topics important to silvicultural practice. Students explore these in depth through independent study and the solving of assigned problems. Field exercises will serve as a means to apply concepts, primarily in hardwood stands. Topics include concepts, techniques, diagnostic methods, and formulation and application of silvicultural prescriptions. Offered one day per week as a block of instruction. Spring.
Prerequisite: Previous undergraduate study of silviculture.

625. Productivity of Forest Stands (3)
In two hours of lecture and three hours of laboratory, whole tree, stand, and forest community productivity are studied from an eco-physiological viewpoint. Quantitative techniques and methods used to evaluate biological as well as economic forest production are learned and utilized. From the perspective established, new trends and developments in silvicultural practice are critically examined. Spring.
Prerequisite: Permission of the instructor.

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).
Prerequisites: FOR 446; background in physical and biological sciences recommended.

640. Advanced Wildland Hydrology (3)
Lecture, discussion, and laboratory sessions in advanced problems of forest and range hydrology, watershed management methods, and techniques and evaluation of new methods of hydrologic data collection and analysis. Fall.
Prerequisite: SIL 540 or FEG 340.

642. Snow Hydrology (3)
Three one-hour lectures and two three-day field trips. Physical characteristics of snow and the energy relations important in its accumulation and dissipation. Problems of measurement and prediction of runoff and melt. Potentials for management. Spring.
Prerequisite: SIL 540 or FEG 340.

677. Advanced Forest Tree Improvement (3)
Two hours of lecture and discussion and three hours of laboratory. A study of advanced principles and techniques for genetic improvement of forest trees. Special emphasis is placed on selection and breeding for growth rates, wood quality, and insect and disease resistance.

Problems of tree hybridization, racial variations, sexual reproduction, and quantitative genetics in forest trees. Laboratory training in cytology and cytogenetics, pollen germination, vegetative propagation and other problems. Independent research problems will be undertaken by the student. Fall.
Prerequisites: FBL 470 and 471, FOR 455.

730. Research Methods in Silviculture (3)
Three hours of lecture or discussion. Research concepts and methodology with particular application to silviculture and its related sciences. More appropriate to beginning students or before taking thesis work. Fall.
Prerequisite: Permission of the instructor.

735. Forest Soil Fertility (Applied Studies) (2-4)
Two hours of lecture and one hour of discussion. Up to six hours of laboratory depending on number of credit hours. Influence of soil fertility on development and growth of seedlings and trees, and techniques involved to determine this influence. Chemical and biological analysis to determine levels of soil fertility. Nutrient element deficiencies and their correction by soil amendments and fertilizers. Term projects by the student will be undertaken. Spring (even years).
Prerequisites: CHE 332 and 333, FBO 530, FOR 446 and SIL 635, or equivalent.

737. Forest Soil Physics (4)
Three hours of lecture and discussion and three hours of laboratory. Presentation of principles of soil physics including water flow, storage and availability, soil permeability, heat transfer, and their consideration as root environmental factors. Analytical procedures are introduced and evaluated. Applications of soil physics to silvics, soil fertility, watershed management and hydrology, soil biology and land-use. Spring.
Prerequisites: FOR 345, 446, or their equivalents. Physical chemistry and integral calculus strongly recommended.

796. Special Topics in Silviculture (1-3)
Lectures, seminars, and discussion. Advanced topics in silviculture. Check schedules of classes for details of subject matter. Fall and/or Spring.

797. Graduate Silviculture Seminar (1)
Three-hour class discussion. Assigned reports and discussion of silvicultural topics. Spring.

798. Research Problems in Silviculture (1-12)
(Credit hours arranged according to nature of problem)
Fall, Spring, and Summer.

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.

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.

WPE—WOOD PRODUCTS ENGINEERING

300. Properties of Wood for Designers (2)
Two hours of lecture. An introduction to the basic structure and properties of wood for the designer. Discussion of the effects of wood structure and properties on practical woodworking techniques. Fall.

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. Spring.

326. Fluid Treatments (2)
Two hours of lecture. An introduction to wood-moisture relationships, wood permeability and pressure treatments, thermal conductivity, water-vapor movement, and drying and fire retardancy. The flow of fluids, heat and water vapor are treated as analogous phenomena and are related to the cellular structure of wood. Unsteady-state flow of gases, heat and water vapor are introduced. Spring.

327. Fluid Treatments Laboratory (1)
Three hours of laboratory. Laboratory studies in relative humidity measurement, wood-moisture relationships, the relationship between permeability and treatability, wood-preservative treatments, wood drying and flame testing. Spring.
Prerequisite: WPE 326 (or concurrent).

343. Introduction to Structural Design (3)
Three hours of lecture. The concepts of structural design are introduced with fundamental strength of materials. There are practical applications of steel, timber, and concrete in contemporary structural designs. Systems such as trusses, arches, and frames are introduced. Spring.

361. 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.

386. Structure and Properties of Wood (3)
Two hours of lecture and three hours of laboratory. Structure of wood in relation to defects, properties and uses. The variability of wood. Identification of major U.S. timber by gross features. Spring.

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.
Prerequisite: FBO 300 or equivalent is recommended.

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.

389. Wood Identification Laboratory (1)
Three hours of laboratory. Identification of principal commercial timbers of United States on gross characteristics. Spring.
Prerequisite: WPE 387.

390. Fiber Identification Laboratory (1)
Three hours of laboratory. Identification of woody and nonwoody papermaking fibers. Spring.
Prerequisite: WPE 387.

399. Field Trip (2)
Two weeks supervised study and reporting of representative wood products industries. Required of all students in WPE. Estimated individual expenses are $200-$250 while on the trip. Spring.

400. Introduction to Forest Products (2)
Two hours of lecture. Characteristics of the products of the forest tree and manufacture of wood products. Spring.

404. Design of Wood Structural Elements (3)
Lectures. A development of the principles involved in designing structural elements in wood and practice in their application. Fall or Spring.

420. Adhesives, Sealants, and Coatings (3)
Two hours of lecture and three hours 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 when used with wood systems. Emphasis will be placed on knowing how to apply this knowledge to understand current practice and to solve problems that may occur. Laboratory demonstrations to identify materials, methods of application, and methods of evaluating these materials. Fall.
Prerequisite: Junior standing.

422. Composite Materials (3)
Two hours of lecture and three hours of laboratory. Manufacturing methods, physical and mechanical properties, and major uses of each of the following products will be examined—decorative plywood, construction and industrial plywood, particleboards, waferboards, fiberboards, laminated beams, laminated-veneer lumber, wood polymer composites, and paper overlays. 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.
Prerequisites: WPE 320. Concurrent or prior registration in ERE 362.

442. Light Construction (3)
Two hours of lecture and two hours of discussion. Elements of light frame construction, blueprint reading, and estimating. Fall.

444. Materials Marketing (3)
Three hours of lecture and discussion. Marketing functions, agencies and management in the wood products and related industries. Principles of salesmanship and their application. Spring.

450. Construction Equipment (3)
Three hours of lecture. Principles of selection, operation, and maintenance of construction equipment. Primary types of site preparation, handling and assembly devices and their efficient utilization will be examined. Spring.
Prerequisite: Senior standing.

454. Construction Management (3)
Three hours of lecture. Fundamental concepts of construction management activities. Topics include construction contracts, scheduling, project planning, estimating and bidding. Fall.
Prerequisite: OPM 365 or permission of the instructor.

497. Senior Seminar for Wood Products Engineering Majors (2)
Discussion and assigned reports in current problems and new developments in Wood Products Engineering. Spring.

498. Research or Design Problem (1-3)
Conferences, library, laboratory and/or field research on a specific problem in Wood Products Engineering. Typewritten report (original and one copy) required. Fall, Spring, and Summer.
Prerequisite: Permission of the instructor and advisor.

State University of New York

STATE UNIVERSITY OF NEW YORK

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Secretary of the University ..... MARTHA J. DOWNEY, B.S., M.A.

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

When founded in 1948, the University consolidated 29 State-operated, but unaffiliated, institutions. In response to need, the University has grown to a point where its impact is felt educationally, culturally, and economically the length and breadth of the state.

More than 381,000 students are pursuing traditional study in classrooms or are working at home, at their own pace, through such innovative institutions as Empire State College, whose students follow individualized and often nontraditional paths to a degree. Of the total enrollment, more than 100,000 students are 24 years or older, reflecting State University's services to specific constituencies, such as refresher courses for the professional community, continuing educational opportunities for returning service personnel, and personal enrichment for the more mature persons.

State University's research contributions are helping to solve some of modern society's most urgent problems. It was a State University scientist who first warned the world of potentially harmful mercury deposits in canned fish, and another who made the connection between automobile and industrial smoke combining to cause changes in weather patterns. Other University researchers continue important studies in such wide-ranging areas as immunology, marine biology, sickle-cell anemia, and organ transplantation.

More than 1,000 Public Service activities are currently being pursued on State University campuses. Examples of these efforts include: special training courses for local government personnel, State civil service personnel, and the unemployed; participation by campus personnel in joint community planning or project work, and campus-community arrangements for community use of campus facilities.

A distinguished faculty includes nationally and internationally recognized figures in all the major disciplines. Their efforts are recognized each year in the form of such prestigious awards as Fulbright-Hayes, Guggenheim, and Danforth Fellowships.

The University offers a wide diversity of what are considered the more conventional career fields, such as engineering, medicine, literature, dairy farming, medical technology, accounting, social work, forestry, and automotive technology. Additionally, its responsiveness to progress in all areas of learning and to tomorrow's developing societal needs has resulted in concentrations which include pollution, urban studies, computer science, immunology, preservation of national resources, and microbiology.

SUNY programs for the educationally and economically disadvantaged have become models for delivering better learning opportunities to a once-forgotten segment of society. Educational Opportunity Centers offer high school equivalency and college preparatory courses to provide young people and adults with the opportunity to begin college or to learn marketable skills. In addition, campus based Educational Opportunity Programs provide counseling, developmental education and financial aid to disadvantaged students in traditional degree programs.

Overall, at its EOC's, two-year colleges, four-year campuses and university and medical centers, the University offers 3,600 academic programs. Degree opportunities range from two-year associate programs to doctoral studies offered at 12 senior campuses.

The 30 two-year community colleges operating under the program of State University play a unique role in the expansion of educational opportunity, by:

Providing local industry with trained technicians in a wide variety of occupational curricula;

Providing transfer options to students who wish to go on and earn advanced degrees, and;

Providing the community with yet another source for technical and professional upgrading as well as personal enrichment.

During its brief history, State University has graduated more than 930,000 alumni, the majority of whom are pursuing their careers in communities across the state.

State University is governed by a Board of Trustees, appointed by the Governor, which directly determines the policies to be followed by the 34 State-supported campuses. Community colleges have their own local boards of trustees whose relationship to the SUNY board is defined by law. The State contributes one-third to 40 percent of their operating cost and one-half of their capital costs.

The State University motto is: "To Learn—To Search—To Serve."

STATE UNIVERSITY OF NEW YORK

UNIVERSITY CENTERS

State University of New York at Albany
State University of New York at Binghamton
State University of New York at Buffalo
State University of New York at Stony Brook

COLLEGES OF ARTS AND SCIENCES

Empire State College
State University College at Brockport
State University College at Buffalo
State University College at Cortland
State University College at Fredonia
State University College at Geneseo
State University College at New Paltz
State University College at Old Westbury
State University College at Oneonta
State University College at Oswego
State University College at Plattsburgh
State University College at Potsdam
State University College at Purchase

COLLEGES AND CENTERS FOR THE HEALTH SCIENCES

Downstate Medical Center at Brooklyn
Upstate Medical Center at Syracuse
College of Optometry at New York City
Health Sciences Center at Buffalo University Center*
Health Sciences Center at Stony Brook University Center*

AGRICULTURAL AND TECHNICAL COLLEGES

Agricultural and Technical College at Alfred
Agricultural and Technical College at Canton
Agricultural and Technical College at Cobleskill
Agricultural and Technical College at Delhi
Agricultural and Technical College at Farmingdale
Agricultural and Technical College at Morrisville

SPECIALIZED COLLEGES

College of Environmental Science and Forestry at Syracuse
Maritime College at Fort Schuyler
College of Technology at Utica/Rome
Fashion Institute of Technology at New York City**

STATUTORY COLLEGES***

College of Agriculture and Life Sciences at Cornell University
College of Ceramics at Alfred University
College of Human Ecology at Cornell University
School of Industrial and Labor Relations at Cornell University
College of Veterinary Medicine at Cornell University

COMMUNITY COLLEGES

(Locally-sponsored, two-year colleges under the program of State University)

Adirondack Community College at Glens Falls
Broome Community College at Binghamton
Cayuga County Community College at Auburn
Clinton Community College at Plattsburgh
Columbia-Greene Community College at Hudson
Community College of the Finger Lakes at Canandaigua
Corning Community College at Corning
Dutchess Community College at Poughkeepsie
Erie Community College at Williamsville, Buffalo and Orchard Park
Fulton-Montgomery Community College at Johnstown
Genesee Community College at Batavia
Herkimer County Community College at Herkimer
Hudson Valley Community College at Troy
Jamestown Community College at Jamestown
Jefferson Community College at Watertown
Mohawk Valley Community College at Utica
Monroe Community College at Rochester
Nassau Community College at Garden City
Niagara County Community College at Sanborn
North Country Community College at Saranac Lake
Onondaga Community College at Syracuse
Orange County Community College at Middletown
Rockland Community College at Suffern
Schenectady County Community College at Schenectady
Suffolk County Community College at Selden, Riverhead and Brentwood
Sullivan County Community College at Loch Sheldrake
Tompkins Cortland Community College at Dryden
Ulster County Community College at Stone Ridge
Westchester Community College at Valhalla

*The Health Sciences Centers at Buffalo and Stony Brook are operated under the administration of their respective University Centers.

**While authorized to offer such baccalaureate and master's degree programs as may be approved pursuant to the provisions of the Master Plan, in addition to the associate degree, the Fashion Institute of Technology is financed and administered in the manner provided for community colleges.

***These operate as "contract colleges" on the campuses of independent universities.

College of Environmental Science and Forestry

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Director of Public Safety ..... BRIAN M. SPEER
Director of Analytical and Technical Services ..... ROWENA V. KATHER
Director of Administrative Data Processing and Institutional Research ..... SHEILA M. CROWLEY
Director of Forest Properties ..... RICHARD A. SCHWAB
Dean, School of Biology, Chemistry and Ecology ..... STUART W. TANENBAUM
Dean, School of Continuing Education and Assistant Vice President for International Programs . VACANT
Dean, School of Environmental and Resource Engineering ..... WILLIAM P. TULLY
Dean, School of Forestry ..... JOHN V. BERGLUND
Director, Forest Technician Program ..... WESLEY E. SUHR
Acting Dean, School of Landscape Architecture ..... RALPH A. SANDERS
Director, Graduate Program in Environmental Science ..... MOHAN K. WALI
Director, Adirondack Ecological Center .. WILLIAM F. PORTER
Director, Empire State Paper Research Institute ..... BENGT LEOPOLD
Acting Director, Polymer Research Institute . ISRAEL CABASSO
Director, Ultrastructure Studies Center WILFRED A. CÔTÉ, JR.
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Director, Cellulose Research Institute ..... TORE E. TIMELL
Project Leader, U.S. Forest Service Cooperative Research Unit ..... ROWAN A. ROWNTREE
Director, Renewable Materials Institute WILFRED A. CÔTÉ, JR.

COLLEGE FACULTY AND PROFESSIONAL STAFF

DISTINGUISHED TEACHING PROFESSOR

EDWIN H. KETCHLEDGE, *Distinguished Teaching Professor*, Department of Environmental and Forest Biology

THEODORE J. STENUF, *Distinguished Teaching Professor*, Department of Paper Science and Engineering

DISTINGUISHED ADJUNCT PROFESSOR

HARRY L. FRISCH, *Distinguished Adjunct Professor*, Department of Chemistry

DISTINGUISHED PROFESSOR EMERITUS

CONRAD SCHUERCH, *Distinguished Professor Emeritus*, Department of Chemistry

MICHAEL M. SZWARC, *Distinguished Professor Emeritus*, Polymer Research Institute

This listing represents an official record of the State University of New York College of Environmental Science and Forestry faculty and professional staff for 1984. It is designed for use in 1984-85.

The date in parentheses after each name denotes the first year of service, two or more dates, the term of service.

LAWRENCE P. ABRAHAMSON (1977), *Senior Research Associate*, School of Forestry and Department of Environmental and Forest Biology; B.S., Michigan Technological University, 1964; M.S., University of Wisconsin, 1967; Ph.D., 1969

JUDD H. ALEXANDER (1979), *Adjunct Professor*, Graduate Program in Environmental Science; B.A., Carleton College, 1949; P.M.D., Harvard Business School, 1967

DOUGLAS C. ALLEN (1968), *Professor*, Department of Environmental and Forest Biology; B.S., University of Maine, 1962; M.S., 1965; Ph.D., University of Michigan, 1968

WAYNE ALLEN (1979), *Technical Assistant*, Forest Technician Program of the School of Forestry

IRA H. AMES (1972), *Adjunct Professor*, Department of Environmental and Forest Biology; B.A., Brooklyn College, 1959; M.S., New York University, 1962; Ph.D., 1966

DAVID G. ANDERSON (1959), *Vice President for Administration and Services; Professor*; A.A.S., State University of New York College of Forestry (Ranger School), 1950; B.S., State University of New York College of Forestry, 1953; M.S., University of Utah, 1958; M.P.A., Syracuse University, 1974

ROBERT E. ANTHONY (1953), *Technical Specialist*, Department of Environmental and Forest Biology; A.A.S., State University of New York Agricultural and Technical College at Morrisville, 1952

RAYMOND J. APPLEBY (1982), *Technical Assistant*, Department of Paper Science and Engineering; A.S., State University of New York Columbia-Greene, 1980

ROBERT W. ARSENEAU (1972), *Programmer/Analyst*, Administrative Data Processing; A.A.S., Mohawk Valley Community College, 1967; B.S., Syracuse University, 1978

CAROLINE B. BAILEY (1978), *Technical Assistant*, School of Landscape Architecture

JAMES P. BAMBACHT (1967), *Professor*, Department of Paper Science and Engineering; A.B., Kalamazoo College, 1954; M.S., The Institute of Paper Chemistry, 1956; Ph.D., State University of New York College of Environmental Science and Forestry, 1973

C. ELLISON BECK (1970), *Technical Specialist*, Analytical and Technical Services, Office of the Vice President for Administration and Services

DONALD F. BEHREND (1960-67) (1968), *Vice President for Program Affairs; Professor*, Department of Environmental and Forest Biology; Graduate Program in Environmental Science; B.S., University of Connecticut, 1958; M.S., 1960; Ph.D., State University of New York College of Forestry, 1966

JOHN D. BENNETT (1960), *Associate Professor*, School of Forestry; B.A., Ohio Wesleyan University, 1954; Ph.D., Syracuse University, 1968; *Chancellor's Award for Excellence in Teaching* (1973)

CAMILLO A. BENZO (1975), *Adjunct Associate Professor*, Department of Environmental and Forest Biology; B.A., Utica College of Syracuse University, 1964; Ph.D., University of Pennsylvania, 1969

JOHN V. BERGLUND (1965), *Dean and Professor*, School of Forestry; B.S., Pennsylvania State University, 1962; M.S., 1964; Ph.D., State University of New York College of Forestry, 1968

DONALD H. BICKELHAUPT (1969), *Research Assistant*, School of Forestry; B.S., State University of New York College of Forestry, 1970; M.S., State University of New York College of Environmental Science and Forestry, 1980

ARTHUR J. BILCO (1983), *Assistant Director of Physical Plant*, Office of the Vice President for Administration and Services

PETER E. BLACK (1965), *Professor*, School of Forestry; Graduate Program in Environmental Science; B.S., University of Michigan, 1956; M.F., 1958; Ph.D., Colorado State University, 1961; *Executive Chairman of the Faculty* (1974-78)

RAYMOND W. BLASKIEWICZ (1982), *Assistant Registrar*, Registrar's Office; B.S., State University of New York College of Environmental Science and Forestry, 1979

CONSTANCE H. BOBBIE (1982), *Associate Librarian*, F. Franklin Moon Library; B.S., Bemidji State College, 1956; M.A., University of Minnesota, 1962

WILLIAM R. BORGSTEDE (1971), *Technical Assistant*, Department of Environmental and Forest Biology; A.A.S., Miner Institute, 1966; A.A.S., State University of New York College at Delhi, 1970; B.S., State University of New York College of Environmental Science and Forestry, 1975; M.S., Syracuse University, 1978

CARL F. BRAENDLE (1976), *Assistant Director of Campus Public Safety*, Office of the Vice President for Administration and Services

STEPHEN B. BRANDT (1983), *Research Associate Professor*, Department of Environmental and Forest Biology; Graduate Program in Environmental Science; B.A., University of Wisconsin, 1972; M.S., 1975; Ph.D., 1978

BRUCE W. BREITMEYER (1983), *Forest Property Manager*, Newcomb Campus; B.S.F., University of Michigan, 1975; M.F., 1982

JEROME BREZNER (1961), *Professor, Curriculum Director*, Department of Environmental and Forest Biology; A.B., University of Rochester, 1952; A.M., University of Missouri, 1956; Ph.D., 1959; Postdoctoral, Dartmouth Medical School, 1960; Executive Chairman of the Faculty, (1974-76)

MARION A. BRISK (1984), *Visiting Assistant Professor*, Chemistry Department; B.A., Queens College, 1970; M.A., 1972; Ph.D., City University of New York, 1975

KENNETH W. BRITT (1971), *Senior Research Associate*, Department of Paper Science and Engineering; B.Chem., Cornell University, 1929

ROBERT H. BROCK, JR. (1967), *Chairman and Professor*, Department of Forest Engineering; B.S., State University of New York College of Forestry, 1958; M.S., 1959; Ph.D., Cornell University, 1971

RAINER H. BROCKE (1969), *Senior Research Associate*, Department of Environmental and Forest Biology; Graduate Program in Environmental Science; *Director*, Cranberry Lake Biological Station; B.S., Michigan State University, 1955; M.S., 1957; Ph.D., 1970

DAVID F. BRODOWSKI (1977), *Technical Specialist*, Department of Environmental and Forest Biology; B.S., Cornell University, 1975

ALTON F. BROWN (1963), *Technical Specialist*, Empire State Paper Research Institute

THOMAS E. BROWN (1977), *Adjunct Assistant Professor*, Department of Environmental and Forest Biology; B.S., Niagara University, 1957; M.S., State University of New York College of Forestry, 1968

PATRICIA BURAK (1983), *Adjunct Associate Foreign Student Counselor*, Office of Student Affairs; B.A., State University of New York College at Oswego, 1973, M.A., State University of New York College at Albany, 1974

ROBERT L. BURGESS (1981), *Chairman* and *Professor*, Department of Environmental and Forest Biology; Graduate Program in Environmental Science; B.S., University of Wisconsin (Milwaukee), 1957; M.S., University of Wisconsin (Madison), 1959; Ph.D., 1961

KENNETH F. BURNS (1970), *Technical Assistant*, School of Forestry; A.A.S., Paul Smith's College, 1969

HARRY W. BURRY (1962), *Senior Research Associate and Extension Coordinator*; *Associate Professor*, School of Forestry; B.S., New York State College of Forestry, 1941; M.F., State University of New York College of Forestry, 1964

ISRAEL CABASSO (1981), *Professor*, Department of Chemistry; *Acting Director*, Polymer Research Institute; B.S., Hebrew University, 1966; M.S., 1968; Ph.D. Weizmann Institute of Science, 1973

PAUL M. CALUWE (1969), *Associate Professor*, Department of Chemistry; *Associate Member*, Polymer Research Institute; Ph.D., University of Leuven, Belgium, 1967

WILBUR H. CAMPBELL (1975), *Associate Professor*, Department of Chemistry; A.A., Santa Ana College, 1965; B.A., Pomona College, 1967; Ph.D., University of Wisconsin, 1972

HUGH O. CANHAM (1966), *Associate Professor*, School of Forestry; B.S., State University of New York College of Forestry, 1960; M.S., 1962; Ph.D., 1971

COSTAS A. CASSIOS (1978), *Adjunct Professor*, School of Landscape Architecture; B.S., University of Thessaloniki, 1965; M.S., Graduate Industrial School, 1969; M.S., University of Wisconsin, 1972; Ph.D., 1976

JOHN D. CASTELLO (1978), *Assistant Professor*, Department of Environmental and Forest Biology; B.A., Montclair State College, 1973; M.S., Washington State University, 1976; Ph.D., University of Wisconsin, 1978

THOMAS M. CATTERSON (1982), *Senior Research Associate*, Office of Research Programs; B.S., State University of New York College of Forestry, 1967; M.S., State University of New York College of Environmental Science and Forestry, 1973

ROBERT E. CHAMBERS (1967), *Professor*, Department of Environmental and Forest Biology; Graduate Program in Environmental Science; B.S., Pennsylvania State University, 1954; M.S., 1956; Ph.D., Ohio State University, 1972

ROLLA W. COCHRAN (1964), *Assistant to the President for Community Relations*, Office of the President; *Associate Professor, Coordinator of Demonstration and Information*, Institute of Environmental Affairs; B.A., Denison University, 1949; M.S., Ohio State University, 1951

JOHN C. COFFEY (1982), *Assistant Director of Physical Plant for Facilities*, Maintenance and Operations; B.S., Rensselaer Polytechnic Institute, 1971; B. Architecture, 1972; M.R.P., Syracuse University, 1977; Registered Architect, New York State

ETHEL M. COMP (1978), *Personnel Associate*, Office of the Vice President for Administration and Services

HARRY J. CORR (1967), *Director of Business and Fiscal Affairs*, Office of the Vice President for Administration and Services; B.S. Siena College, 1957

WILFRED A. CÔTÉ, JR. (1950), *Professor*, Department of Wood Products Engineering; *Director*, Renewable Materials Institute and N.C. Brown Center for Ultrastructure Studies; B.S., University of Maine, 1949; M.F., Duke University, 1950; Ph.D., State University of New York College of Forestry, 1958; *Executive Chairman of the Faculty* (1970-72)

JAMES E. COUFAL (1965), *Professor and Curriculum Coordinator*, School of Forestry; Certificate, State University of New York College of Forestry (Ranger School), 1957; B.S., State University of New York College of Forestry, 1960; M.S., 1962; Ed.S., State University of New York at Albany, 1976

PHILLIP J. CRAUL (1968), *Professor*, School of Forestry; B.S.F., Pennsylvania State University, 1954; M.S., 1960; Ph.D., 1964

JAMES O. CREVELLING (1970), *Forest Property Manager*, Southern Properties, Wanakena and Cranberry Campuses; A.A.S., Paul Smith's College, 1965; B.S., University of Massachusetts, 1967

CLAY M. CROSBY (1964), *Research Assistant*, Empire State Paper Research Institute; B.S., State University of New York College of Forestry, 1964; M.S., 1970

SHEILA M. CROWLEY (1977), *Director, Administrative Data Processing and Institutional Research*, Office of the Vice President for Administration and Services; A.B., Albertus Magnus College, 1967; M.S., Syracuse University, 1979

JUSTIN F. CULKOWSKI (1978), *Director of Alumni Affairs*, B.S., State University of New York College of Environmental Science and Forestry, 1973; M.B.A., Syracuse University, 1983

TIBERIUS CUNIA (1968), *Professor*, School of Forestry; Forest Engineer, Ecole Nat. des Eaux et Forets, 1951; M.S., McGill University, 1957

GEORGE W. CURRY (1966), *Professor* and *Director of B.L.A. Program*, School of Landscape Architecture; B.A., Michigan State University, 1962; B.S., 1965; M.L.A., University of Illinois, 1969

MIROSLAW M. CZAPOWSKYJ (1979), *Adjunct Professor*, School of Forestry; Diplomforstwirt, Ludwig-Maximiliams University, Munich, 1949; M.S., University of Maine, 1958; Ph.D., Rutgers University, 1962

ANDREA CZERKIES (1981), *Technical Assistant*, Department of Paper Science and Engineering; B.S., State University of New York College of Environmental Science and Forestry, 1981

BENJAMIN V. DALL (1975), *Professor*, School of Forestry; Graduate Program in Environmental Science; B.S., Yale University, 1955; M.F., 1956; J.D., University of Virginia, 1959; Ph.D., Pennsylvania State University, 1972

ROBERT W. DAVIDSON (1957), *Professor*, Department of Wood Products Engineering; B.S., Montana State University, 1948; M.S., State University of New York College of Forestry, 1956; Ph.D., 1960

ARNOLD C. DAY (1947), *Technical Specialist*, N.C. Brown Center for Ultrastructure Studies

TIMOTHY R. DAY (1981), *Assistant Professor*, School of Landscape Architecture; B.S.L.A., California Polytechnic State University, 1976; M.L.A., Harvard Graduate School of Design, 1980

LOUIS D. DE GENNARO (1980), *Adjunct Professor*, Department of Environmental and Forest Biology; B.S., Fordham University, 1948; M.S., Boston College, 1950; Ph.D., Syracuse University, 1959

SALVACION DE LA PAZ (1973), *Associate Librarian*, F. Franklin Moon Library; B.S.L.S., University of the Philippines, 1956; M.S.L.S., Simmons College, 1962

CARLTON W. DENCE (1951), *Professor*, Empire State Paper Research Institute; B.S., Syracuse University, 1947; M.S., State University of New York College of Forestry, 1949; Ph.D., 1959

ARTHUR G. DILLON (1976), *Technical Specialist*, Department of Paper Science and Engineering; B.S., State University of New York College of Environmental Science and Forestry, 1974; M.S., 1983

DANIEL L. DINDAL (1966), *Professor*, Department of Environmental and Forest Biology; Graduate Program in Environmental Science; B.S. Ed. and B.S. Agri., Ohio State University, 1958; M.A., 1961; Ph.D., 1967; *Chancellor's Award for Excellence in Teaching* (1974)

BARBARA DI PIAZZA (1983), *Counselor*, Office of Student Affairs; B.A., Hamilton and Kirkland Colleges, 1976; M.S., Syracuse University, 1981

JULIA O. DOMINGUE (1980), *Technical Specialist*, Department of Forest Engineering; B.A., University of Illinois, 1975; M.S., 1979

ALLAN P. DREW (1980), *Assistant Professor*, School of Forestry; B.S., University of Illinois, 1965; M.S., University of Arizona, 1967; Ph.D., Oregon State University, 1974

MICHAEL J. DUGGIN (1979), *Professor*, Department of Forest Engineering; B.Sc., Melbourne University, 1959; Ph.D., Monash University, 1965

PATRICK R. DURKIN (1980), *Adjunct Assistant Professor*, Graduate Program in Environmental Science; B.S., State University of New York College at Fredonia, 1968; M.S., Fordham University, 1972; Ph.D., State University of New York College of Environmental Science and Forestry, 1979

ANDREW L. EGGERS (1967), *Technical Specialist*, Educational Communications Section, Office of the Vice President for Administration and Services

WILLIAM P. EHLING (1983), *Adjunct Professor*, Graduate Program in Environmental Science; B.A., Syracuse University, 1943; M.A., 1952; Ph.D., 1954

ELIZABETH A. ELKINS (1973), *Associate Librarian*, F. Franklin Moon Library; B.A., Hartwick College, 1968; M.L.S., State University of New York at Geneseo, 1970; *Chancellor's Award for Excellence in Librarianship* (1980)

DONALD P. ELY (1980), *Adjunct Professor*, Graduate Program in Environmental Science; B.A., State University College for Teachers, Albany, 1951; M.A., Syracuse University, 1953; Ph.D., 1961

ARTHUR R. ESCHNER (1961), *Professor*, School of Forestry; Graduate Program in Environmental Science; B.S., State University of New York College of Forestry, 1950; M.S., Iowa State College, 1952; Ph.D., State University of New York College of Forestry, 1965

AMINUR EUSUFZAI (1977), *Research Assistant*, Empire State Paper Research Institute; B.Sc. (Hons.), Dacca University, 1957; M.Sc., 1960; B.Sc. (Hons.) Forestry, Peshawar University, 1962; M.S., West Virginia University, 1969; M.S., State University of New York College of Environmental Science and Forestry, 1982

MILDRED FAUST (1976), *Adjunct Professor*, School of Biology, Chemistry and Ecology; A.B., Penn College, 1921; M.S., University of Chicago, 1923; Ph.D., 1933

JOHN P. FELLEMAN (1973), *Professor*, School of Landscape Architecture; Graduate Program in Environmental Science; B.C.E., Cornell University, 1966; M.E.C., 1966; N.D.E.A. Fellow, University of North Carolina, 1967; D.P.A., New York University, 1973

JOHN S. FISHLOCK (1965), *Technical Assistant*, Department of Environmental and Forest Biology; A.A.S., State University of New York College of Forestry (Ranger School), 1975

CLAUDE C. FREEMAN (1959), *Associate Professor*, School of Landscape Architecture; B.S., State University of New York College of Forestry, 1959

ROBERT H. FREY (1977), *Assistant Vice President for Academic Programs, Associate Professor*, Graduate Program in Environmental Science; B.A., Valparaiso University, 1965; M.Ed., Springfield College, 1966; Ed.D., Indiana University, 1973

ROBERT L. FRIEDMAN (1967), *Director of Admissions*, Office of the Vice President for Program Affairs; A.B., Syracuse University, 1952; M.A., 1954

HARRY L. FRISCH (1980), *Adjunct Distinguished Professor*, Department of Chemistry; Associate Member, Polymer Research Institute; A.B., Williams College, 1947; Ph.D., Polytechnic Institute of Brooklyn, 1952

DOUGLAS H. FROST (1982), *Assistant Director of Business Affairs*, Office of the Vice President for Administration and Services; A.A., College of San Mateo, 1962; B.S., Wagner College, 1967

TAMMY J. FULLER (1982), *Senior Programmer/Analyst*, Administrative Data Processing; A.O.S., Powelson Business Institute, 1981

JOHN E. GANNON (1980), *Adjunct Associate Professor*, Department of Environmental and Forest Biology; B.S., Wayne State University, 1965; M.S., University of Michigan, 1967; Ph.D., University of Wisconsin, 1972

JAMES W. GEIS (1968), *Assistant Vice President for Research Programs, Executive Director of the Institute of Environmental Program Affairs, Professor*, Department of Environmental and Forest Biology; Graduate Program in Environmental Science, B.S.F., University of Illinois, 1965; M.S., 1967; Ph.D., State University of New York College of Environmental Science and Forestry, 1972

RONALD J. GIEGERICH (1977), *Technical Assistant*, Department of Environmental and Forest Biology; A.A.S., State University of New York Agricultural and Technical College at Cobleskill, 1976; B.S., State University of New York College of Environmental Science and Forestry, 1978

MICHAEL GOODEN (1983), *Technical Assistant*, Newcomb Campus; A.A.S., State University of New York Agricultural and Technical College at Morrisville, 1976; B.S., State University of New York College of Environmental Science and Forestry, 1978

SERGE N. GORBATSEVICH (1956), *Associate Professor*, Department of Paper Science and Engineering; B.S., State University of New York College of Forestry, 1954; M.S., 1955

W. DOUGLAS GOULD (1983), *Adjunct Assistant Professor*, Department of Environmental and Forest Biology; B.S., University of Manitoba, 1965; M.S., University of Alberta, 1970; Ph.D., 1976

RICHARD H. GRANT (1983), *Research Assistant*, School of Forestry; B.S., Duke University, 1974; M.F.S., Yale University, 1977; Ph.D., State University of New York College of Environmental Science and Forestry, 1982

STEPHEN GRANZOW (1969), *Technical Specialist*, Empire State Paper Research Institute

MIKLOS A. J. GRATZER (1973), *Professor*, School of Forestry; Graduate Program in Environmental Science; Forest Engineer, Sopron University, 1956; B.Sc., University of British Columbia, 1959; M.S. (R.C.), University of Montana, 1965; Ph.D., 1971

PAUL F. GRAVES (1947), *Professor*, School of Forestry; Graduate Program in Environmental Science; B.S., New York State College of Forestry, 1939; M.F., 1941; Ph.D., Syracuse University, 1949

CHARLES GREEN, JR. (1979), *Adjunct Professor*, Department of Paper Science and Engineering; B.S., University of Iowa, 1956

DAVID H. GRIFFIN (1968), *Professor*, Department of Environmental and Forest Biology; B.S., State University of New York College of Forestry, 1959; M.A., University of California, 1960; Ph.D., 1963

JAMES P. HALLIGAN (1979), *Technical Assistant*, School of Forestry; B.S., State University of New York College of Environmental Science and Forestry, 1974

JUDITH C. HAMILTON (1979), *Financial Aid Advisor*, Financial Aid Office; B.S., State University College at Brockport, 1967; M.S., State University of New York at Albany, 1968

ROBERT B. HANNA (1977), *Assistant Director*, N.C. Brown Center for Ultrastructure Studies; *Associate Professor*, Department of Wood Products Engineering; B.S., University of Michigan, 1967; M.S., State University of New York College of Forestry, 1971; Ph.D., State University of New York College of Environmental Science and Forestry, 1973

DAVID L. HANSELMAN (1963), *Professor* and *Director of B.S./E.S. Program*, School of Landscape Architecture; Graduate Program in Environmental Science; B.S., Cornell University, 1957; M.S., 1958; Ph.D., Ohio State University, 1963

ROY C. HARTENSTEIN (1959-65) (1967), *Professor*, Department of Environmental and Forest Biology; Graduate Program in Environmental Science; B.S., State Teachers College at Buffalo, 1953; M.S., Syracuse University, 1957; Ph.D., State University of New York College of Forestry, 1959

JAMES M. HASSETT (1981), *Assistant Professor*, Department of Forest Engineering; Graduate Program in Environmental Science; A.B., Cornell University, 1970; M.S., Syracuse University, 1979

JOHN P. HASSETT (1980), *Research Associate*, Chemistry Department; Graduate Program in Environmental Science; B.S., University of Maryland, 1971; M.S., University of Wisconsin, 1973; Ph.D., 1978

RICHARD S. HAWKS (1979), *Associate Professor*, School of Landscape Architecture; Graduate Program in Environmental Science; B.L.A., State University of New York College of Environmental Science and Forestry, 1972; M.L.A., Harvard University, 1978

GORDON M. HEISLER (1973), *Adjunct Associate Professor*, School of Forestry; B.S., Pennsylvania State University, 1961; M.F., Yale University, 1962; Ph.D., State University of New York College of Forestry, 1970

ROBERT D. HENNIGAN (1967), *Professor*, Department of Forest Engineering; Graduate Program in Environmental Science; B.C.E., Manhattan College, 1949; M.A., Syracuse University, 1964, P.E., New York State

LEE P. HERRINGTON (1965), *Professor and Coordinator*, Research and Graduate Studies, School of Forestry; Graduate Program in Environmental Science; B.S., University of Maine, 1959; M.F., Yale School of Forestry, 1960; Ph.D., Yale University, 1964

ROBERT A. HOLM (1982), *Associate Professor*, Department of Paper Science and Engineering; B.S., University of Illinois, 1958; M.S., University of Delaware, 1961; Ph.D., 1962

BERNARD T. HOLTMAN (1968), *TV/Motion Picture Producer-Director, Director*, Educational Communications Section, Office of the Vice President for Administration and Services; B.A., Siena College, 1950; M.S., Syracuse University, 1972

MARY O'BRIEN HOOVEN (1980), *Food Service Supervisor*, Wanakena and Cranberry Lake Campuses, B.A., State University of New York at Buffalo, 1972

PAUL F. HOPKINS (1979), *Assistant Professor*, Forest Engineering; B.S., University of Maine, 1977; M.S., State University of New York College of Environmental Science and Forestry, 1979

ALLEN F. HORN, JR. (1957), *Professor*, School of Forestry; B.S., Michigan State University, 1950; M.S., 1951; Ph.D., State University of New York College of Forestry, 1957; L.L.B., Syracuse University, 1967

STEPHEN B. HORSLEY (1979), *Adjunct Associate Professor*, School of Forestry, B.S., Pennsylvania State University, 1965; M.S., University of Massachusetts, 1968; Ph.D., 1970

JOEL R. HOWARD (1974), *Visiting Instructor*, School of Forestry; B.S., State University of New York College of Environmental Science and Forestry, 1973; M.S., 1978; Ph.D., North Carolina State University, 1984

JOHN J. HOWARD (1978), *Adjunct Associate Professor*, Department of Environmental and Forest Biology; B.A., University of New Hampshire, 1966; M.P.H., Yale University, 1970, Dr. P.H., 1973

JEFFREY J. JAHNKE (1982), *Assistant Professor*, Forest Technician Program of the School of Forestry; B.S., Michigan Technological University, 1970; M.S., Washington State University, 1981

ROBERT V. JELINEK (1972), *Professor*, Department of Paper Science and Engineering; B.S., Columbia University, 1945; M.S., 1947; Ph.D., 1953

HAZEL S. JENNISON (1965), *Research Associate*, Analytical and Technical Services, Office of the Vice President for Administration and Services; B.S., Western Kentucky State University, 1941; M.S., Syracuse University, 1966

DAVID L. JOHNSON (1975), *Associate Professor*, Department of Chemistry; Graduate Program in Environmental Science; B.S., Antioch College, 1965; Ph.D., University of Rhode Island, 1973

DIANNE M. JUCHIMEK (1967), *Associate Librarian*, F. Franklin Moon Library; B.S., University of Illinois, 1965; M.S.L.S., Syracuse University, 1967

RONALD R. KARNS (1965), *Editorial Associate*, Office of Publications; B.S., Ohio State University, 1954

JAMES P. KARP (1983), *Adjunct Professor*, Graduate Program in Environmental Science; B.S., Penn State University, 1960; J.D., Villanova University, 1964

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DU-WEI XIA (1983), *Visiting Research Assistant*, Department of Chemistry; B.A., Chengdu University of Science and Technology, 1981

HARRY W. YAWNEY (1981), *Adjunct Professor*, School of Forestry; B.S., Pennsylvania State University, 1955; M.S., 1957; Ph.D., State University of New York College of Environmental Science and Forestry, 1979

ROBERT A. ZABEL (1947), *Professor*, Department of Environmental and Forest Biology; B.S., University of Minnesota, 1938; M.S., New York State College of Forestry, 1941; Ph.D., State University of New York College of Forestry, 1948

ROBERT M. ZABLOTOWICZ (1982), *Adjunct Assistant Professor*, Department of Environmental and Forest Biology; B.S., California Polytechnic State University, 1975; Ph.D., University of California, Riverside, 1978

EMERITUS

MAURICE M. ALEXANDER (1949-1983), *Professor Emeritus*; B.S., New York State College of Forestry, 1940; M.S., University of Connecticut, 1942; Ph.D., State University of New York College of Forestry, 1950

GEORGE R. ARMSTRONG (1950-1981), *Professor Emeritus*; B.S., State University of New York College of Forestry, 1949; M.S., 1959, Ph.D., 1965

LAWRENCE J. BELANGER (1947-1965), *Registrar Emeritus*; *Professor Emeritus*; B.S., Syracuse University, 1932; M.S., New York State College for Teachers, Albany, 1941

FLOYD E. CARLSON (1930-1969), *Professor Emeritus*; B.S.F., University of Washington, 1928; M.F., 1930

RHONDDA K. CASSETTA (1973-1981), *Associate for Institutional Research Emeritus*; A.B., Elmira College, 1933

DANIEL M. CASTAGNOZZI (1956-1977), *Professor and Director Emeritus*; A.A.S., State University of New York College of Forestry (Ranger School), 1950; B.S.F., University of Michigan, 1952; M.F., State University of New York College of Forestry, 1957

JAMES E. DAVIS (1947-1965), *Professor Emeritus*; B.S., Cornell University, 1924; M.F., 1926

RUSSELL C. DECKERT (1952-1976), *Professor Emeritus*; B.S.F., University of Georgia, 1938; M.F., Duke University, 1943

CARL H. DE ZEEUW (1945-1982), *Professor Emeritus*; A.B., Michigan State College, 1934; B.S., 1937; M.S., New York State College of Forestry, 1939; Ph.D., State University of New York College of Forestry, 1949

GEORGE F. EARLE (1952-1983), *Professor Emeritus*; B.F.A., Syracuse University, 1937; M.F.A., Yale University, 1946

JOHN H. ENGELKEN (1952-1982), *Forest Property Manager Emeritus*; B.S.F., Utah State University, 1950

JEAN E. FISHER (1950-52) (1963-1981), *Senior Research Associate Emeritus*, B.S., University of Idaho, 1941

RUSSELL E. GETTY (1966-1973), *Professor Emeritus*; B.S., Iowa State College, 1936; M.S., 1951

DONALD F. GREEN (1965-1978), *Registrar Emeritus*; A.B., New York State College for Teachers, Albany, 1942; M.S., 1950

GEORGE H. HAINES (1953-1968), *Director of Business Affairs Emeritus*; B.S., University of Rhode Island, 1932

WILLIAM M. HARLOW (1928-1965), *Professor Emeritus*; B.S., New York State College of Forestry, 1925; M.S., 1926; Ph.D. 1928

RAY R. HIRT (1921-1959), *Senior Professor Emeritus*; B.S., Hamline University, 1917; M.S., New York State College of Forestry, 1924; Ph.D., 1928

EDWIN C. JAHN (1938-1972), *Dean Emeritus*; *Professor Emeritus*; B.S., New York State College of Forestry, 1925; M.S., 1926; Ph.D., McGill University, 1929

THEODORE J. KOCHANEK (1971-1976), *Director of Physical Plant Emeritus*

RONALD F. LAPLAINE (1948-1983), *Technical Specialist Emeritus*, Department of Paper Science and Engineering

CHARLES C. LARSON (1950-1983), *Professor Emeritus*; A.S., North Dakota State School of Forestry, 1938; B.S., University of Minnesota, 1940; M.S., University of Vermont, 1943; Ph.D., State University of New York College of Forestry, 1952

ORRIN L. LATHAM (1930-1966), *Associate Professor Emeritus*; B.S.F., Iowa State College, 1927; Yale University, 1932

JOSIAH L. LOWE (1933-1975), *Professor Emeritus*; B.S., New York State College of Forestry, 1927; Ph.D., University of Michigan, 1938

AUBREY H. MACANDREWS (1926-1962), *Professor Emeritus*; Truro Agriculture College, 1922; B.S., New York State College of Forestry, 1925; M.S., 1926

RAYMOND L. MARLER (1970-1981), *Senior Research Associate Emeritus*; B.S., University of Michigan, 1948; M.F., 1948

RENATA MARTON (1957), *Senior Research Associate Emeritus*, Master Ph. (Chemistry), Jagiello University, 1934; Ph.D., 1936

JOHN A. MEYER (1958), *Associate Director Emeritus*; *Senior Research Associate* and *Professor Emeritus*; B.S., Pennsylvania State College, 1949; M.S., 1950; Ph.D., State University of New York College of Forestry, 1958; Chancellor's Award for Excellence in Professional Service, 1977

HOWARD C. MILLER (1950-1982), *Professor and Extension Specialist Emeritus*, B.S., New York State College of Forestry, 1941; Ph.D., Cornell University, 1951

JOHN L. MORRISON (1946-1971), *Professor Emeritus*; A.B., University of Nebraska, 1933; A.M., 1935; Ph.D., University of California, 1941

FREDERIC W. O'NEIL (1937-1974), *Professor Emeritus*; B.S., New York State College of Forestry, 1933; M.S., 1935

RICHARD E. PENTONEY (1953-1979), *Vice President for Program Affairs Emeritus*; B.S., University of California, 1949; M.S., State University of New York College of Forestry, 1952; Ph.D., 1956

LUCIAN P. PLUMLEY (1936-1967), *Director Emeritus*, Ranger School; *Professor Emeritus*; New York State College of Forestry, (Ranger School), 1931; B.S., New York State College of Forestry, 1935

SHELLEY W. POTTER, JR. (1956-1979), *Forest Property Manager Emeritus*; B.S., University of Michigan, 1951

ROBERT B. RAYMISH (1956-1983), *Assistant Director of Physical Plant Emeritus*, Office of the Vice President for Administration and Services

CONRAD SCHUERCH (1949-1983), *Distinguished Professor Emeritus*; B.S., Massachusetts Institute of Technology, 1940; Ph.D., 1947

BRADFORD G. SEARS (1941-1976), *Dean Emeritus*; *Professor Emeritus*; B.S., New York State College of Forestry, 1939; M.S., State University of New York College of Forestry, 1948

HARDY L. SHIRLEY (1945-1967), *Dean Emeritus*; *Professor Emeritus*; B.A., Indiana University, 1922; Ph.D., Yale University, 1928; D.h.c., University of Helsinki, 1958; D.Sc., Syracuse University, 1966

SAVEL B. SILVERBORG (1947-1977), *Professor Emeritus*; B.S., University of Idaho, 1936; Ph.D., University of Minnesota, 1948

JOHN B. SIMEONE (1948-1983), *Professor Emeritus*; 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*; B.S., New York State College of Forestry, 1943; M.S., State University of New York College of Forestry, 1948; Ph.D., Yale University, 1957

GERALD H. SMITH (1946-1979), *Professor Emeritus*; B.S., New York State College of Forestry, 1937; M.B.A., Syracuse University, 1956; *Executive Chairman of the Faculty* (1972-1974)

LEROY C. STEGEMAN (1929-1965), *Professor Emeritus*; B.S., Michigan State College, 1928; M.S., University of Michigan, 1929

VIVIAN R. SUTTON (1962-1976), *Associate Professor Emeritus*; B.A., Oberlin College, 1934; M.A., Bryn Mawr College, 1937; Ph.D., 1942

MICHAEL M. SZWARC (1952-1979), *Distinguished Professor Emeritus*; Ch.E., Warsaw Polytechnic College, 1932; Ph.D., Hebrew University, 1945; Ph.D., Manchester University, 1947; D.Sc., 1949

WILLIAM C. TIERSON (1949-1983), *Director of Wildlife Research Emeritus*; B.S., State University of New York College of Forestry, 1949; M.F., 1967

LESLIE L. TURAI (1976-1982), *Professor Emeritus*; B.S., University of Debrecen, 1936; M.S., 1937; Ph.D., University of Budapest, 1938

ARTHUR T. VIERTEL (1946-1975), *Associate Professor Emeritus*; B.S., New York State College of Forestry, 1942; Ph.D., State University of New York College of Forestry, 1954

WILLIAM L. WEBB (1937-1975), *Professor Emeritus*; *Dean Emeritus*; B.S., University of Minnesota, 1935; M.S., 1940; Ph.D., Syracuse University, 1950

WALTER L. WELCH (1950-1965), *Associate Professor Emeritus*; A.B., Syracuse University, 1946

SIDNEY A. WHITT (1968-1976), *Professor Emeritus*; B.S., University of Alabama, 1933; M.S., Massachusetts Institute of Technology, 1937; D. Engr. Sc., New York University, 1962

JOHN M. YAVORSKY (1948-56) (1967), *Professor* and *Dean of Continuing Education Emeritus*; B.S., New York State College of Forestry, 1942; M.S., 1947; Ph.D., State University of New York College of Forestry, 1955

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Alumni	320 Bray
Analytical and Technical Services	139 Baker
Assistant Vice President for Academic Programs	227 Bray
Assistant Vice President for Research	200 Bray
Auto-tutorial Center	16 Moon
Business and Fiscal Affairs	100 Bray
Career Services	108 Bray
Cellulose Research Institute	314 Baker
Community Relations	123 Bray
Computer Services	320 Baker
Counseling Services	107 Bray
Educational Communications	302 Illick
Empire State Paper Research Institute	317 Walters
Facilities	Maintenance Building
Film Library	104 Moon
Financial Aid	111 Bray
Graduate Program in Environmental Science	217 Bray
International Forestry	205 Marshall
Institute of Environmental Program Affairs	200 Bray
Institutional Research	206 Bray
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Maintenance and Operations	Maintenance Building
Personnel	224 Bray
Polymer Research Institute	215 Baker
President	204 Bray
Publications	123 Bray
Public Safety Department	8 Bray
Registrar	113 Bray
School of Biology, Chemistry and Ecology	311 Baker
School of Continuing Education	231 Baker
School of Environmental and Resource Engineering	208 Walters
School of Forestry	106 Marshall
School of Landscape Architecture	331 Marshall
Student Council	19 Marshall
Ultrastructure Studies Center	417 Baker
U.S. Forest Service Cooperative Research Unit	5 Moon
Veterans' Affairs	107 Bray
Vice President for Administration and Services	208 Bray
Vice President for Program Affairs	227 Bray
Vice President for Student Affairs	107 Bray

Coordinator for 503-504 Programs at the State University of New York College of Environmental Science and Forestry is David G. Anderson, Vice President for Administration and Services.

STATE UNIVERSITY OF NEW YORK
COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY
SYRACUSE, NEW YORK 13210

State University of New York

COLLEGE OF

ENVIRONMENTAL SCIENCE AND FORESTRY

1985—86 CATALOG

CORRESPONDENCE DIRECTORY

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College of Environmental Science and Forestry
Syracuse, New York 13210
(315) 470-6500

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Director of Admissions
110 Bray Hall
470-6600

Graduate Studies
Office of Academic Programs
227 Bray Hall
470-6599

Financial Assistance
Coordinator of Financial Aid
111 Bray Hall
470-6670

Transcripts and Academic Records
Registrar
113 Bray Hall
470-6655

Housing
Coordinator of Undergraduate Housing
Office of Residential Life
Steele Hall
Syracuse University
Syracuse, New York 13210
423-2720

The State University of New York College of Environmental Science and Forestry is accredited by the Middle States Association of Colleges and Secondary Schools: the B.S. degree program in Forestry is accredited 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; and the B.S. degree program in forest engineering is accredited by the Accreditation Board for Engineering and Technology.

Additional information is available upon request from any of the above addresses. This undergraduate/graduate catalog was published by the College of Environmental Science and Forestry, June 1985.

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 College of Environmental Science and Forestry.

The State University of New York College of Environmental Science and Forestry does not discriminate on the basis of race, sex, religion, national origin, age, handicap, marital or veteran's status in admissions, employment, and treatment of students and employees in any program, activity, or service.

State University of New York

COLLEGE OF

ENVIRONMENTAL SCIENCE AND FORESTRY

1985-86 General Catalog

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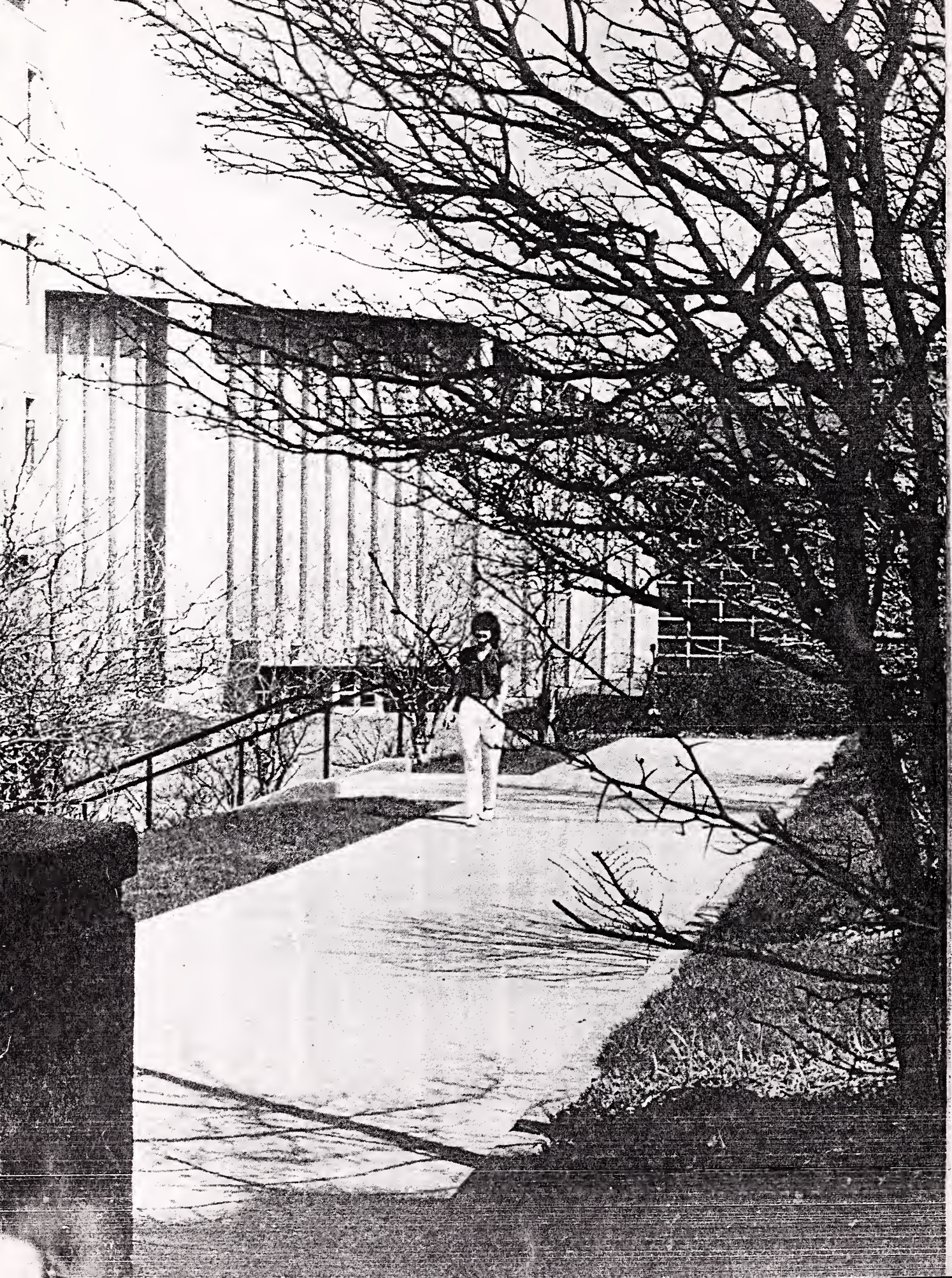


Academic Calendar

SYRACUSE CAMPUS

FALL 1985

New Student Orientation Program	Sept. 1	Sunday
Academic Advising	Sept. 2	Monday
Registration for New Students	Sept. 2	Monday
Classes Begin	Sept. 3	Tuesday
Graduate Student Registration	Nov. 19	Tuesday
Early Registration—Undergraduate	Nov. 20—26	Wednesday—Tuesday
Thanksgiving Recess	Nov. 27—Dec. 1	Wednesday—Sunday
Early Registration—Undergraduate	Dec. 2—6	Monday—Friday
Last Day of Classes	Dec. 13	Friday
Exam Period	Dec. 16—20	Monday—Friday

SPRING 1986

Orientation and Advising for New Students	Jan. 13	Monday
Registration for New Students	Jan. 13	Monday
Classes Begin	Jan. 14	Tuesday
Spring Recess	Mar. 8—16	Saturday—Sunday
Early Registration	Mar. 31—Apr. 11	Monday—Friday
Last Day of Classes	Apr. 30	Wednesday
Reading Day	May 1	Thursday
Exam Period	May 2—8	Friday—Thursday
Commencement	May 11	Sunday

ESF: What's In A Name?

1911. Governor John A. Dix signed a bill establishing the New York State College of Forestry at Syracuse University.

1948. Legislative action incorporated into State University of New York all state-supported higher education. Thus, the State University College of Forestry at Syracuse University.

1972. By special legislative act, the College was renamed the State University of New York College of Environmental Science and Forestry.

Why, in the first place, all the name changes? And, secondly, what difference do they make? What, really, is in our name?

ESTABLISHING A TRADITION

The beginnings and early development of the New York State College of Forestry were largely due to James R. Day, chancellor of Syracuse University, and community leaders who were attuned to the growing national sentiment favoring forest conservation and who sensed the need for a professional school of forestry. The legislative act which created the College instructed that the institution "conduct such special research in state-wide investigations in forestry as will throw light upon and help in the solution of forestry problems..." and that it be "the institution for educational work in forestry in the State."

From the very first years of its existence under the first dean, Hugh P. Baker, the College responded to the broad needs of environmental professionalism. While other schools and colleges of forestry became more specialized, the College at Syracuse broadened to include the essentials of environmental science: design, engineering, and the life sciences, as well as resource management.

With the formation of the State University of New York in 1948, coordination and systematization came to higher education in the state. The University, according to its charter, was to "supplement, not supplant, the great network of private colleges and universities." The College of Forestry, which from its beginning had been state-supported and governed by a Board of Trustees currently made up of nine members appointed by the Governor and six *ex officio* members, was recognized as a specialized college within the State University system.

Stemming from Chancellor Day's early sponsorship of the College, Syracuse University and ESF have long been engaged in numerous fruitful devices of institutional cooperation. This relationship is probably the most outstanding example in this country of collaboration between public and private institutions of higher education. Even as a part of State University, the College maintains this unique position. The major character of the relationship stems from the fact that since its beginning, the College purchased from Syracuse University the major portion of its supportive and enrichment instruction, thus allowing the College to more fully develop its professional upper division and graduate level instruction.

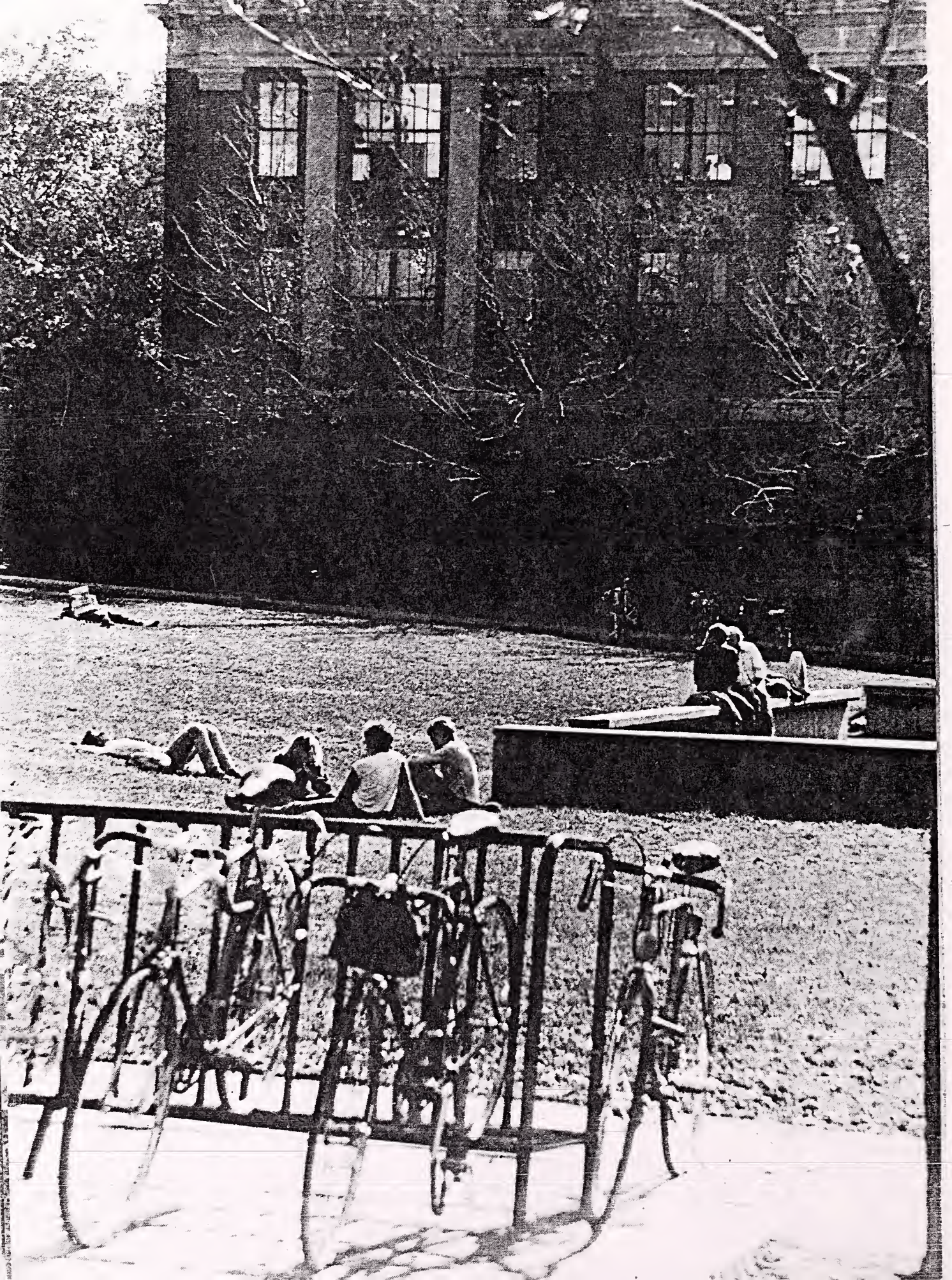
Other cooperative areas are living centers and dining facilities, athletic programs, the use of the University's infirmary and health counseling services, the bookstore facilities, the University library system, joint Commencement ceremonies held in the Carrier Dome, and participation in numerous social activities including the elaborate religious, dramatic, and cultural benefits of a large university.

ESF TODAY

The third phase in the evolvement of the College's name came in 1972 when it was rechartered as the State University of New York College of Environmental Science and Forestry. Thus, the name reflects more deeply the traditional grounding and concern of forestry in the environment; it illuminates more clearly the capabilities of its program.

The College of Environmental Science and Forestry has completed a plan, conceived more than a dozen years ago, to achieve complete upper division/graduate status. Undergraduate students wishing to embark upon a career in the environmental sciences and forestry will enroll for two years at a junior college or four-year institution, studying an ESF prescribed program and transfer to this college as juniors. The move to upper division/graduate college status marks another step in the College's long-standing commitment to educate professionals capable of facing the complex environmental problems of today and of the future.

For nearly 75 years, the full thrust of the State University of New York College of Environmental Science and Forestry has been focused on the environment on all of its six campuses and in each of its three mission areas—instruction, research, and public service. The College has been, and continues to be, devoted to the advancement of environmental science and forestry.



The Mission: Instruction, Research, and Public Service

INSTRUCTION

In the fall of 1984, student enrollment reached 1,478. Of this number, 1,009 were undergraduates and 469 were graduate students. In addition, there were 13 students engaged in postdoctoral work.

Undergraduate Education

At the baccalaureate level, the College offers professional study in eight areas: *chemistry; environmental and forest biology; environmental studies; forest engineering; paper science and engineering; wood products engineering; resource management;* and *landscape architecture*. These programs are registered with the New York State Education Department.

Each of these curricula leads to the bachelor of science degree. In the case of landscape architecture, an additional year of study results in a bachelor of landscape architecture degree, and in the forest engineering program, a fifth year leading to a bachelor's degree in civil engineering can be taken at Syracuse University or State University at Buffalo.

Graduate Education

The College awarded its first graduate degree in 1913. Today the College offers advanced degrees in seven major program areas: *environmental and forest biology; chemistry; resource management and policy; silviculture and forest influences; environmental and resource engineering; landscape architecture; and environmental science*. These programs are registered with the New York State Education Department.

Graduate study leads to the master of science degree, the master of landscape architecture degree, and the doctor of philosophy degree. A postdoctoral study program, closely related to the College's research effort, is also available.

In addition to these degrees, the College and Syracuse University provide the opportunity for graduate students to complete concurrently a degree at ESF and, at Syracuse University, either the J.D. degree in the College of Law, the M.P.A. degree in the Maxwell School of Citizenship and Public Affairs, the M.A. or M.S. degree in the S.I. Newhouse School of Public Communications, or the M.B.A. degree in the School of Management. Students must complete at least one semester of graduate level coursework at ESF before being considered for a concurrent degree program at Syracuse University.

Technical Education

At the paraprofessional level, the College has been training forest technicians since 1912 at its Wanakena Campus in the Adirondack Mountains. It is the oldest Ranger School in the United States and offers a two-year *forest technology* curriculum. Graduates are awarded an associate in applied science degree. In this curriculum, students take their first year of general education at a two- or four-year college. The second year, with its emphasis on practical field training in the relationships between forest technology and managerial needs, is taken at Wanakena with its 2,800 acres of forested land. Graduates of this degree program in practical forestry are prepared for positions as forest rangers; federal, state, and private industry forest technicians and forestry aides; district forest supervisors; timber inventory specialists; timber sales supervisors; forest surveyors and engineering aides; and forest protection technicians.

Continuing Education

The philosophy that education is a lifelong pursuit is an ancient one and was written into the law creating the College. This concept is doubly important to the sciences and professions in this technological age when, with knowledge expanding in all directions, major environmental problems still remain to be resolved. The informational needs of New York's citizens also are undergoing change. The increasing urban character of our population; the changing pattern of agricultural and forest land ownership and use; the rise in level of education and sophistication in a more efficient society; and the increase in leisure time, travel mobility and need for recreational facilities and pursuits all contribute to a growing need for educational opportunities in environmental science and forestry for adult audiences.

The College has, over the years, succeeded in communicating knowledge on forest resources management, utilization, and conservation to a variety of off-campus publics. The entire College faculty has contributed to these programs. To reinforce this commitment,

the College established a School of Continuing Education upon which to base expanded educational opportunities at both the undergraduate and graduate course levels.

Conferences, symposia, seminars, and shortcourses on various aspects of forestry and the related sciences are conducted at both the basic and applied levels. Audiences include forest owners, managers, and operators; wood engineers and forest industries personnel; academic and scientific groups; conservation and recreation personnel from local and other public and private planning groups; and citizen-action committees. Upon request, continuing education programs can be designed to meet specific needs of professional organizations, agencies, and industry. Credit or noncredit courses, at campus or off-campus sites, can be arranged.

Expansion of in-service training courses, establishment of environmental learning centers on College forest properties, and production of media materials for public information and education are examples of activities directed toward updating and upgrading professional clients and broadening the public's awareness and appreciation of New York's forestlands and other natural resources.

For information on specific continuing education projects, inquiries should be sent to Director, Office of Continuing Education and Extension.

RESEARCH

The College's commitment to scientific inquiry stretches far back to its second year of existence. In 1912, Dean Hugh P. Baker initiated the first research project of the College by joining forces with the U.S. Forest Service in an industry study designed to show what kinds of firms were using wood in New York State and the species and quantities used.

In the 1980's, the College's research program has attracted a worldwide clientele of industrial, governmental, professional and scientific groups, and through liaison with them, the program maintains its vigor and relevancy to the important environmental issues. Support from this clientele amounts to more than $4 million a year, a two-fold increase in the last decade.

Students and faculty from across the College contribute to the depth and diversity of the research program. Findings from these studies are applied to a host of issues and problems through various demonstrations and information devices. Recent examples include studies of limestone quarry reclamation; the development of polymeric materials for artificial human organs; nonchemical control measures for insect pests, e.g., the gypsy moth; studies of the ecology of Antarctic birds; new wood pulping processes leading to pollution-free water and air effluents; and the ecological effects of winter navigation in the Great Lakes and the St. Lawrence River.

Institute of Environmental Program Affairs

Research and public service programs at the College of Environmental Science and Forestry are given additional emphasis through the Institute of Environmental Program Affairs (IEPA). This Collegewide coordination vehicle was initiated in 1972 in recognition of the College's traditionally broad and integrated approach to natural resources science and in response to new perceptions of the relationship between human endeavors and environmental quality. The Institute, which is staffed by the Office of Research Programs, functions to bring together groups of faculty scientists to explore research and public service needs and opportunities which transcend the programs of the schools, departments, and organized research centers and institutes of the College.

Study teams of scientists and graduate students from many disciplines have collaborated with external program cooperators from governmental agencies, citizens' groups, and private industry to pursue multidisciplinary research and public service programming as part of the IEPA program. Early efforts were focused on regional natural resource and environmental studies conducted at the request of New York State agencies such as the St. Lawrence-Eastern Ontario Commission, the Tug Hill Commission, the Catskill Study Commission, and the Adirondack Park Agency. Other studies which transcend regional problems and issues have been conducted with diverse sponsorship, including environmental service systems, leisure time and recreational activities appropriate to the Hudson River Basin; solid waste processing and heavy metals recovery from processing residues from the forest products industry; wetlands evaluation studies; remote sensing techniques to facilitate environmental monitoring of coastal water quality and land use patterns; reclamation of open pit limestone quarries; the siting of nuclear power generation facilities; and environmental assessment studies associated with proposals for extended season navigation in Lake Ontario and the St. Lawrence River.

More recently, IEPA has provided a focus for faculty interested in pursuing research and public service programming through diverse sponsorships in particular areas of high public concern. Three task forces are currently operating in these areas to develop new project activity and coordinate the Collegewide research focus in bioenergy projects, acid precipitation and atmospheric deposition, and sludge and sludge management concerns.

Empire State Paper Research Institute

The Empire State Paper Research Institute (ESPRI) is the only worldwide basic research organization in the pulp and paper field. It performs investigations in cooperation with the Empire State Paper Research Association (ESPRA), which is comprised of 78 pulp and paper companies in 14 countries. The Institute was

established in 1945 when the members of ESPRA recognized the need for new scientific and technical knowledge and methods, and since then ESPRI has been able to maintain an efficient balance between the practical and theoretical bases of the pulp and paper industry.

Housed in the modern J. Henry Walters Hall with its own pilot paper mill, and staffed by scientists who are internationally recognized for their accomplishments, ESPRI provides a research base for long-range industry development. Its program has widened in scope to cover almost all aspects pulping and papermaking, including additive retention, oxygen pulping and bleaching, effluent control, sheet drying, printability, and energy efficiencies.

Polymer Research Institute

Scientists at the College have made many original contributions to the field of pure and applied polymer chemistry, including the development of living polymers, the study of anionic polymerization and electron-transfer initiation, and work on the permeation of gases and films through polymeric films.

College faculty members specializing in polymer chemistry have trained several hundred graduates and postdoctoral researchers, many of whom now hold leading positions in universities and industrial and governmental laboratories.

Nelson Courtlandt Brown Laboratory for Ultrastructure Studies

This Center, located in Baker Laboratory, is a teaching, research, and service facility of the College. It is equipped to handle virtually every type of modern microscopy. This includes light, scanning electron, and transmission electron microscopy. Among the major items of equipment are: two RCA EMU-3 transmission electron microscopes; an RCA EMU-4, an ETEC Autoscan scanning electron microscope, energy dispersive X-ray analyzer, several types of light microscopes, high vacuum evaporators, microtomes and ultramicrotomes. The laboratory resources include specimen preparation rooms, several photographic darkrooms, three electron microscope laboratories and other supporting facilities.

The primary service of the Center is teaching; course offerings include photomicrography, scanning electron microscopy, and interpretation of cellular ultrastructure. Research is a second major activity since support is provided for students, faculty, and research staff who have projects involving structural studies. Public service is extended to local high school groups, medical facilities, other regional colleges and universities, and industry.

Adirondack Ecological Center

The Adirondack Ecological Center (AEC) is located on the College's Newcomb Campus in the center of the Adirondack Mountains. Staffed by resident scientists, technicians, and support staff, the AEC conducts studies of the Adirondack region year-round. Research includes studies of managed and unmanaged forest lands, wildlife populations and habitats, terrestrial and aquatic ecology, and wilderness management. Work is carried on in close collaboration with the New York State Department of Environmental Conservation, the U.S. Fish and Wildlife Service, the U.S. Department of Agriculture, and forest industries.

The vigorous research program of the Center provides excellent opportunities for collaboration by Syracuse-based faculty and students. Several graduate students are regularly in residence at Newcomb pursuing their thesis research.

Renewable Materials Institute

The Renewable Materials Institute (RMI) has as its principal goal research on wood and other renewable materials such as agricultural waste products, which would include straw, rice hulls, and bagasse. To meet its mission, research on the characterization of the material itself is primary. Closely related with it is the determination of physical properties which control the behavior of the material during utilization as well as in use in consumer products. In exploring renewable materials, strong emphasis is placed on energy considerations. This can be in terms of energy savings during production or economies of energy because of the use of the end product in housing or in some other application. Also included are related studies in the combustion of wood, the efficiency of heating with wood and the emissions resulting from wood combustion.

The principal facilities for the materials characterization are found in the Center for Ultrastructure Studies and include the transmission electron microscopes, a scanning electron microscope with EDXA and rapid particle analysis. All of the facilities of the Department of Wood Products Engineering are also available, including a sawmill, veneer and plywood manufacturing facility, dry kilns, wood machining equipment, and timber testing laboratory. The facilities of other research institutes and Departments in the College are also available for special projects.

Tropical Timber Information Center

The Tropical Timber Information Center (TTIC) provides identifications of wood samples and information about tropical woods for both general characteristics and technical properties. These services are oriented toward importers and users of tropical woods. The Center began operation in 1975 as part of the Department of Wood Products Engineering and is one of only two such sources of information in the western hemisphere. The Center also carries out special studies under contract for production of data that is not available in the literature. The technical base for operation of the

Center is a large, worldwide collection of authenticated wood samples and an extensive collection of reference materials in Moon Library and the Department of Wood Products Engineering. Both of these resources have been built up over the past 60 years by close cooperation with institutions throughout the world. Activity of the Center is oriented toward requests for services from importers and users of tropical woods and to expanding the collections.

Cellulose Research Institute

Research at the Cellulose Research Institute is at present centered on the fine structure of native cellulose and its transformations into other commercially important forms of cellulose. For example, the structural differences between native and regenerated celluloses have been determined, for the first time, through x-ray crystallographic studies. The same techniques are now being used to study the structural aspects of cellulose mercerization, an important commercial process in cellulose chemistry. Other recent research has been concerned with the organization, chemical composition, and function of the vascular cambium in trees, the ultimate source of all wood and bark produced in nature.

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

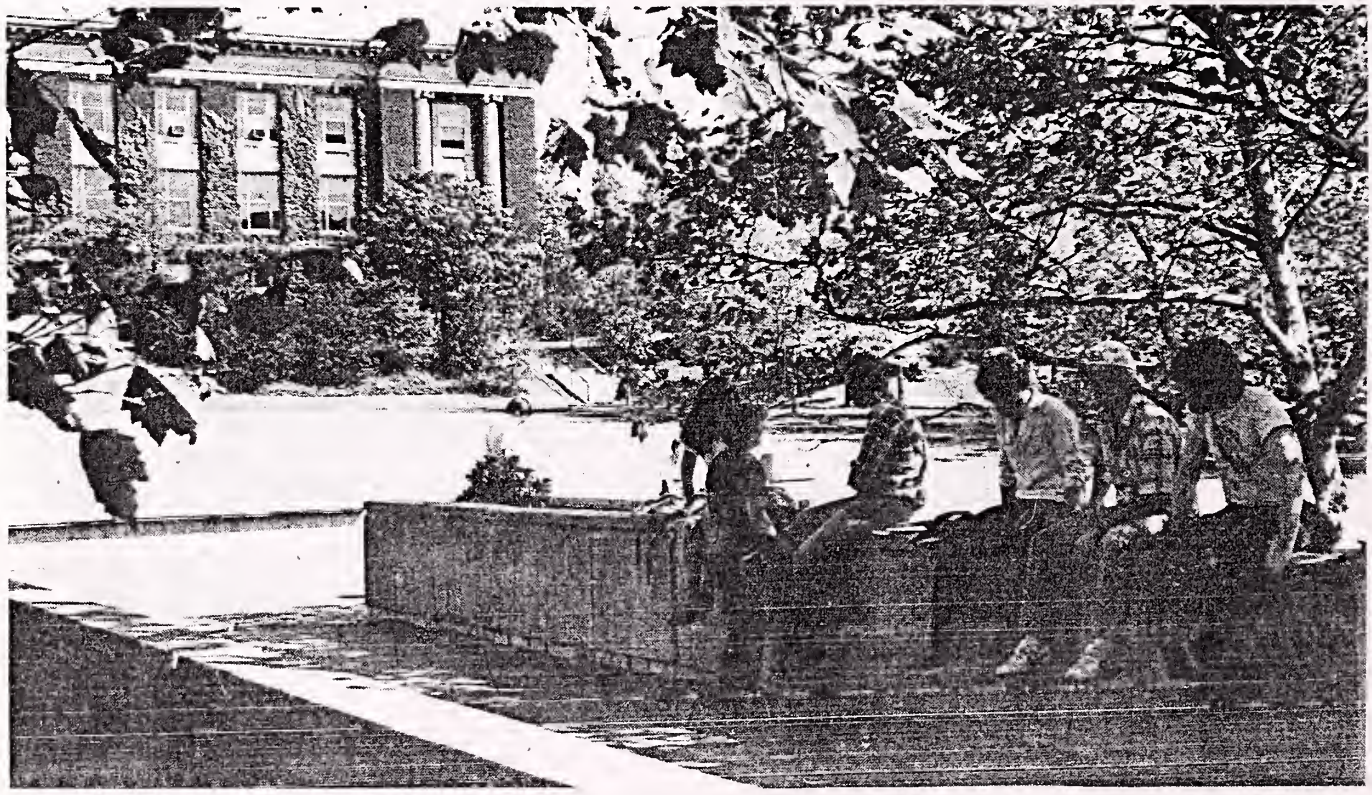
The Northeast Forest Experiment Station of the U.S. Department of Agriculture-Forest Service maintains a research center at the College. Until 1977, this unit pursued studies of forest-centered recreation with the aim of developing methods for integrating recreation and other uses of forests.

Beginning in 1978, the Cooperative Research Unit was re-oriented to research on urban environmental forestry problems. This provides increased opportunities for faculty and students to collaborate with Forest Service scientists in studies of urban and environmental problems.

PUBLIC SERVICE

The College, throughout its 73-year history, has continued to respond to its specific legislative mission prescribing major responsibilities in the area of public service. Public education and information, technical advice and guidance to cooperating local, state, and federal agencies and organizations, and technical assistance to the forest and wood-using industries constitute the principal formal public service activities. The Institute of Environmental Program Affairs (described in the Research section) coordinates the College's public service activities on the professional level.

While the list of public service contributions is lengthy, a few examples include: the College's Film Library; the Tree Pest and Disease Service, which provides technical advice to private citizens and to governmental agencies; and the participation of ESF faculty members in Central New York's Poison Control Center. Altogether, the public service programs of the College reach approximately one million New York State residents each year.



The Campuses

The College operates a multiple campus system with regional campuses and field stations located at Syracuse, Tully, Wanakena, Warrensburg, Cranberry Lake, Newcomb, and Clayton. This system, composed of about one million square feet of facilities in 186 buildings on 25,000 acres of land, represents the largest fully-utilized campus in the world.

THE SYRACUSE CAMPUS

The main campus is in Syracuse and lies on 12 acres adjacent to Syracuse University in an area that traditionally has been known as "The Hill." Located here are the Schools of Biology, Chemistry, and Ecology; Environmental and Resource Engineering; Forestry; Landscape Architecture; and Continuing Education. In addition, the main campus houses the Institute of Environmental Program Affairs, the Empire State Paper Research Institute, the Polymer Research Institute, a cooperative research unit of the USDA Forest Service, the Ultrastructure Center, the Graduate Program in Environmental Science, and the Renewable Materials Institute..

These program units are housed in five major academic buildings (Baker Laboratory, and Walters, Bray, Marshall, and Illick Halls). The main campus also includes Moon Memorial Library, the Maintenance Building, and several other small service and storage facilities.

Specialized facilities at the Syracuse campus include electron microscopes, plant growth chambers, air-conditioned greenhouses, a bio-acoustical laboratory, a 1,000-curie cobalt-60 radiation source, radioisotope laboratory, computing center, and specialized instrumentation including nuclear magnetic resonance spectrometers, electron spin resonance spectrometer, gas chromotography, mass spectrometer, ultracentrifuge, and X-ray and infrared spectrophotometer. Photogrammetric and geodetic facilities of the forest engineering department include one of the most extensive arrays of equipment in the United States, with a Nistri TA-3 stereocomparator, Mann comparator, computerized Nistri photocartograph, and nine other varieties of plotters. The paper science and engineering laboratory has a semicommercial paper mill with accessory equipment. The wood products engineering department has a complete strength-of-materials laboratory as well as a pilot scale plywood laboratory and a machining laboratory. The greenhouses and forest insectary are used to produce plant and insect material for classroom and laboratory. Extensive collections are available for study, including wood samples from all over the world, botanical materials, insects, birds, mammals, and fishes.

The **F. Franklin Moon Library** contains more than 90,000 cataloged items and over 900 journals are currently received. The collection constitutes a specialized information source for the forestry, environmental science; and landscape architecture programs of the college, and it 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 and engineering, photogrammetry, silviculture soil science, water resources, world forestry, wildlife biology, wood products engineering, and zoology.

The collections of Syracuse University libraries (SU's Science and Technology Library is immediately adjacent to the ESF campus), and SUNY Upstate Medical Center are within walking distance. These libraries may be used by all members of the College of Environmental Science and Forestry. Other collections located throughout New York State and the United States are readily accessible through Inter-library loan. All Syracuse University collections may be searched by using the SULIRS on-line catalog located in Moon Library.

The library building, opened for service in 1968, can accommodate 132,000 volumes and can seat 575 persons. The main reading areas are located on the upper level adjacent to the open stacks and are divided by the card catalog and reference service area. The library contains a current periodical room, a bibliographic center containing indexes and abstracts, individual study carrels and library faculty offices. The Hoverter Archives and special collections, conference room, audio tutorial center, Directed Studies Center and the computer terminal room are located on the lower level.

Leisure reading material is not housed separately but is distributed throughout the collection. This collection contains books on national and world social problems, humanities, education, and popular books concerned with the environment. The archives consists of historical items relevant to the college and forestry development in New York State. The special collections area of the archives contains rare, scarce, and valuable books, and folios as well as the Fletcher Steele collection on landscape architecture, and the Thomas Cook collection on papermaking.

Public services provided by the library faculty includes a credit course, orientation, class lectures, study guides,

user aids, and reference desk service. Moon Library is a member of the SUNY OCLC network.

The **Educational Communications** unit directly supports the program areas of the College through development and application of media materials and methods for the classroom, for the presentation of research findings, and for public service endeavors. These include television programming, slide/tape and motion picture production and photographic services. Other services to the College community include engineering, audio-visual equipment distribution, and maintenance and support functions. The Educational Communications staff also participates directly and actively in instructional programs in environmental communication at both the undergraduate and graduate levels, as well as through the School of Continuing Education.

The College provides *academic computer services* in several forms. Remote communication facilities are available for both batch and interactive processing on the Syracuse University systems, and local/stand-alone facilities are available in the form of micro-computers dispersed about the ESF campus. Syracuse University operates an academic computer center consisting of two IBM 4341's and one DEC-KL10, all of which are accessible via terminals (20 public access and 60 restricted access) on the ESF campus. Clusters of micro-computers have been established by each of the academic divisions of ESF for purposes of faculty-staff-student use and education. Computer applications take advantage of extensive software on the Syracuse University systems including packages for statistics, graphics, text editing, and general mathematical functions as well as most of the major programming languages—FORTRAN, APL, BASIC and PASCAL finding the heaviest usage. In addition, a color graphics facility is being developed at ESF to satisfy the many needs for graphics analysis, design, and communication.

THE TULLY CAMPUS

Located about 25 miles south of Syracuse is the Tully Campus which is composed of the Heiberg Memorial Forest and the Genetic Field Station.

Heiberg Memorial Forest is located on the northern escarpment of the Allegheny Plateau. It includes 3,800 acres of diverse terrain and forest growth. The Forest is utilized both as an extensive outdoor teaching laboratory and as a site for intensive research. The **Forest Ecosystem Lab**, which is a highly instrumented outdoor teaching laboratory, a large complex of all-weather classrooms, many experimental plantings from throughout the world, and a commercial-scale maple syrup operation are among the developments on this forest. Each fall the Heiberg Memorial Forest is the site of an intensive program for environmental and resource management students in a total ecosystem approach to forest community management instruction.

THE WANAKENA CAMPUS

The Wanakena Campus, located on the Oswegatchie River, 65 miles northeast of Watertown and 35 miles west of Tupper Lake, is the site of the **James F. Dubuar Forest** and the **School of Forestry's Forest Technician Program**. This campus, with its large instructional and demonstration forest of 2,800 acres, supports the College's associate degree program for the training of forest technicians. This is the oldest forest technician school in the country. This campus is situated on the western plateau of the "lakes region" of the Adirondacks.

In addition to its full academic program, this campus hosts various summer short courses in forest biology and forest technology.

THE WARRENSBURG CAMPUS

The Warrensburg Campus is located in the southeastern Adirondack region and encompasses the **Charles Lathrop Pack Demonstration Forest**, an area of roughly 2,800 acres of heavily forested land noted for its white pine. The Forest has been under intensive management since 1927 for the combined purpose of instruction, research, and demonstration in forestry and allied fields.

Each year this campus hosts the Summer Session in Field Forestry, a seven-week course devoted to introductory instruction in field forestry principles and techniques. The course is required of all entering students in Environmental and Resource Management and is open to election by students in Environmental and Forest Biology.

Formal offerings in Continuing Education and various meetings and conferences are also held here for practicing professionals and organizations directly associated with forestry and allied environmental fields.

THE CRANBERRY LAKE CAMPUS

The Cranberry Lake Campus, approximately 1,000 acres of forested property situated in the northwestern section of the Adirondack Mountains of northern New York State, is the site of the College's **Biological Station** where the College operates an eight-week summer field program in environmental biology. The campus is bounded by 150,000 acres of New York State forest preserve lands, by Cranberry Lake and by isolated forest bogs and beaver meadows.

The extensive facilities are intensely utilized in a comprehensive curriculum of upper-level and graduate courses.

Use of this campus before and after the summer session program varies to include individual research projects, cooperative studies with other agencies and visits by large groups from both the College and outside institutions.

THE NEWCOMB CAMPUS

Located in the central Adirondack Mountains, Newcomb is the largest of the regional campuses and home to the **Adirondack Ecological Center** where extensive studies of animal biology and ecology are carried out. Also located there is **The Archer and Anna Huntington Wildlife Forest** which is about 15,000 acres in size.

This campus is of mountainous terrain and contains a variety of vegetative types and wildlife. The campus is used year round for a general research and forest management program participated in by faculty, graduate students, and visiting scientists.

THE FIELD STATIONS

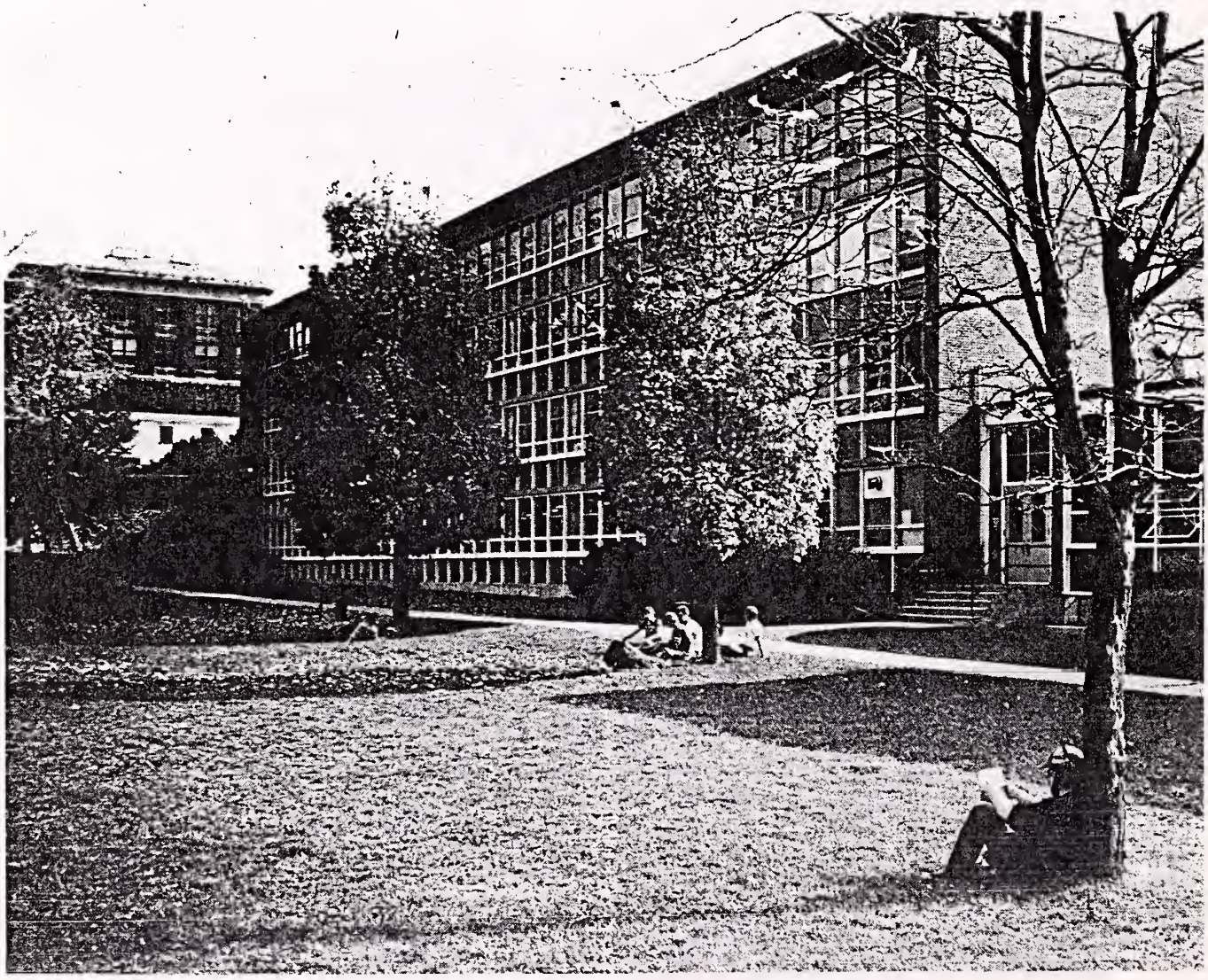
In addition to its regional campus system, the College operates several field stations which directly support the instruction, research, and public service programs of the institution. The 44-acre **Forest Experiment Station**, located only a few minutes drive from the main campus in Syracuse, is used to support main campus academic programs. Located at the Station are a large arboretum, tree nursery, and experimental greenhouse facility. Adjacent to the Tully Campus is the College's **Genetic Field Station**. It is a 59-acre area devoted to relatively short-term outplantings of plant materials developed in the various genetic research projects of the College. With its irrigation system and layout of level blocks, it is an excellent facility for developing hybrids, for grafting, doing experiments, and for research in heritability. A magnificent island, the **Ellis International Laboratory**, is situated in the heart of the Thousand Islands—St. Lawrence River area off the village of Clayton. Accessible only by boat, this laboratory is an unusually appropriate site for the Collegewide, cooperative and international, environmental monitoring and research activities of the St. Lawrence Seaway area. The College's most recent acquisition is a 15.2-acre facility on **Wellesley Island**. This island property, formerly a Coast Guard Station, has shore frontage on the American channel of the St. Lawrence Seaway. It is ideally suited for aquatic studies of many types.

The Syracuse Metropolitan Area

The College of Environmental Science and Forestry is located on one of several hills that overlook Syracuse, a growing metropolitan area of nearly 500,000. Known as the "Salt City" because of the great salt industry which was centered here for more than seventy years, Syracuse is today a city of diversified industry and commerce. The area is a leader in the manufacture of china, quality shoes, air conditioning equipment, medical diagnostic equipment, drugs, automotive parts, and lighting equipment.

The City of Syracuse offers students many cultural, recreational, and educational opportunities, including a symphony orchestra, several museums, live theater, and historical points of interest.

Called the "Crossroads of New York State," Syracuse is one of the few cities in the nation situated at the crossing point of two major superhighways. It is located at the intersection of the 500-mile east-west New York State Thruway and the north-south Penn-Can Highway. Driving time from New York City, Philadelphia, Boston, Toronto, and Montreal is about five hours; from Buffalo and Albany about three hours. The city is served also by a modern international airport and major bus and rail lines.



Academic Life

Society is increasingly in the hands of those who have broad foresight and a balance of judgment in applying scientific, sociological, and technical knowledge to guide human and environmental forces. Modern civilization—with its compelling demands from industry, government, and educational institutions—requires people who think objectively and constructively, and who act creatively and responsibly.

From its beginnings in 1911, the State University of New York College of Environmental Science and Forestry has served New York State and the nation in meeting the needs of its citizens in regard to the environment through education, research, and public service. The faculty and students of the institution are committed to the resolution of immediate environmental problems, the development of the knowledge necessary to predict occurrences in the future, and the presentation of public policy alternatives that will both protect the environment and accommodate the real needs of society.

At the undergraduate level, ESF offers curricula in the general areas of resource management, engineering, environmental design, and the physical and life sciences that prepare graduates to enter and contribute to the professional world or to continuing their education at the graduate level, at ESF or elsewhere.

Graduate years are a time of discovery and excitement, a time of answers and new insights, a time of personal productivity and contributions to scholarship. It is during graduate education that the student sharpens the ability to think critically and analytically, to plan research, to design experiments, to work effectively with the basic research tools as well as specialized equipment, and to undertake the discipline of purposeful study toward a specific goal.

The College currently supports significant graduate degree programs in six discipline areas and in its broad program in Environmental Science, which encourages multidisciplinary study. Both undergraduate and graduate programs of the College reflect the work of its faculty and their student colleagues, who, together, utilizing some of the most modern facilities and laboratories in the country, maintain a long-standing tradition of academic and professional excellence.

This catalog provides an introduction to the College and its programs of undergraduate and graduate study and research. It only begins to suggest the diversity and depth of the existing and potential programs that make environmental science the challenge of the 1980's and beyond.

UNDERGRADUATE ADMISSION

The College of Environmental Science and Forestry is an upper division/graduate center, enrolling at the undergraduate level transfer students who have completed at least two years of postsecondary coursework. Outstanding high school seniors can assure their acceptance by the College as junior transfers by applying to the Advanced Early Admission program.

Freshman and sophomore level courses may be taken at any two- or four-year college or university; all students considering transfer to ESF as juniors should follow the prescribed program appropriate to their intended major at the College. Each curriculum offered at the College of Environmental Science and Forestry and listed in this catalog defines the required lower division courses necessary for admission. These requirements are listed in the Areas of Study section of the catalog.

Students who are certain they intend to transfer to ESF may enroll in established pre-environmental science programs organized by the College in cooperation with a number of two- and four-year colleges in and out of New York State. Students who attend these colleges will find a smooth articulation has been established and upon successful completion of these prerequisites will generally gain admission to the college with full junior status. It is not required to specifically attend one of these colleges; a student may obtain the necessary lower division courses at almost any college or university in the country.

Application to ESF's associate degree program in Forest Technology at the Wanakena Campus must be made one year in advance. Therefore, high school students desiring to attend the Wanakena program in 1987 must apply this year. For further information on ESF's School of Forestry's Forest Technician Program, see page 54, or contact the Office of Admissions.

ADVANCED EARLY ADMISSION PROGRAM

High school students who are strongly motivated toward attending ESF may apply to the College of Environmental Science and Forestry during their senior year under the *Advanced Early Admission Program.*

Those seniors whose academic background is successfully competitive will receive a letter of acceptance to the College for entrance two years later with full junior status, contingent upon successful completion of all prerequisite courses of the first two years of the curriculum to which they have been admitted. The prerequisite

courses will be outlined and described in an enclosure with the acceptance letter.

This early acceptance will alleviate much of the anxiety about admissibility. High school seniors will know prior to graduation if they have been accepted to the College for entrance at the junior level. It affords those accepted students the opportunity to attend any college of their choice that offers the appropriate lower division courses. SUNY applications for the Advanced Early Admission Program may be obtained from high school guidance offices in New York State or directly from the Office of Admissions at ESF.

TRANSFER ADMISSIONS

For those students not accepted under the Advanced Early Admission Program, admission to the College of Environmental Science and Forestry is based on the student's previous college coursework, overall academic aptitude, and interest in the programs offered at this College. Consideration is given to both the quality and appropriateness of the student's prior academic experience. The minimum grade point average for consideration is 2.0 (4.00 = A).

PRE-ESF COOPERATIVE TRANSFER PROGRAMS

The College, working in cooperation with other collegiate institutions, both in and out of New York State, has developed 55 pre-environmental science and forestry programs. The development of these programs illustrates that high school students can look forward to a wide selection of colleges in which they can obtain all the necessary lower division courses and appropriate advisement to transfer to ESF as full juniors.

These colleges represent the total spectrum of higher education (private, public, 4-year, 2-year) and are located in New York, Connecticut, Massachusetts, New Jersey, Pennsylvania, Rhode Island, Iowa, and Maryland. Students who attend these colleges will find a smooth articulation has been established and once they transfer to ESF will share a common academic background with other transfer students.

Currently, the list of cooperating colleges includes:

New York State Colleges

Adirondack Community College, Glens Falls
Broome Community College, Binghamton
Canisius College, Buffalo
Cayuga County Community College, Auburn
Columbia-Greene Community College, Hudson
Community College of Finger Lakes, Canandaigua
Corning Community College, Corning
Dutchess Community College, Poughkeepsie
Erie Community College, Buffalo
Herbert H. Lehman College, Bronx
Herkimer Community College, Herkimer
Hudson Valley Community College, Troy
Jamestown Community College, Jamestown
Jefferson Community College, Watertown
LeMoyne College, Syracuse
Mohawk Valley Community College, Utica
Monroe Community College, Rochester
Nassau Community College, Garden City
Niagara County Community College, Sanborn
North Country Community College, Saranac Lake
Onondaga Community College, Syracuse
Orange Community College, Middletown
Paul Smith's College, Paul Smiths
Rockland Community College, Suffern
Siena College, Loudonville
Suffolk County Community College, Selden
Sullivan County Community College, Loch Sheldrake
SUNY Alfred Agricultural and Technical College, Alfred
SUNY Canton Agricultural and Technical College, Canton
SUNY Cobleskill Agricultural and Technical College, Cobleskill
SUNY College at Cortland, Cortland
SUNY Delhi Agricultural and Technical College, Delhi
SUNY College at Geneseo, Geneseo
SUNY Morrisville Agricultural and Technical College, Morrisville
SUNY College at New Paltz, New Paltz
SUNY College at Oneonta, Oneonta
SUNY College at Oswego, Oswego
Syracuse University, Syracuse
Tompkins Cortland Community College, Dryden
Ulster County Community College, Stone Ridge
Westchester Community College, Valhalla

Out-of-State Colleges

Allegany Community College, Cumberland, MD
Berkshire Community College, Pittsfield, MA
Camden County College, Blackwood, NJ
Garrett Community College, McHenry, MD
Holyoke Community College, Holyoke, MA
Housatonic Community College, Bridgeport, CT
Keystone Junior College, LaPlume, PA
Kirkwood Community College, Cedar Rapids, IA
Mercer County Community College, Trenton, NJ
Middlesex Community College, Edison, NJ
Montgomery Community College, Rockville, MD
Ocean County College, Toms River, NJ
Roger Williams College, Bristol, RI
Union College, Cranford, NJ

TRANSFER CREDIT

Courses transferred for credit must be appropriate to the student's curriculum choice. Credit will be awarded for all such courses completed with a passing grade of "D" or better.

Furthermore, courses to be transferred as required courses in a curriculum must be acceptable in content. Course credit hours are transferred, but grades and grade points are not.

No transfer credit will be awarded until all final transcripts are received. It is the student's responsibility to see that this is done.

COLLEGE PROFICIENCY EXAMINATIONS

The College recognizes that an increasing number of students are obtaining college-level credit through examination and/or completion of College credit while in high school. The College's policy on this, and other forms of nontraditional credit, is to grant the same amount of credit in parallel courses as the student's previous collegiate institution granted. It becomes the student's responsibility to be sure that *all* earned credits are on the previous college transcript and clearly identified by academic discipline.

EDUCATIONAL OPPORTUNITY PROGRAM

The basic goal of the Educational Opportunity Program at the College is to provide qualified students with a college education—the opportunity for personal growth and professional development. Upon completion of the program, graduates will be provided access to jobs in professional fields. The program is not designed for students who need only financial assistance. It serves students who ordinarily would not be able to attend college because of a lack of financial resources and insufficient academic preparation. To qualify, students must be New York State residents and demonstrate the potential to successfully complete the courses of study at the College.

Further information regarding the Educational Opportunity Program may be obtained by contacting the EOP Director.

INTERNATIONAL STUDENTS

The College accepts international students on the undergraduate level if they can satisfy all regular admission requirements. It is recommended, however, that students from foreign countries obtain their baccalaureate degree in their home country, and apply to the College as graduate students. Experience has shown that this arrangement provides for greater academic achievement and more efficient use of the student's time and funds. International students applying for admission must satisfy all of the course prerequisites for their intended major. In addition they must:

1. Demonstrate proficiency in the English language through acceptable performance on the Test of English as a Foreign Language (TOEFL) and/or the College Entrance Examination Board (CEEB) Achievement Text in English, and
2. Produce evidence of their ability to meet all their financial obligations.

Undergraduate international students must file official State University of New York foreign student admission forms. Prior to international student acceptance, adequate financial resources must be demonstrated, and after acceptance health and accident insurance must be obtained before the student will be allowed to register at the College.

International students who are currently at an American college may apply for transfer to the College. They must meet all entrance requirements of international students plus those of a transfer student as listed above. Permission to transfer must be obtained from the U.S. Immigration and Naturalization Service district office having jurisdiction over the college in which the student is currently enrolled.

HEALTH EXAMINATION BOARD

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

GRADUATE ADMISSION

Admission to graduate study may be granted only to applicants with at least a bachelor's degree from a recognized institution and whose preparation has been suitable in quality and content for the proposed field of major study. Applicants will be evaluated on the basis of the following: (1) their academic record should show at least a B or 80 percent average for the junior and senior years; (2) Graduate Record Examination aptitude scores, and, in some cases, subject matter (advanced) tests indicative of graduate study ability (see below); (3) supporting letters of recommendation; (4) a statement of specific educational and professional goals which describes the choice of degree program and the students' plan for the pursuit of the objectives in the program; and (5) other evidence of scholarly achievement and potential. Admission is selective with priority given to applicants who have high scholastic standing.

ADVANCED TESTS

Subject matter (advanced) test scores are required by the following programs:

Graduate Programs	*Advanced Test*
Chemistry	Chemistry
Environmental and Forest Biology	Biology

PROCEDURE

All applicants are required to submit Graduate Record Examination aptitude scores. This examination is offered several times each year in major cities of the world. For information on registration and scheduling write to the Educational Testing Service, Princeton, New Jersey 08540. Test scores should be sent to the Office of Academic Programs (Institutional number R2530).

The College provides a special application form for graduate work. Requests for information and applications should be addressed to the Office of Academic Programs.

INTERNATIONAL STUDENTS

Citizens of other countries with special educational objectives are accepted for graduate study in all programs. They must show satisfactory evidence that they have completed studies in their major field equivalent to those at a recognized American institution with a scholastic record equivalent to a B average in their junior and senior years. They must submit Graduate Record Examination scores as explained in the section on Admission Requirements. Also, applicants whose native language is other than English must submit scores on the Test of English as a Foreign Language (TOEFL). This requirement may be waived if the student has received a degree from an American institution. This examination is offered several times each year in major cities of the world.

For information on registration and scheduling, write to the Educational Testing Service, Princeton, New Jersey 08540, U.S.A. In submitting test scores, request that they be sent to the Office of Academic Programs.

EXPENSES

APPLICATION FEE

When a student applies for admission to an undergraduate program at any of the State University of New York units, a nonrefundable application fee is required. More information about fee and guidelines for exemptions is provided in the "Application Guidebook" for the State University of New York. There is a $35 application fee for those applying for graduate study.

ADVANCED PAYMENT FEE

All admitted undergraduate students pay a fee of $50, which is credited to the student's first semester tuition. This payment should be sent to the College Business Office accompanied by the form provided by the Office of Admissions. The payment is required prior to May 1, or 30 days after acceptance, whichever is later. It is refundable up to May 1, or within that 30-day period. There is no advanced payment fee required for those accepted for graduate study.

TUITION AND FEES (Effective Fall 1985)

The tuition and fee structure of the College of Environmental Science and Forestry covers usage of library, infirmary, physical education facilities, ROTC, special testing, and other services, as well as an assessment for student activities and charges for expendable supplies and equipment.

Tuition is charged in the following rate per semester:

Tuition Type	NYS Resident Students	Out-of-State Students
Undergraduate Matriculated		
Full-Time	$ 675.00	$1,600.00
Part-Time	$ 45.00/credit hour	$ 107.00/credit hour
Graduate Matriculated		
Full-Time	$1,075.00	$1,867.50
Part-Time	$ 90.00/credit hour	$ 156.00/credit hour
Continuing Education—Non-Degree		
Students who do not hold a Baccalaureate Degree		
Course Nos. 0-599	$ 45.00/credit hour	$ 107.00/credit hour
Course Nos. 600-999	$ 90.00/credit hour	$ 156.00/credit hour
Students who do not hold a Baccalaureate Degree		
Course Nos. 0-499	$ 45.00/credit hour	$ 107.00/credit hour
Course Nos. 500-999	$ 90.00/credit hour	$ 156.00/credit hour
Maximum Total Tuition for 12 credit hours or more	$1,075.00	$1,867.50

RESIDENCY

'Residence' for purposes of this (tuition payment) question refers to the principal or permanent home to which the student returns. If the principal or permanent home has not been located in New York State for a twelve-month period prior to the date of registration for the academic term for which this application is made, the student will be presumed to be an Out-of-State resident for purposes of tuition.

STUDENT ACTIVITY FEES

In addition to tuition, the student body has voted to assess each full-time undergraduate student $38 per year year to cover the cost of student activities. Full-time, non-matriculated students are charged a fee of $19 per semester, and part-time matriculated students $1.50 per credit hour. Full-time graduate students likewise have a mandatory activity fee of $20. ESF students also pay an activity fee to Syracuse University to cover SU-sponsored activities and services available to ESF students, not duplicated by College organizations. These fees are $26.75 for full-time undergraduate and $15 for full-time graduate students. Part-time matriculated students are charged $17.50 per year payable at fall registration; part-time matriculated graduate students are charged $10 per year.

COLLEGE FEE

There is a State University of New York general college fee of $25 per year for all full-time students. Part-time student fee is $.85 per credit hour.

COMMENCEMENT FEE

A commencement fee of $14 is required at the beginning of the semester in which the degree is expected. Additional costs are incurred by graduate students for the binding, abstracting, and microfilming of theses.

TERMS OF PAYMENT

A check or money order for tuition and fees should be made payable to State University of New York College of Environmental Science and Forestry. This payment is required by the last day of the registration period and can be paid at the College's Business Office either prior to registration or during registration. A fee of $10 or $20 may be assessed for payment later than the established date.

HOUSING AND BOARD COSTS

ESF does not operate student residences or dining halls. These facilities are offered by Syracuse University. Specific information about available housing and board plans is available from the Office of Residence and Dining Services, Syracuse University, Syracuse, New York 13210.

In general, housing costs at SU range from $1,920 to $2,500 for an academic year, reflecting the diversity of available accommodations for graduate or undergraduate, single or married students. Most dormitory rooms accommodate two students and are furnished with beds, mattresses, desks, chairs, study lamps and dressers. A commercial linen service is available to those who order it. Separate dormitories are maintained for graduate students.

Furnished and unfurnished apartments are also available for both single and married students. These are located in a housing complex approximately two miles from the main campus, and are regularly serviced by a free shuttle-bus.

A variety of options on board offerings are available for all students, whether or not they reside in University dormitories. Costs range from $1,060 to $1,990 for an academic year.

In addition, a wide variety of living arrangements in private homes and apartment complexes is available in the Syracuse metropolitan area.

Payment for housing and board is made directly to Syracuse University.

OTHER COSTS

Students majoring in resource management attend a seven-week Summer Session in Field Forestry at the Warrensburg Campus between the sophomore and junior years. Forest biology majors have the option of attending this session or the Summer Session in Environmental Biology at the Cranberry Lake Biological Station at the end of the junior year. Cost for the Warrensburg session is approximately $725 and $600 for the four-week program at Cranberry Lake, plus travel and personal expenses.

An extended field trip of up to two weeks at the end of the junior year costs approximately $250 for Wood Products Engineering students.

Field trips for Landscape Architecture students range between $125 and $150. In addition, students enrolled in the five-year Landscape Architecture program are required to spend one semester off campus. **This is a self-described 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.**

The cost of books and supplies is approximately $300 a year. Additional costs for personal expenses, recreation, clothes and travel depend on the individual, and they may range from $600 to $800 a year.

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The cost of books and supplies is approximately $300 a year. Additional costs for personal expenses, recreation, clothes and travel depend on the individual, and they may range from $600 to $800 a year.

REFUNDS

The following policies apply to tuition liability and refunds for students canceling their registration.

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%

Application for refund must be made within one year after the end of term for which the tuition was paid to State University. The first day of class session is considered the first day of the semester, and Saturday of the week in which this first session occurs is considered the end of the first week for refund purposes. It is interpreted that a student who does not attend any class sessions after Saturday of the first week and who notifies the College of his intent to cancel registration on or before the second Saturday following the first day of classes will be considered to have canceled his registration during the first week.

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

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

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

Notwithstanding any other provisions for refund, when a student has withdrawn through circumstances beyond the student's control, under conditions in which the denial of refund would cause undue hardship, the Chief Administrative Officer of the unit may, at his discretion, determine that no liability for tuition has been incurred by the student, provided the student has not completed more than one half of the term and has not received or will not receive academic credit for the term. Such action, including the reason for withdrawal, must be in writing.

FINANCIAL ASSISTANCE

The College of Environmental Science and Forestry offers four basic forms of student financial assistance: scholarships or grants, part-time employment, long-term loans, and assistantships for graduate students. These 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 *Financial Assistance at ESF*, a separate publication which is mailed to all applicants, and is available to the public by contacting the Office of Financial Aid.

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 student problems. All students are encouraged to apply for financial aid.

HOW TO APPLY

Each year students interested in receiving financial assistance, *except for graduate assistantships*, must complete the application process. (Graduate students who wish to be considered for a graduate assistantship refer to page 25, and follow those instructions.) *Two forms are necessary to apply:*

1. The candidate must complete a College Aid Application and Financial Aid Transcript and return it to the Office of Financial Aid by MARCH 15. The application is included in the publication, *Financial Assistance at ESF*. Applications will be accepted after March 15; it should be noted, however, that available funds may already be committed to other students. Applicants need not wait for notification of acceptance to the College before applying for financial aid.

2. The candidate must also complete and submit by February 15 the Family Financial Statement (FFS) to the American College Testing Co., Iowa City, Iowa. The FFS is available in the College's Office of Financial Aid, high school guidance offices, and most college financial aid offices.

Students are invited to discuss with the professionals in the Financial Aid Office any problems in financing their education.

This application information is based on current requirements, and financial aid systems and forms are undergoing constant change. Applicants are urged to contact the Office of Financial Aid for the latest information and requirements.

SELECTION OF RECIPIENTS

In making award decisions, consideration is given primarily to comparative financial need; however, scholastic standing, character, and potential contribution to the College community are also factors in making certain awards.

Retention of Awards—State

All students who are awarded financial assistance will be required to maintain satisfactory academic progress each semester in order to keep their awards. Satisfactory academic progress for all programs, *except New York State* (TAP, Regents, etc.), is defined on page 23 of this catalog.

Recipients of a New York State award must adhere to the following State requirements:

(1) Academic Progress—A student will need to read the stated minimums on the following charts to be eligible for the next semester award.

Standard of Satisfactory Academic Progress for Purpose of Determining Eligibility for State Student Aid
All Campuses—State University of New York

Calendar: Semester — Programs: Associate Degrees and Certificate Programs

Before being certified for this payment,	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
a student must have accrued at least this many credits,	0	3	9	18	30	45	60	75
with at least this grade point average.	.0	.5	.75	1.3	1.5	1.7	2.0	2.0

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.

Calendar: Semester — Program: Baccalaureate Degree

Before being certified for this payment,										
a student must have accrued at least this many credits,	0	3	9	18	30	45	60	75	90	105
with at least this grade point average	0	.5	.75	1.20	1.40	1.50	1.60	1.70	1.80	1.90

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.

Calendar: Semester — Programs: All Graduate Level Programs except Professional

Before being certified for this payment,	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
a student must have accrued at least this many credits,	0	6	12	21	30	45	60	75
with at least this grade point average.	0	2.0	2.5	2.75	3.00	3.00	3.00	3.00

(2) Program Pursuit—Students must complete a minimum number of semester hours each semester. *A.A.S. Degree students* are required to complete 75 percent of the full-time load. Full-time is defined as 12 credit hours. Therefore, .75 × 12 = 9. Nine credit hours must be completed each semester.

Bachelor, Master, and Ph.D. students must complete 100 percent of full-time load each term. Full-time is 12 credit hours. Therefore, students must register for and complete at least a minimum of 12 credit hours each term.

Waivers

Should a student fall below the requirement, he/she may apply for a waiver. Students are allowed *only one* waiver during undergraduate work and *only one* during graduate work. The issuance of the waiver will be granted only after the student and the institutional waiver designee have mutually concurred that such issuance is in the best interest of the student. Request for a waiver is made through the Vice President of Student Affairs.

Calendar: Academic Year — Program: Associate Degree

Academic years completed at ESF	2	3
A student must have successfully completed this number of credit hours	45	76
with at least this cumulative grade point average	2.000	2.000

Calendar: Academic Year — Program: Baccalaureate Degree

Academic years completed at ESF	3	4	5	6
A student must have successfully completed this number of credit hours	70	100	130	160
with at least this cumulative grade point average	2.000	2.000	2.000	2.000

Calendar: Academic Year — Program: All Master Level Programs

Academic year completed at ESF	1	2	3
A student must have successfully completed this number of credit hours	15	27	42
with at least this cumulative grade point average	3.00	3.00	3.00

Calendar: Academic Year — Program: All Ph.D. Level Programs

Academic year completed at ESF	1	2	3	4	5	6	7
A student must have successfully completed this number of credit hours	15	27	42	54	66	75	90
with at least this cumulative grade point average	3.000	3.000	3.000	3.000	3.000	3.000	3.000

Retention of Awards—Title IV

In order for students to be eligible for Title IV Federal Student Assistance (Pell Grants, Supplemental Educational Opportunity Grant, National Direct Student Loan, College Work-Study Program, PLUS), both undergraduate and graduate students must meet specified criteria.

The criteria that students must meet to be eligible for Title IV student aid is the same criteria *all ESF* students must adhere to with regards to institutional academic policies, and specifically academic progress towards their degree. The evaluation criteria are:

(1) Appropriate grade point average for satisfactory academic progress.
(2) Successfully accumulate credits towards their degree.
(3) Obtain their degree within the prescribed degree time limit. Time limits vary for individual programs and are illustrated on the adjacent charts.

Appeal/Probation/Reinstatement

Students who fall beneath the minimum standards may appeal through the College Academic Affairs Committee to retain their eligibility for receipt of Title IV Federal Student Assistance. (See Academic Dismissal p.26.)

These appeals should be evaluated for mitigating circumstances such as injury, illness, etc., and the reasonableness of the student's ability to move back up to the appropriate standard. If the College Academic Affairs Committee places a student on "academic probation," the student is still eligible for Title IV aid as defined by the statement of "Good Academic Standing" (p.26).

Notification

Students will be notified via certified mail of their individual circumstances if they fall below the standards, appeal loss of eligibility, or reinstatement of eligibility.

SCHOLARSHIP AND GRANT PROGRAMS (SEOG)

Supplemental Educational Opportunity Grants

The College is the recipient of funds authorized under Title IV-A of the Higher Education Act of 1965, as amended. These funds enable the College to award grants to undergraduate students who have financial need. Grants range from $200 to $2,000 per year.

ESF Educational Opportunity Grant Program (EOP)

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

Prospective Educational Opportunity Program students must apply for financial aid when submitting their admissions applications.

Pell Grants (Formerly Basic Educational Opportunity Grants)

The Pell (BEOG) Program was authorized in the Education Amendments of 1972. Grants are available to eligible full-time and half-time undergraduate students. The amount of the award can vary from $250 to $2,100.

Applications are available from high school guidance offices or any college office of financial aid. Students should submit the Student Aid Report (SAR) to the Office of Financial Aid as soon as it is received from the processor.

Regents Programs

Additional information and applications for the following programs are available from the College or:

New York Higher Education Services Corporation
Tower Building
Empire State Plaza
Albany, New York 12255

REGENTS COLLEGE SCHOLARSHIPS

High school students who are New York State residents may qualify for a $250 annual scholarship by taking a competitive exam during their senior year.

TUITION ASSISTANCE PROGRAM

These awards are available to New York State residents who are enrolled in full-time degree programs. Based on income, awards range from $300 to full tuition. Separate application is necessary.

REGENTS GRANTS OR CHILDREN OF DECEASED OR DISABLED VETERANS

These 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 award entitles a New York State resident to $450 per year.

Vocational Rehabilitation Grants

Financial assistance and program counseling are provided by New York State for students with disabling handicaps. Information is available from any Office of Vocational Rehabilitation.

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.

Additional information and counseling are available from the Veterans' Affairs Counselor at the College. Local veterans' administration offices, or the State

Regional Office, 111 West Huron Street, Buffalo, New York 14202, can provide information and application forms.

Social Security Benefits

The 1965 amendments to the Social Security Act extended the age limit for a child's benefits from 18 to 22, providing the child is a full-time student. Local Social Security offices have additional information. These benefits are slated to expire in 1985.

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 about the programs, 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, New York 12234.

Private Fellowships, Scholarships, and Grants

The College administers a number of programs which have been established by private individuals, companies, organizations and foundations. These scholarships and grant programs have varying eligibility requirements and are awarded to students according to their respective guidelines which are described in more detail in *Financial Assistance at ESF*. The following is a list of the programs: Alumni Memorial Awards; Alumni Educational Grants; Nelson Courtlandt Brown Scholarship Fund; Henry H. Buckley Student Aid Award; Simeon H. Bornt III Scholarhip Award; Eugene C. Reichard Scholarship Award; Walter Tarbox Memorial Scholarship; Warren Bennett Memorial Award; Wilford A. Dence Memorial Award; Meyer Environmental Chemistry Scholarship Award; Meyer Wood-Plastic Scholarship Award; Edward Aalbue Memorial Scholarship; Lt. Gary Scott Memorial Scholarship; Gerald H. Williams Scholarship; Mary E. Palmer Memorial Scholarship; Portia Farrell Morgan Scholarship; Phyllis Roskin Memorial Award; and Student Association grants.

Syracuse Pulp and Paper Foundation, Inc. Scholarships

Scholarships from this foundation are awarded to United States citizens who are students in paper science and engineering. The scholarship may amount to the recipient's annual tuition charge. Incoming transfer students entering the program may ascertain the award amounts currently being offered and request a Pulp and Paper Scholarship application from the Office of Financial Aid. It is necessary to reapply each year for the scholarship.

State University Supplemental Tuition Assistance

A limited number of small grant awards are determined annually by the College for students with financial need.

EMPLOYMENT OPPORTUNITIES

College Work-Study Program (CW-SP)

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 minimum wage and increase as duties and responsibilities increase.

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.

A part-time employment program is available to qualified veterans. More information is available from the Veterans' counselor at the College.

LOANS

National Direct Student Loans

These loans are available to students with financial need who are enrolled at least half-time. Amounts which can be borrowed are $3,000 for 2 years and $6,000 for 4 years with a maximum of $12,000, including graduate study. Repayment and 5 percent interest begin 6 months after leaving college. Deferment and cancellation benefits are available for certain situations.

Guaranteed Student Loans

This program is administered by the New York Higher Education Services Corporation (NYHESC) for New York State residents. These loans are available from a bank or other lending agent to students who are registered at least half-time. Undergraduates can borrow an aggregate of $12,500 for their undergraduate studies, and a graduate student can borrow an aggregate of $25,000. Repayment and 8 percent interest begin 6 months after leaving college (an additional 1 percent interest is paid at the time the loan is received). Applications are available at local banks.

Parent's Loan (PLUS)

Parents of students may borrow up to $3,000 annually and $15,000 overall, at an interest rate of 12 percent. Loan repayment begins 60 days after receipt of the loan. Total loans to parents and students cannot exceed total cost of education. Applications are available at local lending institutions.

Emergency Loans

The College is able to provide registered students interest-free, short-term loans (30 days). These loans are available because of the interest and support of the following donors: Alumni Association Short-term Loan Fund; David B. Schorer Memorial Fund; and Edward Vail Emergency Fund.

Students should contact the Office of Financial Aid when need arises for a short-term loan.

GRADUATE ASSISTANTSHIPS

Assistantships are awarded to students of demonstrated scholarship and whose education and experience enable them to assist in laboratory instruction and research. The amounts of the assistantships range from $4,800 to $9,000 per year. In addition, tuition may be waived. Students who hold an assistantship must be enrolled for full-time study.

Beginning graduate students may apply for assistantships on their application for admission, and continuing graduate students should consult with their major professors.

ACADEMIC POLICIES

The following academic policies are extracted from the complete undergraduate and graduate policies which are contained in the *Student Handbook*. The *Student Handbook* is available from the Office of Student Affairs, 104 Bray Hall.

UNDERGRADUATE AND GRADUATE POLICIES

Published Requirement

Students must satisfy the requirements for graduation in effect at the time of their first matriculation as a student. Students may graduate under the requirements stated subsequent to those in effect at their matriculation, but they may not use prior ones.

Attendance

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

Education 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:

"1. No person shall be expelled from or be refused admission as a student to an institution of higher education for the reason that he is unable, because of his religious beliefs, to attend classes or to participate in any examination, study or work requirements on a particular day or days.

"2. Any student in an institution of higher education who is unable, because of his 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.

"3. 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 his religious beliefs, an equivalent opportunity to make up any examination, study or work requirements which he may have 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.

"4. 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.

"5. 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 his availing himself of the provisions of this section.

"6. 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 his rights under this section."

Audits

Students may informally audit ESF courses 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 formally audit courses with the permission of their major professor and the course instructor. They may not be used to satisfy any graduation requirements. Formally audited courses will appear on the 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.

Withdrawal from ESF

Students who withdraw on or before the "drop date" for a semester will have their records marked "(date): Withdrawal." Courses will appear for that semester with the grade of "W."

Students who withdraw after the "drop date" for a semester, but before the semester ends, will have either "WP" (withdraw passing) or "WF" (withdraw failing) listed after each such course.

Students who withdraw from the College 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.

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 merely as an educational device designed to encourage greater effort on the part of students who appear to be having difficulty in meeting certain academic standards. 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 College Academic Affairs Committee.

UNDERGRADUATE POLICIES

Credit Hour Load

To be classified as full-time, an undergraduate 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.

Evaluation

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

Grade	*Definition*	*Grade Points*
A		4.0
A-	Excellent	3.7
B+		3.3
B	Good	3.0
B-		2.7
C+		2.3
C	Passing	2.0
C-		1.7
D	Minimum Passing	1.0
F	Failure	0
I/F	Unresolved Incomplete	0

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
SAU	Audit (Satisfactory)
UAU	Audit (Unsatisfactory)
I	Incomplete

Grade Point Averages

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

Academic Honors

PRESIDENT'S LIST

Students who carried 12 or more credits of coursework graded "A - F" and earned a minimum grade point average of 3.00 will be placed on the President's List for that semester.

Graduation Honors

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

A minimum of 30 credits of ESF and Syracuse University courses have been completed as a matriculated, upper-division student.

A grade point average of: 3.00 - 3.33, *cum laude*; 3.34 - 3.82, *magna cum laude*, 3.83 - 4.00, *summa cum laude*.

Academic Dismissal

Undergraduate students who earn less than a 2.00 cumulative grade point average shall have their records reviewed by the appropriate Collegewide faculty committee which may delegate this authority. Based upon this review, students with less than this minimum cumulative grade point average will be placed on either academic probation or dismissed from ESF. The decision on probation or dismissal will be based upon an overview of the total academic record and the mathematical possibility for attaining a 2.00 cumulative average by the projected graduation date.

When extraordinary conditions contributed to the academic dismissal of students, such students may submit a written appeal to the dismissal decision to the Office of Academic Programs. These appeals will be reviewed by the appropriate faculty committee which will decide either to sustain the dismissal or place the students on probation. There is no appeal beyond this committee.

Students who have been dismissed for academic performance may not reapply until at least one semester has elapsed.

Students dismissed a second time for academic performance may not again be considered for readmission.

Graduation Requirements

Undergraduate students are responsible for meeting the following requirements for graduation:

A. Matriculated status as an undergraduate student.
B. All course requirements must be satisfied.
C. A minimum cumulative grade point average of 2.00 (4.00 = A) for all courses taken as a matriculated student at ESF.
D. At least 24 of the last 30 credits must be registered through ESF.
E. Consistent with the State Education Department requirements, a total of at least 120 credits from courses accepted as transfer credit by ESF and courses successfully completed while a matriculated student at ESF.

Graduation Rate

Of the transfer students who began their studies in the fall of 1981 at ESF, 77 percent received their degree, or continued in a five-year program, after four semesters of study. For those who began in the fall of 1982, approximately 80 percent received their degree, or are continuing in a five-year program, after four semesters of study. Further information on student retention is available from the Office of Academic Programs at ESF.

GRADUATE POLICIES

Master's Credit Hours

A minimum of 30 credit hours of graduate level work is required for the master's degree. This degree shall represent completion of at least one academic year of graduate-level study or an equivalent that can be shown to accomplish the same goals.

Doctoral Credit Hours

For the doctorate, credit hour requirements vary depending on the student's background and specific degree program. Early in a student's program the coursework requirement will be established which is intended to provide the student with the required level of competency to satisfactorily complete the doctoral candidacy examination. The doctorate shall represent completion of at least three full-time academic years of graduate study beyond the baccalaureate degree or an equivalent that can be shown to accomplish the same goals.

Doctoral Research Tool Requirement

There is no Collegewide requirement for languages or other tools of research for doctoral students. However, the faculty of any program may establish such requirements.

Time Limit

Students must complete all requirements for the master's degree within three years of the first date of matriculation. For the doctoral degree, students must complete all requirements for their degree within three years of satisfactory completion of the doctoral candidacy examination or they will be required to retake the candidacy examination.

Credit Hour Load

A graduate student must be registered for at least one credit each semester, excluding summers, from the first date of matriculation until all degree requirements have been completed. Failure to register will indicate the student no longer wishes to pursue a graduate degree.

Although there is no full-time requirement for degree purposes, there is such a requirement for those who qualify for a tuition waiver and for some other forms of financial support. For these students the following definition applies:

With a master's degree, or the completion of 24 or more credits after the bachelor's degree, students holding an assistantship are considered full-time if they are registered for nine or more credits. All other students are considered full-time if they carry 12 or more credits. All graduate students in landscape architecture must carry 12 or more credits to be considered full-time.

Evaluation

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

Grade	*Definition*	*Grade Points*
A		4.0
A-	Excellent	3.7
B+		3.3
B	Passing	3.0
B-		2.7
C+		2.3
C	Minimum Passing	2.0
C-		1.7
F	Failure	0
I/F, I/U	Unresolved Incomplete	0

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
U	Unsatisfactory
SAU	Audit (Satisfactory)
UAU	Audit (Unsatisfactory)
I	Incomplete

Grade Point Averages

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, i.e., all courses graded "A - F."

Master's Study Integration

Students enrolled in a master's degree program are required to demonstrate the ability:

A. to critically evaluate, organize, analyze, and synthesize the coursework and other components of their program of study;
B. to relate these components to current concepts and issues in their chosen field and associated disciplines;
C. to work logically and independently; and
D. to communicate effectively.

Master's study integration requirements may be met by successful completion of one of the following three options. The faculty of any program may limit the number of permissible options for its students. As permitted by their program, students will choose and follow one option with the approval of their major professor and with the guidance of their steering committee. Each option must be designed to satisfy the above requirements.

OPTION 1. THESIS OR PROJECT AND DEFENSE

Scope. Under this option, in addition to completion of necessary coursework, students must prepare either:

1. a research-oriented thesis which investigates a problem that expands or clarifies knowledge in the field, with generalizable results, or
2. an application-oriented project which applies skills or techniques from the field to a specific problem.

Whichever is chosen, students are required to define an appropriate problem for investigation; review relevant information sources; develop a study design; collect, organize, analyze, and interpret data; and draw conclusions.

Product. The thesis or project must be documented in a thorough and appropriate format and style. It must be in a permanent form, which may consist of print or nonprint materials.

Credits. Students must satisfactorily complete 6 to 12 credits for the investigation leading up to completion of the document. These credits will be graded on an "S/U" basis. Students must register for the approved number of credits for their investigation sometime during the three-year limit for the master's degree. They may register for more than the approved number of credits for their investigation, but the excess credits may not be used to fulfill the minimum 30 credits required for the master's degree.

Defense Examination. The thesis or project must be successfully defended.

OPTION 2. ACADEMIC OR PROFESSIONAL EXPERIENCE AND MASTER'S COMPREHENSIVE EXAMINATION

Scope. Under this option, in addition to completion of necessary coursework, students must engage in an academic or professional experience which applies, enriches, and/or complements the more formal coursework of their plan of study. This option might include, but not be limited to, an internship or an independent study experience. Whatever the form of the option, its objectives, organization, procedure, and manner of documentation must be submitted in writing and be approved by the student's major professor and steering committee before the experience is begun.

Product. This experience must be reported in a thorough and appropriate format and style. It need not be in a permanent form.

Credits. Students must satisfactorily complete 6 to 12 credits for this experience. These credits will be graded on an "S/U" basis. Students must register for the approved number of credits for their experience sometime during the three-year time limit for the master's degree. They may register for more than the approved number of credits for their experience, but the excess credits may not be used to fulfill the minimum 30 credits required for the master's degree.

Master's Comprehensive Examination. At the completion of their plan, students must successfully pass a comprehensive examination covering the major field, allied fields, and the content of their completed experience.

OPTION 3. COURSEWORK AND MASTER'S COMPREHENSIVE EXAMINATION

Scope. Under this option, students must satisfactorily complete a minimum of 42 hours of graduate level coursework appropriate to their field of study. As in other options, the design and sequencing of the coursework plan must be conducted with the guidance and approval of the student's major professor and steering committee.

Product. No product is required beyond that required for individual courses.

Credits. Students must satisfactorily complete a minimum of 42 credits of graduate level coursework. Students must complete these required credits sometime during the three-year time limit for the master's degree.

Master's Comprehensive Examination. At the completion of their plan, students must successfully pass a comprehensive examination covering the major field and allied fields.

Doctoral Thesis

Nature and Purpose

A thesis must be completed and successfully defended in order for the doctoral degree to be awarded. The doctoral thesis is the final and most important component of the series of academic experiences which culminate in the awarding of the Ph.D. degree. Three major functions are fulfilled by the thesis experience: (1) It is a work of original research or scholarship which makes a contribution to existing knowledge; (2) It is an educational experience which demonstrates the candidate's mastery of research methods and tools of the specialized field; and (3) It demonstrates the student's ability to address a major intellectual problem and arrive at a successful conclusion.

Examinations

Doctoral Preliminary Examination

An examination may be required of those admitted into a doctoral program to ascertain their level of understanding of the basic principles and techniques necessary to function effectively in that program. The results of the preliminary examination will be used to guide the major professor and the student in determining the appropriate coursework necessary to complete that requirement for the doctorate.

The format for the examination will be determined by the faculty in the program involved. It is recommended that the examination be primarily written with a supplemental oral presentation. When a preliminary examination is required, it should be conducted as early as possible in a student's program, at least before the completion of the student's second semester.

Doctoral Candidacy Examination

A student admitted into a doctoral program must satisfactorily complete a candidacy examination covering the major field and, in a broader manner, allied fields in order to be advanced into the status of doctoral candidate.

The purposes of the doctoral candidacy examination are to determine the student's knowledge of factual material and ability to use this knowledge creatively and intelligently.

The doctoral candidacy examination must be taken when the majority of coursework is completed but before the student begins serious thesis investigation. The candidacy examination must be passed at least one year before the student may present a thesis for defense.

Defense Examination for Thesis or Project

All graduate students who are required to complete a thesis or project must successfully defend it and have it accepted by the College.

The purposes of the defense examination are to determine the validity and significance of the data; and evaluate the student's understanding of investigative methods, ability to critically analyze data, and ability to relate the study results to the appropriate field and to more general scientific principles and knowledge.

Academic Dismissal

Graduate students who earn less than a 3.00 cumulative grade point average or who earn two grades of "U" shall have their records reviewed by the College Academic Affairs Committee, which may delegate this authority. Based upon this review, students either will be placed on academic probation or will be dismissed from ESF. The decision on probation or dismissal will be based upon an overview of the total academic record, the mathematical possibility for attaining a 3.00 cumulative average by the projected graduation date, and the recommendation from the major professor, program coordinator, and school dean or program director.

When extraordinary conditions contributed to the academic dismissal of students, such students may submit a written appeal to the dismissal decision to the Office of Academic Programs. These appeals will be reviewed by the College Academic Affairs Committee, which will decide either to sustain the dismissal or place the students on probation. There is no appeal beyond this committee.

Students who have been dismissed for academic performance may not reapply until at least one semester has elapsed.

Students dismissed a second time for academic performance may not again be considered for readmission.

Graduation Requirements

Graduate students are responsible for meeting the following requirements for graduation:

A. The student must be in a matriculated status as a graduate student.
B. The approved academic plan for each student must be completed within the applicable time limit.
C. For the doctoral degree, the student must be admitted to candidacy and a thesis completed and successfully defended.
D. A minimum cumulative grade point average of 3.00 (4.00 = A) for all graduate level courses taken during the program of study at ESF must be achieved.
E. Consistent with the State Education Department requirements, a total of at least 30 graduate credits is required for the master's degree and, for the doctorate, at least three full-time academic years of graduate study beyond the baccalaureate degree or an equivalent that can be shown to accomplish the same goals.

STUDENT LIFE

HOUSING

The College of Environmental Science and Forestry does not operate its own residence facilities or food service. Students enter into a Room and Board Contract with Syracuse University, which has housing facilities available adjacent to the State-operated College. Contracts for room and board made with Syracuse cover a *full academic year* (both fall and spring semesters) and are not normally renegotiable during that time period.

Students have a choice of living centers at Syracuse University—large halls, apartment houses, cottages, fraternities and sorority houses, or cooperative units. Student resident advisors live on each floor or in each unit and are available for counseling, advisement, and referral services.

Syracuse University also has housing units available for married students and their families.

Students who wish to live off campus may contact Alternative Action Services (ALTERACTS), a student-run housing organization at Syracuse University. An extensive listing of available housing in the Syracuse area is provided free of charge.

FOOD SERVICE

Syracuse University offers different meal plans to help meet the varying nutritional needs and interests of individual students. Students living in University apartments, co-ops, fraternities and sororities or off-campus can take advantage of the board plans available. Students living in dormitories and area housing without full kitchen services are required to subscribe to a board plan.

The College does not provide a food service program. However, a snack bar, located in the basement of Marshall Hall, is open 8 a.m. to 3:30 p.m. weekdays during the academic year.

EXTRACURRICULAR ACTIVITIES

Students at the College of Environmental Science and Forestry have many extracurricular activities to choose from, both on campus and in the community.

At the College

The *Undergraduate Student Association* (USA) and the *Graduate Student Association* (GSA) are the official representative bodies on campus governing student activities. Undergraduate and graduate students elect representatives from each school to manage the affairs of their respective organizations and the concerns of their constituents.

Campus organizations offer students an opportunity to broaden their knowledge and meet other students with similar personal and academic interests. These include such groups as: the *Bob Marshall Club*, an organization of students concerned about the future of the Adirondack Mountains; the *Forestry Club*, the traditional sponsor of the intercollegiate Woodsmen's Team; *Botany Club*; *Forest Engineers Club*; *Mollet Club*, an organization of landscape architecture students; *Papyrus Club*; and the *Recycling Club*.

Other groups on campus include *Saengerbund*, the College singing group; and *Alpha Xi Sigma*, senior honorary society. There are also student chapters of the *Wildlife Society*, the *Society of American Foresters*, the *American Chemical Society, the American Fisheries Society*, the *American Water Resources Association*, the *Forest Products Research Society, the American Society of Landscape Architects*, the *Associated General Contractors, Society of Wood Science and Technology*, and the *Technical Association of Pulp and Paper Industries (TAPPI)*.

The two major student publications at ESF are the *Knothole*, a weekly newspaper, and the *Empire Forester*, an annual yearbook which has won several awards in past years.

Recent GSA-sponsored activities include a lecture series, a traditional fall picnic, and various social functions designed to encourage interaction between graduate students and College faculty.

At Syracuse University

Students at the College of Environmental Science and Forestry have all the privileges of Syracuse University students: participation in student government, organizations, sports, and other extracurricular activities.

Men and women at the College participate in all Syracuse University intercollegiate sports, club sports, and intramurals. Archbold Gymnasium on the Syracuse University campus is the center of athletics and physical education. Additional indoor facilities are provided through Manley Field House and the Carrier Dome which is the site of Syracuse University home football and basketball games. Facilities at Skytop recreation area include a lodge, and 22 tennis courts. The Women's Building offers instructional, social, and recreational facilities. All full-time undergraduate women are eligible to participate in intercollegiate competition in tennis, field hockey, volleyball, basketball, swimming, and diving.

Students are provided with many opportunities for acquiring musical training and performing experience through the Syracuse University Band, (Symphonic Band, Wind Ensemble, Stage Band, Concert Band and Jazz Workshops), the Syracuse University Orchestra, and the Syracuse University Chorus.

Membership is allowed in all Syracuse University student groups, including a wide variety of clubs, the International Student Association, religious and military

organizations, and professional and honor societies.

In the Syracuse Area

The City of Syracuse and its surrounding countryside offer many cultural, educational, and recreational opportunities. The city has several fine museums, including the Everson with its outstanding collection of works by local, regional, and international artists; a local repertory theater; several points of historical interest; a professional symphony orchestra; and a Civic Center which attracts artists from around the world.

Eight parks lie within the city limits, numerous county and state parks, including Beaver Lake Nature Center and Montezuma National Wildlife Refuge are within a short drive.

COLLEGE SERVICES

Career and Counseling Services

The Office of Career and Counseling Services is available throughout the students' college career as a place where at any time they may seek the advice of experienced counselors. This office should be the first contact when questions or personal problems arise. Most student problems can be dealt with in one or two brief contacts. Severe problems requiring extensive assistance are referred to the cooperative facilities at Syracuse University and/or specialized agencies in Syracuse.

The Office is designed to provide assistance to students throughout the year to help them adjust to and successfully graduate from ESF. Through various presentations, counseling sessions, group activities and workshops, students are given the opportunity to develop such skills as decisionmaking, studying, and test taking. Additional programs deal with adjustments related to transferring colleges and exploring relationships between academic pursuits and career objectives. Special efforts are made to assist students identified as having academic difficulties, learning disabilities, or adjustment problems. A key component of this office is to provide a variety of opportunities through resource materials, presentations, job development, and counseling to meet the individual needs of each student at his/her various stages of career readiness. Some career services offered through this Office are skills development workshops; list of full-time, part-time, and summer jobs; on campus recruiting; company literature; career newsletters; reference information; and an alumni job list.

Each year this office conducts a Placement Survey to monitor the success and progress of our college graduates. The reports are shared with the college community and made available to the public upon request.

Since 1983, placement statistics for ESF graduates, 6-9 months past graduation, have not varied significantly. On the average 78 percent of the graduates are employed, 14 percent are continuing their education, and 8 percent are available for employment.

More detailed information is available in the Office of Counseling and Career Placement in Room 107, Bray Hall.

Services for the Handicapped

Students who experience short-term handicaps and/or incapacitating injuries that need special transport or classroom assistance should contact the Office of Student Affairs.

The Office of Administration and Services, assisted by Student Affairs, also provides specialized support services and adapts general resources to assist more permanently handicapped students to obtain maximum academic, social, and cultural benefits within the College community. Some of the specific services provided or made available include: pre-admissions guidance, orientation, mobility training, reader recruitment, preferential housing assignments, tutoring and other supportive services as required to meet individual living/learning needs. The College is also prepared to respond to handicapped students' needs for personal and career counseling and job placement assistance.

For further information, contact the ESF 504 Coordinator, Mr. David G. Anderson, Office of Administration and Services, Room 209, Bray Hall (315) 470-6622. The College maintains liaison relationships with rehabilitation agencies within the local community and the state, including the Office of Vocational Rehabilitation and the Commission for the Visually Handicapped. For specific information regarding their own eligibility, students should contact the respective agency directly.

Health and Medical Facilities

Students may consult a physician for medical care or health advice at the Syracuse University Student Health Service. Full-time students are entitled to unlimited visits to the out-patient clinic and also 10 days of confinement per college year with ordinary medical care in the infirmary. Infirmary usage over 10 days will be at prevailing infirmary rates. Some laboratory examinations, if necessary for treatment or diagnosis of common illness, are provided without cost. Most common legal drugs are provided at a minimal charge.

A student accident or sickness insurance plan, available at fall registration, not only supplements the usual infirmary privileges, but is also a health protection plan during the summer months when students are not under the care of the Health Service. Married students with dependents who are not covered by Health Service privileges are strongly urged to provide themselves and their families with special insurance made available to University students. *All international students are required to carry health and accident insurance.*

SU Speech and Hearing Clinics

The Gebbie Speech and Hearing Clinics provide remedial assistance to all regularly enrolled students who may be handicapped by hearing, speech, and voice disorders. This service is free to students.

SU Psychological Services and Research Center

Students desiring an analysis of their aptitudes, abilities and interests may secure special testing programs at the Testing and Evaluation Service Center on the Syracuse University campus.

SU ROTC Opportunities

Students attending the College are eligible to participate in the Army or Air Force ROTC Program at Syracuse University.

ROTC at Syracuse University consists of both 4- and 2-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 six-week and four-week camps and on-campus programs are available to suit individual needs.

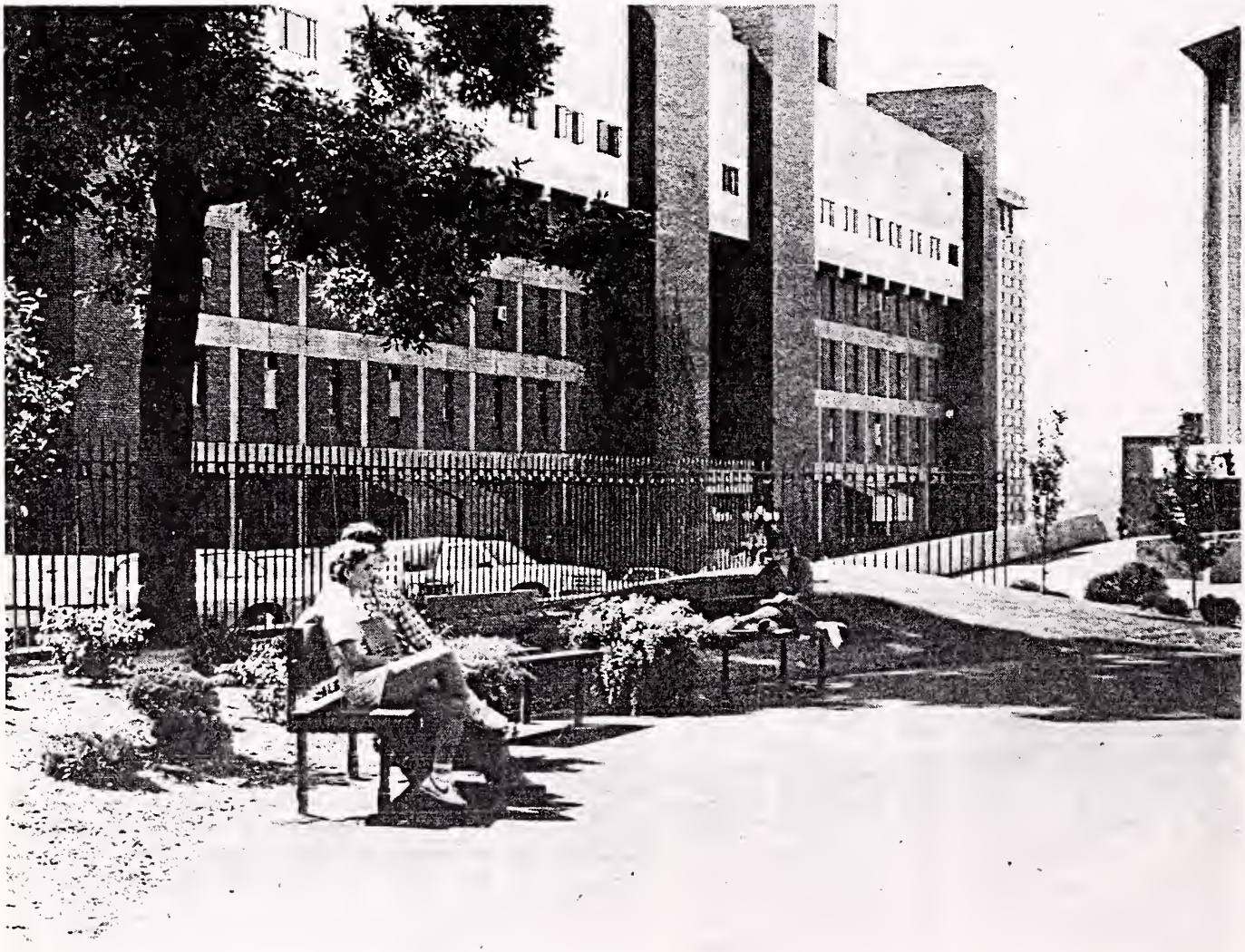
The ROTC programs offer academic instruction, alternate and supplementary career opportunities, leadership experience and financial aid.

ESF Alumni Association

The Alumni Office serves as the liaison between the College, the Alumni Association Board of Directors and more than 9,000 alumni. The Association supports education programs through scholarships, publishes a quarterly newsletter and represents alumni concerns.

ESF Student Rules and Regulations

The complete listing of guidelines for all students attending ESF is found in a separate publication, the *Student Handbook*, which is distributed at registration. "Rules and Regulations of Conduct and Behavior" which pertains to all students is included in the *Handbook*. It is the student's responsibility to be familiar with these regulations and abide by them.



Degree Programs and Areas of Study

The College is authorized to award degrees in the following programs. Enrollment in other than registered or otherwise approved programs may jeopardize a student's eligibility for certain financial aid programs.

School of Biology, Chemistry and Ecology

Chemistry; B.S., with areas of study in biochemistry, natural products chemistry, environmental chemistry, or natural and synthetic polymer chemistry. (HEGIS CODE 1905)

Forest Chemistry; M.S., Ph.D., with areas of study in biochemistry, natural products chemistry, environmental chemistry, or natural and synthetic polymer chemistry. (HEGIS Code 1905)

Environmental and Forest Biology; B.S., M.S., Ph.D., with areas of study in ecology, entomology, environmental physiology, fish and wildlife biology and management, pathology and mycology, pest management, plant science, soil ecology, or zoology. (HEGIS Code 0499)

Interdepartmental area of study in chemical ecology; M.S., Ph.D.

School of Forestry

Forest Technician Program; A.A.S. (HEGIS Code 5403)

Resource Management—General Forestry; B.S. (HEGIS CODE 0115)

Forest Resources Management; M.S. Ph.D., with areas of study in policy and administration, forestry economics, forest management, recreation management, silviculture, silvics, forest soil science, tree improvement, forest influences, international forestry, urban forestry, and quantitative methods. (HEGIS Code 0115)

School of Environmental and Resource Engineering

Forest Engineering; B.S. (HEGIS Code 0999)

Paper Science and Engineering; B.S. (HEGIS Code 0999)

Wood Products Engineering; B.S., with options in building construction, or forest products in which emphasis may be chosen in marketing, production systems engineering, or wood science. (HEGIS Code 0999)

Environmental and Resource Engineering; M.S., Ph.D., with areas of study in forest engineering, paper science and engineering, or wood products engineering. (HEGIS Code 0999)

School of Landscape Architecture

Environmental Studies; B.S. (HEGIS Code 0201)

Landscape Architecture; B.L.A. (HEGIS Code 0204)

Landscape Architecture; M.L.A., with areas of study in social/behavioral studies, natural/physical applied sciences, or design process, methods and management. (HEGIS Code 0204)

Collegewide Program

Graduate Program in Environmental Science; M.S., Ph.D., with areas of study in energy, environmental communications, land use, urban ecosystems, waste management, and water resources. (HEGIS Code 0420)

THE SCHOOL OF BIOLOGY, CHEMISTRY AND ECOLOGY

STUART W. TANENBAUM, *Dean*

The School of Biology, Chemistry and Ecology offers two curricula through the Department of Environmental and Forest Biology and the Department of Chemistry.

ENVIRONMENTAL AND FOREST BIOLOGY

ROBERT L. BURGESS, *Chairman*

The Department of Environmental and Forest Biology provides students with a firm foundation in basic biology forest ecosystem dynamics, and environmental science. It encompasses a variety of interconnected disciplines concerned with living systems, and treats 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.

The critical importance modern society places upon the utilization of natural resources and the quality of our environment adds new and increasingly diverse dimensions to the services a well-trained biologist can render. The department is committed to meet this dynamically changing array of opportunity through diverse courses enriched by an active program of research that focuses upon upper-level undergraduate and graduate study. Through the addition of selected electives to a required core, undergraduates may focus their program toward a special biological field (see p. 35) or toward future graduate study. Graduate students may develop a course of study under the guidance of a major professor and graduate committee within any of several study concentrations (see p. 35).

The academic programs stimulate interest in the recognition and understanding of plants, animals, and protists, and deal with an understanding of the dynamic changes in biological systems in the context of the broad fields of ecology, physiology, evolution, and genetics. This is accomplished by an integration of coursework with a strong research program, much of which is concerned with natural resource management and improvement of the quality of our environment.

Undergraduate Program

The curriculum for the Bachelor of Science degree is built around a core of required courses which provide the

student with a general education, a basic background in the principles of the biological and the physical sciences, and an orientation to forestry. Its design develops breadth in biology as well as depth in a selected biological field. Thus, although individual course selections may vary, all students major in environmental and forest biology and each, with an assigned advisor, develops a special plan of study.

A dual-major program is available that meets the undergraduate requirements of both the School of Forestry and the School of Biology, Chemistry and Ecology (see p. 63).

A total of 125 credit hours, 60 of them prior to matriculation, is required for the Bachelor of Science degree. In addition to the core courses specified below, at least 21 hours in biology must be completed and, of these, at least 15 must be from courses in the College of Environmental Science and Forestry. Six of the 21 credit hours must involve subject matter in plant science and six in animal science, both exclusive of the five-hour summer field requirement. The balance of the required hours is chosen in consultation with the advisor.

Lower Division Courses

The curriculum facilitates transfer of freshman and sophomore credits from other institutions. To assume training in residence at the junior level, entering students must have successfully completed a minimum of 60 credits which include:

Course Area	*Credit Hours*
General Chemistry with Laboratory	8
Organic Chemistry with Laboratory	8
General Physics with Laboratory	8
Mathematics proficiency, through Integral Calculus	4-8
English	6
*Social Sciences—Humanities	9-12
General Botany and Zoology **OR** General Biology with Laboratory	8
Biology Electives	3-6
TOTAL MINIMUM LOWER DIVISION CREDITS	60

*A course in technical writing and/or speech is recommended as part of the Social Science—Humanities group.

Upper Division Courses

Junior Year			*Credit Hours*
First Semester	EFB 336	Dendrology I	3
	EFB 320	General Ecology	3
	EFB 352	Elements of Forest Entomology	3
	Electives		6
			15
Second Semester	APM 491	Introduction to Probability and Statistics	3
	FOR 345	Soils **OR** GOL 105 Earth Science	3
	EFB 325	Cell Physiology	3
	Electives		6
			15
SUMMER FIELD EXPERIENCE—Must be met as described on page 34			5

Senior Year			*Credit Hours*
First Semester	Electives		15
Second Semester	EFB 407	Principles of Genetics	3
	EFB 408	Genetics Laboratory	1
	Electives		11
			15
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

A total of 125 credit hours is required to complete the B.S. degree in Environmental and Forest Biology.

SUMMER FIELD EXPERIENCE

Between the junior and senior year, each student completes a minimum of five semester credit hours (or equivalent) during residence in an approved academic program in field biology. This requirement can be met by the appropriate selection of courses at the Cranberry Lake Biological Station (CLBS) where courses are offered during each of two sessions (see p. 35). Earning five credits at one session satisfies the requirement; any additional courses taken in the other session count as elective credits.

One of the following alternatives to the CLBS program may be selected to fulfill the summer field requirement:

Alternative 1

Students desiring an experience in the principles and practices of professional forestry may attend the Summer Session in Field Forestry at the Pack Forest, Warrensburg Campus. Field instruction at this Campus emphasizes subject matter in forestry, surveying, mensuration, and cartography.

Alternative 2

Other biological field stations may be attended to earn the minimum five semester hours credit (or equivalent). Petitions requesting this alternative must include course descriptions and the program contemplated and be submitted no later than one month prior to the end of the spring semester preceding the summer program. A current file of alternative stations and course descriptions is maintained by the director of the Cranberry Lake Biological Station.

Electives

General requirements for graduate study and a wide range of federal, state, municipal, and private biology positions are met by the curriculum. Through skillful selection of electives, the student may prepare for special biological fields related to natural resources or the environment. Those training for biological positions in federal and state service should review Civil Service publications and become familiar with specific course requirements early enough to make timely elective choices. Students are urged to use some elective time to enhance their communications skills. Courses in technical writing, applied communications or a language (as approved by their faculty advisor) are useful.

Special Biological Fields

Animal Physiology. Without further specialization, job opportunities in this field are limited, but those at the bachelor level include technician work in a laboratory, medical school, hospital, or in a liberal arts college; clerical work in government information agencies such as at the National Medical Library, and the Smithsonian Institution; and sales opportunities with the pharmaceutical and chemical industries.

Entomology. Insects play significant roles, both beneficial and detrimental, in their interactions with man, his resources, and his environment. Courses are available that enable a student to fulfill requirements of Civil Service and a variety of other employers. Program strengths are in forest entomology, medical entomology, pest management, and environmental toxicology.

Environmental Microbiology. Microbiology is a dynamic and exciting science that deals with bacteria, molds, algae, yeasts, protozoa, rickettsiae, and viruses: their roles in industry, disease, the environment, and everyday life. Careers in microbiology are available throughout the public and private sectors, and related to many different professions and industries.

Fish and Wildlife Biology and Management. A basic and applied program in fish and wildlife biology, including management and behavior, is provided for the student whose objectives are to develop professional skills in the biology and management of these natural resources.

Forest Pathology and Mycology. Protection of vascular plants and wood products from invading organisms, such as fungi, is basic to forest productivity, effective wood product use, and the maintenance of environmental quality. Program strength is in the ecological, physiological, genetic, and environmental aspects of disease. Students may train for positions in forest pathology, mycology, pest management, plant quarantine, or diagnostic laboratories. Opportunities for employment exist with federal, state, and private agencies.

Pest Management. Modern control of insects and disease dictates practices appropriate to maintaining an acceptable environmental quality. Through proper selection of courses, a student is able to achieve training that will result in wise selections of methods for an integrated approach to pest management. Training is more than adequate to prepare students for state examinations required for pesticide applicator's certification.

Plant Physiology. Plant physiology, part of the broader science of botany, concerns the life processes that occur in plants. Career opportunities are available in federal, state, and local governments through their extensive testing and monitoring programs. Additionally, positions are available in agriculture and forestry concerning pathogenic microorganisms and physiological mechanisms of infection.

Plant Science. Students may prepare for a wide variety of opportunities in the botanical professions. Essential to understanding plants are their biochemical and physiological processes; their interactions with the environment and with one another; with animals and other organisms; their genetic makeup, evolution and classification. Requirements may be satisfied for technical positions in areas such as botany, plant ecology, tree genetics, plant physiology, horticulture, tree maintenance, or plant quarantine.

Zoology. A broad program is provided for the student whose objectives are to go on for graduate study or to further training in such subjects as physiology, soil invertebrate ecology, animal behavior, or animal ecology. Some opportunities with federal and state agencies are available at the baccalaureate level.

Cranberry Lake Biological Station

Students in Environmental and Forest Biology satisfy their summer requirement by attending either session at the Cranberry Lake Biological Station. Courses at the Station are designed to come after the junior year spent on the Syracuse Campus. Students elect courses during one session for a total of five semester-hours. Extra credits earned by attending both sessions count toward elective hours in biology. Students from other institutions are welcome.

Cranberry Lake and its environs are ideally suited for an advanced biology summer program. The surrounding topography is rolling hill and lake country dotted with numerous small ponds, closed bogs, and stream drainages. The lake is the third largest body of water in the Adirondacks. Because 80 percent of the shoreline is in State ownership, the lake remains relatively unspoiled by recreational developments and pollution problems. Much of the original forest cover in the region was harvested years ago; today a rich variety of community types occupy those sites as the vegetation reverts to natural conditions. The remaining virgin forests also provide the student with many examples of stable forests, each type reflecting the particular environmental conditions controlling forest development. A wealth of wildlife parallels the variety of cover types over the region. The area provides easy access to a wide range of additional ecosystems ranging from bog to alpine types.

Facilities include four classroom-laboratories; dining facilities capable of serving 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 field trips each day into the surrounding forest and aquatic ecosystems.

Students wishing more information about the Summer Program, including courses and fees, may write to the Director, Cranberry Lake Biological Station, State University of New York College of Environmental Science and Forestry, Syracuse, New York 13210.

Graduate Program

The graduate program in Environmental and Forest Biology is organized in nine interdependent concentrations that provide comprehensive coverage within specific interest areas. Each concentration is governed by indicated faculty who define the scope of subject matter, recommend acceptance of students and guide them in a course of study. Some of these concentrations follow taxonomic lines while others are broad unifying areas basic to all taxa. Students choosing to emphasize a taxonomic category should explore the desirability of engaging to some extent in the broader interdisciplinary areas. Similarly, it is opportune for students

enrolled in the latter to develop a degree of specialization in at least one taxon to assure a useful mix of talents.

Most students seeking the M.S. degree include a research thesis and its defense. (see p. 27). There also is an option to earn the degree with 42 hours of coursework, the latter specified by the student's advising faculty according to concentration core requirements. All who seek the Ph.D. must include original research and dissertation or its equivalent in the form of refereed publications.

The major center of activity is Illick Hall, with the laboratories, classrooms, controlled spaces, and equipment that one would expect in a modern building in which 85,000 square feet of working space is available for graduate study and research. Laboratories, many of them temperature and temperature-humidity controlled, and one sound-controlled, are provided for study and research in plant development, physiology, tissue culture, biochemistry and toxicology, ecology, and animal behavior. An herbarium, mycological collections, insect and other arthropod collections, and the Roosevelt Wildlife Collection of vertebrates are maintained in archival condition as useful 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.

Also available to the Department's students and faculty is a variety of sophisticated instrumentation: convenient access to a computer center; radioisotope counting equipment, including liquid scintillation spectrometer and Cobalt-60 source; diverse analytical equipment and measuring devices; gas-liquid chromatography; and, in collaboration with the Chemistry Department, a comprehensive analytical expertise. The Nelson C. Brown Center for Ultrastructure offers scanning and transmission electron microscopy capability.

Supportive to the program are the academic resources, including courses, of Syracuse University, SUNY's Upstate Medical Center and the several campus facilities described elsewhere in this catalog. Our students participate as well in courses and utilize faculty and facilities at Cornell University in cooperative exchanges.

Excellent field sites and facilities are available for research in all aspects of the program in nearby or moderately distant locations from the Syracuse campus. 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 that collectively offer a variety of habitat diversity from highlands to aquatic-terrestrial zones. The ponds, streams, and lakes in Central New York and the St. Lawrence River are regularly used by graduate students in wetlands and aquatic ecology and fishery biology.

Further academic advantages stem from the urban setting of the Syracuse campus. The Greater Syracuse area provides a convenient laboratory for studies basic to urban ecology: the growth and protection of woody vegetation, green-space 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 study-in-depth of many elements of basic biology offering substantial assistance toward the solution of pressing human problems.

Of the nine available study concentrations, eight are contained within the department: *Ecology, Entomology, Environmental Physiology, Fish and Wildlife Biology and Management, Pathology and Mycology, Plant Science, Soil Ecology, and Zoology.* One concentration, *Chemical Ecology*, is shared with faculty of the Chemistry Department.

Ecology

ALEXANDER (Vertebrates, Wetlands), ALLEN (Forest Insects), BEHREND (Wildlife), BRANDT (Fisheries Biology), BROCKE (Wildlife, Bioenergetics), BURGESS (Forest Ecology), CHAMBERS (Wildlife), DINDAL (Invertebrates), GEIS (Plants, Wetlands), KURCZEWSKI (Insect Behavior), MITCHELL (Invertebrates, Bioenergetics), MÜLLER-SCHWARZE (Vertebrates, Behavior), NAKAS (Microbiology), PORTER (Vertebrate Ecology), RAYNAL (Higher Plants, Taxonomy), RINGLER (Aquatic Ecology), SCHAEDLE (Plant Nutrition), SHIELDS (Vertebrate Behavior), SIMEONE (Forest and Wood-boring Insects), VANDRUFF (Wildlife), WERNER (Limnology).

Understanding relationships between living organisms and their environment is fundamental to environmental science which also encompasses man's role in ecological systems. Ecology is an integrative science which depends on an understanding of ecological theory, habitat characteristics, and the basic biological attributes of organisms. This concentration incorporates this knowledge into areas of practical concern. Specific research may entail the study of distribution and abundance of organisms, community structure including trophic relationships, diversity or succession, and ecosystem properties such as patterns of energy transfer and biogeochemical cycling.

Entomology

ABRAHAMSON (Forest Insects, Pest Management), ALLEN (Forest Insects, Population Ecology), BREZNER (Physiology), CASTELLO (Virology, Insect Vectors), KURCZEWSKI (Morphology, Taxonomy, Behavior), LANIER (Forest Insects, Pheromones, Cytotaxonomy), MILLER (Pest Management), MITCHELL (Population Ecology), NAKATSUGAWA (Toxicology), NORTON (Spiders and Mites, Insect Larval Taxonomy), RINGLER (Aquatic Entomology), SIMEONE (Forest and Wood-inhabiting Insects).

Adjunct Faculty

CAMPBELL (Forest Entomology) HOWARD (Medical Entomology).

Graduate study opportunities prepare students in the basic aspects of insect life and the role of insects in relation to man and his 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 man and those playing key roles as parasites and predators of pest-species. Current research areas include population dynamics of forest defoliators, pheromone communications among beetles and moths, speciation of insects as understood through behavioral and cytogenetic study, natural control of insects in

forest systems and basic biochemistry of insect detoxification mechanisms.

Environmental Physiology

BREZNER (Insect Physiology), CASTELLO (Plant Virology), GRIFFIN (Fungus Physiology), HARTENSTEIN (Invertebrate Physiology), MITCHELL (Environmental Energetics), NAKAS (Microbial Physiology), NAKATSUGAWA (Insect and Vertebrate Toxicology), SCHAEDLE (Plant Physiology), WALTON (Plant Physiology), WILCOX (Plant Physiology).

The Environmental Physiology Concentration provides students with advanced training in the nature and control of biological processes. Current interests include mechanisms of action of plant growth hormones; biochemical regulation of seed germination; plant and microbial enzymology; virology; toxicity and disposition of insecticides and environmental toxicants in vertebrates; production and action of plant phytoalexins and antibiotics; plant defenses against phytophagous invertebrates; mycorrhizae, ion transport; mineral nutrition, cambial physiology and photosynthesis.

Fish and Wildlife Biology and Management

ALEXANDER (Vertebrates, Herpetology), BEHREND (Vertebrates), BRANDT (Fisheries Management), BROCKE (Vertebrates), CHAMBERS (Vertebrates), MÜLLER-SCHWARZE (Vertebrate Behavior); PAYNE (Ornithology), PORTER (Vertebrate Ecology), RINGLER (Fisheries, Aquatic Ecology), SHIELDS (Vertebrate Behavior), VANDRUFF (Vertebrates, Ornithology), WERNER (Limnology, Fisheries).

Study in this area provides students with advanced preparation in biological concepts of fish and wildlife populations as they relate to the proper management of these resources. Increasing concern for these wild animal resources has been matched by strong student interest in educational programs which 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.

Areas of research include population-habitat relationships, predator ecology, urban wildlife relationships, endangered species studies, feeding ecology of fishes, stream ecology, ecology of larval fishes and homing behavior of fishes.

Forest Pathology and Mycology

ABRAHAMSON (Forest Pathology, Entomology), CASTELLO (Forest Pathology), GRIFFIN (Fungus Physiology), MANION (Forest Pathology), NAKAS (Microbiology), VALENTINE (Genetics), WANG (Mycology), WILCOX (Mycorrhizae).

Forest Pathology and Mycology train students to develop an expertise responsive to the increasing pressures on forest and shade tree systems for wood fiber, public services, and amenities. This requires new sophisticated levels of disease understanding, disease control, a broad knowledge of fungi, bacteria and viruses, their environmental impacts and their roles in biodeterioration. Areas of interest include: environmental, fungal and viral tree diseases; mycorrhizae; wood decay and biodegradation processes; monitoring and impact assessment of disease in forest and urban tree systems; chemical and biological control of tree diseases; epidemiology of tree diseases and the genetics of resistance to tree diseases and to pathogen variability; physiology of fungus growth and development; taxonomy and biology of decay and imperfect fungi; and fungus ultrastructure.

Plant Science

BURGESS (Egology), CASTELLO (Virology), GEIS (Ecology), GRIFFIN (Mycology, Fungus Physiology), LOWE (Mycology), MANION (Pathology), NAKAS Microbiology), RAYNAL (Ecology, Taxonomy), SCHAEDLE (Physiology), SILVERBORG (Pathology), TEPPER (Anatomy, Morphogenesis), VALENTINE (Genetics), WALTON (Physiology), WANG (Mycology), WILCOX (Physiology, Mycorrhizae).

Adjunct Faculty

FAUST (Taxonomy), GOULD (Environmental Microbiology), ZABLOTOWICZ (Microbiology).

Plants, as the principal energy source for ecological food chains, serve as the structural and functional foundation of natural and managed ecosystems. The plant science concentration provides opportunity for study in a broad range of specialties fundamental to the understanding of plants and their interaction with other organisms, emphasizing both forest 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; decay, discoloration and biomodification of wood; taxonomy, physiology, growth and ultrastructure of fungi; heritability of wood properties and disease resistance of trees; biochemistry and physiology of plant growth regulators; photosynthesis; mineral nutrition; mycorrhizae; morphogenesis in shoot and root systems; and plant tissue culture.

Soil Ecology

DINDAL (Invertebrates), HARTENSTEIN (Invertebrates, Physiology), MITCHELL (Invertebrates, Energetics), NAKAS (Microbiology), NORTON (Invertebrates, Taxonomy), WANG (Mycology), WILCOX (Mycorrhizae).

Soil ecology includes the study of interrelationships of soil-inhabiting organisms (as individuals, populations and communities) with their biotic, chemical, and physical environments. This field is a frontier of science because of the myriad of undescribed species of soil-dwelling arthropods, nematodes and annelids, and the wealth of incompletely understood symbiotic relationships. Soil ecology deals with fundamental aspects of biodegradation and nutrient cycling, important for improvements in crop culture and enlightened waste disposal.

The soil ecology concentration is supported by courses in physical aspects of soils, plant and animal taxonomy and general ecology.

Zoology

ALEXANDER (Vertebrates, Wetlands), BROCKE (Vertebrates), CHAMBERS (Wildlife Ecology, Management), DINDAL (Invertebrates), HARTENSTEIN (Physiology, Invertebrates), MITCHELL (Invertebrates, Bioenergetics), MÜLLER-SCHWARZE (Vertebrate Behavior), NORTON (Arachnology), PORTER (Wildlife Biology), RINGLER (Fish Behavior), VANDRUFF (Vertebrates, Wildlife Biology), WERNER (Limnology, Aquatic Ecology).

Zoology provides opportunity for in-depth coursework and fundamental research in morphology, physiology, taxonomy, and behavior of invertebrate and vertebrate animals. Zoology is supportive of other concentrations such as Ecology, Fish and Wildlife Biology and Management, and Soil Ecology. Graduate studies include both basic and applied research on animals of our natural ecosystems, including their associated soils and waters.

FOREST CHEMISTRY

ANATOLE SARKO, *Acting Chairman* (Physical and Polymer Chemistry), BOYER (Biochemistry), CABASSO (Polymer Chemistry), CALUWE (Organic Polymer Chemistry), CAMPBELL (Phytoenzymology), HASSETT (Environmental Chemistry), JOHNSON (Environmental Chemistry), LALONDE (Organic and Natural Products Chemistry), SILVERSTEIN (Ecological Chemistry), SMID (Physical and Polymer Chemistry), SMITH (Physical and Polymer Chemistry), TIMELL (Wood Chemistry).

The academic program in forest chemistry enables the student to develop not only an understanding of chemical phenomena, but also an appreciation for chemistry that can link it to the biological and applied sciences. Programs include courses in traditional areas of chemistry, with additional study in those fields pertaining to environmental science and forestry. This broad spectrum of academic offerings is possible through close cooperation with Syracuse University, where a wealth of accessory courses at both the undergraduate and graduate levels are available. Emphasis on the investigative function of chemical science is manifest in the wide array of ongoing research projects within the department.

The Department of Chemistry offers the following areas of concentration leading to the Bachelor of Science degree:

Biochemistry and Natural Products Chemistry

Environmental Chemistry

Natural and Synthetic Polymer Chemistry

Students in all options, by selecting proper electives, may be certified on graduation as having completed an American Chemical Society approved curriculum. All options are excellent grounding for professional work at the B.S. level or for advanced graduate study.

Undergraduate Program

Lower Division Courses

For students transferring into the College as juniors, recommended courses consist of 68 credits or an associate degree and include:

Course Area	*Credit Hours*
Biology with Laboratory	8
General Chemistry with Laboratory	8
Organic Chemistry with Laboratory	8
Physics with Laboratory	8
Economics	3
English	6
Language, Literature or Communication	6
Electives	12-15
*Mathematics	6-9
TOTAL MINIMUM LOWER DIVISION CREDITS	68

*Mathematics through integral calculus. An additional mathematics course beyond integral calculus is required for the B.S. degree.

Upper Division Courses

Junior Year			*Credit Hours*
First Semester	FCH 325	Organic Chemistry III	4
	[3]CHE 332	Quantitative Analysis	2
	CHE 333	Quantitative Analysis Laboratory	1
	FCH 360	Physical Chemistry	3
	[1]Professional Elective		2-4
	Elective		3
			15-17
Second Semester	[2]Math or Elective		3
	FCH 380	Instrumental Methods	3
	FCH 361	Physical Chemistry	3
	CHE 357	Physical Chemistry Laboratory	2
	FCH 384	Spectrometric Identification of Organic Compounds	2
	[1]Professional Elective		2-3
	Elective		3
			18-19

[1]A sequence of professional electives should be chosen in the junior year. In addition to the freshman biology courses, a student whose emphasis is in biochemistry must take 3 semester hours of genetics and at least one other 3-semester-hour biology course. A student whose emphasis is in natural products must take 3 semester hours of biology in addition to the freshman biology courses and an additional hour of organic chemistry laboratory (FCH 496).
[2]One course of mathematics or applied mathematics beyond MAT 397, or equivalent, is required.
[3]CHE designations refer to courses offered at Syracuse University.

Biochemistry and Natural Products Chemistry Option

This option is designed for students who wish to approach problems in the life sciences with the tools and point of view of the chemist. In addition to a major concentration in the several branches of chemistry, the student obtains a solid grounding in the fundamentals of physics, mathematics, and biology. Professional electives can provide a minor concentration in botany, ecology, entomology, zoology, or physiology. Collaborative efforts of chemists and biologists are providing new solutions to problems of environment, natural resources, and health.

Senior Year — *Credit Hours*

First Semester	LIB 300	Library Research	1
	FCH 495	Introduction to Professional Chemistry	1
	FCH 571	Wood Chemistry I	2
	FCH 574	Wood Chemistry Laboratory	1
	FCH 530	Biochemistry I	3
	FCH 531	Biochemistry Laboratory	2
	[1]Elective		3
	Elective		3
			16
Second Semester	[2]FCH 498	Introduction to Research	5
	FCH 497	Undergraduate Seminar	1
	FCH 532	Biochemistry II	3
	FCH 573	Wood Chemistry III	2
	Elective		3
	Elective		3
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

[1]Introduction to Polymer Science, FCH 550 (3 credit hours) is suggested.
[2]Petition by student to Department for replacement of this requirement will be considered to allow time for special interest.

A total of 134 credit hours is required to complete the B.S. degree in Chemistry with the Biochemistry and Natural Products option.

Environmental Chemistry Option

The environmental chemistry option is designed for those students who wish to obtain a solid fundamental background in chemistry which will enable them to make a strong contribution towards the identification and solution of problems in the areas of pollution, air and water quality, analysis and basic research in environmental chemistry. A large number of professional electives, available through course offerings of other departments such as biology and engineering, provide the important interface with other disciplines necessary for a working understanding of the complex problems inherent in environmental studies.

Senior Year — *Credit Hours*

First Semester	LIB 300	Library Research	1
	FCH 495	Introduction to Professional Chemistry	1
	FCH 510	Environmental Chemistry I	3
	FCH 515	Methods of Environmental Chemical Analysis	3
	Chemistry Elective		3
	[1]Elective		3
	Elective		3
			17
Second Semester	[2]FCH 498	Introduction to Research	5
	FCH 511	Environmental Chemistry II	3
	FCH 497	Undergraduate Seminar	1
	FCH 519	Environmental Chemistry Seminar	1
	Electives		6
			16
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

[1]Biochemistry I, FCH 530, (3 credit hours) is suggested.
[2]Petition by student to Department for replacement of this requirement will be considered to allow time for special interest.

A total of 134 credit hours is required to complete the B.S. degree in Chemistry with the Environmental Chemistry option.

Natural and Synthetic Polymer Chemistry Option

This option is designed for students interested in the structure and physical properties of man-made and natural materials, the giant molecules of wood, plastics, polysaccharides, proteins, rubbers, and fibers. The recently discovered chemistry of these materials constitutes one-half the concern of the chemical industry and is the origin of a major revolution in our way of life and our understanding of nature. This special subject area is an advanced core of studies beyond the basic courses of the classical undergraduate chemistry curriculum.

Senior Year			Credit Hours
First Semester	LIB 300	Library Research	1
	FCH 495	Introduction to Professional Chemistry	1
	FCH 550	Introduction to Polymer Science I	3
	FCH 551	Polymer Techniques	2
	FCH 571	Wood Chemistry I	2
	FCH 574	Wood Chemistry Laboratory	1
	[1]Elective		3
	Elective		3
			16
Second Semester	[2]FCH 498	Introduction to Research	5
	FCH 552	Introduction to Polymer Science II	3
	FCH 497	Undergraduate Seminar	1
	FCH 573	Wood Chemistry III	2
	Electives		6
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

[1]Biochemistry I, FCH 530 (3 credit hours) is suggested.
[2]Petition by the student to Department for replacement of this requirement will be considered to allow time for special interest.

A total of 134 credit hours is required to complete the B.S. degree in Chemistry with the Natural and Synthetic Polymer option.

Graduate Program

Recent years have seen profound advances in the fundamental knowledge of chemical areas which have special significance for forestry and the environment. The following research areas have received active attention by both faculty and graduate students in the programs: polymer chemistry and physics; wood chemistry; environmental chemistry; biochemistry; chemistry of natural products, including ecological chemistry; and materials sciences.

Requirements for a master of science or doctor of philosophy degree in chemistry include a research project and thesis, along with an appropriate program of courses at the College and at Syracuse University.

Specific projects may vary from year to year, since they reflect the current interests of the faculty. Current research projects with *physiochemical* emphasis are: the chemistry, physics, solid-state and solution properties of natural and synthetic polymers, including studies in thermodynamics, statistical mechanics, crystallization, morphology, elasticity, conformation of macromolecules, optical properties, polymer catalysis, mechanism of polymerizations, polyelectrolytes, ion binding to macromolecules and ion pairing; chemistry of free radicals, radical ions and charge transfer processes; structure and properties of ionic solutions in nonaqueous media; crystal structure and morphology of cell wall constituents; membrane properties and technology; and heavy metal speciation. Current *organic* chemistry programs deal with synthesis of special polymers such as high temperature aromatic block, stereoregular vinyl polymers, and polysaccharides, various aspects of natural products isolation and synthesis including the characterization of insect and mammalian attractants. In *biochemistry*, department members are studying mechanisms of action of plant growth hormones and other biologically active natural products, biochemical regulation of growth and development, and plant enzymology.

Graduate research laboratories in the Hugh P. Baker Laboratory are well equipped for polymer studies, chemical, and biochemical research. Instrumentation includes analytical and preparative ultracentrifuges, Warburg respirometer, recording infrared and ultraviolet spectrophotometers, mass spectrometer, differential refractometer, electron spin resonance spectrometer, nuclear magnetic resonance spectrometers, automatic membrane osmometers, solid- and solution-state light scattering photometers, recording polarimeter and optical dispersion spectrometer, analytical and preparative high performance liquid chromatographs, combined gas chromatographs—mass spectrometry center, spectrofluorimeter, several ultramicrotomes, electron microscopes, X-ray diffraction, instrumentation chromatography and cold laboratories, and radiochemical laboratories with counters for solids, liquids, and gases.

INTERDEPARTMENTAL AREA OF STUDY

The following concentration in chemical ecology is offered in collaboration with faculties of the Department of Environmental and Forest Biology and the Department of Chemistry. Interested students should apply to the department of major interest, which will have prime responsibility for setting requirements. Faculty from both departments can aid in 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 to grapple with problems requiring an understanding of both.

Chemical Ecology

LANIER (Insect Pheromones), MÜLLER-SCHWARZE (Vertebrate Pheromones), SILVERSTEIN (Pheromone Chemistry), SIMEONE (Insect Pheromones), TANENBAUM (Microbial Chemistry).

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 occur at all taxonomic levels: between uni- and multicellular organisms, microbes and plants, plants and plants, plants and animals, microbes and animals, animals and animals. Study of such interactions has been accelerated in recent years through joint efforts of biologists and chemists in meaningful research accompanied by a growing body of literature.

THE SCHOOL OF ENVIRONMENTAL AND RESOURCE ENGINEERING

WILLIAM P. TULLY, *Dean*

The School of Environmental and Resource Engineering offers three undergraduate curricula and one graduate program which support the engineering aspects of environmental science and forestry through the Departments of Forest Engineering, Paper Science and Engineering and Wood Products Engineering. A Bachelor of Science degree is awarded in each of these fields while advanced degrees (M.S. and Ph.D.) are offered through the graduate program in Environmental and Resource Engineering.

The undergraduate curricula provide students with a broad base of study and specialized education in engineering, science, and technology. Students learn to apply their education to improve the economic use of forest and rural resources, to enhance environmental quality and to increase the efficiency of processes and the wise use of water and timber, wood, paper, and related fibrous material products. Graduates are prepared for a variety of careers in industry and government service in these fields.

The specific requirements for entering each curriculum at the junior level and for completing the coursework residency requirements for the B.S. degree are described with the individual departmental programs which follow. During late May the School offers a Summer Institute for pre-ESF students preparing to enroll in these curricula one or two years hence. Participants receive detailed academic guidance and learn about career opportunities.

Qualified applicants with associate degrees in engineering science or an appropriate blend of science and mathematics usually gain full admission at the junior level. Graduates of two-year technology programs also may qualify for junior standing in certain curricula if their previous studies included the courses appropriate to departmental requirements.

Graduate Program

The Graduate Program in Environmental and Resource Engineering is based on a synthesis of the professional activities of the three curricular areas described above. Both the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees are offered. The program provides students with a balanced understanding of scientific research, engineering measurement, and engineering analysis and design, and with specialized depth and appropriate interdisciplinary breadth of knowledge in environmental and resource engineering. Its graduates are prepared for professional careers as leaders in the private and public sectors of research, engineering, technology, teaching and administration in the industries and professions served by this program.

In its broadest sense this program is concerned with the application of science and engineering to the development and improved utilization of the natural environment and its forest-related resources. Thus, graduate education is understood to involve a wide range of scientific and engineering abilities and attitudes.

Specialized areas of study have been delineated to serve student interests. Within these areas of study, an individually-designed study program is developed for and with each student. A partial listing of specialized areas of graduate study and research include: wood science and technology, composite materials and wood treatments, wood biodeterioration and wood protection, design of timber structures, tropical timbers, anatomy and ultrastructure, pulp and paper technology, fiber and paper mechanics, chemistry of pulping and bleaching, colloid chemistry and fiber flocculation, chemical process engineering, pollution abatement engineering, forest engineering, water resources engineering, transportation and soils, energy and environmental quality, and remote sensing and photogrammetry.

Applicants to the graduate program in Environmental and Resource Engineering must meet general Collegewide requirements, have prior education or experience suitable for beginning advanced study in their chosen area of specialization and have a deep commitment to the advancement of the academic and professional aspects of their career goals. Some coursework deficiencies may be corrected within individual study programs.

Candidates for the Master of Science degree must complete a program of study totaling at least 30 hours of credit earned through graduate level coursework. Six to 12 of these credits shall be given for a master's thesis or project. Up to six credit hours of graduate level coursework may be transferred from another institution.

The Ph.D. program usually builds upon a master's degree and demands further advanced mastery of material in the area of study and the dissertation topic. This includes additional graduate level coursework beyond the M.S. degree as determined with the student's committee.

Candidates for the Ph.D. must demonstrate competence in at least two tools of research (statistics, computer programming or foreign language), pass a doctoral candidacy examination, and write and defend a dissertation.

Students are able to draw on the combined resources of the three academic departments in the School. In addition, courses and facilities of other schools of the College as well as Syracuse University complement those of the School of Environmental and Resource Engineering.

Prospective students who desire more information than is presented for each of the departmental descriptions and specialties described should contact the Dean, School of Environmental and Resource Engineering.

FOREST ENGINEERING

ROBERT H. BROCK, *Chairman* (Photogrammetric and Geodetic Engineering, Mapping Systems)
DUGGIN (Agricultural Assessment, Remote Sensing, Physics), HASSETT (Environmental Engineering, Water Resources), HENNIGAN (Water Resources, Environmental and Water Quality Management and Policy), HOPKINS (Surveying, Site Assessment, Remote Sensing), LEE (Computers and Systems Engineering, Transportation and Equipment, Soil Mechanics), MCCLIMANS (Soils, Hydrology, Site Engineering), PALMER Engineering Economics, Energy, Production and Harvesting Systems), TULLY (Structure, Engineering Hydrology, Water Resources).

A large portion of our nation's resources exists on forested and rural lands. These include: the increasingly valued renewable resources of timber, biomass and wildlife; the sustaining resources of water, soil and nutrients; and the derivative resources of paper, wood, and fibrous products and recreation and amenity values. Forest engineering is a unique field of engineering which is concerned with the design of systems and facilities to improve the sustained high quality yield of resources and multiple use benefits of goods and services from forested and rural lands.

The undergraduate curriculum in Forest Engineering provides a broad base of study and specialized education in engineering with an emphasis on site development for improved resource use and conservation. Instruction focuses on: locating and quantifying resources; designing harvesting, conveyance and transportation systems and networks for water and timber; designing structures, facilities and pollution abatement systems; and engineering planning for the development of sites and regions for multiple use.

Programs of advanced studies toward an M.S. or Ph.D. degree in environmental and resource engineering are offered. Individually designed programs provide graduates with sufficient understanding of the methodologies of scientific research and of the principles of engineering analysis or design to work with competence in resource related research, engineering design and management. There are opportunities for individuals who seek advanced education in such areas as water resources engineering, photogrammetry and remote sensing, transportation and soils, energy and environmental quality as well as forest engineering.

Because of the special importance of continual measurement and evaluation of the broad scaled parameters which affect the resource base, unique opportunities for study are available for students aiming toward professional careers involving the conceptualization, design, and maintenance of geographically referenced resource information systems. This includes elements of surveying, photogrammetry, remote sensing, and resource information systems design.

Undergraduate Program

The primary objective of this curriculum is to prepare qualified engineering graduates to operate with professional competence within the context of forest and natural resources development. The curriculum includes basic, forest, and engineering sciences. It utilizes elements of traditional engineering disciplines and develops its unique aspects from interweaving engineering design with an understanding of the natural environment and its renewable resource base including water, soil, timber, wildlife, and amenity values. Studies in the humanities and social and economic sciences are integrated throughout the curriculum to help achieve a broad and balanced perspective of professional practice in forest engineering.

Qualified graduates in search of advanced degree education enjoy ready acceptance to engineering graduate schools throughout the country. Graduates of the Forest Engineering curriculum may enter an established five-year program in either civil, industrial, or mechanical engineering at Syracuse University. A bachelor of science degree in engineering will be awarded by Syracuse University upon completion of the requirements of the fifth year.

To enter the Forest Engineering curriculum at the junior level, a transferring student must have acceptable college credit in the following coursework areas or be able to have suitable coursework substitutions for courses listed in the junior and senior years.

The curriculum in Forest Engineering is accredited by the Accreditation Board for Engineering and Technology (ABET).

Students must meet these minimum requirements, and they are encouraged to exceed the minima in the elective areas, to facilitate scheduling during the upper division years.

Lower Division Courses

Course Area	*Credit Hours*
Biology (Botany preferred)	3
General Chemistry with Laboratory	8
Engineering Physics with Laboratory	8
Calculus through Differential Equations	15
English	6
Economics (Macro- and Microeconomics)	6
Engineering Drawing (Graphics)	1
Computer Programming	3
Engineering Mechanics (Statics and Dynamics)	4
Electrical Science	3
Humanities or Social Science Electives	3
TOTAL MINIMUM LOWER DIVISION CREDITS	60

Upper Division Courses

Junior Year			*Credit Hours*
First Semester	ERE 362	Mechanics of Materials	3
	ERE 371	Surveying for Engineers	3
	FOR 321	General Silviculture	3
	CIE 327	Principles of Fluid Mechanics	4
	EFB 335	Dendrology	2
	Elective		3
			18
Second Semester	FEG 340	Engineering Hydrology and Flow Controls	4
	FEG 350	Introduction to Remote Sensing	2
	FEG 363	Photogrammetry I	3
	MEE 285	Design of Mechanical Equipment	3
	IOR 327	Engineering Statistics	3
	ERE 351	Basic Engineering Thermodynamics	2
			17

Senior Year			Credit Hours
First Semester	FEG 410	Structures I	4
	FEG 420	Harvest Systems Analysis	1
	FEG 430	Engineering Decision Analysis	3
	CIE 437	Soil Mechanics and Foundations I	4
	FOR 477	Resource Policy and Management	3
	Elective		3
			18
Second Semester	FEG 454	Tractive Power Systems	2
	FEG 437	Transportation Systems	3
	ERE 440	Water Pollution Engineering	3
	FEG 489	Forest Engineering Planning and Design	3
	Elective in Engineering Design Sequence		3
	Elective		3
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	70

TOTAL UPPER AND LOWER DIVISION ELECTIVE REQUIREMENTS

Humanities or Social Sciences: At least 9 credit hours must be elected in social sciences or humanities, at least 6 of which are recommended to be upper division. (If lower division English coursework does not include at least 3 credit hours of humanities coverage, then an additional 3 credit hours of humanities are required.) Humanities coursework deals with branches of knowledge concerned with man and his culture, while social sciences coursework concerns individual relationships in and to society. Traditional subjects in these areas are philosophy, religion, history, literature, fine arts, sociology, psychology, anthropology, economics, and modern languages beyond the introductory skills courses, while modern nontraditional subjects are exemplified by courses such as technology and human affairs, history of technology, and professional ethics and social responsibility. Subjects such as accounting, industrial management, finance, personnel administration, ROTC studies, and skills courses, such as public speaking and technical report writing, do not fulfull the humanities and social science content.

Engineering Sciences: Electrical Science and coverage of Dynamics (separately or in combination with Statics) are required.

Engineering Design: At least 3 credit hours are required in upper division engineering coursework as part of an advisor approved sequence which complements other forest engineering coursework and provides the equivalent of at least 1 credit hour of depth in the design and synthesis component of the program, such as:

- Design of Wood Structural Elements
- Structures II
- Soil Mechanics II
- Air Pollution Engineering
- Introduction to Design
- Synthesis of Mechanical Systems

A total of 130 credit hours is required to complete the B.S. degree in Forest Engineering.

Graduate Program

Graduate studies and research are primarily concerned with environmental and resource related programs. Individual study programs leading to the master of science and doctor of philosophy degrees are available to meet the student's needs and interests in graduate study. Successful programs of graduate study may be efficiently designed by students with bachelor of science degrees in engineering or in forestry, natural sciences, physics, or mathematics.

Study programs with emphasis on environmental and resource engineering measurements may be designed in remote sensing, photo interpretation, geodetic engineering, analytical photogrammetry and photogrammetric systems. Programs emphasizing engineering analysis and design are available in water resources, environmental engineering, water quality management engineering, energy, transportation, harvesting and site engineering systems. Included are the monitoring, measurement and evaluation of physical parameters affecting water, soil, timber, vegetation, and wildlife.

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 Schools at both ESF and at Syracuse University. Exceptional departmental support exists for programs in environmental engineering measurements in the form of remote sensing and photogrammetric laboratories and the extensive forest properties owned by the College at which research may be conducted.

External support comes from several active sources, including industrial, commercial and governmental. Over the past two decades, close cooperation has developed special study and research opportunities with these sources.

PAPER SCIENCE AND ENGINEERING

BENGT LEOPOLD, *Chairman* (Organic Chemistry and Mechanical Properties of Fibers and Paper)

BAMBACHT (Pulping, Papermaking, Paper Machine Operation), BRITT (Chemistry of Paper Formation), DENCE (Organic Chemistry, Pulping, Bleaching), GORBATSEVICH (Pulping, Bleaching, Paper Technology and Paper Properties), HOLM (Water and Air Pollution Abatement, Computer Simulation), JELINEK (Computer Applications, Process Engineering, Thermodynamics), LAI (Organic Chemistry, Pulping), LUNER (Surface and Colloid Chemistry of Papermaking Systems), MARK (Mechanical Properties of Fibers and Paper), MARTON (Mechanical and High-Yield Pulping), ROTHENBERG (Pulping, Bleaching), STENUF (Chemical Engineering, Instrumentation, Thermodynamics, Flow Phenomena, Process Control, Corrosion), THORPE (Fiber Physics, Paper Physics and Mechanics).

Outstanding for its vigorous growth and diversity of products, the pulp and paper industry is the fifth largest in the nation and exceptionally strong worldwide. Its need for professional men and women with training in science, engineering and technology is increasing even more rapidly than the industry itself. The College pioneered instruction in this area in 1920 with the organization of the paper science and engineering department, which has maintained a singularly high position in professional education for the continuing development of the pulp, paper and allied industries. Its graduates, who are in constant demand, occupy positions

of leadership throughout the world.

The curriculum in Paper Science and Engineering is designed to provide a broad base of study and to prepare students for a variety of careers in the paper and related industries. Excellent opportunities are provided for men and women qualified to fill positions as research chemists, process engineers, technical service representatives, line management personnel, and many others.

The program provides education in the physical sciences and chemical engineering, with specific emphasis on those aspects of these disciplines which relate to the manufacture of pulp and paper. This includes the chemistry and anatomy of wood, the conversion of wood to pulp and paper, and the chemistry and physics of paper and paper formation. Instruction in chemical engineering includes a foundation of unit operations basic to the pulp and paper industry, as well as specialized courses, such as water and air pollution engineering.

The department is located in Walters Hall, opened in 1969. This facility is devoted exclusively to education and research in the field of pulp and paper. In addition to a large number of special purpose laboratories and highly sophisticated scientific equipment, the department maintains an experimental pulp and paper mill equipped with machinery and instrumentation for studies of pulping, pulp purification, reuse of secondary fibers, refining, paper additives, and papermaking. This facility includes one 12-inch and one 48-inch fourdrinier paper machine, one pressurized and several atmospheric disk refiners, one pressurized grinder for mechanical pulping, and auxiliary equipment. In addition, the Department maintains an environmental engineering laboratory designed to demonstrate various methods used for the recycling of waste paper and the treatment of waste water. Also included is a modern chemical engineering laboratory, used for studies in all phases of unit operations and processes, process control, and analog simulation.

Undergraduate Program

The curriculum is entered at the junior level. Students with an associate degree in engineering science, science and mathematics, or chemical

Lower Division Courses

Course Area	*Credit-Hours*
Botany or Biology with Laboratory	4
General Chemistry with Laboratory	8
Organic Chemistry with Laboratory	8
Quantitative Analysis	3
Physics with Laboratory	8
Mathematics—Analytic Geometry and Calculus, Differential Equations	12
Computer Science	3
Economics	3
English	6
Engineering Drawing	1
Humanities or Social Science Electives	8
TOTAL MINIMUM LOWER DIVISION CREDITS	64

Upper Division Courses

Junior Year			*Credit Hours*
First Semester	FCH 572	Wood Chemistry II	3
	FCH 360	Physical Chemistry	3
	PSE 300	Introduction to Papermaking	3
	WPE 387	Wood Structure and Properties	3
	PSE 370	Principles of Mass and Energy Balance	3
	PSE 371	Fluid Mechanics	3
			18
Second Semester	PSE 372	Heat Transfer	2
	FCH 361	Physical Chemistry	3
	WPE 390	Wood and Fiber Identification Laboratory	1
	PSE 301	Pulp and Paper Processes	3
	PSE 302	Pulp and Paper Processes Laboratory	1
	ERE 377	Process Control	3
	LIB 300	Library Research Methods	1
	*Elective		3
			17

SUMMER MILL EXPERIENCE: PSE 304 Mill Experience 2
(Twelve weeks of full-time pulp or paper mill employment approved by the Department between the junior and senior years.)

Senior Year			*Credit Hours*
First Semester	PSE 461	Pulping Technology	3
	PSE 465	Paper Properties	4
	PSE 473	Mass Transfer	3
	PSE 491	Paper Science and Engineering Project	1
	*Electives		6
			17
Second Semester	PSE 466	Paper Coating and Converting	2
	PSE 468	Papermaking Processes	3
	ERE 440	Water Pollution Engineering	3
	*Electives		6
			14
		TOTAL MINIMUM UPPER DIVISION CREDITS	68

*At least 9 hours of electives must be selected from an advisor-approved sequence of technical courses. Examples of suggested areas are shown below.

TECHNICAL ELECTIVES

Colloid and Surface Chemistry	Applied Mathematics
Instrumental Analysis	Computer Modeling
Polymer Chemistry	Principles of Management
Pollution Abatement	Mechanics
Independent Research Project	Engineering Design
Thermodynamics	Materials Science

A total of 132 credit hours is required to complete the B.S. degree in Paper Science and Engineering.

technology usually qualify for admission if their studies have included 8 credit hours of organic chemistry with laboratory. Other applicants with two years of college study may also gain admission if their curriculum includes the appropriate courses. Minor deficiencies can usually be made up during the junior year.

The Paper Science and Engineering curriculum consists primarily of chemical engineering courses and specialized courses relating to the manufacture of pulp and paper products.

Graduate Program

Graduate studies reflect the strong trend toward diversification in the industry and offer opportunities for obtaining master of science and doctor of philosophy degrees in a variety of subjects related to the manufacture of pulp and paper. Individual study programs are designed to meet specific personal needs. Typical areas of study range from the development of new pulping processes, chemical interactions on the paper machine and the disposal of pulping and papermaking effluents, to the fluid dynamics of fiber suspensions, the colloid chemistry of papermaking constituents, and the physical properties of fiber networks.

An important component of the graduate program is thesis research under direction of a graduate advisor. Much of this research is carried out under the auspices of one of the outstanding research facilities in the world, the Empire State Paper Research Institute (ESPRI), an integral part of the department. Its research activities aim to generate new information regarding the fundamentals, the science, the engineering and the technology of the papermaking process, utilizing advanced techniques such as electron microscopy, specialized spectrophotometry, nuclear magnetic and electron spin resonance and nuclear tracer methods. Recent work has been directed to fundamental investigations of pulping, bleaching, additives, paper recycling, effluent disposal, the papermaking process, the properties of paper, reactions of wood components during mechanical and chemical treatments, the structure of wood and wood fibers, evaporation, fluid dynamics, heat transfer, and chemical recovery.

Many research projects are carried out in cooperation with other College departments. Examples of such projects include a wide-ranging study of the toxicity of paper industry effluents in cooperation with the Department 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 Wood Products Engineering, as well as the Department of Aerospace and Mechanical Engineering at Syracuse University.

The department enjoys excellent external support in the form of graduate fellowships and grants from ESPRI, the Syracuse Pulp and Paper Foundation, and other industry sources, as well as a number of government granting agencies.

WOOD PRODUCTS ENGINEERING

GEORGE H. KYANKA, *Chairman* (Applied Mechanics, Structures) CÔTÉ (Cellular Ultrastructure, Light and Electron Microscopy), DAVIDSON (Physical Properties of Wood), HANNA (Ultrastructure and Microscopy), R. MEYER (Wood Properties and Anatomy), SACZYNSKI (Construction), SMITH (Adhesives, Coatings, Wood-based Composites).

While wood is one of the oldest structural materials known to man, it occupies a position of major economic importance today with the annual tonnage of wood produced in the United States exceeding that of any other major structural material. This fact becomes even more important in this age of environmental and ecological concern because wood is the only major structural material that comes from a renewable natural resource, and demand is growing for more efficient utilization of available material. Improved efficiency must be based on solid scientific and engineering information. The Department of Wood Products Engineering provides undergraduate instruction in basic wood science and technology and stresses the application of science and engineering to building construction and the production, design, and utilization of wood-based materials. At the graduate level, the Department provides guidance via advanced courses and research opportunities in wood science, timber engineering, and construction management and engineering.

Undergraduate Program

The Department of Wood Products Engineering prepares students for a wide variety of professional occupations concerned with the use of wood as a material. Two curriculum options are available: Construction and Wood Science and Technology. Both options have elective courses which permit tailoring the program to serve the needs of individual students from a wide variety of two-year preparatory programs. The Wood Science and Technology option is individualized to serve students that wish to emphasize Marketing, Management and/or Technical Sales.

As the only major engineering material derived from a renewable natural resource, wood is receiving increased attention as an alternative to other materials which originate from the depleted nonrenewable resources. Thus, a principal aim of the departmental program is to teach students the fundamental properties of wood as a material to promote efficient wood processing, product design, and final use, whether as a piece of furniture or as a complete building.

To enter either option at the junior level, a transferring student must have acceptable college credit in the following coursework areas. Individuals not meeting the basic outline shown are encouraged to contact the Admissions Office to work out special arrangements and/or additional study requirements.

Construction Option

Current economic pressures are dictating that the construction industry become more efficient in the design and construction of new facilities and structures. These structures range in size from residential structures to massive power generation stations. Consequently, the industry has increased its demand for technically trained professionals who have the skills to manage construction projects. These professionals must be prepared to develop new and innovative construction techniques, deal with a highly organized union work force, prepare competent cost estimates, and manage entire projects from start through completion.

Although the Construction curriculum emphasizes the use of wood as a building material, it allows the students an opportunity to develop a broad

Lower Division Courses

Required Courses	*Credit Hours*
General Chemistry with Laboratory	4
General Physics with Laboratory	8
Mathematics through Integral Calculus	8-9
English	6
Computer Programming	3
TOTAL MINIMUM LOWER DIVISION CREDITS	62

Some Recommended Additional Courses for Wood Science and Technology Option: Accounting, biology or botany, economics (Micro and Macro), engineering drawing, organic chemistry, statistics, and electives in the humanities and social sciences.

Some Recommended Additional Courses for Construction Option: Accounting, economics, (Micro and Macro), engineering drawing, soil mechanics, statistics, surveying, and electives in the humanities and social sciences.

Students are encouraged to consult the Admissions Office and the Department of Wood Products Engineering (315/470-6880) for answers to questions regarding program requirements.

CONSTRUCTION

Upper Division Courses

Junior Year			*Credit Hours*
First Semester	WPE 387	Wood Structure & Properties	3
	WPE 361	Engineering Mechanics-Statics	3
	ERE 371	Surveying for Engineers	3
	ACC 204	Financial Accounting Systems	3
	Elective		3
			15
Second Semester	ERE 362	Mechanics of Materials	3
	ERE 364	Engineering Materials	3
	ACC 252	Introduction to Managerial Accounting	3
	WPE 450	Construction Equipment	3
	Statistical Analysis		3
	Elective		3
			18
INDUSTRIAL FIELD TRIP (a two-week field trip immediately following final exam period): WPE 399 Field Trip			2
Senior Year			*Credit Hours*
First Second	WPE 420	Adhesives, Sealants, and Coatings	3
	WPE 454	Construction Management	3
	FEG 410	Structures	4
	CIE 437	Soil Mechanics & Foundations I	4
	WPE 497	Senior Seminar	2
			16
Second Semester	WPE 326	Fluid Treatments	2
	WPE 327	Fluid Treatments Laboratory	1
	Management Elective		3
	WPE 422	Composite Materials	3
	WPE 404	Design of Wood Structural Elements	3
	Elective		3
			15
		TOTAL MINIMUM UPPER DIVISION CREDITS	66

A total of 128 credit hours is required to complete the B.S. degree in Wood Products Engineering with the Construction option.

educational background in construction which will prepare them for a wide range of job positions in the construction industry and related fields. The program has a certain degree of flexibility which allows the student to specialize in a particular area of interest.

Illustrative electives are listed below:

Engineering

Structural Analysis
Foundation Design
Building Systems
Energy Systems
Engineering Design

Management

Marketing
Business Law
Accounting
Finance
Operations Research

Environmental

Air Pollution Engineering
Solid Waste Disposal
Waste Water Treatment
Environmental Sanitation
Land Use Planning

The following are some of the position titles past graduates now hold:

Assistant Project Superintendent
Project Supervisor
Construction Manager
Cost Engineer
Resource Scheduler
Timber Engineer
Truss Design Engineer
Research Engineer
Construction Consultant
Technical Sales Representative

Wood Science and Technology Option

The wood science and technology option prepares students for employment in the wood products industry. A wood science and technology graduate should be able to walk into any wood products manufacturing operation and, after observing the process be able to fully understand what is going on. Instruction is individualized by selecting emphasis courses that are combined with required core courses designed to develop a comprehensive knowledge and understanding of wood as a raw material. The wood science and technology option trains wood technologists, utilizing an individualized program with a series of emphasis courses to develop additional background in marketing or specialization in wood science and technology.

Students wishing to enter graduate school can plan a series of electives to meet entrance requirements of major graduate institutions, whether in wood science and technology, business administration, or another branch of the sciences.

A special knowledge of the material properties of wood and the suitability of specific wood species for use in various products or processes enable a graduate with marketing emphasis to assist a customer in selection of the

right wood product for the intended end use or makes possible the procurement of the best wood raw material for some manufacturing operation. These situations include considering the correct species of wood, treatments to prolong the useful life of a wood product, or selection of the most suitable manufactured product, such as medium density fiberboard or plywood, for a specific application. In some cases market research surveys or economic analyses may be required. Complete understanding of the employer's products, the material properties of wood, and the customer's special needs and problems are necessary for the marketing specialist to function efficiently. In addition to many sales-related or purchasing-related positions are other employment possibilities such as those requiring analysis of economic and trade conditions or relating engineering properties of wood to established or new product lines.

Numerous manufacturing methods are used to produce the over 5,000 products that use wood in one form or another. By studying various production systems and ways to modify wood properties, a production-oriented wood technologist is prepared for a career in the manufacture of forest products (veneer, plywood, particleboard, etc.). These careers deal with product and process development, quality control, production control, design engineering, personnel relations, and management.

Wood science and technology deals with materials science and engineering. Graduates that have stressed the science and technology of wood are prepared to utilize their knowledge of wood in numerous ways: to increase the efficiency of wood use, apply existing or new knowledge to wood product manufacture or utilization, or to do the research and development required for the new products, processes, and treatments necessary to meet the increasing demands made on our limited forest resources for wood commodities. Such research projects could be either basic, in which case the frontiers of wood science are extended, or applied, in which case existing knowledge is applied to current technological problems. Much of the work that needs to be done is technology transfer, so that known techniques of wood science and technology can be applied to the manufacturing or utilization environment. A wood science and technology graduate who has a good background in wood as a material can adapt the present state of knowledge to a broad range of utilization, research, or manufacturing operation, research, or manufacturing operations. Employment opportunities include corporations, trade associations, government research institutes, and universities. An M.S. degree is highly recommended for those wishing to formally enter the research field, and a Bachelor's degree for those wishing to work in technical service or manufacturing.

Job titles of recent graduates include:

Technical Sales Representative
Applications Engineer
Regional Sales Manager
Export Trade Analyst
Product Development Engineer
Marketing Research Analyst
Quality Control Engineer
Plant Engineer
Production Supervisor
Forest Products Specialist
Materials Research Associate
Wood Products Technologist
Research Associate in Wood Science
Product Development Engineer

Emphasis Courses

Students desiring to emphasize various aspects of Wood Science and Technology should select 24 credit hours of emphasis courses. These courses are defined upon consultation with the academic advisor. Typical concentration areas can be chosen from the following partial listing to complement the desired career objective:

Finance
Accounting
Marketing
Materials Science
Operations Management
Quality Control
Engineering Economics

WOOD SCIENCE AND TECHNOLOGY
Upper Division Courses

Junior Year			*Credit Hours*
First Semester	FBO 305	Dendrology	2
	WPE 361	Engineering Mechanics-Statics	3
	WPE 387	Wood Structure & Properties	3
	WPE 388	Wood & Fiber Identification Laboratory	2
	*Electives		6
			16
Second Semester	WPE 326	Fluid Treatments	2
	WPE 327	Fluid Treatments Laboratory	1
	ERE 362	Mechanics of Materials	3
	WPE 322	Mechanical Processing	3
	*Emphasis Course		3
	Statistical Analysis		3
			15
INDUSTRIAL FIELD TRIP (a two-week field trip immediately following final exam period): WPE 399 Field Trip			2
Senior Year			*Credit Hours*
First Semester	WPE 420	Adhesives, Sealants, and Coatings	3
	WPE 497	Senior Seminar	2
	*Emphasis Courses		6
	*Electives		3
			14
Second Semester	WPE 422	Composite Materials	3
	FOR 404	Economics of Wood-Using Industries	3
	WPE 404	Design of Wood Structural Elements	3
	*Emphasis Courses		6
	*Electives		3
			18
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

*Specific courses selected for these requirements must have the advisor's approval.

A total of 127 credit hours is required to complete the B.S. degree in Wood Products Engineering with the Wood Science and Technology option.

Computer Applications
Tropical Timbers
Wood Chemistry
Physiology and Pathology
Independent Research

Graduate Program

Recent research projects in wood ultrastructure have dealt with the interaction of coatings and adhesives with the wood substrate, with cell wall development, with the effectiveness of wood preservatives, and with the identification of natural inclusions in wood. Projects in tropical wood identification and structure-property relations in foreign and domestic timbers are examples of work in the field of systematic wood anatomy. The field of wood physics has had active projects in the permeability of wood and the mechanics of fluid transport. Current projects in the field of mechanics are focused on the elastic behavior of wood and wood-base composites, fracture mechanics of wood, the behavior of new structural designs such as truss systems, and the mechanical properties of laminated-veneer-lumber. Other active research areas include biodegradation, properties of juvenile wood, and the growth-wood quality relationships. In addition, there is growing interest in studying the physical properties of wood-based composite materials and the chemical modification of wood, as well as wood finishing systems.

Laboratory facilities include a mechanical testing laboratory with a wide range of testing machines, a physics laboratory with electronic instrumentation, and complete wood processing facilities including a sawmill, plywood mill, dry kilns, and wood preservation equipment. One of the United States' largest foreign wood collections is used for graduate research and to support the program of the Tropical Timber Information Center (TTIC).

The Department has available a complete microscopy laboratory, containing transmission electron microscopes, scanning electron microscope with energy dispersive x-ray analysis and particulate analysis accessories, a wide variety of light microscopes, and related equipment. Extensive equipment for chemical analysis and nuclear chemical techniques also serve the research program.

THE SCHOOL OF FORESTRY

JOHN V. BERGLUND, *Dean*
(Silvics, Silviculture)

Syracuse Campus

ABRAHAMSON (Entomology, Pathology, Pesticides), BENNETT (Economic Theory, Economic Thought in Forestry), BICKELHAUPT (Nursery Soils, Forest Soils), BLACK (Water and Related Land Resources), BURRY (Forestry Extension, Wood Utilization), CANHAM (Forestry Economics, Economics, Economics of Natural Resources), COUFAL (Silviculture), CRAUL (Forest Soils), CUNIA (Operations Research, Biometry), DALL (Environmental Law and Policy), DREW (Tree Physiology, Physiological Ecology), ESCHNER (Forest Influences, Forest Hydrology), GRANT (Micrometeorology), GRATZER (Forest Recreation, Forest Management), GRAVES (Forest Resource Policy, Planning and Management), HALLIGAN (Silviculture), HERRINGTON (Meteorology, Urban Forestry), HORN (Mensuration, Law), HOWARD (Silvics, Forest Management), KOTEN (Forest Management, Management Science and Planning), MAYNARD (Tree Improvement), MONTEITH (Forestry Economics, Land Use), MORRISON (Forest Recreation, Forestry Extension), NYLAND (Silviculture, Forestry Practice), PETRICEKS (Resource Economics, International Forestry Economics), RICHARDS (Silviculture, Urban Forestry), STITELER (Statistics), WHITE (Forest Soils, Silviculture).

Forest Technician Program—Wanakena Campus

JAHNKE (Ecology, Silviculture, Forest Management, Fire Management, Systems Analysis), MARTIN (Mensuration, Tree Physiology and Morphology, Wildlilfe Ecology), MILLER (Forest Roads, Installations, Aerial Photogrammetry, Graphics, Recreation) REMELE (Ecology, Silviculture, Surveying, Personnel Management), SUHR (Dendrology, Soil and Water Measurements).

Adjunct Faculty

CZAPOWSKYJ (Forest Soil Science), HEISLER (Meteorology), HORSLEY (Silvics), MARQUIS (Silviculture), ROWNTREE (Urban Forestry), SLOAN (Policy), TABER (Renewable Resources, Extension Program), YAWNEY (Silviculture).

Undergraduate Program in Resources Management

The School of Forestry prepares students for the critical role of managing forests and related resources and their environments for human benefit. Management here embraces the integration of basic ecological and social principles into comprehensive plans for the manipulation and use of forest and open lands for the sustained production of timber, forage, water, wildlife, and recreational values. Such management must be consistent with current and future national needs, and with the protection and enhancement of environmental quality. It also includes the effective implementation of these programs technically and via the administrative process, in accordance with established policies and goals and in cooperation with individuals and organizations, both public and private.

The successful management of forests and related resources involves many different people working together as teams to bring their special expertise to bear on problems created by society's demands upon these basic resources. The School of Forestry presently offers three undergraduate degree programs designed to help students fit into different parts of the interdisciplinary multi-level teams mentioned:

1. A professional forestry and resource management degree program, at the bachelor's level, offered at the Syracuse Campus.
2. A forest technician degree program at the associate's level, offered at the Wanakena Campus. For details of this program see p. 54.
3. A dual-major program that meets the bachelor's degree requirements of both the School of Forestry and the Department of Environmental and Forest Biology. For details of this program see p. 63.

Since the dual biology/forestry program and the forest technician program are covered in separate sections, the discussion which follows pertains to the School's professional forestry and resource management program.

Students completing the School's professional forestry program qualify for practice as foresters and environmental managers with public and private organizations or as private consultants serving a wide array of clients. The potential for a meaningful, rewarding career in service to human welfare becomes significant when one recognizes the vast amount of land area covered by forests. About 60 percent of New York State is classified as forest land, while roughly one-third of the land area of both the United States and the world is so classified. The goods and services that flow from this vast resource base are of critical and growing importance to the needs of modern society and influence, in a major way, the quality of the environment.

The professional forestry and resource management program offers opportunity for students to pursue special interests, to prepare for advanced study, or to develop their capabilities for service in a variety of fields pertinent to renewable natural resources and the environment, but not specifically forestry oriented. For example, it is possible to obtain provisional certification for teaching secondary science with some additional coursework, and many other nonforestry careers are possible.

Though it represents the oldest area of professional instruction in the College, the current curriculum was implemented with the entering class of 1973, with some modification made since then. It is accredited by the Society of American Foresters and meets the educational requirements of the U.S. Government Office of Personnel Management for forester employment in Federal agencies. A core of required upper division courses, totaling 42 semester hours, presents the basic principles and practices underlying the purposeful management of forest and related resources for optimum production and use of any one, or combination, of their potential products and services.

Considerable emphasis in the curriculum is placed on field instruction to provide students with intimate knowledge of how the forest ecosystem functions and how it is manipulated and used for a variety of owner objectives. Close to half of the required upper division core courses is conducted wholly or primarily in the forest environment and entail substantial physical activity such as conducting field surveys, inventorying timber and other resources, and thinning forest stands. Attendance at a seven-week, eight-credit hour Summer Session in Field Forestry is required prior to registration for the junior year. This session emphasizes field skills and techniques and introduces ecological concepts, and serves as the major avenue of entrance into the professional forestry curriculum.

A unique feature of the curriculum in the fall semester of the junior year is a set of team-taught blocked courses emphasizing ecological foundations and applications based on the skills learned at the Summer Program in Field Forestry. This fall semester is largely held at the facilities of the College's 4,000-acre Heiberg Forest, nearby the Syracuse Campus, with all transportation provided by the College. The Summer Program in Field Forestry and the fall semester of the junior year total 24 credit hours of field oriented core courses, and as part of the conditions for admission to this curriculum, applicants must be willing and able to function effectively in the field under a wide range of terrain and weather conditions. Any questions or concerns about this requirement should be directed to the Director of Admissions.

Extensive elective opportunities, totaling about one-fourth of the curriculum, allow students to shape their programs to meet individual needs and interests. In a broad sense, electives may be chosen to provide extensive coverage of either forest resource science or management, and they may be oriented toward immediate employment or as a base for graduate study. More specifically, one student might choose to broaden knowledge of forest resource management or science by distributing electives to cover all of the

Lower Division Courses

Course Area	*Credit Hours*
Biology (Botany and Zoology preferred) with Laboratory	8
General Chemistry with Laboratory	8
Physics I with Laboratory	4
Calculus I	3
Economics (Microeconomics required)	3
Political Science (U.S. Institutions)	3
Introductory Sociology **OR** Introductory Psychology	3
Computer Programming (Language)	3
*English	6
**Social Science/Business Electives	9
***Mathematics/Physical Science Electives	6
****Free Electives	8
TOTAL MINIMUM LOWER DIVISION CREDITS	64

*Standard freshman English sequences are acceptable, but where possible the student is *strongly* urged to take technical report writing.

**Courses in sociology, psychology, U.S. history, macroeconomics, political science, anthropology, U.S. geography, business, finance, or accounting. *Note:* students *may be* admitted with only 9 credit hours of the required or elective courses in economics, political science, psychology/sociology and social science/business areas. The remaining 9 credit hours of deficiencies must be made up as early as possible in the student's ESF program, including the use of summer sessions.

***Courses in mathematics, physics, chemistry, geology, computer science, meteorology, logic. Math courses must be of a level equivalent to Calculus II or be in some way complementary to Calculus I.

****Free electives and electives in the specified categories should be chosen with the clear idea that they are in preparation for an upper-division, professional program. Courses in the free elective category that have been found to be helpful include personnel management, group dynamics, technical report writing, speech, foreign language, logic, pre-calculus math, first aid and CPR, graphics/drafting, surveying, real estate, marketing, conservation law, ecology, dendrology, plant pathology, philosophy, religion, fine arts or other arts, sciences or business courses. Free electives can also include further courses from the directed elective categories. All electives should be chosen with the particular career goals of a student in mind.

areas of forestry's multiple-use, while another might choose to enhance depth of understanding of a more specialized area by concentrating electives in areas such as timber, watersheds, forest wildlife, recreation, entomology, pathology, soils, international forestry, or urban forestry. Electives may also be taken at Syracuse University, usually to add to a student's general education or to gain knowledge of an area of business management, communications, geography or other similar topics not offered at ESF. Elective course selections must have the approval of the student's faculty advisor, and it is very important that they be planned early in the student's program.

A significant feature of the elective component of the professional forestry and resource management curriculum is that the spring semester of the senior year consists wholly of electives and thus is available for a variety of independent or group study activities. These may be conducted in whole or in part on any one of the College's several campuses, or off campus at another institution, in cooperation with some resource management agency or firm, or in conjunction with an overseas academic program operated by the College. Proposals for off-campus study must be well planned. They are subject to faculty review and approval and are carried out with varying degrees of faculty guidance to ensure adherence to academic standards. Utilization of the spring senior semester in such a fashion may result in the need for a fifth semester to meet graduation requirements.

A total of 135 credit hours is required to complete the B.S. degree curriculum. For students contemplating entrance to the program, it is required that they have completed at least 64 semester credit hours or have earned an associate degree, and further, that a minimum of 56 of these credits be distributed among specific course areas as outlined below. The maximum number of freshman-sophomore semester credit hours which may be transferred is 64. Students who have completed more than 64 lower division credits may transfer up to 12 additional hours of junior-senior level courses and should seek advice on upper division credits at the time of matriculation. The professional forester must understand both the biological and social influences that affect the use of forest resources. Prospective students should choose lower division elective courses that will serve to broaden and enhance their understanding in the social and political sciences, humanities, and communication skills.

Upper Division Courses

			Credit Hours
Summer:	[1]Summer Program in Field Forestry		
	FOR 301	Field Dendrology	1
	FOR 302	Forest Surveying and Cartography	2½
	FOR 303	Introduction to Forest Mensuration	3½
	FOR 304	Introduction to Forestry	1
			8
Junior Year			
First Semester	FOR 322	Forest Mensuration	1
	FOR 331	Introduction to the Physical Environment	6
	FOR 332	Silvics-Silviculture	8
			15
Second Semester	FOR 360	Principles of Management	3
	FOR 370	Management of the Forest Enterprise	3
	APM 391	Introduction to Probability and Statistics	3
	[2]Electives		7
			16
Senior Year			
First Semester	APM 492	Forest Biometrics	3
	FOR 400	The Social Environment of Resource Management	3
	FOR 461	Management Models	3
	[2]Electives		6
			15
Second Semester	[2]Electives		17
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	71

[1]SUMMER PROGRAM IN FIELD FORESTRY—7 weeks, 8 credit hours: Required of all students (except Forest Technician Program and Paul Smith's Forest Technician Program graduates) *prior* to registration for junior year.

[2]One half of the student's elective hours during the junior and senior years must be in courses taken in no fewer than three of the following schools: Forestry, Environmental and Resource Engineering; Biology, Chemistry and Ecology; Landscape Architecture. The remaining elective hours should be used to round out the professional education of a student. Note: a required course of 2-3 credit hours is under consideration for the Second Semester of the Senior Year.

A total of 135 credit hours is required to complete the B.S. degree in the Professional Forestry and Resource Management Curriculum.

Graduate Education

FOREST RESOURCES MANAGEMENT

Graduate education in the School of Forestry builds upon the basic foundations of knowledge and skill acquired by students in its professional undergraduate curriculum, in similar professional programs at other schools, or in undergraduate programs focused on any of the fields important to Forest Resources Management. Graduate study programs are created to suit the needs of each individual student and are designed to prepare the student for careers in resource administration, management, scientific research, professional education, and a variety of other specialized positions in public and private employment bearing directly or indirectly on forest resources management. Students with nonforestry undergraduate or master's degrees with strong interest in forest resources management are encouraged to apply.

The practice of forestry is based on a number of fields of science ranging

from applied physics to sociology. Graduate study in the School of Forestry focuses on one or more of these fields in the context of resources management. Understanding the forest ecosystem as a provider of goods and services and as a modifier of the physical environment is the thrust of silviculture—culture of the forest. The fields of meteorology, soils, hydrology, and silvics (forest ecology) support study and research in silviculture. Tree improvement is the science and practice of improving the forest through genetics. The societal environment in which forests are managed is founded in the study of public and private policy on forestry economics. Forest management provides the bridge between the biological and societal requirements. Recreation management is the management of the forest for recreation. Basic to all these fields is the study of quantitative methods (statistics, mensuration). Urban and international forestry are broad study areas.

The *nine areas of special interest* in the Forest Resources Management program are:

POLICY AND ADMINISTRATION—Dall, Graves, Horn
FORESTRY ECONOMICS—Bennett, Canham, Monteith, Petriceks
FOREST MANAGEMENT—Burry, Gratzer, Herrington, Horn, Koten
RECREATION MANAGEMENT—Gratzer, Morrison
SILVICULTURE—Abrahamson, Berglund, Coufal, Halligan, Howard, Lea, Richards, Yawney
SILVICS—Berglund, Drew, Horsley, Howard
FOREST SOIL SCIENCE—Bickelhaupt, Czapowskyj, White
TREE IMPROVEMENT—Maynard
FOREST INFLUENCES—Black, Eschner, Heisler, Herrington

In addition, there are three areas of study which integrate study in the above areas or serve as foundations for study in all areas. These are:

INTERNATIONAL FORESTRY—Petriceks, Yavorsky
URBAN FORESTRY—Herrington, Richards, Rountree, Sanders
QUANTITATIVE METHODS—Cunia, Horn, Stiteler

The description of these areas of study is not intended to infer compartmentalization of study. Indeed, most students in the School have programs of study which encompass two or more of the study areas and are encouraged to develop integrative programs of study by the School faculty.

Master's Degree Program

All three of the College's master's options are available to students in the School of Forestry. The appropriate option must be selected with the approval of the student's committee.

Doctoral Degree Program

Although a doctoral program is usually built upon a master's degree obtained at the College or elsewhere, the program can be entered directly from a baccalaureate degree.

There is no minimum credit requirement for the doctoral program, but the usual load is 30 credit hours beyond that required for the master's degree. The field work for writing of a dissertation usually takes at least 12 months. In addition, written and oral candidacy examinations, intended to test the student's mastery of subject matter essential to the student's dissertation topic, and an oral defense of thesis examination are required. A preliminary examination may be required prior to the candidacy examination. The student's committee may require languages or other tools be included in the student's program.

The Major Professor and Student's Committee

Each graduate student in the School is assigned, or has selected via the application process, a Major Professor or faculty advisor to act as the director of the student program of study. The student and his/her Major Professor are assisted in planning the student's program and in determining successful completion of the program by the student's committee. Each student's committee and study program are designed to meet the student's specific needs.

Joint Study with Other Schools of the College

In a number of areas, particularly forest biology, close cooperation and joint programs of study can be established with faculty in other schools of the College. If a student is particularly interested in the forestry implications of, say, insect damage, then admission to the School of Forestry programs is indicated. On the other hand, if the student's interest is focused on the insect, then a program centered in the School of Biology, Chemistry and Ecology may be more appropriate.

Joint Degree Programs with Syracuse University

Joint degree programs which provide the student with two master's degrees, one from the College and another from Syracuse University, are available with the following Schools:

School of Management
Maxwell School of Public Administration
College of Law
Newhouse School of Communication

The joint degree programs usually add an additional year to a normal master's program of study.

AREAS OF SPECIAL INTEREST

POLICY AND ADMINISTRATION

Graduate study in the area of resources policy and administration is designed to prepare students for leadership positions in the broad range of responsibilities at the planning, budgeting, programming, and operating levels of public agencies and businesses. The expanded role of federal and state government oversight over resource use and land management has brought substantially increased need for thorough understanding of policy matters, legal requirements, and governmental and political interactions with resource owners and users. Advanced courses, seminars and special problems structured around these needs and the complex interrelationships of society with resources are offered. A wide array of complex problems of administrative management, resources policy issues, and related legal, financial, and executive needs are included among the topics that may be emphasized.

Students are encouraged to round out their academic programs through the courses offered by other units of the College as well as Syracuse University Graduate School of Citizenship and Public Affairs and the School of Management or other graduate units. Students with undergraduate preparation in forestry, liberal arts, engineering, or

other appropriate areas who have strong interest in resource administration and policy can be served through selection of necessary emphases that complement work already taken.

The broad array of possibilities of course selection and the diverse points of view that are available allow the student to build a program to meet specific career objectives. The breadth and diversity also offers the student an opportunity to develop talents for managerial leadership and policy positions in various aspects of enterprises and public agencies whose work is critical to the future of resources management.

FORESTRY ECONOMICS

The program is designed to meet the needs of the student with an undergraduate degree in forestry or forest products. With some additional courses in forestry, the program also serves the graduate in liberal arts, engineering, or business, should interest point toward the economics of forest management. The goals are depth of understanding and familiarity with economic tools contributing to making competent decisions in resource economics, management, and policy.

The core of the program consists of courses in forestry and resource economics as offered by School faculty. In addition, one must be aware of the social and biological environment in which forestry economics is applied. To this end the program is supplemented by courses in general economics, statistics and operations research, resource policy, business administration, and related managerial and biological fields. The course offerings and facilities of the School, the rest of the College, and Syracuse University are actively drawn upon.

Individual programs are tailored to fit the student's particular interest: for example, the economics of timber management, land use economics, economics of natural environments, economic development and forestry. Graduates with the master's degree find employment typically as forest economists or resource analysts with federal and state agencies, and with private industry. Graduates with the Ph.D. usually find careers in teaching or research.

FOREST MANAGEMENT

Forest management focuses on the planning and implementation processes necessary to achieve integrated use of forests and associated natural resources. The educational objective is to develop expertise sufficient for capable, professional resource management under a variety of natural and societal environments.

The study of forest management requires a broad knowledge of both the natural and social environments as the basis for an understanding of the way in which these environments affect or are affected by the development and utilization of forests and associated wildlands. Implementation of plans also requires an understanding of the social environment as well as the managerial process to facilitate working with people both inside and outside of the organization.

Programs are flexible and a student may pursue a special interest in a single product, several products or services, tools and processes of planning for integrated forest use, or in developing managerial skills. The emphasis of the program, however, would be in the application of the skills and knowledge to the management of forest lands. Where appropriate, courses may be taken at Syracuse University's School of Management and the Maxwell School of Public Administration to complement course offerings in the School of Forestry and other Schools of the College. Recent graduates have found employment in all of the diverse areas described above.

RECREATION MANAGEMENT

Graduate study in this area equips students with a broad understanding of the nature and purposes of outdoor recreation and how they relate to natural resources, and builds the skills necessary for capable recreation management.

Individual programs combine study in resources management with relevant studies in the social and political sciences and development of analytical capabilities needed to implement plans and programs. Other schools of the College and of Syracuse University, treating such areas as planning, engineering, design, and education, provide a wide range of supporting courses and facilities.

All program areas in RMP require that each student take a minimum of 12 credits of coursework within the School of Forestry. Courses in Applied Mathematics (APM) can also be used to meet this requirement. If a student's prior preparation is inadequate to meet the graduate program objectives, the major professor and/or committee will suggest appropriate remedial coursework to make up the deficiency.

SILVICULTURE

Classical silviculture can be defined as the theory and practice of the manipulation of forest ecosystems, including the control of vegetation establishment, composition, growth, and quality. The nature of cultural treatments, the theories upon which they are based, and the biological, physical, and social constraints to their implementation are stressed in this area of specialization. Elements of forest vegetation are intensively examined from the dual standpoints of fulfilling management goals for goods and services and maintaining or enhancing biotic productivity for the future.

Management goals are considered to include all the many and varied goods and services that the basic forest resource is capable of supplying. Forest productivity is of basic concern; the student specializing in this area progresses through formal coursework and research toward an understanding of the effect of various treatments on the continuous, balanced, and adequate supplies of wood, water, wildlife, recreation opportunities, and amenity values. One major area of emphasis within this specialization relates to treatment of tree stands for their continued production of wood products and other commodities. Another emphasis centers on the treatment of stands that are managed for several values simultaneously, where the harmonious integration of uses is of concern. A third emphasis focuses on evaluation and manipulation of vegetation systems primarily for their on-site values, such as in wilderness and recreation areas, highway and utility rights-of-way, mining and other wasteland reclamation, and urban greenspace. This involves a broad interpreta-

tion of forest ecosystems that includes herbaceous and shrub systems as well as silvics.

The Silviculture graduate specialization is aimed at preparing foresters to understand and evaluate forest ecosystems in whatever depth may be required, and to prescribe treatments or further experimentation to attain management objectives or increase knowledge toward this end.

SILVICS

Silvics has been defined as that branch of forestry which provides the scientific base for the cultural treatment of forest vegetation by (1) studying and defining interrelationships within forest ecosystems and (2) cataloging general intraspecific characteristics of tree species. In a sense, silvics is the ecology of managed forest ecosystems, although unmanaged and natural forests are often studied intensively to provide the benchmark conditions from which the silviculturist begins.

The specialist in silvics must maintain channels of communication with colleagues in the basic disciplines, including those in soil physics, soil chemistry, micro-meteorology and climatology, genetics and tree breeding, plant ecology and physiology, wildlife biology, entomology, and pathology. In addition, certain tools, including a comprehensive knowledge of probability and statistics, the ability to use modern computers effectively, and a familiarity with measurement and sampling theory, are required by specialists in most applied sciences including silvics.

The specialist in silvics is essentially at one focal point of much of what has been called fundamental forest research. His most useful function and worthwhile contribution to the field of forestry may very well depend on the ability to synthesize relevant material and, through experimentation, provide the silviculturist with information and possible techniques for use in the cultural treatment of forest vegetation.

FOREST SOIL SCIENCE

Graduate studies in this area of specialization may be directed toward aspects of soil science related to the quantity and/or quality of goods and services in the management of resources of nonagricultural lands, and the impact of management practices on environmental quality. These include soil moisture, soil temperature, and nutrient element status interrelationships in the evaluation of soil productivity; evaluation of ecosystems to quantify nutrient element balances and cycling; amelioration of soils for increased productivity; and impact of various land-use practices on soil productivity.

Modern well-equipped laboratories are available for graduate student use in plant, soil, and water chemical analyses; soil water-holding capacity and compaction; infiltration and runoff; and other chemical and physical property investigations. The extensive College properties noted previously permit forest soil research to be conducted under a wide variety of environments and ecological conditions.

Programs are coordinated with other areas of specialization through cooperation among school personnel, with other departments of the College, Syracuse University, and the U.S. Forest Service.

TREE IMPROVEMENT

Tree improvement is an important component of forestry, and as demands on the resource increase, it will become even more vital. The most common objective of a tree improvement program is to develop populations of trees that are well-adapted, rapid growing, and disease-free. Other possible objectives may be to increase the aesthetic or recreational value of forest trees through selection for other traits.

Modern, well-equipped laboratories and greenhouses are available for graduate student use. Many established test plantations are available for collection of materials and field evaluations. Graduate students will take formal coursework in plant biochemistry and physiology, statistical genetics, and plant breeding. This specialization prepares graduates for positions in seed orchard management, tree improvement, and forest genetics with private, state, and federal organizations.

FOREST INFLUENCES

Forest influences as an area of graduate study includes all the effects resulting from the presence of forest trees and associated vegetation on climate, the hydrologic cycle, erosion, floods, and soil productivity. Health considerations and human comfort have often been included in older definitions of forest influences, and are assuming greater importance today with our growing concern for the environment.

Included among the principal studies in this area are energy exchange between forest and atmospheres; moderation of urban environments by vegetation; soil and slope stability; and watershed hydrology, including snow.

Graduates fill a variety of positions in research, teaching, and public and private management as watershed management specialists, hydrologists, environmental officers, meteorologists, and ecologists.

INTERNATIONAL FORESTRY

Graduate education in international forestry is designed to assist individuals who are intent upon pursuing internationally-oriented careers in forestry and related fields.

Instruction is aimed at supplementing and enriching the student's technical forestry knowledge and providing the broad background deemed necessary for effective service in a variety of professional areas. These include forestry advisor, teacher, or research specialist with national and international agencies, private business and industrial firms, philanthropic foundations, and voluntary service organizations whose activities include the development and use of forest resources in other lands.

At the master's level, program emphasis is on the attainment of general competence in research methods, foreign languages, cultural anthropology, world geography, and international affairs, plus a broad understanding of the world forestry situation. At the doctoral level, program concentration is on a specialized discipline area such as forestry economics, forest policy and administration, forest management, or silviculture. Orientation to the world forestry field is achieved in part through the selection of formal coursework, and in part through providing an opportunity for the student to conduct his thesis research in residence abroad.

A wide variety of course offerings are available to support the nonforestry elements of this area of study through Syracuse University. Opportunity for field training and research in tropical

forestry and related fields is available to qualified candidates, especially at the doctoral level, under cooperative agreements maintained by the College with the Institute of Tropical Forestry in Puerto Rico and the University of the Andes, Merida, Venezuela.

URBAN FORESTRY

Graduate study in urban forestry allows the student to pursue either of two broad objectives. Professional Urban Forestry skills may be broadened in the many areas of information important to the practice of forestry in urban and urbanizing areas through advanced coursework and applied research. More specialized study may be pursued in scientific disciplines supporting the practice of urban forestry. Active areas of specialized research and study in the School includes soils, greenspace ecology, atmospheric science, tree improvement, forest resource inventory and evaluation, and resource economics and planning. There is strong interaction with other urban-related areas of study within the College, including remote sensing, botany, pathology, entomology, wildlife ecology, and landscape architecture. Academic departments in the Maxwell School of Public Affairs at Syracuse University such as Geography, Economics, Political Science and Sociology, cooperate with teaching and research programs in urban forestry. The U.S. Forest Service Northeastern Forest Experiment Station maintains a permanent staff of scientists in their Urban Forest Research Project on campus who are engaged in studies dealing with the planning and management of urban forest ecosystems. This work complements the College's participation as one of nine universities in the Consortium for Environmental Forestry Studies, an organization of scientists and graduate students studying a wide range of problems in urban forestry.

QUANTITATIVE METHODS

Study in the area of quantitative methods is designed to develop professionals skilled in mathematical and statistical problem solution and equipped to act as biomatricians or mensurationists.

The program is designed primarily for students who have done their undergraduate work in areas such as biological sciences, forestry, wildlife, or agriculture. Others who lack background courses may take this material concurrently. Students may concentrate in statistics, operations research, biometry, or forest mensuration. Syracuse University's computer facility and a wide range of courses in mathematics, statistics, and quantitative methods give strong support to the program.

FOREST TECHNICIAN PROGRAM

History and Description

In 1912, some 1,800 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 Technician Program has trained over 3,000 graduates, most of whom are now working in a variety of forest activities, and it has earned the Wanakena Campus a national reputation for excellence. The Program is administered by and is an integral part of the School of Forestry. This relatively unique model of a single professional School offering all levels of work from the technician through post-doctoral emphasizes the teamwork approach to forest resource science and management espoused by the School.

The two-year curriculum trains students as forest technicians. The degree of Associate in Applied Science in Forest Technology (A.A.S.) is awarded. The objectives of the curriculum are to provide students with a knowledge of the field practice of forestry as related to forestry managerial needs; the ability to work and communicate effectively with professional and paraprofessional forestry personnel; and an understanding of the sciences and practices of forestry with some emphasis on ecological applications.

Graduates 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.

The curriculum is designed to allow graduates immediate job entry at the technician level. Students interested in a professional degree in forestry and resource management should investigate the School of Forestry's bachelor's degree curriculum described on page 48. However, it should be understood that transfer into the School's professional forestry curriculum, and other ESF bachelor's degree programs, is possible upon completion of the A.A.S. degree at Wanakena. There is also a transfer package agreement with the University of Michigan, School of Natural Resources.

If a student feels transfer to a baccalaureate program is a possibility after graduation from the Forest Technician Program, he or she should pay close attention to the footnotes under "Freshman Year" on page 55.

The freshman year forest technology curriculum consists of general studies courses which may be taken at any accredited four-year college, community or junior college, or agricultural and technical institute except Farmingdale or Alfred (although transfer credits from these schools are acceptable otherwise).

The second year of the curriculum is offered at the School of Forestry's Forest Technician Program on 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 relationships between forest technology and managerial needs. Fifty percent of the studies are devoted to field exercises, most of which are held on the School's forest. This managed forest, containing both hardwood and coniferous species, covers an area some 3½ miles long with widths varying up to 2¼ miles. On two sides, the forest is bounded by State Forest Preserve lands. The forest is also

adjacent to several square miles of virgin timber within the Adirondack Forest Preserve. This excellent forest backdrop for the technology program provides a diverse laboratory for instructional purposes.

Since the Program is situated within a forest environment, some applicants may mistakenly believe that the forest technology program is one of forest lore and wilderness survival. It is, therefore, strongly emphasized that the forest technician curriculum demands high quality academic achievement. Students cannot complete the program without 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, at no additional expense to the student, are made during the year in connection with courses in dendrology, silviculture, forest management, forest recreation, wildlife ecology, and surveying.

LIFE AT WANAKENA

The Wanakena Campus 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.

The main Program building consists of a central service unit with dormitory wings on either side. The central unit contains classrooms, laboratories, a student lounge, faculty offices, the library, a kitchen, dining room and 47 student rooms, each housing two students.

Faculty houses are nearby on the campus. Other buildings include a maintenance shop, garages, a sugar house, 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 forest technician curriculum at the Wanakena Campus are required to live in the campus's dormitories. An exception may be made for married students who bring their families and rent their own 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 Wanakena Campus does not maintain an infirmary, nor does it employ a physician or nurse. There are two excellent physicians and a dentist as well as an excellent Community Hospital in nearby Star Lake, New York. 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 FTP students are available through Syracuse University and it is strongly suggested that the student

FOREST TECHNOLOGY CURRICULUM
(Associate of Applied Science Degree)

Freshman Year	Credit Hours
(Completed at a college of the student's choice)	
[1]General Biology	8
English (A technical report writing course is highly recommended.)	6
[2]Math	6
Economics	3
[3]Electives	7
	30

[1]Courses selected may be in general biology, but at least one course in introductory botany is preferred.

[2]Competency in plane trigonometry and college algebra is required. If demonstrated, credits become electives. If students feel transfer to a baccalaureate program is a possibility, they would be well advised to take calculus.

[3]If a student feels transfer to a baccalaureate program is a possibility, general chemistry and physics should be taken as electives. Otherwise, courses in sociology, psychology, political science, geology, soils, accounting, business, computer science, etc. are desirable electives.

Senior Year (Wanakena Campus)			Credit Hours
First Semester	FTC 200	Dendrology I	2
	FTC 202	Plane Surveying I	4
	FTC 204	Forest Mensuration and Statistics I	3½
	FTC 206	Forest Ecology	3
	FTC 207	Aerial Photogrammetry	2
	FTC 208	Forest Installations	3
	FTC 213	Forest Protection I	2
	FTC 223	Graphics	1
			20½
Second Semester	FTC 203	Plane Surveying II	1
	FTC 205	Forest Mensuration and Statistics II	2
	FTC 209	Forest Roads	2
	FTC 211	Silviculture	2½
	FTC 214	Personnel Management	1½
	FTC 215	Timber Harvesting	2
	FTC 217	Forest Management	3½
	FTC 218	Forest Recreation	1½
	FTC 219	Elements of Wildlife Ecology	1½
	FTC 221	Soil and Water Measurements	1½
	FTC 227	Forest Protection II	2
	FTC 228	Structure and Growth of Trees	1½
	FTC 229	Silviculture II or	2
	FTC 230	Plane Surveying III	
			24½

A total of 75 credit hours is required. Upon satisfactory completion, an Associate of Applied Science (A.A.S.) degree in Forest Technology will be awarded.

consider such coverage before reporting to the Campus. Application forms are available through ESF's Office of Student Affairs.

Because of the comparatively isolated location of the Wanakena Campus, a stock of books and supplies used in connection with the second year of the program is maintained on campus for sale to students.

During the first year of the program, College-enrolled students will be guided by the rules and regulations that govern attendance at their local campus. During the second year of the program, students will be guided by the general rules and regulations for College of Environmental Science and Forestry students and an additional set of Wanakena Campus "house rules."

ADMISSION

Admission Requirements

Requirements for entrance into the forest technician curriculum require a minimum of high school units consisting of: English; history (social science); science (including biology); mathematics (including trigonometry or Math 11); and electives. Mechanical drawing, technical report writing, and computer science are suggested electives.

In addition to the academic requirements, the following must also be met by all applicants:

1. The applicant must be strongly motivated toward a career as a forest technician.
2. The applicant must be willing and able to meet the physical requirements of the program which include pole and tree climbing, walking 2 to 6 miles through forest areas often carrying 15-20 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 full medical examination report must be submitted.

Questions concerning any of these requirements should be referred to the Director of Admissions who may, under special circumstances, waive some of them.

Admission Procedures

The decision to admit any student to the Forest Technician Program rests solely with the College of Environmental Science and Forestry. Most openings in the program are filled by students who received conditional acceptances while still seniors in high school, contingent on successful completion of the first year of college. Remaining openings are filled by transfer students who have already attended college. Therefore, it is suggested that the potential forest technician student apply while still a high school senior.

Here is the procedure:

1. Seniors in high school must submit a regular SUNY freshman application for the College of Environmental Science and Forestry, using a Curriculum Code 620 (Forest Technology). These applicants should indicate entry date to be one year in advance of the current year.
2. Submit a regular application to that school selected for the first year of study, using Curriculum Code 620. It is important that students gain entry on their own for the first year of studies. The College will request information at a later date concerning what institution the student will be attending.

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 studies, and they must be appropriate to those courses and comparable in subject matter, content, and level. All second year courses must be taken at the Wanakena Campus 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

Cost of the first year will vary with the specific institution attended.

Estimated costs of the second year program on the Wanakena Campus are as follows:

N.Y. Resident

Tuition	*Board, Room*	*Books, Supplies*
$1,350	Approx. $3,100	Approx. $800

Nonresident

Tuition	*Board, Room*	*Books, Supplies*
$3,200	Approx. $3,100	Approx. $800

An additional estimated expense of $200 will likely be incurred to cover the cost of laundry and clothing. There is also a $20 graduation fee and a $13 student activity fee, plus a $25 residence deposit and a $25 equipment deposit. The latter two fees are fully or partially refundable, depending on breakage charged to a student during the year.

FINANCIAL ASSISTANCE

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 on pages 20-25 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 School assists in placement of graduates. The reputation of the School of Forestry's Forest Technician Program assists 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.

THE SCHOOL OF LANDSCAPE ARCHITECTURE

RALPH A. SANDERS, *Acting Dean*

FACULTY

GEORGE W. CURRY. *Professional Experience*: The Reimann-Buechner Partnership, Landscape Architects, Syracuse; The Curry-Paulo Partnership; Member, Syracuse Conservation Advisory Council, Syracuse Urban Cultural Parks Advisory Committee, and Chairman, Syracuse Landmark Preservation Board. Licensed Landscape Architect, New York State. *Fields of Specialization*: Site Planning, Urban Analysis and Design, Historic Preservation.

TIMOTHY R. DAY. *Professional Experience*: The Architects Collaborative Inc., Architects and Planners; EDAW, Inc. *Fields of Specialization*: Rural Planning, Solar Energy at the Community Scale, Visual Resource Management, Remote Sensing.

GEORGE F. EARLE. *Professional Experience*: School of Architecture, Syracuse University; Artist; President, World Affairs Council. *Fields of Specialization*: History of Art, Cultural History; Painting, Latin American Art; History of Landscape Architecture; Design; Pre-Colombian Art.

JOHN P. FELLEMAN. *Professional Experience*: Planning Engineer, Monroe County, N.Y.; Urban Planner, NYS Hudson River Valley Commission; Chief Planner, Bruce Howlett, Inc.; Partner, Impact Consultants; Licensed Professional Engineer, New York State; Designated Planner-in-Charge, New York State. *Field of Specialization*: Site Systems Engineering; Route Location; Environmental Simulation.

CLAUDE C. FREEMAN. *Professional Experience*: Russell Bailey and Associates, Landscape Architects and Planners; Alfred Obrist, Landscape Architect and Civil Engineer. *Fields of Specialization*: Site Design, Plant Materials, Graphics.

DAVID L. HANSELMAN. *Professional Experience*: Ohio Department of Education, Ohio Department of Natural Resources, Ohio State University. *Fields of Specialization*: Communications Strategies and Message Design, Non-Print Communications.

RICHARD S. HAWKS. *Professional Experience*: EDAW, Inc., Cambridge Research Institute. *Fields of Specialization*: Regional Planning and Design, Facility Siting and Routing, Geographic Digital Data Banks.

ALLEN R. LEWIS. *Professional Experience*: Bucks County Planning Commission, Pennsylvania. Member, American Institute of Certified Planners. *Fields of Specialization*: Community Planning; Planning Theory; System Dynamics; Modeling and Simulation.

FRANK L. MARAVIGLIA. *Professional Experience*: Senior High School Teacher; Business and Management Consultant; President, Centre of Applied Creativity, Baltimore, Maryland; Faculty, Annual Creative Problem Solving Institute, SUNY Buffalo, Organizational Communication. *Fields of Specialization*: Technical Graphics, Creative Problem Solving, Education, Communication, Video, Management.

JAMES E. PALMER. *Professional Experience*: Research Associate, The Environmental Institute, University of Massachusetts; Associate Social Scientist and Resource Planner, Carlozzi, Sinto & Vilkilis, Inc.; College Planner, Kresge College, University of California at Santa Cruz. *Fields of Specialization*: Landscape Perception, Design Evaluation, Social Impact Assessment, Environment and Behavior Research Methods.

ROBERT G. REIMANN. *Professional Experience*: City of Montreal Department of Public Works, Parks and Playgrounds; Sargent, Webster, Crenshaw and Folly Architects; James E. Glavin and Associates; Principal, Reimann-Buechner Partnership; Director, Professional Practice Institute (ASLA); Director, Landscape Architecture Foundation; Fellow, American Society of Landscape Architects; Member, ASLA Council on Education. *Fields of Specialization*: Environmental Design, Passive Energy Conservation, Site Planning and Design.

HAMID SHIRVANI. *Professional Experience*: University of Southern California; University of California, Los Angeles; Southern California Institute of Architecture; Pennsylvania State University; Shirvani & Associates; The Planning Center; Technokam Regional Development Corporation; London Borough of Barnet, U.K.: Maidment & Brady, U.K.; Devereux and Partners, U.K. *Fields of Specialization*: Urban planning and design, environmental policy development, political economy and developing countries.

RICHARD C. SMARDON. *Professional Experience*: Wallace, Floyd, Ellenzweig, Inc., Cambridge, Mass.; Executive Office of Environmental Affairs, Commonwealth of Massachusetts; Oregon State University Extension Service; Institute for Urban and Regional Development, University of California; USDA Forest Service. *Fields of Specialization*: Landscape and Environmental Planning, Visual Resource Analysis, Environmental Assessment/Administration, Wetland Assessment.

KATHLEEN A. STRIBLEY. *Professional Experience*: Department of Landscape Architecture, The Ohio State University; Anderson-Lesniak and Associates, Inc.; Research Project, University of Michigan; Johnson, Johnson and Roy, Inc.; Colvin-Robinson Associates, Inc.; Dalton•Dalton•Little•Newport, Inc. *Fields of Specialization*: Design and Behavior; Public Participation; Urban Design, Parks and Recreation; Site Planning and Design.

DANIEL A. SUNDQUIST. *Professional Experience*: American Peace Corps; EDAW, Inc., University of New Hampshire. *Fields of Specialization*: Site Planning and Design, Environmental Impact Assessment, Siting and Routing, Synaesthetics.

Introduction

The alteration of the physical environment has been a product of human activity since the earliest times of human settlement. 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 that requiring skilled individual effort and often demanding multidisciplinary attention.

The School of Landscape Architecture offers curricula designed to educate students to contribute in varied ways to the wise use of land and landscape. Each degree program provides a basis for students to establish career directions in landscape architecture or in related disciplines. These curricula are offered at both the undergraduate and graduate levels.

UNDERGRADUATE PROGRAM

The School of Landscape Architecture offers two undergraduate degree programs—the Bachelor of Science with a major in Environmental Studies (B.S./E.S.) and the Bachelor of Land-

Lower Division Courses

Course Area	*Credit Hours*
Written Communications Required credit hours in this area should be taken in courses dealing with English comprehension, the basic skills of grammar and composition.	3
Humanities Required credit hours in this area should be taken in coursework in philosophy, literature, art, music, drama, and language.	9
Social Sciences Required credit hours in this area should be taken in coursework in history (preferably U.S.), cultural geography, sociology, psychology, political science (preferably U.S. institutions), social or cultural anthropology, or economics.	9
Natural Sciences Required credit hours in this area must include a course in general biology. Additional hours should be taken from coursework in ecology, physical geography, earth science, geology, biology, chemistry, and physics.	6
Mathematics Required credit hours in this area should be taken in computer programming, statistics, or mathematics at the level of college algebra, trigonometry, and calculus.	3
Electives	32
TOTAL MINIMUM LOWER DIVISION CREDITS	62

scape Architecture (B.L.A.).

Both degrees share the ultimate purpose of providing senior level education for those concerned with the condition and form of the physical environment. The B.S./E.S. degree is basically designed for those students desiring a general undergraduate degree to be followed by an environmentally related graduate degree. The B.L.A. degree is basically designed for those students desiring to enter the profession of landscape architecture either directly after completing this degree or after completing a graduate degree. Students are urged to seek complete clarification of the two degree programs with regard to their own career goals by arranging an interview with the School.

All students apply for either the B.S./E.S. or B.L.A. degree upon application to the College.

BACHELOR OF SCIENCE IN ENVIRONMENTAL STUDIES

The Bachelor of Science in Environmental Studies (B.S./E.S.) program is primarily concerned with interrelationships among the natural environment, people, and the human environment, including society's institutions. Its focus is on the issues involving the condition and form of the physical environment. The goal of the program is to educate students to be more sensitive, articulate, and knowledgeable about the complex environmental issues facing contemporary society.

The B.S./E.S. degree is granted at the end of four years and requires the successful completion of 125 credit hours. Students typically enter the program with 62 lower division credits. During their junior and senior years, students are required to complete a group of core courses in the humanities, natural, and social sciences. The particular emphasis of an individual student's program is determined by the development of two concentration areas investigating specific environmental concerns directly related to the student's career purposes and goals. It is recommended that students engage some integrative academic experience during their senior year that provides an opportunity to synthesize their environmental studies education.

The complexity and scope of coursework required in the B.S./E.S. program demands both discipline and commitment from students seeking the degree. A clear sense of purpose and objectives is necessary to beneficially engage the curriculum. To successfully meet each student's objectives, a close-working relationship between faculty and student is also necessary. The program's flexibility makes it especially suited for advanced undergraduates desiring a general environmental background in preparation for either graduate training or environmental careers that may appropriately be entered with a baccalaureate degree.

Students receiving the B.S./E.S. degree have pursued graduate study in the disciplines of planning, landscape architecture, and other environmentally related areas such as business, education, and law. Students with academic standing in the top one-third of their class may apply at the end of their junior year for advanced standing admission to the School's M.L.A. program in community design and planning.

Prerequisites for Entry into the B.S./E.S. Program

Because of the wide range of opportunities available to students who enter the B.S./E.S. program, it is important that they prepare themselves with a broad range of lower division coursework. Understanding the issues involved in the condition and form of the physical environment requires a background in the humanities, natural, and social sciences. The following required and recommended prerequisite coursework will prepare the entering student to engage the B.S./E.S. curriculum.

Each applicant is required to submit a statement of program interest. This statement should describe how study in the B.S./E.S. program will contribute to the student's educational and career goals. It should reflect an understanding of the curriculum and represent the student's preparedness to take advantage of the special nature of the program.

BACHELOR OF LANDSCAPE ARCHITECTURE

The B.L.A. degree 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) as the first professional degree offered at the School. The B.L.A. is granted at the end of five years of study and requires the successful completion of 160 credit hours. Students enter into the third year of the program with a minimum of 62 lower division credit hours and follow the prescribed curriculum.

The B.L.A. degree program consists of a core of courses involving the basic principles and skills of landscape architecture design, land manipulation and engineering, applied ecology, and communications. Additionally, students are required to participate in an independent study semester of the Off-Campus

Bachelor of Science in Environmental Studies Curriculum

I. CORE REQUIREMENTS

	Credit Hours
A. *WRITTEN COMMUNICATIONS* ..... Coursework intended to develop a professional-level skill in written communication. Required are three credit hours in report writing or equivalent and one credit hour in library research.	4
B. *METHODS AND TECHNIQUES* ..... Coursework intended to develop methods and techniques useful for analyzing environmental information. Required are six credit hours, including a two-credit-hour course in statistics or computer programming.	6
C. *ENVIRONMENTAL CONCEPTS AND SYSTEMS THINKING* ..... Coursework intended to develop critical facilities and systems thinking useful for an appreciation of the holistic nature of environmental issues. Required are six credit hours, including EIN 300 Introduction to Environmental Studies.	6
D. *NATURAL SCIENCES* ..... Coursework intended to provide a natural science foundation useful for understanding natural phenomena and processes. Required are nine credit hours, including EIN 311 Natural Processes in Planning and Design. It is recommended that the remaining courses have a laboratory or fieldwork component.	9
E. *HUMAN-ENVIRONMENT INTERACTIONS* ..... Coursework intended to provide a foundation for understanding the interaction of humans and the environment from social, institutional, and historical perspectives. Required are nine credits, including EIN 390 Social/Cultural Influences and Environmental Form, EIN 451 Introduction to City and Regional Planning, and either EIN 371 History of American Landscape Attitudes, or EIN 471 History of Landscape Architecture.	9
II. CONCENTRATION REQUIREMENTS ..... This coursework provides an opportunity to develop proficiency in two particular aspects of the interrelationship of the natural environment, people, society's institutions, and their influence on the condition and form of the physical environment. Two concentration areas of nine (300 level or above) credit hours each are required. A maximum of three credit hours of independent study may be counted toward each concentration. Internship-type experience may not be counted toward a concentration. Concentrations are proposed by students after consultation with faculty and must be approved by the faculty advisor. Accepted coursework must be of grade C or better.	18
III. DIRECTED ELECTIVES ..... Eleven credit hours of coursework selected with the approval of the faculty advisor to complement core requirements or concentration areas. It may include a senior-year integrative academic experience. It is recommended that some integrative academic experience providing an opportunity to synthesize their environmental studies education be engaged by each student during their senior year. Possible alternatives include independent readings, a research project, an internship, a senior seminar, or an off-campus study. Each option has its own prerequisites and some have limited enrollments.	11
TOTAL MINIMUM UPPER DIVISION CREDITS	63

A total of 125 credit hours is required to complete the B.S. degree in Environmental Studies.

Program during the fall semester of the fifth year. The major objective of the B.L.A. program is the development of 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 obtain a license to practice landscape architecture. At present, the State of New York requires those holding a 5th-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 a license.

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 in designing the form of the environment.

Students receiving a B.L.A. degree have entered the profession as employees in public agencies 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, energy conservation, environmental policy management and research.

Prerequisites for Entry into the B.L.A. Degree Program

Because of the breadth of concern of the B.L.A. degree, it is imperative that entering students prepare themselves with a broad range of lower division coursework. The environmental efforts with which the students will be involved require a strong background in both the natural and social sciences. In addition, prior skill development in graphics, mathematics, and computer science is required. The following required prerequisite coursework must be met to prepare the entering student to engage the B.L.A. curriculum.

ELECTIVE GUIDELINES

Students planning to transfer to the School of Landscape Architecture should consider the following as guidelines in selecting their 35 credit hours of electives. The subject areas are considered *highly desirable* but are not required. Course areas marked (*) are required following transfer to the School, but can be waived if completed prior to transferring. This will allow a student to take additional electives at ESF.

1. In addition to the required prerequisite credit hours listed, further subject coverage in Written and Oral Communications, Natural Sciences, and Social Sciences as listed above is recommended.

2. Art and Design
   Courses in this category should preferably include Art History* and Studio Art. Studio courses

Required Lower Division Courses

Course Area	*Credit Hours*
Written and Oral Communication Required credit hours in this area should be taken in courses dealing with English comprehension, the basic skills of grammar and composition, and public speaking.	6
Graphics A minimum of one semester's work preferably in a course in engineering drawing, mechanical drawing, or architectural drafting may be selected.	3
Natural Sciences Required credit hours in this area must include a course in botany or plant biology. Additional hours should be taken from coursework in ecology*, physical geography, earth science, geology, or environmental geology.	6
Social Sciences Required credit hours in this area are to be taken from coursework in U.S. history, sociology, social psychology, social or cultural anthropology, political science, or economics.	3
Mathematics Required coverage of college algebra and trigonometry. Students with prior coverage in math who can demonstrate proficiency at time of admission may substitute elective hours for this prerequisite. More advanced math is desirable but not required.	6
Computer Science Required course must include introduction to programming utilizing BASIC, FORTRAN, APL, or PASCAL.	3
Electives	35
TOTAL MINIMUM LOWER DIVISION CREDITS	62

*Can be waived at ESF if completed prior to transfer.

in Drawing or Three-Dimensional Design, for which Sculpture, Ceramics, and Photography, are recommended.

3. Analytical Tools
   Courses in this category should preferably include Elementary Plane Surveying*, Air Photo Interpretation*, or Elementary Physics. Additional work in computing technology is highly recommended, particularly in the realm of computer graphics and computer-assisted design (CAD). Demonstration of academic excellence in environmental design and design graphics through submission of a portfolio is highly recommended as part of the admission's process to the B.L.A. program.

GRADUATE PROGRAM
MASTER OF LANDSCAPE ARCHITECTURE

The master's degree is open to those students who hold an undergraduate degree and meet the prerequisites for admission. The program is accredited by the American Society of Landscape Architects and focuses on community design and planning. The three-year course of study provides a strong foundation of design theory and process while emphasizing mastery of the skills associated with an individually selected area of concentration. The core curricula focus on processes of community design and planning. Students are required to integrate the core coursework with an elected area of concentration. The program requires cross-disciplinary study to prepare students to enter a variety of emerging positions in the public and private sectors. Illustration of these positions may be found in design research, community development, impact analysis, and environmental management. Although these positions require working knowledge of design, they transcend the traditional skills normally associated with project design. Processes related to management, analysis techniques, technological application, and the social and natural sciences are considered necessary to undertake these and other similar positions. Graduates of the program are currently employed by government, educational institutions and private offices practicing environmental design and analysis across a broad and comprehensive scope or purview. The M.L.A. degree is granted upon the completion of 72 credit hours (42 graduate) in a prescribed curriculum.

A variety of joint degree program opportunities exists for applicants wishing to develop a unique career track. Concurrent professional degrees in Law, Public Administration, Public Communication, or Business Management may simultaneously be pursued at Syracuse University. Ph.D. programs for careers in teaching and research are available within the College's Graduate Program in Environmental Science, and with a variety of programs at Syracuse University, such as geography. Applicants interested in dual degree programs are encouraged to contact the College's Graduate Admissions Office at an early date.

M.L.A. DEGREE PROGRAM

The M.L.A. curriculum has four components: a foundation year, a sequence of required core courses, a series of elected courses in an area of concentration, and a terminal experience. The foundation coursework provides the skill and knowledge basis for engaging environmental design. The required core courses have as their focus the development, enhancement, and refinement of understanding of landscape architectural philosophy, theory, skills, and techniques, as focused on community design and planning. Emphasis is placed on the refinement of proficiency in design analysis skills, concepts, and objectives.

Each student is required to select and complete nine credit hours of directed graduate electives in a declared area of concentration within the major of community design and planning. The specific concentration is the responsibility of each student and must be approved by the student's faculty advisor or major professor prior to the end of the first year. Illustrative concentrations include: physical, cultural, communication/public participation, urban design, visual analysis, and environmental simulation.

Three terminal experience options are available: thesis or project, coursework, academic; or professional experience. A project consists of the critical application of professional knowledge and skills to a landscape architectural problem. A thesis consists of research

Bachelor of Landscape Architecture Curriculum

Third Year			Credit Hours
First Semester	LSA 320	Introduction to Landscape Architecture and Planning	3
	LSA 326	Landscape Architectural Design Studio I	3
	CMN 382	Graphic Communication	2
	EIN 311	Natural Processes in Planning and Design	3
	EFB 320	General Ecology or Elective*	3
	Elective		2
			16
Second Semester	LSA 327	Landscape Architecture Design Studio II	3
	LSA 330	Site Research and Analysis	2
	EIN 371	History of American Landscape Attitudes	3
	EIN 390	Social/Cultural Influences and Environmental Form	3
	ERE 306	Elements of Map and Air Photo Interpretation or Elective*	1
	ERE 308	Elements of Plane Surveying or Elective*	1
	ENG 404	Technical Writing	3
			16

Fourth Year			Credit Hours
First Semester	LSA 422	Landscape Design Studio III	4
	LSA 433	Plant Materials	2
	LSA 434	Design Materials	1
	LSA 442	Site Grading	2
	LSA 443	Site Drainage Systems	1
	EIN 451	Fundamentals of City and Regional Planning	3
	EIN 471	History of Landscape Architecture	3
			16
Second Semester	LSA 423	Landscape Design Studio IV	4
	LSA 425	Orientation for Experiential Studio	2
	LSA 444	Vehicular Circulation Design	1
	LSA 445	Introduction to Structures	1
	LSA 455	Professional Practice in Landscape Architecture	2
	EIN 470	Art History or Elective*	3
	LIB 300	Library Research	1
	Elective		3
			17

Fifth Year			Credit Hours
Summer	LSA 533	Plant Materials	2
First Semester	LSA 524	Experiential Landscape Design Studio V (Off-Campus Program)	16
Second Semester	LSA 522 or	Landscape Design Studio VI—Urban Design	4
	LSA 525 or	Landscape Design Studio VI—Site Design	4
	LSA 527	Landscape Design Studio VI—Regional Design	4
	LSA 545	Professional Practice Studio	2
	Architecture Elective		3
	Elective		3
	Elective		3
			15

*Elective only with prior coverage in required area.

A total of 160 credit hours is required to complete the B.L.A. degree.

NOTE: A number of the courses listed in the B.L.A. curriculum are in the process of being revised. Upon revision, new course descriptions will be available after approval by the College of Environmental Science and Forestry Faculty.

which expands or clarifies basic knowledge related to community environmental design. The coursework option involves selected electives in the designated area of concentration. The academic/professional experience is typically a semester-long internship with a public agency, private firm, or nonprofit institution.

The following describes the broad sequential linkages of the six-semester program:

First Year: Foundation courses in design analysis, physical factors, graphics, history, and theory, and start of graduate elective sequence, or engagement of additional undergraduate technical subjects. The scale focus is human, site, and neighborhood.

Second Year, Fall Semester: The third semester of study is intended to provide an introduction to decision-making processes, including computer applications in community design and planning. An examination of the impact of physical factors on the environment is provided. Scale focus includes municipal and site in rural/suburban scenarios.

Second Year, Spring Semester: The fourth semester of study is intended to investigate community design and planning through a variety of projects focusing on the form and condition of environments supporting human behavior. Methods of research and analysis relevant to social determinants at the scale of an urban district are introduced.

Third Year: This year is individually designed, with the assistance of a major professor, to meet the student's career objectives while satisfying the requirements of the selected concentration area, and terminal experience. Study and research opportunities exist both at the Syracuse Campus and throughout the world. Often, all or a portion of the fall semester involves off-campus pursuits, while the spring semester entails final coursework and project documentation.

Research and community service play a significant role in the graduate program, primarily through funded projects and projects/thesis. Not only does research provide new knowledge and applications for the profession, but it enriches the curriculum, enhances faculty expertise and develops student skills in rigorous observation, clear thinking, and lucid writing.

By the nature of a profession which exists on evolving frontiers of human interaction with natural and built environments, much of the research in landscape architecture deals with issues in an exploratory way. Faculty members and graduate students usually work together on research projects in an atmosphere of mutual learning. Approaches may vary from rigorously quantitative analysis of data, to highly qualitative evaluation of broad problems, to application of design and planning methods to specific cases.

M.L.A. Program Sequence

The M.L.A. program is established as a three-year sequence of courses. The following sequence illustrates a typical three-year program.

First Year		Credit Hours
LSA 520	Design Analysis Studio I	3
CMN 382	Graphic Communication	2
LSA 671	History of Landscape Architecture	3
[1]LSA 697	Topics and Issues of CDP	2
LSA 521	Design Analysis Studio II	3
LSA 330	Site Research and Analysis	2
ERE 306	Air Photo Interpretation	1
LSA 445	Elements of Structures	1
LSA 496	Site Grading	2
[2]Directed Electives		5
		24

Second Year		Credit Hours
LSA 620	Community Design and Planning Studio I	3
LSA 652	Community Development Process	3
LSA 656	Environmental Factors, Community Response, and Form	3
[3]LSA 433	Plant Materials	2
[3]LSA 434	Design Materials	1
LSA 621	Community Design and Planning Studio II	3
LSA 650	Behavioral Factors of Community Design	3
Directed Electives		6
		24

Third Year

[4]Typical Options for Integrative Experience:

		Thesis/Project		Academic/ Professional Experience		Coursework	
		Fall	*Spring*	*Fall*	*Spring*	*Fall*	*Spring*
LSA 898	Academic/Professional			12			
LSA 899	Thesis/Project	3	6				
LSA 641	Formal Organization		1		1		1
LSA 642	Project and Program Scheduling		1		1		1
LSA 643	Ethical Issues in Community Design and Planning		1		1		1
Directed Electives		9	3		9	12	9
		12	12	12	12	12	12

[1]Also required for students who enter with advanced standing.
[2]Directed electives are selected in consultation with the student's advisor. They are designed to augment the student's undergraduate preparation, to develop the required concentration.
[3]Usually not required for students who enter with advanced standing.
[4]The precise number of credit hours taken by a student during a given semester in LSA 899, LSA 898, or in directed electives is determined in consultation with the student's advisor.

The College library and the several libraries on the Syracuse University campus offer reference material to support study programs. Facilities at the School include adequate studio and office space as well as three research laboratories. The School also has reproduction, model making, photographic, audio-visual, micro-computer, video, noise, solar, and visual simulation equipment. The College's Computer Center is fully interfaced with Syracuse University to provide a complete range of academic and research capabilities. The College also has a fully-equipped video tape recording (VTR) studio, photogrammetic labs and micro-computer based image processing capability for LANDSAT tape interpretation.

The School is unique in its location within the College of Environmental Science and Forestry. This situation provides the M.L.A. candidate with the opportunity to draw upon information and knowledge in ecology, natural sciences, resource management, forestry and many other related environmental disciplines. The U.S. Forest Service Urban Forestry unit located at the College provides a unique opportunity to promote interdisciplinary environmental design research. In addition, the relationship with Syracuse University provides the School with an extensive intellectual as well as physical resource basis.

The Syracuse area has the largest concentration of landscape architectural firms in the state, outside New York City. With a metropolitan population of nearly 500,000, the city has many opportunities for urban-oriented study. Also, the city's central location in Upstate New York provides easy access to a rich variety of community design and planning contexts throughout the northeastern U.S. and the major metropolises of Canada.

Students seeking admission to the M.L.A. program may apply to enter in either the first or second year based on education and experience. Admission to the first year requires:

1. An undergraduate degree.
2. Graduate Record Examination scores.
3. Undergraduate transcript.
4. Three letters of recommendation.
5. A completed course in each of three areas:
   a. botany, biology, or ecology;
   b. geology, geomorphology, or earth science;
   c. anthropology, psychology, or sociology;
   d. computer application or programming course.

In addition, students seeking admission to the second year must have:

6. Accredited design degree or equivalent;
7. Design and engineering portfolio;
8. TOEFL scores required for all applicants whose native language is not English. Applications should be made prior to March 1 for the following fall.

DUAL UNDERGRADUATE PROGRAM IN ENVIRONMENTAL AND FOREST BIOLOGY AND RESOURCES MANAGEMENT

This dual curriculum is designed to provide students with a strong background in basic biology and forestry. In doing so it meets the core course requirements in two undergraduate curricula: Environmental and Forest Biology, and Resources Management. The Dual Program is one level in a continuum of Biology and Forestry study opportunities at the College:

Environmental and Forest Biology
Environmental and Forest Biology with Forestry Electives

Resources Management
Resources Management with Biology Electives

DUAL PROGRAM

Upon completion of the Dual Program, graduates will be highly qualified to work professionally in forested ecosystems. The breadth of training received by students who elect this option will prepare them for a career in forestry and other aspects of environmental science in the federal, state, and private sectors. Exposure to diverse courses and extensive field experience enhances their employment opportunities in multidisciplinary programs that are characteristic of contemporary approaches to forestry management and other environmental problems.

The Dual Program requires a minimum of five semesters at the upper division level. Six semesters may be necessary for those students who lack appropriate lower division courses, or who wish to develop specific interests in forest biology or forestry. A total of 147 credit hours, 62 of them prior to matriculation, is required for this Bachelor of Science degree. In addition to the 58 credit hours of upper division core courses listed below, six of the elective credit hours must be in Plant Science, six in Animal Science, six in FOR (Forestry) and three in WPE (Wood Products Engineering) or FEG (Forest Engineering), exclusive of the eight-hour summer camp experience.

There is less opportunity to take free electives in the Dual Program than in the two curricula which it combines. It is recommended that elective requirements in plant science and animal science address critical support areas such as forest pathology, plant ecology, fish and wildlife management, and forest entomology. Similarly, forestry electives in silviculture, hydrology, or tree improvement are examples of elective opportunities in important forestry support areas. In all cases, choice of electives depends on the student's professional goals. Course selection is made after consultation with each of two advisors; one from the School of Environmental and Forest Biology and one from the School of Forestry.

To facilitate transfer at the junior level, it is important that students satisfy the lower division course requirements prior to matriculation at the College of Environmental Science and Forestry.

Students entering at the junior level should have successfully completed a minimum of 62 credits which include:

Lower Division Courses

Course Area	*Credit Hours*
General Chemistry with Laboratory	8
Organic Chemistry with Laboratory	8
General Physics with Laboratory	8
Mathematics, through Integral Calculus	6-8
English	6
General Botany and Zoology OR General Biology with Laboratory	8
*Social Sciences/Humanities (Sociology or Psychology preferred)	6
*Political Science (U.S. Institutions)	3
*Microeconomics	3
Computer Science	3
Biology Elective	3
	62

Upper Division Courses

Junior Level			*Credit Hours*
Fall Semester	EFB 320	General Ecology	3
	EFB 336	Dendrology I	3
	**EFB 352	Elements of Forest Entomology	3
	****Elective		6
			15
Spring Semester	APM 391	Statistics	3
	EFB 325	Cell Physiology	3
	FOR 360	Principles of Management	3
	****Elective		3
	***Social Science/Humanities		3
			15

Summer:	FOR 301, 302, 303, 304 Field Forestry Program at Warrensburg		8
Fall Semester	FOR 305	Forestry Concepts and Applications	1
	FOR 331	Introduction to Physical Environment	6
	FOR 332	Silvics/Silviculture	8
	FOR 322	Mensuration	1
			16
Senior Level			*Credit Hours*
Spring Semester	FOR 370	Management of Forest Enterprise	3
	EFB 407	Genetics	3
	EFB 408	Genetics Laboratory	1
	****Electives		9
			16
Fall Semester	APM 492	Biometrics	3
	FOR 400	Social Environment of Resource Management	3
	FOR 461	Management Models	3
	****Electives		6
			15

*Students may be admitted with 3 credit hours in each of these subject areas. Deficiencies must be removed as early as possible in the student's program.

**A spring course, EFB 351, may be substituted if scheduling problems conflict with EFB 352. This will open up 3 hours of electives during the fall semester rather than in the spring.

***If this requirement is satisfied in the freshman and sophomore years, biology or forestry electives may be substituted.

****These electives should include at least 3 credits in WPE or FEG, 6 credits in FOR, 6 credits in plant sciences, and 6 credits in animal science.

GRADUATE PROGRAM IN ENVIRONMENTAL SCIENCE

MOHAN K. WALI, *Director*

The collegewide Graduate Program in Environmental Science (GPES) offers M.S. and Ph.D. degrees in environmental science through a transdisciplinary program which draws upon faculty from across the College as well as selected faculty participants from Syracuse University. Concurrent degree programs are also offered between GPES and Syracuse University's Maxwell School of Citizenship and Public Affairs, S. I. Newhouse School of Public Communications, School of Management, and College of Law.

A PERSPECTIVE

Amid the phenomenal advances in engineering technology in this century, there arose an unprecedented demand for materials and processing. Concomitantly, a burgeoning human population, coupled with increasing demands for food, fiber, and fuel resulted in large scale disturbance of the environment, overexploitation of natural resources and insensitive land use practices. Polluted air and water, land areas made derelict by mining, energy-intensive agricultural practices, increased use of pesticides, large scale industrial growth with its attendant waste products, unprecedented numbers of automobiles, networks of roadways, and expanding urbanization brought to the fore the political, economic, and some recently-acquired social-cultural realities.

The understanding of and solutions to contemporary environmental problems transcend disciplinary boundaries. Hence, environmental science must not only integrate the traditional scientific disciplines but also the problems of technological development, of generated residuals and the risk of environmental hazards, and of associated economic and social choices.

ENVIRONMENTAL SCIENCE is the field of enquiry in which the knowledge and principles of physical, biological, and social sciences flow as systems processes within the contextual framework of unifying policies. These policies, in turn, determine the design, the plan and the regulation seeking mitigation of environmental problems. While the emphasis in some cases may be on immediate environmental problem-solving, understanding the problem must be the key for effective and long-term resolution. Additionally, the study of environmental problems in many cases affords great opportunities for the enrichment of the basic knowledge of traditional disciplines and the testing of some of their basic tenets.

MISSION

The central mission of GPES is transdisciplinary education and research for effective resource use, resource conservation, and environmental enhancement and protection. Future environmental scientists will require sound knowledge of the traditional disciplines, as well as the understanding of a number of ancillary subject areas. Their effectiveness will be demonstrated through technology transfer that brings the science from the experimental to real world situations. The challenge lies in the translation of environmental awareness and concerns into well informed, scientifically-based action. It is here that the central role of a program like GPES resides: *Transdisciplinary education and research to foster the effective use of natural resources while protecting the environmental base from which all resources flow.*

Therefore, the Graduate Program in Environmental Science engenders the following approaches to prepare the student to scientifically deal with environmental problems, and to perform as an effective environmental professional:

(a) *multidisciplinary approach*—recognition of the necessity to approach environmental problems with input from several disciplines and professions:
(b) *holistic philosophy*—awareness of and deference to the interdependence of elements (including physical, biological, and social systems, human behavior, and cultural values) within ecosystems;
(c) *sound grounding in at least one concentration*—competency to understand and apply the principles of an environmental area of study, and with that strength interact with other disciplines;
(d) *realistic experience*—through internships or other focused projects which provide direct interaction in social, economic, political, and social institutions which underlie decisionmaking; and
(e) nontraditional *problem solving* tools to permit a student to go beyond traditional disciplinary paths.

PROGRAM OF STUDY

Within the framework of POLICY, PLANNING, and REGULATION, there are six areas of concentration: ENERGY, LAND USE, WATER RESOURCES, URBAN ECOSYSTEMS, WASTE MANAGEMENT and ENVIRONMENTAL COMMUNICATION. These concentrations are designed to be broad-based; are not mutually exclusive and intergrade into each other to form a continuum; and some areas of pursuit belong to several concentrations, e.g., environmental assessment and impact analysis. Similarly, faculty interests are diverse and encompass more than one area of concentration.

A. Policy, Planning, and Regulation

FACULTY: BEHREND, DALL, FREY, GEIS, GRATZER, GRAVES, HENNIGAN, KARP, LAMBRIGHT, NAKATSUGAWA, E. PALMER, J. PALMER, PORTER, REIMANN, ROWNTREE, SHIRVANI, SMARDON, WHALEY, YAVORSKY

Policy study, defined as the study of the nature, causes, and effects of alternative public policies, is the integrating force bringing all concentration study areas together in pursuit of the common goal of meaningful and effective research and education in environmental science.

Hence, the examination of policy by decomposition into its components and the design and synthesis of new alternatives, or *policy analysis*, forms a central core of the program. Policies formulated on the basis of contemporary scientific knowledge together with the societal, economic, and cultural values, pave the way for planning and regulation for environmental issues.

Through the study of public policy, students gain an understanding of the causes and consequences of policy decisions which will help integrate environmental knowledge with the scholarship of public administration and political science. This integration is necessary because the careers of graduates will either be directly in the public sector, or closely linked with government agencies. Second, an understanding of the causes and consequences of public policy assists students to solve practical problems. Such understanding is valuable in developing strategies and tactics to accomplish desired objectives. Third, the knowledge of public policy causes and consequences creates political awareness, a virtual necesssity for any professional irrespective of the sector of employment.

An excellent example wherein policy and scientific knowledge are intended to be brought together for decisionmaking is the National Environmental Policy Act of 1969. By this Act, environmental impact statements which consider alternative courses for every stipulated development that has the potential for adverse environmental impact have become institutionalized. The Act provided for active citizen participation; any decisions that invoked the spirit of the Act could be challenged.

Students can opt to specialize in environmental assessment analyses through studies in any one of the GPES concentrations. In practice, such analyses are team efforts, and the program is intended to ensure that potential team members are conversant with, and operationally adapted to, the language and procedures of the disciplines involved. Starting with students who have an in-depth background in an established discipline or profession (e.g., chemistry, biology, engineering, ecology, forestry), the program seeks to build upon existing strengths while broadening the student's ability to deal effectively with the complex, interdisciplinary problems which arise in studies of environmental impact.

B. Areas of Concentration

LAND USE

FACULTY: M. ALEXANDER, BEHREND, BLACK, BROCKE, BURGESS, CHAMBERS, DALL, DINDAL, ESCHNER, FELLEMAN, GEIS, GRATZER, GRAVES, HARTENSTEIN, JOHN HASSETT, HAWKS, KARP, McCLIMANS, J. PALMER, PAYNE, PORTER, RAYNAL, REIMANN, ROWNTREE, SANDERS, SHIRVANI, SMARDON, VANDRUFF

The Land Use Concentration develops an understanding of present and future trends in the magnitude and patterns of land use and estimates future availability of land for multiple uses. It provides opportunity for economic, sociological, political, policy, planning, and ecological foci. It brings together an interdisciplinary mix of coursework, internship experience or research to address land use value conflict situations, ecologically-based land use considerations of carrying capacity, and appropriate means to anticipate and plan for existing and new land development technologies and processes. The following objectives are important: (a) to foster appropriate use of policy, planning, economic and legal devices for encouraging socially responsible use of the land; (b) to clarify the behavioral and perceptual sources of environmental problems and land use decisions; and (c) to develop, test, and refine methods for evaluating land use proposals with important environmental consequences. Options for specialization include: (1) *Land Use Planning*, and (2) *Managemend Land Use Patterns*.

Recommended areas of study include, from (1) physical sciences: energy exchange, soils, remote sensing, visual landscape analysis, meteorology, and soil and water conservation; (2) biological sciences: terrestrial community ecology, wildlife management, and silviculture; (3) social sciences: land use economics, environmental impact, transportation systems, environmental law, and environmental communications.

WATER RESOURCES

FACULTY: M. ALEXANDER, BLACK, BRANDT, BURGESS, ESCHNER,

FELLEMAN, JAMES HASSETT, JOHN HASSETT, HENNIGAN, JOHNSON, MCCLIMANS, MITCHELL, NAKAS, RAYNAL, RINGLER, SCRUDATO, SMARDON, TULLY, WERNER

The Water Resources Concentration develops an understanding of both the technical information and transdisciplinary relationships of various *water-related* issues. Individual programs may emphasize scientific or social subject areas but all students acquire preparation in both areas. Scientific aspects include the basic physical, chemical, and biological interactions occurring in aquatic ecosystems under natural conditions, as well as under modified conditions that result from changes in water quality or quantity. The social aspects are concerned with planning, regulation, law and institutions, and management of water resources. Both as a resource for many human benefits and uses, and as a critical environmental element, water serves as a focus for graduate study in pollution and water quality control, and water and related land resources management. The transdisciplinary nature of the program requires a balance of depth, breadth, and synthesis of studies drawing together many diverse components.

Recommended areas of study include, from (1) physical sciences: civil engineering, geology, geomorphology, hydrology, meteorology, sanitary engineering, soils, and water chemistry; (2) biological sciences: ecology, entomology, fishery biology, forestry, microbiology, water quality, wildlife management, and zoology; (3) social sciences: administration, economics, government, history, law, and policy.

URBAN ECOSYSTEMS

FACULTY: BLACK, BURGESS, HAWKS, HERRINGTON, J. PALMER, RAYNAL, ROWNTREE, SANDERS, SHIRVANI, SMARDON, VANDRUFF

The Urban Ecosystems Concentration focuses on urban system structure and function using both analytic and synthetic techniques. Faculty expertise in soils, meteorology and hydrology, wildlife, energy and reclamation, forestry, design, and human attitudes and behavior combine to facilitate the systemic approach to the study of Urban Ecosystems. Three types of systems are available to the students for field work: (a) the nonmetropolitan community typical of Upstate New York rural areas, (b) the metropolitan central city surrounded by suburbs and agricultural lands, and (c) the megalopolitan seaboard extending from Boston to Washington, D.C.

Recommended areas of study include from (1) physical and engineering sciences: microclimate, water management, soils, remote sensing; (2) biological sciences: urban forestry, wildlife, greenspace silviculture, and botany; (3) social sciences: land economics, geography, human and cultural geography, and ecology.

WASTE MANAGEMENT

FACULTY: J. ALEXANDER, DINDAL, DURKIN, ESCHNER, FREY, HARTENSTEIN, JAMES HASSETT, JOHN HASSETT, HENNIGAN, JOHNSON, MCCLIMANS, MITCHELL, NAKAS, NAKATSUGAWA, SCRUDATO, TANENBAUM.

The Waste Management Concentration encompasses three subject areas: (1) *Toxic Waste Disposal*—Research into natural detoxification is an active and valuable component of waste management studies, and the nature, amounts and disposal/destruction in land fills, or by incineration, chemical neutralization, deep well injection, and ocean dumping are considered thoroughly. (2) *Biomass Utilization*—Includes the use of forest and agricultural wastes and other forms of biomass that have a vast potential for energy production and as biochemical feedstock. (3) *Biogeochemical Management of Wastes*—Waste materials may have unique features due to their specific chemical and physical composition, their temporal and spatial location, and their possible contamination by toxic substances. These waste materials may have useful nutrient and energy attributes which make them amenable for use through biogeochemical processes associated both with natural and man-made systems. They include wood product residuals, wastepaper, wastewater effluents, and sewage sludge.

Depending on subject areas chosen, students obtain an understanding of processes that generate waste; of community, chemical and microbial ecology; environmental chemistry including toxicology; wood chemistry; and implementation considerations including engineering and management components.

ENERGY

FACULTY: HAWKS, HERRINGTON, NAKAS, REIMANN, TANNENBAUM, YAVORSKY

The Energy Concentration provides for study of fuel energy-environment-economy relationships with a focus in three areas: (1) *Conventional and Alternate Energy Sources*—the distribution, politics, and development of conventionally known sources (gas, oil, hydropower, coal, etc.) together with a search for strategies of exploring alternate sources; (2) *Conservation*—efficient use in industry, public and private sectors; and (3) *Reclamation of Disturbed Lands*—the rehabilitation of land mined for coal, tar sands, oil shales, and other materials and minerals. As an example, surface mining for coal is directly related to the overall energy scenario, and the use of coal will be intensified worldwide. This aspect of study is directly related to land use, water resources, air pollution, and waste management.

Recommended areas of study include, from (1) physical and engineering sciences: geology, chemistry, hydrology, engineering systems; (2) biological sciences: ecology, range management, forestry, agriculture; (3) social sciences: environmental law, sociology, and economics.

ENVIRONMENTAL COMMUNICATION

FACULTY: J. ALEXANDER, M. ALEXANDER, BRANDT, BURGESS, CHAMBERS, DINDAL, EHLING, ELY, HANSELMAN, NAKATSUGAWA, PAYNE, PORTER, STITELER, VANDRUFF, WEEKS, YAVORSKY

The Environmental Communication Concentration recognizes four general paths; (1) *Environmental Education and and Interpretation*—Effective communication is a necessary element for fulfilling the social contract in democratic societies. A growing concern in the U.S. public for environmental quality reveals a new interest in the historic, cultural, and natural values associated with our environment. Education and interpretation provides a continuum of environmental knowledge from awareness and appreciation to scientific concept understanding. (2) *Environmental Journalism and Media*—Students who choose this path share

the same general objective as in (1) above; however, they specialize in presentation through mass media. (3) *Public Participation*—More interactive roles in decisionmaking must emphasize the skills and techniques of public participation. Tasks usually start with soliciting public comprehensions and opinions concerning specific environmental issues, and then employing information dissemination and public interaction. Skills and knowledge in social psychology, public relations, message design and presentation, law and government must be applied. (4) *Environmental Mediation*—The purpose here is to effect conflict resolution by avoiding legal action. The public's growing awareness of environmental values leads to increased conflict concerning their use. This new role of trained individuals is to understand the technical issues that underlie the dispute, identify affected groups, and apply various techniques for conflict resolution and group problem-solving.

Recommended areas of study include, from (1) physical sciences: environmental and organic chemistry, environmental geology, mineral resources, energy systems, and soil and water management and conservation; (2) biological sciences: ecology, entomology, and taxonomy; and (3) social sciences: planning, policy, information systems, and instructional technology, journalism, and law.

REQUIREMENTS

The academic requirements of the Graduate Program in Environmental Science are designed to provide graduates with a thorough preparation to meet the challenges of the field as leading scientists and professionals. General programmatic requirements constitute a framework to ensure that the individual study program will meet the need for depth of knowledge in one chosen area of concentration, breadth across at least two areas, and training in the analysis and synthesis of attributes of environmental issues.

Each student must be adequately prepared for advanced work in environmental science. To demonstrate this, each student is required to have satisfactory coverage of basic sciences, professional training, and experience. Students must also have basic training in quantitative methods and demonstrate competence in them. Where preparation in these areas is found deficient at the time of entrance, admission may be made on a provisional basis pending the successful completion of deficiencies.

Master of Science

1. Core: A minimum of 9 credit hours will be required in general courses designed interactively with the chosen areas of concentration. The distribution of these credits will be as follows:
   (i) Three credit hours in environmental policy to prepare the student's background in environmental science institutions and public decisionmaking as they pertain to natural resources of air, land and water, to resource economics, to waste management, and related topics.
   (ii) Three credit hours each in two areas of concentration supporting the chosen area of concentration in order to gain appreciation and knowledge of the interdependence of the processes and components of ecosystems.
2. Area of concentration: A minimum of 15 credit hours (excluding 898, 899, and 999 numbered courses) to ensure the depth of study in one chosen area supplemented by:
   (a) Thesis: Six credit hours of research resulting in a document which clearly demonstrates, the graduate level accomplishments of the student, is of a quality and scope suitable for publication in a scholarly journal; or
   (b) Internship: Six credit hours with a public, private or industrial organization, a graduating essay on the internship, and the successful completion of a comprehensive examination (credit hours determined by major professor and the student's advisory committee). Study projects in the past have included paid internships with such organizations as the National Wildlife Federation, New York State (NYS) Legislature, NYS Department of Environmental Conservation, NYS Energy Research and Development Authority, Agway, Inc., and Cablesystems of Syracuse.
   (c) Additional coursework: Eighteen credit hours followed by the successful completion of a comprehensive examination may be substituted for the thesis and internship options.

Doctor of Philosophy

Requirements for the doctorate are as follows:

1. Core requirements—coverage as stipulated for the Master of Science degree.
2. Credits—completion of at least three full-time academic years of graduate study beyond the baccalaureate degree or an equivalent that can be shown to accomplish the same goals.
3. Language and tools—as required by advisory committee.
4. Preliminary exam—an examination may be required of those admitted into a doctoral program to ascertain their level of understanding of the basic principles and techniques necessary to function effectively in that program. The results of the preliminary examination will be used to guide the major professor and student in determining the appropriate coursework necessary to complete that requirement for the doctorate.
5. Candidacy exam—must satisfactorily complete a candidacy examination covering the major field and, in a broader manner, allied fields in order to be advanced into the status of doctoral candidate.
6. Doctoral dissertation—a thesis must be completed and successfully defended in order for the doctoral degree to be awarded.

(Please also refer to the College graduate policies on page 29.) Students seeking concurrent degrees with Syracuse University are advised to state that desire clearly in their applications; in such cases, students must also meet the entrance and degree requirements of the appropriate Syracuse Univeristy Colleges and Schools. However, students may not apply for the concurrent degree option until they have completed at least one semester of graduate level coursework and earned grades at a superior level.

Graduate Exchange Programs

INTERCAMPUS DOCTORAL EXCHANGE

There is an opportunity for doctoral students at ESF to study for one or two semesters at the following schools: State University Centers at Albany, Binghamton, Buffalo, or Stony Brook; City University of New York; or New York University.

This exchange program provides students with an opportunity to take advantage of over 160 faculty, specialized research laboratories and equipment, technical libraries, and field study areas which complement the extensive programs and resources at ESF which are discussed throughout this catalog.

This fellowship provides a grant-in-aid of up to $5,000 a year and may include a tuition waiver. For further information, please contact the Office of Academic Programs.

COLLEGE OF AGRICULTURE AND LIFE SCIENCES AT CORNELL UNIVERSITY

The State University of New York College of Environmental Science and Forestry and the New York State College of Agriculture and Life Sciences at Cornell University provide an opportunity to exchange graduate students so they can take advantage of special courses, faculty, and research facilities.

There are a number of programs on both campuses which complement one another. The following research and instructional areas at the College of Agriculture and Life Sciences appear likely to be of greatest interest to ESF students:

Agricultural Economics—Land Economics; Resource Economics; Resource Investment and Environmental Quality; Agricultural Land Policy.

Agricultural Engineering—Physical Analysis of Plant and Animal Materials; Soil and Water Engineering; Environmental Systems Analysis; Drainage Engineering; Soil and Water Conservation.

Agronomy—Identification, Appraisal and Geography of Soils; Soil Fertility Management; Soil and Water Conservation; Aquatic Plant Management; Forest Soils; Soil Microbiology; Microbial Ecology; Use of Soil Information and Maps as Resource Inventories; Soil Organic Matter; Soil Chemistry; Weed Science; Dynamic Climatology; Physics of Clouds, Rain, and Rainmaking.

Natural Resources—Wildlife and Fisheries Management; Environmental Conservation; Resource Analysis and Planning; Woodland Management; Forest Ecology; Maple Syrup Production.

Floriculture—Woody Plant Materials; Herbaceous Plant Materials; Plants and Design.

Entomology—Insect Pest Management; Arthropod Pests of World Importance; Biological Control; Insect Pathology; Environmental Biology; Pesticides in the Environment.

Plant Breeding and Pathology—Plant Cell Genetics; Methods of Plant Breeding; Genetics and Breeding for Disease and Insect Resistance; Plant Pathology; Advanced Disease Control; Dendropathology; Pest Management for Plant Protection; Advanced Mycology; Plant Virology; Plant Nematology; Bacterial Plant Pathogens; Disease Physiology; Philosophy of Plant Pathology; Taxonomy of Fungi; Pathology of Trees and Shrubs.

Pomology—Tree Fruits; Orchard Management; Growth and Development of Woody Plants.

Rural Sociology—Rural Development and Cultural Change; Political Structure and Development; Social Power and Community Change; Political Economy of Rural and Regional Development.

For detailed information please contact the Office of Academic Programs.

Course Offerings

Students at the College of Environmental Science and Forestry have not only the academic and research resources of their own institution, but also the resources of nearby Syracuse University and State University Upstate Medical Center.

COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY 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 cognizant departments or programs, approved by the appropriate academic dean, faculty committee, and the college faculty.

Course Numbering System

Code Levels:

100-299 Lower-division undergraduate courses for which no graduate credit may be given.

300-499 Upper-division undergraduate courses for which no graduate credit may be given.

500-599 Graduate courses designed expressly for areas of specialization in post-baccalaureate programs or in the professional program leading to the Bachelor of Landscape Architecture. Undergraduate students with superior academic records may register for these courses.

600-699 Graduate courses which permit undergraduate students to enroll only by petition with a well-documented justification approved by the undergraduate advisor, curriculum director, and course instructor.

700-999 Graduate courses for which no undergraduate may enroll.

General Subject Areas

APM—Applied Mathematics 69
CMN—Communications (Landscape Architecture) 70
EFB—Environmental and Forest Biology 70
EIN—Environmental Influences (Landscape Architecture) 75
ENS—Environmental Science 76
ERE—Engineering (Environmental and Resource Engineering) . 76
ESF—Nondepartmental 79
FCH—Chemistry 79
FEG—Forest Engineering 82
FOR—Forestry (Resources Management) 82
FTC—Forest Technology 84
LIB—Library (College of Environmental Science and Forestry Course) 86
LSA—Landscape Architecture 86
PSE—Paper Science and Engineering 88
RMP—Resource Management and Policy 89
SCE—School of Continuing Education 90
SIL—Silviculture 91
WPE—Wood Products Engineering 92

APM—APPLIED MATHEMATICS

360. Introduction to Computer Programming (3)
The basic course in computer use offered by the College. It is intended to provide the student with the skill and understanding needed to utilize digital computer languages for problem solving. The course will cover instruction in APL, FORTRAN IV, use of operating systems, and some background material in general hardware/software designs. Fall and Spring.

391. Introduction to Probability and Statistics (3)
Two hours of lecture, three hours of laboratory. Elementary probability, theoretical and sampling distributions, hypothesis testing, statistical estimation, analysis of variance, regression and correlation, nonparametrics and sampling concepts. Spring.
Prerequisite: Two semesters of calculus.

492. Forest Biometrics (3)
Two hours of lecture, three hours of laboratory. Analysis of variance including nested and cross-classification. Matrix approach to multiple linear regression and weighted least squares. Nonlinear regression. Sampling methods and design. Applications to forestry problems. Fall.
Prerequisite: APM 391 or equivalent.

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 IV and APL with a discussion of an Assembly Language. Other topics include representation of information, management of files, error control, operational systems and job control. Fall and Spring.

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.

620. Analysis of Variance (3)
Three hours of lecture and recitation and three hours of laboratory. Multiway 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. Fall.
Prerequisites: Graduate standing and an introductory course in statistics covering material through the one-way analysis of variance.

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 or equivalent.

630. Regression Techniques with Applications to Forestry (3)
Two one and one-half hours of lecture. Review of matrix algebra, probability theory and statistical methods. Basic concepts in regression analysis. Classical linear regression model. Least and weighted least squares method. Dummy variables and their uses in regression and covariance analysis. Applications to problems of statistical prediction and estimation from the field of forestry in general and forest mensuration and inventory in particular. Fall.
Prerequisite: APM 391 or equivalent.

635. Multivariate Statistical Methods (3)
Estimation and inference for the multivariate normal distribution. Multivariate analysis of variances, factor analysis, principal components analysis, canonical correlation, discriminant analysis, cluster analysis. Spring.
Prerequisite: One semester of statistics.

650. Operations Research (3)
Two one and one-half hours of lecture. Deterministic and Stochastic Operations Research models applicable to managerial problems. Linear programming, transportation and allocation models, goal programming, dynamic programming, network analysis, and simulation techniques. Spring.
Prerequisites: APM 391 and MAT 227 or equivalent, or permission of the instructor.

CMN—COMMUNICATIONS (LANDSCAPE ARCHITECTURE)

(See also courses listed below under EIN and LSA.)

380. Technical Drawing I (1)
One three-hour drafting room period. Elements of perspective, isometric, oblique, and orthographic projection. Practice in freehand and instrument drawing. Fall.

381. Technical Drawing II (2)
Two three-hour drafting room periods. Elements of perspective, isometric, oblique, and orthographic projection. Practical applications of these principles in machine and architectural drawing, including piping and electrical drawings. Spring.

382. Graphic Communication (2)
Two three-hour studios with up to one hour of studio per week devoted to group presentation meetings, instruction, and review of new techniques such as diagramming, drafting, perspective, and plan graphics. Drawings, examinations, and a final portfolio constitute the basis for grades. Fall.

530. Environmental Communications Studio (2)
Three-hour studio and one-hour discussion. For seniors and graduate students, this course offers the opportunity for students to apply communications theory and strategies through the planning, production, and display of media projects developed around the student's area of professional interest. Enrollment limited to 20 students. Fall.
Prerequisite: CMN 531 or permission of the instructor.

531. Environmental Communications (3)
Three hours of lecture/discussion. An introductory course for seniors and graduate students which presents techniques and processes in education and communications applicable in environmental science, management, planning, and design. Topics include basic teaching, learning and communications theory and strategy, working with the press, electronic media, gaming and simulation, public address techniques, slide/tape production and use, film production and use. Spring.

637. Environmental Communications Project (1-3)
This course is designed to give graduate students an opportunity to work as a team in identifying, developing, administering, and evaluating a communications project related to an environmental issue. Typically, a workshop or shortcourse will be developed and offered for some targeted public through the School of Continuing Education. The nature of the topic and format of the project will be determined according to experience background of students enrolled. Task responsibilities and time commitments are correlated with number of hours for which student has registered. Spring.

682. Video Communications (3)
Three hours of studio plus lecture. This course will provide students with instruction and experience in the skills necessary to provide video tape programs. Each student will prepare and develop a video script for production of a program on an assigned topic. Completed programs will be tested and evaluated. Class size is limited. Fall and Spring.
Prerequisite: Permission of the instructor.

738. Environmental Education Programs of Agencies and Institutions (1-3)
One three-hour seminar session. An analysis of contemporary environmental education objectives, methodologies, and philosophies employed by various public and private institutions. Attendance, readings, and short paper required for one-hour credit. For two or three hours credit, an individual investigation of the environmental education and communications activity of an agency or organization is also required. Fall.

EFB—ENVIRONMENTAL AND FOREST BIOLOGY

The Department 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. In the following list, courses numbered from ( )00 - ( )25 (at each level) are General Biology offerings; those from ( )26 - ( )50 are Plant Sciences, those from ( )51 - ( )75 are Entomology; and those from ( )76 - ( )95 are Animal Science courses.

NOTE: All EFB courses require a minimum prerequisite of one year of college biology or equivalent. A course at an appropriate level may be taken with permission of the instructor.

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.

320. General Ecology (3)
Two hours of lecture, three hours of field trips during the first half of the semester. Three hours of lecture during the second half of the semester. Introduction to ecosystem ecology stressing the dynamic interrelationships of plant and animal communities with their environments, ecological factors, energy flow and trophic levels in natural communities, plant responses and animal behavior, population dynamics, biogeography, and representative ecosystems. The ecological impact of man is reviewed. Fall.

325. Cell Physiology (3)
Three hours of lecture. Introduction to the dynamics of living systems with emphasis on the universality of the biological world. Spring.
Prerequisite: One semester of organic chemistry.

326. Plant Structure, Function and Morphology (4)
Three hours of lecture and three hours of laboratory. An exposition of plant biology with emphasis on the structure and function of the life forms, reproduction, and adaptations of major groups of plants. Fall and Spring.

330. Plant Nutrition (3)
Three hours of lecture. Descriptive aspects of the fundamental activities of plants. Subjects covered include cell structure, water and mineral metabolism, organic nutrition, and a brief introduction to biological control mechanisms. Spring.
Prerequisite: EFB 326 or equivalent.

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. Open only to students in the Forest Engineering curriculum. Fall.

336. Dendrology I (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.

340. Forest and Shade Tree Pathology (3)
Two hours of lecture and three hours of autotutorial 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.

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 Resources Management. Spring.

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.

382. Wildlife Conservation (3)
Two hours of lecture, one hour of recitation. Introduction to the biological principles of conservation including the relationship of natural resources to modern society. The wildlife resource and its conservation will be emphasized. It is not designed for students concentrating in the area of Forest Wildlife Management. Fall.

385. Comparative Vertebrate Anatomy (4)
Three hours of lecture and three hours of laboratory per week. Analysis of vertebrate structure, with emphasis on comparative study of organ systems. Includes evolution of form and function, major adaptive patterns, and phylogenetic relationships in vertebrates. Spring.

386. Vertebrate Histology (3)
Two hours of lecture and three hours of laboratory. A study of tissues from protochordates, fishes, amphibians, reptiles, birds, and mammals, with emphasis on evolution, environment, and function, and with introduction to histopathologies. Spring.

387. Vertebrate Physiology (3)
Three hours of lecture. A study of functional responses of vertebrates to internal and external environmental conditions. Fall.

405. History of Natural Science (1)
One hour of lecture. A review of the history of western science from pre-Ionian times to Darwin, with evaluation of the impact of culture and religion on scientific progress. Spring.

407. Principles of Genetics (3)
Three hours of lecture and discussion. A general course covering concepts of genetics and evolution base 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, the genetic structure of populations and their evolution. Numerical methods for characterizing and analyzing genetic data are introduced. Spring.

408. Principles of Genetics Laboratory (1)
Three hours of autotutorial laboratory. Experiments with plants and animals and computer simulation exercises demonstrate the basic principles of inheritance of Mendelian and quantitative 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. Spring.
Co-requisite: EFB 407.

409. Introduction to Quantitative and Population Genetics (1)
Ten lecture-discussions and four autotutorial laboratories the second half of the semester (incl. Lecture-Lab Modules 5 and 6 of FBL 470 and 471). Basic genetic concepts of quantitative inheritance, the structure of populations and evolution. Laboratory experiments and computer simulations are used to demonstrate these concepts. Numerical methods for characterizing and analyzing genetic data are introduced. Spring.
Prerequisite: An introductory genetic lecture-laboratory course deficient in these areas of genetics and permission of the instructor.
Note: Not open to students taking EFB 407 and 408.

420. Field Experience—Internship (5)
Full-time for at least five weeks, or equivalent, of employment with an agency or professional involved in field activity. A resident faculty member is required to serve as course evaluator. Approval of curriculum director is necessary. See advisor for detailed procedural information. Summer.

421. Ecology of Freshwaters (2)
Half-time for four weeks. Cranberry Lake Biological Station. Experimental and observational studies of environmental and biotic interactions influencing productivity of freshwaters. Basic concepts at the organismic, population, and community level. Summer.

426. Plant Propagation (1)
One combined lecture-demonstration laboratory plus supervised greenhouse assignments. Instruction in principles and practices of plant propagation and in related greenhouse operations. Fall and Spring.
Prerequisite: Senior status in Environmental and Forest Biology curriculum.
Note: Cannot be used to satisfy the 6-hour biology curriculum requirement in the plant sciences.

430. Fungal Physiology (3)
Three hours of lecture and discussion. Principles of growth, morphogenesis, and reproduction of the fungi emphasizing the role of the environment in controlling fungal processes. Spring.
Prerequisite: EFB 325 or equivalent.

431. Fungal Physiology Laboratory (1)
Three hours of laboratory. Selected experiments in the quantitative study of fungal growth, nutrition, sporulation, and spore germination. Spring.
Co-requisite: EFB 430.

435. Adirondack Flora (2)
Half-time for four weeks. Cranberry Lake Biological Station. Field study of the summer flora of the Adirondack Mountains. Summer.

436. Dendrology II (1)
One three-hour field trip/laboratory. A continuation of Dendrology I emphasizing trees and shrubs ecologically important in the Central New York region and economically important in North America. Fall.

440. Principles of Forest Pathology (3)
Three hours of lecture, discussion or laboratory. Concepts and principles of tree diseases in relation to forest practices and practical experience in disease diagnosis and impact evaluation. Fall.
Prerequisite: EFB 340.

441. Field Problems in Forest Pathology (1)
Full-time for one week. Cranberry Lake Biological Station. Field study of important tree diseases in the Adirondacks, including heart-rots, root-rots, cankers, rusts, foliage diseases, mistletoe, and physiological diseases. Also field study of mycorrhizae and other tree-root mutualisms. Summer.

442. Field Mycology (2)
Half-time for four weeks. Cranberry Lake Biological Station. An introduction to the collection and identification of the Adirondack fungal flora. Field techniques and laboratory identification of the major fungi found in selected ecosystems. Summer.

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.

446. Bryoecology (3)
Two hours of lecture and one three-hour laboratory or field trip. A study of the taxonomic diversity and ecological adaptations of Bryophytes in regional ecosystems. Spring.

448. Physiological Ecology of Plants (3)
Three hours of lecture. Examination of the interactions between plants and their environment. Emphasis will be given to the physiology of plants as it is modified by fluctuating external conditions and the mechanisms of plant adaptation. Students completing EFB 448 should not enroll in EFB 330. Fall.
Prerequisites: An introductory course in physics, EFB 320 and EFB 326.

451. Pest Management—Theory and Practice (2)
Two hours of lecture for nine weeks; then one lecture hour and one three-hour laboratory for four weeks. A review of history and governmental policy of pest management, as well as basic instruction in theory and practicum. Spring.
Prerequisite: EFB 352 or equivalent.

452. Principles of Chemical Control (3)
Two hours of lecture; one three-hour laboratory. A study of the chemistry, toxicology, handling and application of chemicals used to manage pest populations. A primer for the State Pesticide Application examinations. Fall.
Prerequisite: EFB 451.

453. Forest and Aquatic Insects (2)
Half-time for four weeks. Cranberry Lake Biological Station. The forest and aquatic insects of Cranberry Lake Region and their role in these environments and habitats. Insect collection required. Summer.

454. Wood Deterioration by Insects (3)
Three hours of lecture, discussion, and demonstration. Biology, identification, ecology of insect and wood interrelations; prevention of injury and control of insects injurious to forest products and wood in use. Spring.
Prerequisite: EFB 352 or equivalent.

476. Vertebrate Ecology (2)
Half-time for four weeks. Cranberry Lake Biological Station. Utilization of unique Adirondack forms and communities to study population dynamics, behavior, systematics, and ecological role of vertebrates; standard field and laboratory techniques. Summer.

478. Microcommunity Ecology (2)
Half-time for four weeks. Cranberry Lake Biological Station. Study of terrestrial invertebrate microcommunities; descriptive and comparative assay of microhabitats incorporating experimental and field techniques. Summer.

479. Field Ornithology (2)
Half-time for four weeks. Cranberry Lake Biological Station. Field study of the ecology, distribution and behavior of birds of the Adirondack region. Techniques used in conducting field studies in avian biology will be emphasized. Summer.

480. Principles of Animal Behavior (4)
Three hours of lecture, one hour of recitation per week. A study of the basic principles of animal behavior, stressing exogenous and endogenous mechanisms of control, with emphasis on the evolution of behavior. Spring.

481. Behavioral Ecology (2)
Half-time for four weeks. Cranberry Lake Biological Station. Study of the behavioral adaptations of animals to their environment. Emphasis will be placed on animal orientation and social behavior. Habitat selection and interspecific interactions will also be considered. Summer.
Prerequisite: EFB 480.

482. Invertebrate Zoology (4)
Three hours of lecture, three hours of laboratory. Structure, function, classification, and evolution of invertebrates. Emphasis on ecological role of invertebrates in specific habitats. Fall.

483. Biology of Birds and Mammals (4)
A course surveying the taxonomy, anatomical-behavioral-physiological adaptations and natural history of birds and mammals. Techniques for the field study of a vertebrate species will be discussed. Fall.

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. Spring.

486. Ichthyology (3)
Two hours of lecture, three hours of laboratory. An introduction to the anatomy, physiology, ecology, behavior, and taxonomy of fishes. Spring.

487. Fishery Biology (4)
Three hours of lecture and three hours of laboratory. Introduction to models of growth, mortality, production, and exploitation; aspects of fish ecology and behavior related to the dynamics and management of fish populations. Fall.
Prerequisite: EFB 486 or equivalent.

488. Ecology of Adirondack Fishes (2)
Half-time for four weeks. Cranberry Lake Biological Station. Study of the ecology of fishes, with detailed individual investigation of the ecology of Adirondack fishes. Summer.

490. Wildlife Ecology and Management (3)
Three hours of lecture. A study of the ecological principles governing wild animal populations and their habitats and the relationship of these principles to management programs and decisions. Spring.
Prerequisites: EFB 320 or equivalent.

491. Wildlife Ecology and Management Practicum (2)
One hour discussion, 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:* LIB 300.

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.

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.

500. Forest Biology Field Trip (1-3)
A five- to ten-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. Estimated student expense, $75. Fall or Spring.

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.

512. Chemical Ecology (3)
Two hours of lecture and one hour of discussion. A treatment of biological phenomena incorporating elements of ecology, physiology, and chemistry as a basis for development, behavior, and survival. Emphasis is on the intra- and inter-specific relationships involving chemical messengers at the organismal, population, and community levels. Spring.
Prerequisites: Organic chemistry, EFB 320, EFB 325.
Note: Also listed as FCH 540.

515. Population Ecology (3)
Two hours of lecture and three hours of laboratory. Description, analysis, evolution, interactions and stability of natural and experimental populations. Spring.
Prerequisite: EFB 320 or equivalent.

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.

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.
Co- or Prerequisite: EFB 524.

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.

531. Plant Physiology Laboratory (1)
One laboratory session. Introduction to methods and procedures of physiological research. Spring.
Co-requisite: EFB 530.

532. Plant Anatomy (3)
Two hours of lecture and three hours of laboratory. An introductory course in plant anatomy designed to familiarize the student with the organization and development of the primary and secondary plant body of higher plants. Spring.
Prerequisite: EFB 326.

533. Chemical Defenses of Plants (3)
Three hours of lecture/discussion about the ways in which plants defend themselves chemically against microorganisms, insects, herbivores, and other plants. Fall.
Prerequisite: A course in physiology or biochemistry.

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.
Prerequisites: EFB 326, EFB 327.

540. Mycology (3)
Two hours of lecture and three hours of laboratory. Fundamentals of the morphology, taxonomy, cytology, life histories, and ecology of fungi. Fall.

541. Wood Microbiology (3)
Two hours of lecture and three hours of laboratory/field trip. Major types of fungus defects of wood and its products and principles of control. Special emphasis on chemistry of wood decay, wood durability, toxicants, lumber discolorations, heart-rots and decay in forest products. Fall.
Prerequisites: Organic chemistry, EFB 340.

551. Forest and Shade Tree Entomology (2)
Two hours of lecture. Important forest and shade tree insects, detection, evaluation, prevention, and control of their damage; their relation to silviculture and management of forests and shade trees. Spring.
Prerequisite: EFB 352 or equivalent.

552. Forest and Shade Tree Entomology Laboratory (1)
Three hours of laboratory/field trip. Identification of important forest and shade tree insects and their damage. Spring.
Pre- or Co-requisite: EFB 551.

553. Biological Control (2)
Two hours of lecture. Theory and practice of biological control of insect pests and weeds. Emphasis on the ecology and utilization of major groups of predators, parasitoids, and pathogens used in pest management and interpretation of mortality. Fall.
Prerequsite: EFB 352 or equivalent.

554. Aquatic Entomology (3)
Two hours of lecture and three hours of laboratory. The biology, ecology, and identification of fresh water insects, with emphasis on the role of aquatic insects in the hydrobiome. Fall.
Prerequisite: EFB 352 or equivalent.

560. Environmental Toxicology of Insecticides (2)
Two hours of lecture. Basis of action of insecticides in living systems, behavior of insecticides and microtoxicants in environment, interaction of insecticides and biological systems. Fall.
Prerequisite: EFB 325 or equivalent course in physiology or biochemistry.

561. Medical Entomology (3)
Three hours of lecture and recitation. Study of arthropods affecting man, domestic animals, and wildlife with emphasis on their biology, control, and relationship to vertebrate disease. Spring (even years).
Prerequisite: EFB 352 or equivalent.

565. Insect Morphology (3)
Two hours of lecture and three hours of laboratory. A comparative study of the external morphology of insects emphasizing evolutionary trends, especially modifications of homologous structures. Topics of special importance include intersegmental relationships, feeding, sensory mechanisms, locomotion, and reproduction. Spring.
Prerequisite: EFB 352.

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.

578. Terrestrial Community Ecology (3)
Three hours of lecture. Relation of terrestrial vertebrates and invertebrates to their physical, chemical, and biological environment. Emphasis on community principles, structural quantification, and evolutionary processes of terrestrial animals. Fall.
Prerequisite: EFB 320 or equivalent.

590. Wilderness Wildlife Management (2)
Two hours of lecture followed by one hour of group discussion. Students will participate in a two-day field trip at Huntington Forest. Completion of a term paper will be required for graduate credit. Fall.

610. Ecological Energetics and Nutrient Cycling (3)
Three hours of lecture and discussion. Investigation of the principles of energy flow and nutrient cycling in ecological systems. The linkage of energy and nutrient fluxes in organisms, populations, communities, and ecosystems is emphasized. Fall.
Prerequisite: A course in general ecology.

625. Membranes and Biological Transport (3)
Two hours of lecture and one hour of discussion. Composition, structure, and physical properties of membranes. Membrane functions including transport, bioelectricity, and cell compartmentalization. Specific transport processes in biological systems. Fall (even years).
Prerequisites: One semester of biochemistry and an advanced physiology course.

630. Fungus Physiology (3)
Two hours of lecture and one hour of discussion. Principles of growth, reproduction, and differentiation of the fungi emphasizing the role of the environment in controlling fungal processes. Spring. (even years).
Prerequisite: Two semesters of physiology or biochemistry.

632. Plant Growth Regulation (3)
Three hours of lecture/discussion on topics concerned with the biochemistry and physiology of plant hormones and synthetic growth regulators. Fall.
Prerequisite: A course in plant physiology or biochemistry.

635. Topics in Plant Nutrition (2)
Two hours of lecture, discussion, and seminars. Advanced course dealing with selected topics of mineral and organic nutrition of plants. Fall (odd years).
Prerequisites: Completion of one or more physiologically-oriented plant science courses.

640. Principles of Forest Pathology (3)
Four hours of lecture, discussion, and laboratory. Concepts and principles of tree diseases in relation to forest practices and practical experience in disease diagnosis and impact evaluation. Fall.
Prerequisites: EFB 340, EFB 641.

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.

642. Principles and Practices of Tree Disease Control (3)
Two hours of lecture and three hours of laboratory or discussion. An advanced course considering the major chemical, cultural, and biological practices and integrated disease management strategies for tree disease control. Spring.
Prerequisites: EFB 440, EFB 540.

643. Plant Virology (3)
Three hours of lecture. The structure function, and replication of virus particles. Transmission mechanisms, vector relationships, symptomatology, and disease control strategies are covered in detail. Spring.
Prerequisite: Organic chemistry.

644. Plant Virology Laboratory (2)
Four hours of laboratory. Methodologies necessary to manipulate viruses and to identify and fully characterize virus unknowns will be presented. Spring (even years).
Prerequisite: EFB 643.

645. Plant Ecology (3)
Two hours of lecture and discussion and one laboratory/discussion. 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: EFB 320 or equivalent.

651. General Insect Taxonomy (3)
Two hours of lecture and three hours of laboratory. Identification and classification of the important orders and families of insects; acquaintance with pertinent taxonomic literature and use of keys; and understanding of evolutionary principles and concepts and a knowledge of systematic theory and practice. Insect collection required. Fall.
Prerequisite: EFB 565.

660. Insecticide Toxicology Laboratory (2)
One hour of discussion and three hours of laboratory. Laboratory experiments in mode of action and behavior of insecticides, biological and instrumental analysis of insecticides including tracer analyses. Spring (odd years).
Prerequisites: EFB 560 or equivalent and permission of the instructor.

678. Practicum in Terrestrial Community Ecology (3)
One hour of lecture, one hour TBS, and three hours of laboratory. Intensive practical application of ecological principles to the study of terrestrial animal communities. Includes experimental and field collection of data, quantifications, synthesis, and final reporting. Fall.
Pre- or Co-requisite: EFB 578 or equivalent.

680. Behavioral and Physiological Ecology (3)
Two hours of lecture and one hour of discussion. An examination of the concepts of animal adaptations to ecological change from a behavioral point of view. Particular emphasis will be placed on the role the environment plays in shaping the behavior of a given species. Behavioral and physiological responses to environmental conditions will be treated as a continuum. Spring (odd years).
Prerequisites: One course in ecology, behavior, and physiology.

682. Invertebrate Symbiosis (3)
Two hours of lecture and one three-hour laboratory. An introduction to the ecology and evolution of interspecific relationships of invertebrates. Spring (even years).
Prerequisites: EFB 320, EFB 482.

690. Management of Wildlife Habitats and Populations (4)
Three hours of lecture and three hours of laboratory; some weekend field trips. For graduate students intending to enter professions in natural resource management, especially fish and wildlife and forestry. Focus is on the application of ecological principles and management techniques in the planning of habitat and harvest management programs for wildlife. Extensive independent work required. Fall.
Prerequisite: EFB 491.

691. Habitat Inventory and Evaluation (3)
Four hours of lecture and discussion. For students intent on careers in natural resource management, environmental planning or environmental impact analysis. Focus is on methods for investigation of species-habitat relationships, and construction of models for the inventory and evaluation of habitat. State-of-the-art habitat evaluation procedures are explored. Spring.
Pre- or Co-requisite: Multivariate Statistics.

692. Biology and Management of Waterfowl (2)
A consideration of the identification, life history, ecology, and economic importance of waterfowl of the Atlantic Flyway. The management of local, flyway, and continental waterfowl populations, including the establishment of hunting seasons, will be discussed. One Saturday field trip. Fall (odd years).

695. Urban Wildlife (2)
Three hours of lecture and discussion with field trips. A study of the occurrence, adaptations, and values of wildlife in urbanized areas, with emphasis on current research and agency programs. Spring (even years).

720. Topics in Soil Invertebrate Ecology (3)
Two one-hour lecture and discussion periods and a three-hour laboratory. Study of literature relating to soil invertebrate microcommunities; taxonomy, culturing, and collection methods of soil fauna; student will conduct an individual research problem. Spring (odd years).

724. Seminar in Aquatic Ecology (1)
Two hours of lecture and discussion. A seminar to explore in some depth areas of current research in aquatic ecology. Fall (even years).
Prerequisite: Six credits in aquatic ecology.

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 and Spring.
Prerequisites: EFB 531 or equivalent, biochemistry with laboratory.

740. Mycorrhizae (3)
Two hours of lecture and three hours of laboratory/discussion. A basic background course covering structural, functional, and ecological aspects of mycorrhizae; their methods of field and laboratory study; and applications in forestry practice. Fall (odd years).

741. Topics in Phytopathology (3)
Two two-hour lectures and discussions. Discussions of specific subjects in phytopathology and wood microbiology. Topic selection is based on availability of expertise and will be announced in advance. This course may be repeated for credit in different specialties. Fall or Spring.

745. Topics in Plant Ecology (2)
Two hours of seminar and discussion. An advanced course dealing with current research in plant community dynamics. May be repeated for additional credit. Fall.
Prerequisite: EFB 445 or EFB 645.

790. Topics in Wildlife Biology (1-3)
Hours to be arranged. Group study of a wildlife management topic. Fall or Spring.
Prerequisite: Six credits of wildlife management courses.

796. Topics in Environmental and Forest Biology (1-3)
Special instruction, conference, advanced study, and research in selected subject areas. Typewritten report required. Check *Schedule of Courses* for details. Fall and Spring.

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.

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. Typewritten report required. Fall and Spring.

830. Physiology of Growth and Development (2)
Lecture. A study of the growth and development of plants and the physiological and biochemical processes that influence the development of form and structure in higher plants. Fall (even years).
Prerequisites: EFB 530, EFB 532, and organic chemistry.

840. Advanced Mycology, Homobasidiomycetes (3)
Review of selected literature as well as laboratory training in identification and research techniques. Fall.
Prerequisite: EFB 540.

841. Advanced Mycology, Heterobasidiomycetes (3)
Review of selected literature as well as laboratory training in identification and research techniques. Spring (even years).
Prerequisite: EFB 540.

842. Advanced Mycology, Ascomycetes (3)
Review of selected literature as well as laboratory training in identification and research techniques. Spring (odd years).
Prerequisite: EFB 540.

843. Advanced Mycology, Deuteromycetes (3)
Review of selected literature as well as laboratory training in identification and research techniques. Fall (even years).
Prerequisite: EFB 540.

851. Advanced Insect Taxonomy (3)
Two hours of lecture and three hours of laboratory. Methods, procedures, and concepts of systematics. Examples and material will be drawn from among important groups of forest insects. Fall.
Prerequisite: EFB 651.

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.

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.

980. Topics in Animal Behavior (2)
Two hours of lecture and discussion. A seminar-type course designed to explore in depth selected and controversial subject areas in animal behavior. Fall or Spring.

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.

EIN—ENVIRONMENTAL INFLUENCES (LANDSCAPE ARCHITECTURE)

(See also courses listed under CMN and LSA.)

300. Introduction to Environmental Studies (3)
Three hours of lecture and discussion per week on the interrelationships among the natural environment, people, and the human environment. Emphasis is placed on developing critical facilities and systems thinking useful for assessing environmental issues. Fall.
Prerequisite: Permission of the instructor.

311. Natural Processes in Planning and Design (3)
Section 1: Landform and Soils
Section 2: Hydrology, Climate and Energy
Section 3: Plant, Animal, and Human Ecology
Three hours of lecture. This course presents an overview of the basic principles governing the dynamics of natural resources and processes which should be understood in planning and designing the human landscape. In each section, sources of reference data application to planning and project scale design will be discussed. Occasional local field trips will be utilized. Fall.
Prerequisite: Permission of the instructor.

371. History of American Landscape Attitudes (3)
Three hours of lecture-discussion. This course presents, through lectures, readings, and slides, uniquely American historical attitudes toward land and nature as shown through various cultural activities and disciplines, such as painting, architecture, landscape architecture, religion, philosophy, utopianism, exploration and recreation, land development and economics, and certain technological developments. Cultural expressions of the 19th century will be of primary interest, but formative attitudes from the Colonial period and certain 20th century results will be included. One-third to one-half of lecture periods are given over to student reports, criticism, and discussion. Spring.
Prerequisite: Permission of the instructor.

390. Social/Cultural Influences and Environmental Form (3)
Three hours of lecture. This course provides an introduction to an interdisciplinary social science analysis of human settlements. The course introduces the basic concepts, vocabulary, theories, and units of analysis for an interdisciplinary social perspective of the environmental form of human settlements. As such, it 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.

451. Fundamentals of City and Regional Planning (3)
Three hours of lecture. An introductory survey course in planning. The historical development of American City and Regional Planning, theories of the planning process, the role of planning in public decision-making, landmark legislation and judicial decision related to planning, and approaches to controlling land use will be presented. Fall.

452. Simulated Planning in Metropolitan Systems: Theory and Practice (3)
Three hours of laboratory, two hours of lecture/discussion. A computerized simulation designed to provide an understanding of the decisionmaking environment of metropolitan planning. Each participant is assigned a role consistent with his/her background. Lectures provide a theoretical framework for the activities in the simulation; a discussion section provides for evaluation. Computer experience is not necessary. Spring.

470. Art History (3)
Three hours of lecture. Informal lectures will emphasize and review assigned text and other readings and handout notes. Slides will be shown regularly; reports, quizzes and examinations. Evolutionary nature of the main cultural periods of Western man and fine art as man's selected environment will be the course emphasis. Spring.
Prerequisite: Permission of the instructor.

471. History of Landscape Architecture (3)
Three hours of lecture. Informal lectures and class participation, reports, assigned text and assigned reserve shelf reading, optional text and handout notes, quizzes and exams. Slides. Historical study and style analysis of Western man's efforts to design his environment and his changing attitudes and relationships to environment. Also, non-Western coverage where significant or influential on Western Man. Study of historical personalities as well as periods that are of environmental concern up into the modern period. Fall.
Prerequisite: Permission of the instructor.

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 the instructor.

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 the instructor.

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 the instructor.

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.
Prerequisite: Environmental Studies senior standing and written approval of an internship contract by faculty sponsor, curriculum director, and field supervisor.

510. Creative Problem Solving Seminar (3)
Three hours of lecture and discussion. A course designed to extend the student's understanding and application of creative problem solving processes. One requirement will be to select and carry out an application of the techniques to a particular problem, with consultation and guidance from the instructor. Critique and survey of the literature on creativity, in-depth analysis of the synectics process, and various procedures which have been developed for nurturing creative behavior comprise the essence of the program. Spring.
Prerequisite: Undergraduate degree or permission of the instructor.

ENS—ENVIRONMENTAL SCIENCE

600. Environmental Policy (3)
Three hours of lecture and discussion. This course develops the components of the interdisciplinary framework necessary for the study of Environmental Policy through systematic survey of theoretical approaches, analytical methods, and the literature of related disciplines. It emphasizes policymaking, analysis, implementation, and evaluation. This course is required for all GPES students. Fall.

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. It is not intended for GPES students in the water resources concentration. Fall.

602. Land Use (3)
Three hours of lecture and discussion. Introduction to the basic concepts and methods of land use planning and policy analysis, and comprehensive examination of land use dimensions: ecological, economic, social, political, and institutional dimensions. This course is not intended for GPES students in the land use concentration. Spring.

603. Urban Ecosystems: Science and Policy (3)
Three hours of lecture and discussion per week. An introduction to the ecosystem approach of describing and assessing urban areas. The study of the integration of natural, cultural, policy, and management systems. This course is not intended for GPES students in the urban ecosystems concentration.

796. Special Topics in Environmental Science and Policy (1-3)
Lectures and discussion, seminars, conferences and group research on topics of special or current interest, in fields related to environmental science and policy. See schedule of classes for current offerings. Fall and Spring.

797. Environmental Science Seminar (1-2)
Discussion of current topics and research related to environmental science. Fall and Spring.

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.

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.

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.

999. Doctoral Thesis Research (Credit hours to be arranged)
Research and independent study for the doctoral degree and dissertation. Fall, Spring, and Summer.

When choosing courses, students must consult their advisors/major professors.

ERE—ENGINEERING (ENVIRONMENTAL AND RESOURCE ENGINEERING)

306. Elements of Map and Air Photo Interpretation (1)
Two hours of lecture and three hours of laboratory per week for five weeks of a semester. Introduction to map and photograph interpretation to extract information useful to site inventory, analysis, planning, and design activities. The physical and geometric properties of maps

and photographs, the characteristics of information contained in them, and the principles and procedures of interpretation are discussed. Spring.

Prerequisite: Junior standing in Landscape Architecture.

308. Elements of Plane Surveying (1)

Two hours of lecture and three hours of laboratory per week for the last five weeks of the semester. Introduction to the principles and procedures of plane surveying for mapping and construction layout purposes. Topics briefly discussed include the basic mathematical principles of surveying, the types and uses of surveying, horizontal and vertical distance measurement, angle measurement, traversing and computations, construction layout, tacheometry, and surveying errors (and their treatment). Spring.

Prerequisites: Junior standing in Landscape Architecture and college level plane trigonometry.

320. APL for Engineers and Scientists (2 or 3)

Programming and operation of time-sharing digital computer systems via the APL language. Analysis, modeling, and solution of basic problems in environmental science and engineering. Students desiring three credits will complete an original, substantial term project. Spring.

Prerequisites: Calculus and physics or permission of the instructor.

350. Wood Preservation (2)

Two hours of lecture with some demonstrations. A survey of basic wood-water relationships, shrinking and swelling, elementary wood structure, wood permeability, capillary forces, heat transmission, agencies of wood deterioration, wood preservation processes, wood fire performance, fire tests, and fire retardant treatments. Not open to WPE students. Fall.

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 open for credit to students who have completed successfully FCH 360 or equivalent.

352. Applied Engineering Thermodynamics (2)

Classical principles applied to devices and systems. Emphasis on efficient design of manufacturing equipment and processes. Power and refrigeration cycles; energy conversion; materials recovery. Environmental case studies and design project. Computer-aided data correlation and system simulation. Spring.

Prerequisites: ERE 351, FCH 360, or equivalent.

362. Mechanics of Materials (3)

Three hours of lecture. Theories of stress, deformation, and stability of common structural materials subjected to various force systems. Fall.

Prerequisites: Integral calculus and statics.

364. Engineering Materials (3)

Two hours of lecture and one three-hour laboratory per week. An introduction to the study of materials science emphasizing the structure and properties of materials used in the construction industry in general. Lab work includes fabrication, testing, and evaluation of actual systems. Spring.

Prerequisites: Junior standing, physics, chemistry, and engineering mechanics.

371. Surveying for Engineers (3)

Two hours of lecture and recitation and three hours of laboratory. The principles of plane surveying for engineers. Subject matter areas include introduction to the theory of measurement and errors. Linear and angular measurements in both the horizontal and vertical planes, traversing and computations, horizontal and vertical control and associated computations, areal and volumetric computation, circular and parabolic curves, state plane coordinates, public land surveys, and the analysis and treatment of systematic and random errors. Laboratory field work and computations culminate in a topographic map. Fall.

Prerequisites: Differential and integral calculus.

375. Elementary Corrosion (1)

One hour of lecture. Basic electro-chemistry, film formation and passivation, galvanic corrosion and pitting, cathodic and anodic protection, protective coatings and inhibitors. Application of the above in the home, car, field, at sea, and in industrial plants. Spring.

377. Process Control (3)

Three hours of lecture. The study of the principles of process control both with and without electronic computers. The emphasis is on sensing and control elements, signal transmission, non-computerized controllers, conversion of signals to digital input for computer programs, control problems such as lag and errors, and applications with emphasis on the paper industry. Spring.

Prerequisite: College level physics.

420. Computer Applications in Science and Engineering (3)

Principles and methods of mathematical modeling for analog and digital computer solution. Applications to data reduction and correlation, statistical analysis, process and equipment simulation, optimization and control, and computer-assisted instruction. Typical examples, class problems and student projects. Current status and future projection of computation equipment, software and operating techniques. Fall.

Prerequisites: Calculus and computer programming, or permission of the instructor.

422. Process Design and Simulation (3)

Two hours of lecture/discussion and three hours of design laboratory per week. Mathematical modeling of process units and systems. Consideration of energy requirements, operating costs, and optimization techniques. Steady-state and dynamic simulation via computer programs. Use of data sources and software, applied to design exercises and case studies. Spring.

Prerequisites: Unit operations and computer programming, or permission of the instructor.

440. Water Pollution Engineering (3)

Two hours of lecture and three hours of laboratory. Introduction to the physical, chemical, and biological parameters of waste water treatment processes and to the principles of the unit operations involved. Study of the design parameters and design procedures of waste water treatment systems. Spring.

Prerequisites: Physics and CHE 356 or equivalent.

441. Air Pollution Engineering (3)

Three hours of lecture and discussions. 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 equivalent.

496. Special Topics (1-3)

Lectures, readings, problems, and discussions. Topics as announced in the areas of environmental or resource engineering. Fall and/or Spring.

510. Energy: Alternate Systems (3)

Three hours of lecture. An introduction to alternate energy resources and conversion processes. Focus is on relatively small-capacity, decentralized systems and means for judging appropriateness, costs, and impacts of application under varying conditions and needs. Instruction modules on passive and active solar heating, wind energy system, biomass resources and conversion, including ethanol production, methane recovery and wood gasification, and internal combustion cogeneration.

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. Fall and Spring.

Prerequisite: ERE 371 or equivalent.

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. Introduction to scanning and transmission electron microscopy. Fall.
Prerequisite: Permission of the instructor.

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.

611. Energy: Production and Conservation (3)
Three hours of lecture. An introduction to the technology, impacts, hazards, and costs of large-scale, centralized power generation, with emphasis on opportunities for resource conservation. Spring.

642. Water Quality Modeling (3)
Two hours of lecture and three hours of laboratory per week. An analysis of the biological, chemical, and physical factors of receiving waters governing the action of wastes and their reactions in receiving waters. Introduction to modeling techniques applicable to water quality management issues. Fall.
Prerequisite: ERE 440 or equivalent as evaluated by the instructor.

643. Water Pollution Engineering (3)
Two hours of lecture and three hours of laboratory. Introduction to the physical, chemical, and biological parameters of waste water treatment processes and to the principles of the unit operations involved. Study of the design parameters and design procedures of waste water treatment systems. Spring.
Prerequisites: Physics and CHE 356 or permission of the instructor.
Note: A student may not enroll in or receive credit for both ERE 440 and ERE 643.

655. Remote Sensing Measurements (3)
Two hours of lecture comprising an in-depth coverage of the theory, design, and application of remote sensing systems and techniques employed to obtain precise spectroradiometric measurements to map and monitor natural resources. Photographic and non-photographic systems are considered. Laboratory experiments in the form of an assignment using remote sensing data. Fall or Spring.
Prerequisites: ERE 572 and FEG 363 or ERE 563 or consent of the instructor.

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 or equivalent.

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. Fall.
Prerequisites: Organic, physical, and analytic chemistry.
Note: A student may not enroll in or receive credit for both PSE 461 and ERE 670.

671. Chemistry of Pulping and Bleaching (3)
Three hours of lecture. Discussion of the chemistry underlying the commercial pulping and bleaching processes, designed to assist in interpreting the phenomena observed in these operations. Emphasis is placed on those reactions which contribute to delignification and the removal of chromophoric groups in lignin and extractives. Spring.
Prerequisite: FCH 572 or permission of the instructor.

675. Principles of Unit Operations (4)
Three hours of lecture and discussion and one two-hour computation period. Fundamentals of fluid dynamics, heat and mass transfer, appropriate analogies and process applications. Stage operations and computation methods. Application to distillation, extraction, gas absorption, evaporation, crystallization and drying. Design, operation, and computer simulation of equipment. Fall.
Prerequisites: Calculus and physical chemistry or permission of the instructor.

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 between paper manufacturing methods, papermaking additives, test results and the ultimate properties desired in the finished paper. Fall.
Prerequisite: Permission of the instructor.
Note: A student may not enroll in or receive credit for both PSE 465 and ERE 677.

678. Paper Coating and Converting (2)
Two hours of lecture plus evaluation of literature, independent project planning, and/or laboratory study. Evaluation and study of the 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 or permission of the instructor.
Note: A student may not enroll in or receive credit for both PSE 466 and ERE 678.

680. The Anatomy and Ultrastructure of Wood (2)
Two hours of lecture and/or demonstration and discussion. The gross, microscopic and submicroscopic structure of wood including organization of the cell wall, distribution of chemical constituents and abnormalities in wood. Fall.

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: Permission of the instructor.
Note: A student may not enroll in or receive credit for WPE 326 or WPE 327 and ERE 682.

684. Mechanical Properties of Wood (3)
Two hours of lecture and three hours of laboratory. The effect of the anatomical and chemical nature of wood on its response to static and dynamic force systems. The theory of elasticity as applied to wood and wood-based composites. Spring.
Prerequisite: Permission of the instructor.

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. Fall.
Prerequisite: Consultation with the instructor.

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 the instructor.

688. Tropical Timbers in Commerce (2)
Two hours of lecture. Introduction to the commercial use of tropical timbers; the factors of forest conditions, stand types and wood qualities influencing their utilization and the development of trade. Sources of information. Spring.
Prerequisite: Permission of the instructor.

689. Tropical Wood Anatomy (1)
Anatomical characters, identification and taxonomy of tropical woods important in commerce. Spring.
Prerequisite: WPE 387 or ERE 360. Recommended that ERE 688 be taken concurrently or previously.

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 the instructor.
Note: A student may not enroll in or receive credit for both ERE 441 and ERE 691.

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 or equivalent.

762. Instrumental Photogrammetry I (3)
Two hours of lecture and three hours of laboratory. The theory and practice of extracting information from photographs with the aid of photogrammetric plotters. Fall or Spring.
Prerequisite: FEG 363 or equivalent.

775. Applied Thermodynamics (3)
The study and application of thermodynamics, including the first and second law, phase relationships, thermochemistry, the production of work and equilibrium relationships. Spring.
Prerequisites: FCH 360, FCH 361 or equivalent.

785. Scanning Electron Microscopy (5)
Two hours of lecture, demonstration and laboratory. Six hours of independent laboratory experience. The theory and operation of the scanning electron microscope including specimen preparation, photographic technique, and interpretation of micrographs. Spring.
Prerequisite: Permission of the instructor.

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 the instructor.

797. Seminar (1-3)
I. Forest Engineering topics. II. Paper Science and Engineering topics. III. Wood Products Engineering topics. Fall and Spring.

798. Research in Environmental and Resource Engineering (Credit hours to be arranged)
I. Independent research topics in Forest Engineering. II. Independent research topics in Paper Science and Engineering. III. Independent research topics in Wood Products Engineering. Fall, Spring, and Summer.

880. Interpretation of Cellular Ultrastructure (2)
One hour of lecture and two hours of demonstration and discussion. The organization and sculpturing of the walls of plant cells; the cellulose microfibril, matrix and incrusting substances, and the warty layer. The ultrastructure and function of cytoplastic organelles in cells. The nucleus, the mitochondrion, the chloroplast, the endoplasmic reticulum, microtubules, the gap junction and the tight junction. The tools and techniques used for light and electron microscopic study of cells, and the interpretation of structural evidence. Directed study and discussion of the latest (current) literature on pertinent topics. Spring.
Prerequisite: Permission of the instructor.

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.

999. Doctoral Thesis Research (Credit hours to be arranged)
Research and independent study for the doctoral degree and dissertation. Fall, Spring, and Summer.

ESF—NONDEPARTMENTAL

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.

FCH—FOREST CHEMISTRY

221. Organic Chemistry I (3)
Two hours of lecture, one hour of recitation. A survey of representative classes of carbon compounds with emphasis on structure, fundamental reactivity, and other important properties and characteristics relevant to biological systems. Fall.

222. Organic Chemistry Laboratory I (1)
One three-hour laboratory. Laboratory techniques in organic chemistry. Melting points, distillation, recrystallization, extraction, column and thin layer chromatography, natural product isolation. Qualitative functional group analysis. Fall.

223. Organic Chemistry II (3)
Three hours of lecture and discussion. The structure and reactivity of organic compounds, utilizing natural products as examples, will be studied in order to develop an organic chemical background for further study of biological chemistry. Spring.
Prerequisite: FCH 225 or equivalent.

224. Organic Chemistry Laboratory II (1)
One three-hour laboratory. Continuation of FCH 222. Simple physical, quantitative, and instrumental techniques applied to organic chemistry. Gas chromatography, polarimetry, kinetics. Introduction to synthesis. Spring.
Prerequisite: FCH 222 or equivalent.
Co-requisite: FCH 223 or equivalent.

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.

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.

361. Physical Chemistry II (3)
Three hours of lecture. Includes discussion on the structure of matter, principles of quantum mechanics, spectroscopy, and chemical kinetics. Spring.
Prerequisite: Physical Chemistry FCH 360 or the equivalent.

380. Instrumental Methods of Analysis (3)
Two hours of lecture and one three-hour laboratory. Lecture includes theory, applicability, and limitations of a number of current methods of instrumental analysis. Laboratory sessions provide practice with several of these techniques. Spring.
Prerequisites: General chemistry and quantitative analysis.

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.

390. Drugs from the Wild (3)

Three hours of lecture and discussion each week. This course is designed to give students a comprehensive understanding of the variety of medicinal agents available from natural sources. Economic and societal aspects will be explored as well as scientific ones. In addition to curative agents, discussion will include toxic substances, folk medicinal (including herbal) preparations, and the so-called "recreational drugs." (Fall)

495. Introduction to Professional Chemistry (1)

The professional chemist and his relationships 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.

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. Evidence of competence and appropriate effort is required for credit. A written report will be expected. Fall and Spring.

Prerequisite: Upper division status.

497. Undergraduate Seminar (1)

One hour per week. Literature surveys and seminars on topics of current research interest and recent advances in chemistry. Spring.

498. Introduction to Research (5)

Eighteen hours of laboratory, library search and report writing. Solution of a selected research problem using special laboratory techniques. Typewritten report on data, procedures, results, and conclusions. Spring.

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. Fall.

Prerequisites: An introductory course in physical chemistry is required and a shortcourse in computer programming is recommended.

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. Spring.

Prerequisite: Chemistry through physical chemistry, or consent of the instructor.

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.

519. Environmental Chemistry Seminar (1)

One hour of lecture. Seminars on current research and issues in environmental chemistry and related areas. Spring.

520. Nuclear and Radiation Chemistry (2)

The two one-hour lectures will cover the information required for the basic understanding of nuclear reactions, the types of radiation emitted, the instrumentation necessary to detect and measure this radiation, the principles of radioisotope tracer techniques, and radiation chemistry which is the effect of radiation on organic systems. Visits to the Cornell Reactor and the Nuclear Medicine Department of the Upstate Medical Center will be arranged. Spring.

Prerequisites: Physical, organic and inorganic chemistry or by permission of the instructor.

Note: This course can be taken independently of FCH 521.

521. Nuclear Chemical Techniques (1)

The laboratory will consist of one four-hour laboratory class every two weeks, with one hour to be made up at the student's discretion to accommodate counting periods which extend over several weeks. A short movie by the AEC each week will be required for the sixth hour. The laboratory will give each student the opportunity to use the individual counting instruments, gain experience in the handling and preparation of radioactive samples and the use of the 1000-curie-cobalt source in radiation chemistry. Spring.

Prerequisite: Physical, organic, and inorganic chemistry or permission of the instructor. Advanced tentative registration is required.

Co-requisite: FCH 520.

524. Topics in Natural Product Chemistry (3)

Three hours of lecture and discussion each week. A course intended to introduce the student to various types of secondary metabolites including several of past and current interest because of their pronounced biological activities. Modes of chemical reactivity and means of structure determination and syntheses are covered. Spring.

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.

Prerequisites: One year of organic chemistry and one year of physical chemistry.

531. Biochemistry Laboratory (2)

Six hours of laboratory. This course will stress techniques used in biochemical research. Techniques used include various types of chromatography, electrophoresis, and spectrophotometry and methods involved in the isolation, purification, and assay of enzymes. Fall.

Prerequisite: One semester of quantitative analysis with laboratory.

532. Biochemistry II (3)

Three hours of lecture. Topics discussed are: application of tracer techniques to biochemistry, the chemical and biochemical properties of lipids, theories on the origin of life, photosynthesis and the biosynthesis of steroids and terpenes, plant aromatics, amino acids, porphyrins and other aspects of nitrogen metabolism. Spring.

Prerequisites: FCH 530 and its prerequisites.

539. Principles of Biological Chemistry (3)

Three hours of lecture. Principles of biochemistry with emphasis on their relationship to biology. Topics include basic metabolic pathways, structure, and function of proteins, enzymes, and nucleic acids, energy relationships and biochemical control mechanisms. Nonchemistry majors. Fall.

Prerequisite: A two-semester course in organic chemistry is desirable, but a one-semester course is acceptable.

540. Chemical Ecology

This course is the same as EFB 512. Refer to description on page 73.

Note: Credit cannot be received for both FCH 540 and EFB 512.

550. Introduction to Polymer Science I: Polymer Synthesis and Mechanisms (3)

Three hours of lecture. 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, reaction on polymers, polyelectrolytes. Fall.

Prerequisites: One year of organic chemistry and one year of physical chemistry.

551. Polymer Techniques (2)

One hour of lecture and discussion and three hours of laboratory; lab reports. Techniques of polymer preparation: free radical solution and emulsion polymerization, gel permeation. Molecular weight determination by light scattering, osmometry, viscosity, gel chromatography. Structure characterization by X-ray diffraction, electron microscopy, nuclear magnetic polarized microscopy, stress-strain and swelling equilibrium and thermal analysis. Fall.

Prerequisites: One year of organic and one year of physical chemistry.

552. Introduction to Polymer Science II: Polymer Properties and Technology (3)

Three hours of lecture. Introduction to the 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. Spring.

Prerequisites: One year of organic chemistry and one year of physical chemistry.

555. Natural and Synthetic Polymers: An Overview (2)

Two hours of lecture. A series of 24 introductory lectures on all aspects of polymer science. The material covered will include: types of natural and synthetic polymers; molecular size and shape; molecular weight determinations; chemical synthesis and reactions; polymer type vs. properties; properties in the liquid state; properties in the solid state; rubber and elastomers; crystallinity and morphology; mechanical and thermal characteristics; manufacturing and polymer technology. Fall.

Prerequisites: Organic chemistry. Some knowledge of physical chemistry is helpful, although not required.

560. Chromatography and Related Separation Sciences (3)

Three hours of lecture and discussion each week. A course designed to give the student a thorough understanding of analytical and isolation chemistry by modern chromatographic, distributive and molecular sieving techniques. The chemistry of the systems discussed will be stressed as well as the important physical aspects. Spring.

Prerequisite: Two semesters each of organic and general chemistry.

571. Wood Chemistry I: General Wood Chemistry (2)

Two hours of lectures. 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.

572. Wood Chemistry II: Wood and Pulping Chemistry (3)

Three hours of lectures. 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. Chemistry of the industrial pulping processes with emphasis on sulfite and kraft pulping of wood. Chemistry of the major bleaching agents. Chemical byproducts in the pulping industry. Complete tree utilization in the manufacture of pulp and paper. Fall.

Prerequisite: One or two semesters of a three-credit undergraduate course in organic chemistry.

573. Wood Chemistry III: Biosynthesis of Wood (2)

Two hours of lecture. Chemistry of pectin and starch. Photosynthesis with emphasis on the chemical phase. Chemistry of the primary cell wall in plants. Biosynthesis of cellulose, hemicelluloses, pectin, and starch. Biosynthesis of aromatics, including lignin. Biodegradation of wood. Fall.

Prerequisite: FCH 571 or an equivalent course in general wood chemistry.

574. Wood Chemistry IV: Wood Chemistry Laboratory (1)

Three hours of laboratory. Reports. Gravimetric and spectrophotometric determinations of lignin. Determination of the number-average molecular weight of ethylcellulose by osmometry. Estimation of the weight-average molecular weight of ethylcellulose by viscometry. Calibration of a gel permeation chromatography (GPC) column. Separation and characterization of larch arabinogalactans A and B by GPC. Fall.

Prerequisite: FCH 571 Wood Chemistry I or an equivalent course in general wood chemistry.

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—532 or FCH 539 or equivalent.

650. Physical Chemistry of Polymers I (3)

Three hours of lecture. Includes: thermodynamics of polymer solutions, phase equilibria, fractionation, structure-property relationships, elementary chain statistics, molecular geometry, network elasticity, polyelectrolyte theory, and viscosity. Fall.

Prerequisites: One year of organic chemistry and one year of physical chemistry.

651. Physical Chemistry of Polymers II (3)

Three hours of lecture. Viscoelasticity. The glassy state and glass transition temperature. The crystalline state and crystallization kinetics. Characterization of structure and morphology of polymer solid states. Survey of structure and properties of native polymers. Spring.

Prerequisites: One year of organic and one year of physical chemistry.

652. Organic Chemistry of Polymers I (3)

Three hours of lecture. A broad survey of the chemistry of polyfunctional molecules and methods for their conversion to high molecular weight materials. Synthesis of a variety of specialty polymers and chemical reactions on natural and synthetic polymers. Some relations between molecular structure and useful properties. Spring.

Prerequisite: One year of organic chemistry.

653. Organic Chemistry of Polymers II (3)

Three hours of lecture. Kinetics and mechanism of polymerization processes, with emphasis on addition polymerization reactions initiated by radical, cationic and anionic initiators. Mechanism of stereospecific polymerization. Structure of polymers. Reactions on polymers and their modification for specific end uses. Block and graft polymers. Spring.

Prerequisites: One year of organic chemistry and one year of physical chemistry.

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.

798. Research in Chemistry
(Credit hours arranged according to nature of problem)

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 typewritten report required. Fall, Spring, and Summer.

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.

997. Seminar (1)
Seminars scheduled weekly; an average of twenty to thirty seminars are given annually. Discussion of recent advances in chemistry. Credit is given only once to a student. Fall and Spring.

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

340. Engineering Hydrology, and Flow Controls (4)
Three hours of lecture and three hours of laboratory and discussion. Analysis of the waters of the earth, their occurrence, circulation, and distribution; physical properties and their interaction with their environment. Principles of hydrologic budgeting and routing; and basic hydraulics of open channel, conduit, groundwater and overland flow. Applications of probability as a basis for the design of solutions to groundwater, surface runoff, flooding and water supply problems. Spring.
Prerequisites: CIE 327, IOR 326, and APM 360.

350. Introduction to Remote Sensing for Engineers (2)
Two hours of lecture. 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 standing and FEG 363 (which may be taken concurrently with FEG 350).

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: Physics and calculus or permission of the instructor.

363. Photogrammetry (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 and Spring.
Prerequisite: ERE 371 or equivalent.

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 concrete 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, APL Computing.

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. A context is developed for the application of other Forest Engineering courses.
Prerequisites: EFB 315, FOR 321.

430. Engineering Decision Analysis (3)
An introduction to the design process as a decision model, with emphasis on techniques for determining economic attractiveness of engineering alternatives, and analyzing construction and production operations. Includes a survey of mathematical models useful for operations planning and analysis. Fall.
Prerequisite: IOR 326.

437. Transportation Systems (3)
Three hours of lecture and three hours of laboratory. Interrelationships among natural features, transportation types, design, and management objectives to provide the most effective system within the 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.
Prerequisite: CIE 437, FEB 422.

447. Hydrologic and Quality Controls (3)
Two hours of lecture and three hours of laboratory. A continuation of FEG 340 coupled with principles and practices of water quality control for forested sites and low density areas. Design of facilities and systems for water, sewerage and waste water treatment and for the abatement of pollution from nonpoint sources. Planning and analysis for water resources development. Spring.
Prerequisites: FEG 340, ERE 488 and CIE 437 or equivalent as evaluated by the instructor.

454. Tractive Power Systems (2)
Two hours of lecture per week. An introduction to analysis and design of tractive power systems used in timber extraction and other forestry, agriculture, and construction applications. Spring.
Prerequisites: MEE 285, ERE 351, FEG 420.

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 photogrammetric projects and designing optimum procedures for selected photogrammetric tasks. Fall.
Prerequisite: FEG 363.

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 standing in forest engineering.

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 the instructor.

FOR—FORESTRY (RESOURCES MANAGEMENT)

301. Field Dendrology (1)
Approximately one half-day lecture, five eight-hour field study, presented as the first portion of the Summer Program in Field Forestry held at Pack Demonstration Forest, Warrensburg, N.Y. Field Identification and ecology of common woody species of the southeastern Adirondack area. Natural and cultural history of the area as it affects the growth and development of these species. Summer.

302. Forest Surveying and Cartography (2½)
Course consists of approximately thirteen, eight-hour class days, combining lectures and practical field applications. The course stresses development of functional ability in the areas of cartography, overland navigation, and land measurement. It is part of the Summer Program in Field Forestry held at Pack Demonstration Forest, Warrensburg, N.Y. Summer prerequisite for FOR 303, 322, 332.
Prerequisite: FOR 301.

303. Introduction to Forest Mensuration (3½)
Lecture and field practice on methods and procedures for measuring trees, forest stands, and forest products. Descriptive statistics and sampling are introduced as they relate to the measuring process. Emphasis is placed upon field procedures and performance. The course is part of the Summer Program in Field Forestry held at Pack Demonstration Forest, Warrensburg, N.Y. Summer.
Prerequisites: FOR 301 and FOR 302.

304. Introduction to Forestry (1)
Approximately one day of lecture and at least four all day field trips, presented as an integral part of the Summer Program in Field Forestry. Students will be introduced to the diversity of forestry and the activities of a professional forester, and will visit forestry field operations and wood-using industries. Summer.

305. Forestry Concepts and Applications (1)
Lectures and some labs will help students explore basic concepts of forestry, the breadth of and scope of forestry-related activity, and the diversity of forest values and uses. Topics include an introduction to many disciplines related to forest management and use, and study of how basic concepts from physical, biological, and social sciences are applied in forestry. Required of all forestry juniors.

321. General Silviculture (3)
Two hours of lecture and one three-hour laboratory first half of semester, three hours of lecture last half of semester. Survey of silvical principles and concepts and practice of silviculture for the production of goods and services from the forest. Designed for students in curricula other than resources management. Not available for resources management majors. Fall.

322. Forest Mensuration (1)
Lecture, field, and laboratory work blocked in time and subject matter with FOR 331 and 332. Principles and methods used in the measurement of the trees and forest stands, the use of aerial photos for mapping and inventory, and the theory and application of compound interest to forestry decisions. Fall.

331. Introduction to the Physical Environment (6)
Lectures, discussions, field, and laboratory work blocked in time and subject matter with FOR 332 and 322. Study of the environmental media: air, soil, and water, through examination of the flow of energy and matter within and between these components of the environment. Drawing together information from geology, physical geology, soil science, water science, and meteorology, this course provides understanding of these areas, their interactions, and the interface with the biological system. Fall.
Prerequisite: Junior year standing in FOR curriculum or equivalent. Course should be taken concurrently with FOR 332 Silvics-Silviculture, because of the blocking of these two courses.

332. Silvics-Silviculture (8)
Three one-hour lectures and five three-hour labs or field trips. Fundamentals of silvics and practices of silviculture enabling manipulation of forests to attain objectives of the forest owner. Emphasis is placed on the biological interrelationships within the forest community, including site factors and forest stand dynamics, and the consideration of these in silvicultural operations. Fall.
Prerequisites: Summer Program in Field Forestry, and FOR 331 (taken concurrently) or permission of the instructor.

335. Regional Silviculture (3)
Three hours of classroom study. Topics cover regional factors that influence silvicultural methods commonly used in different forest types. Provides study of various silvicultural systems used in operating forest properties in various regions, with attention to geographical differences in land use, market opportunities, species characteristics, and economic conditions. Spring.
Prerequisite: FOR 332 or FOR 321.

345. Soils (3)
Two hours of lecture and three hours of laboratory. Introduction to the fundamentals of soil science with particular reference to forestry, but including other land uses. Spring.

360. Principles of Management (3)
Three hours of lecture and recitation. Basic principles and concepts of management which are universally applicable to any organization, business enterprise, or public agency. The various approaches to management including the classical, behavioral and quantitative concepts with emphasis upon the integrative approach, now required to meet modern society's changing life styles and values and the new awareness of the public regarding environmental matters and natural resources management. Spring.

364. Soil and Water Conservation Policy (3)
Three hours of lecture. An integrated, historical survey of water and related land resource conservation in the United States. Interrelationships of governments and private organizations in their functions of policy-setting and planning, administration of programs, and evaluation of projects. Three lectures per week. Spring.

370. Management of the Forest Enterprise (3)
Two hours of lecture and one hour of discussion and laboratory. This course is concerned with the management alternatives, both of a technical and social nature, that are available in the planning for and the production of timber, recreation, wildlife, forage, and water from the forest and with the criteria for choice to meet management objectives. Spring.

371. Range Management (3)
Three hours of lecture and discussion covering range ecology, inventory and evaluation; animal husbandry and grazing management; multiple-use of rangelands; range improvement practices; and range policy and administration. Spring.
Prerequisite: Upper division status in Resource Management or Biology, or by permission of the instructor.

373. Timber Harvesting (3)
Two hours of lecture and one three-hour laboratory and discussion. Harvesting as a production system including equipment, equipment mixes, costs and manpower in serving and logmaking and primary and secondary transportation. Evaluation of various systems as to environmental impacts. Wood as a raw material to the primary processing system and trees as inputs to the harvesting system. Spring.

400. The Social Environment of Resource Management (3)
Three hours of lecture and discussion. This course describes the institutional framework within which the resource manager practices his profession. It intends to show how economics, law, public policy, pressure groups and financial considerations constrain the professional judgment of the resource manager and the goals and objectives of the institution employing him. Fall.
Prerequisites: FOR 332, 360, 461, 322 and one hour of computer science; Senior standing.

404. Economics of Wood-Using Industries (3)
Three hours of lecture and discussion. Structure and organization of selected wood-using industries. Analysis of decisionmaking by the firm. Principles of production and marketing including demand and cost analysis and pricing. Special issues and current problems of the industries, and introduction to the newer mathematical and statistical tools for meeting them. Spring.
Prerequisite: Microeconomics.

405. World Forestry Resources: Problems and Prospects (3)
Three hours of lecture and discussion plus guided readings, pertaining to world forest resources and the problems and opportunities associated with their use and development. Major topics include: world forest resources; production and trade; principal wood-producing countries; forestry and the problems of underdevelopment; and special areas and topics of interest to world forestry. Spring.
Prerequisite: Senior status preferred.

433. Commodity Production Silviculture (3)
Six hours of lecture and study, or field work classroom instruction and exercises will introduce topics, followed by field exercises

stressing application of silvicultural methods for growing wood products, mostly in hardwood stands. Topics will cover concepts, techniques, diagnostic methods, and field application of silvicultural prescriptions in both even- and uneven-aged management. Offered one day per week as a block of instruction and exercise. Spring.

Prerequisites: FOR 331-332, and one mensuration course beyond Summer Program in Field Forestry; Senior standing.

434. Greenspace Silviculture (3)

Two hours of lecture, one to three hours seminar or field trip. Concepts, techniques, and field practice of evaluating and manipulating vegetation systems, including site conditions, woody and herbaceous vegetation, and use impacts; primarily for on-site values in park, recreation, wildlife and multiple-use lands, roadsides, utility rights-of-way, protection areas, etc. Fall.

Prerequisites: At least one silviculture course and senior status or permission of the instructor.

446. Forest Soil Classification, Survey, and Interpretation (3)

Two hours of lecture and discussion, one three-hour laboratory. Detailed examination of soil genesis and classification, and the survey and description of the soilscape. Interpretations are made for various land uses, especially forestry. Fall.

Prerequisites: FOR 331 or 345 or an introductory soils course.

455. Forest Tree Improvement (3)

Two hours of lecture, three hours of laboratory or field work. General principles and methods of tree improvement practiced in this country and abroad. Tree selection, techniques of vegetative propagation, hybridization, polyploidy, establishment of seed orchards, clonal and offspring testing and other problems. Spring.

Prerequisites: FBL 470, or Introduction to Mendelian Genetics or Population Genetics.

461. Management Models (3)

Three hours of lecture. Introduction to the various models used in managerial decisionmaking. Emphasis is on the characteristics of the various models: their formulation, assumptions, uses, and limitations. The major topics covered will include: the role of models in management; simple optimization; constrained optimization; multi-valued choices; time adjustment of value; simulation; and models in nondeliberated decisions. Integration of the deliberative and intuitive models is stressed. Fall.

472. Fundamentals of Outdoor Recreation (3)

Three hours of lecture. 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 on major recreational issues and conflicts faced by area managers, and how they integrate solutions into their plans. Spring.

473. Planning and Development of Forest Recreation Areas (3)

Three hours of lectures or equivalent laboratory and assignments. Planning and designing forest recreation areas, structures, and facilities. Development of construction plans for camp and picnic sites, for waterfront areas and for trails. Emphasis is on the functional relationship between planning and design, management, and maintenance. Field trips required. Fall.

Prerequisite: FOR 472.

475. Sociology and Psychology of Leisure Behavior (3)

Three hours of lecture and discussion. Introduction to theory and research findings dealing with the sociological and psychological aspects of leisure behavior; field work and lectures demonstrate applications, particularly with regard to leisure behavior. Spring.

Prerequisites: FOR 472, and an introductory course in sociology or psychology, or permission of the instructor.

477. Resource Policy and Management (3)

Three hours of lecture supplemented by one hour of discussion and/or lecture. Public and private forest policy formation; principles of modern management; overall management and operation of a productive forest property. Primarily for forest engineers. Not available to Resource Management undergraduates. Fall.

Prerequisites: Mensuration and silviculture, senior standing in Forest Engineering, or by permission of the instructor.

480. Urban Forestry (3)

Two hours lecture and three hours of laboratory or field trip. Introduction to urban forestry: its professional status and potentials. Elements of urban physical geography. Nature and functions of various kinds of urban greenspace; their physical and social interactions as an integrated system, and management within the broader context of urban processes. Field practice in evaluating urban greenspace resources. Spring.

Prerequisites: Senior status. FOR core courses or permission of the instructor. For students in other schools FOR 434 is desirable.

496. Special Topics in Environmental and Resource Management (1-3)

Guided readings, lectures, discussions, tutorial conferences, or special coursework designed to help the undergraduate student apply scientific analysis of a social, biological, or physical nature to questions within his area of interest. Questions and analyses would include those dealing with forest resources management and administration; forest cultural practices; land use and land use planning; hydrology and watershed management; outdoor recreation; resource economics; world forestry; and others. Fall and Spring.

Prerequisite: Permission of the instructor.

498. Special Studies in Environmental and Resource Management (1-6)

Independent research in environmental and resource management for selected undergraduate students. Selection of subject areas determined by the student in conference with appropriate faculty member. Final written report is required for departmental record. Fall, Spring, and Summer.

Prerequisite: Cumulative G.P.A. of at least 2.50 and approval of the instructor and advisor.

499. Independent Study in Resources Management (7-12)

Independent study of some significant aspect of environmental and resources management. The selection of the topic will be determined by the student in consultation with his advisor. Guidance will be provided by a faculty committee. Limited to seniors in Resources Management. Fall or Spring.

Prerequisite: Must have cumulative G.P.A. of at least 3.00.

FTC—FOREST TECHNOLOGY

200. Dendrology I (2)

Twenty-five hours of lecture and 34 hours of field time. A study of the distinguishing characteristics, growth features, distribution, associates and importance of the major tree species of North America. Seasonal field identification and on-the-spot discussion of habitats, associates, and the place in succession of the predominant forest trees and shrubs as found in the Adirondack area of the Northeast, plus a limited number of introduced species. Fall.

202. Plane Surveying I (4)

Fifty-four hours of lecture and 100 hours of field and laboratory time. An introduction to the theory and practice of plane surveying. Emphasis is on individual skill development through small crew projects, 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 and introduction to map use and preparation. Field projects include traversing, methods, and proficiency projects in handling typical surveying instruments. Fall.

203. Plane Surveying II (1)

Twelve hours of lecture and 32 hours of field time. A continuation of FTC 202 with emphasis on small crew field projects introducing the use of the engineer's level and the theodolite. Classroom work is directed at explaining the United States Public Land Survey system and introducing the concepts of modern deed descriptions and recordkeeping pro-

cedures. A trip to the County Court House is scheduled for a first hand look at a modern deed and record keeping operation. Spring.
Prerequisite: FTC 202.

204. Forest Mensuration and Statistics I (3½)
Sixty-seven hours of lecture and 36 hours of field time. A classroom and field study of the basic principles and skills required for timber measurements. Volume tables, their use and construction are studied. Cruise reports are required in which the student presents cruise results. Various methods of forest sampling are studied including methods of calculating necessary sampling intensities and sampling errors. Fall.

205. Forest Mensuration and Statistics II (2)
Four hours of lecture and 44 hours of field and laboratory time. A field problem of practical nature utilizing methods for collecting, analyzing, and presenting data dealing with timber volumes. Spring.
Prerequisite: FTC 204.

206. Forest Ecology (3)
Forty-one hours of lecture and 52 hours of field time. Study of weather and weather data collection; students manning a forest weather station. Study of climate and soil factors, how they affect trees and forests and the interactions both within the forest community and within the forest ecosystem. Introduction to cover type mapping. Final field problem and written and oral report on the detailed analysis of a forest transect. Fall.

207. Aerial Photogrammetry (2)
Fourteen hours of lecture and 48 hours of laboratory. Development of the ability to interpret important ground features by viewing aerial photos singly and in pairs, using stereoscopic techniques and equipment. Work scale problems and make reliable horizontal and vertical measurements. Use radial line plotter and zoom transfer scope for transfer of detail to base map. Forest type mapping and forest inventory using photos. Fall.

208. Forest Installations (3)
Thirty-six hours of lecture and 60 hours of field time. This course provides the student with the technical competence necessary to use, plan, construct, and maintain such typical forest improvements as telephone lines, radio systems, trails, and light frame structures. Fall.

209. Forest Roads (2)
Twenty-two hours of lecture and 32 hours of laboratory time. This course provides the student with the technical competence necessary to administer, locate, and design the construction and maintenance of a typical forest gravel road. Spring.
Prerequisite: FTC 202.

211. Silviculture (2½)
Thirty hours of lecture and 40 hours of laboratory and field work blocked with forest management. Lectures based on text study cover orientation, terminology and present a framework of the various treatments used in many common stand conditions to bring the forest into a more productive state in accord with the objectives of management. Emphasis on thinning in computer simulation and field practice. Exercises in planting and pruning. Demonstrations in chemical silviculture. Spring.
Prerequisite: FTC 206.

213. Forest Protection I (2)
Thirty-eight hours of lecture and 36 hours of laboratory/field time. A study of the insect and disease agents that damage trees and their role in the total forest community. The course covers identification of local forest insects and disease-causing organisms, study of the major pest groups of other forest regions, and control measures including the effects of pesticides on the environment. Field trips cover local pests and the damage caused, while laboratory work covers major groups of pests likely to be encountered elsewhere. Fall.

214. Personnel Management (1½)
Fourteen hours of lecture and 12 hours of laboratory. A study of company and agency organization functions, including selection of and placement of personnel, training of personnel and performance evaluations, planning for and administering crew responsibilities, human relations in the working situation and special personnel problems of the forest are covered. Techniques of foremanship are applied in various field exercises in other courses, along with the duty of safety hazards, accident prevention, accident classification and accident reporting. Spring.

215. Timber Harvesting (2)
Sixteen hours of lecture and 36 hours of field time. This course acquaints the student with the basic harvesting methods and techniques, with emphasis on the Northeast, along with the knowledge of how and where harvesting fits in with other forest uses. Students gain technical competence in timber sale contract administration and basic timber appraising. Spring.

217. Forest Management (3½)
Thirty-seven hours of lecture and 68 hours of lab and field work blocked with silviculture. Coverage of the common problems met in organizing a forest property to approach the goals of ownership. Study and practice in techniques of growth measurement and the gathering and use of forest records in general. Review actual examples and case studies of forest management and production activities. Summary application of pertinent information from many other courses in a work plan involving management decisions for an assigned forest property. Spring.
Prerequiste: FTC 206.

218. Forest Recreation (1½)
Fifteen hours of lecture and 32 hours of laboratory or field time. This course acquaints the student with the forest recreational resources—its present and future needs. Principles of recreation development and management are discussed with special emphasis placed on the technical aspects. Spring.

219. Elements of Wildlife Ecology (1½)
Twenty-four hours of lecture and four hours of field time. A study of the principles of wildlife ecology with fundamentals related to the actions of the preservationist, conservationist, and particularly those of the forest manager. Spring.

221. Soil and Water Measurements (1½)
Sixteen hours of lecture and 32 hours of laboratory and field time. A basic introduction to precipitation and streamflow measurements taken at weather stations, snow courses, streamgaging stations, and other sample points. Includes introduction to physical properties of soils related to land management. Discusses forest management practices commonly used to control erosion and water quality. Spring.
Prerequisite: FTC 206.

223. Graphics (1)
Sixteen hours of lecture. An introduction to lettering and drafting with emphasis on the skills needed by the forest or surveying technician. Individual skill development is achieved through several projects. The concept behind each project is explained in handout material and lecture, and each student is then expected to complete the project on his/her own time. Freehand and mechanical lettering plates are produced in addition to precision and map drawings. Fall.

227. Forest Protection II (2)
Twenty-three hours of lecture and 24 hours of field and laboratory time. The basic principles of fire ecology, forest fire behavior, fire danger and fire danger rating, forest fire prevention and control, and prescribed burning are covered. Handtool fire suppression techniques are demonstrated and practiced. Spring.
Prerequisite: FTC 213.

228. Structure and Growth of Trees (1½)
Nineteen hours of lecture and twelve hours of laboratory. A study of the various tissues of forest trees and how their growth and development are affected by internal and external factors. Differences in stem structures of some of the more important commercial tree species of the United States are studied in the laboratory, and these differences are related to the commercial uses of these species. Spring.
Prerequisite: An introductory course in general botany or biology.

229. Silviculture II **(2)**
Twenty-six hours of lecture and 28 hours of field and laboratory. Continuation of FTC 211 dealing mainly with the handling of the more complex hardwood and mixed stands common to the Northeast. Special coverages will be offered on current practices of regional importance beyond the Northeast where graduates are likely to be employed. Spring.

230. Plane Surveying III **(2)**
Twenty-six hours of lecture and 28 hours of field time. A continuation of FTC 202 and FTC 203 with emphasis on small crew projects using the theodolite. Advanced field techniques are discussed and practiced, such as the determination of the true-meridian by the method of direct solar observation, layout of highway curves and simple triangulation procedures. Each topic is developed in detail in the classroom before each field project is completed. Spring.
Prerequisites: FTC 202 and FTC 203.

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 that of the SFT. A maximum of 6 credit hours may be taken by any student in total. Semesters as arranged. Fall, Spring, or Summer.

LIB—LIBRARY (COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY COURSE)

300. Library Research **(1)**
Fifteen hours of class time per semester (usually the first five weeks). Introduction for students at all levels to basic library material and the research process leading to preparation of a bibliography. Fall and Spring.

LSA—LANDSCAPE ARCHITECTURE
(See also courses listed under EIN and CMN.)

320. Introduction to Landscape Architecture and Planning **(3)**
Three hours of lecture. The course presents an overview of the professions of landscape architecture and planning. It surveys the historic and contemporary situations of environmental design and planning. The course introduces the socio-cultural and natural factors which influence the form and condition of the physical environment. It will introduce issues, personality, and projects. Fall.

326. Landscape Architecture Design Studio I **(3)**
Six hours of studio and one hour of lecture. The first in a sequence of studios focusing on the concepts, skills, and methods of design. This course introduces students to the basic vocabulary, concepts, and principles of design; the application and operation of these in the physical environment, development of three-dimensional spatial concepts. The requirements for this course include readings, examinations, field trips, design exercises, and projects. (Student field trip expense $125-$150.) Fall.
Prerequisite: Permission of the instructor.

327. Landscape Design Studio II **(3)**
One hour of lecture and six hours of studio. The second in a sequence of studios focusing on the concepts, skills, and methods of design. This course continued the development of design abilities through study of the interrelationship between the requirements of a design established in a program, the visual character of the site and the development of a designed result. The development of spatial concepts which meet principles of composition organization and a given set of requirements. The requirements for this course include readings, examinations, field trips, design exercises, and projects. (Student field trip expense $125-$150.) Spring.
Prerequisites: LSA 326, with a minimum grade of C, and CMN 382.

330. Site Research and Analysis **(2)**
One hour of lecture and three hours of studio. This course will require those enrolled to apply principles of natural resources and processes to assess the land use and development potentials and limitation of a site. The principles will include landforms, soils, hydrology, climate, energy, and plant, animal, and human ecology. A variety of manual and computer techniques for data collection, analysis and synthesis of natural systems information will be explored. The course will concentrate on the comparison of synthesis techniques and their implications for land use and design decisionmaking. Occasional local field trips will be utilized. Spring.
Prerequisite: EIN 311 or permission of the instructor.

422. Landscape Design Studio III **(4)**
Twelve hours of studio. This course is a continuation of skill development, theory, and strategies as they relate to design issues and process. Emphasis is placed on in-depth investigation on projects of a direct scale illustrating form derivation and the man-made and natural form. Occasional field trips to illustrate various design solution. Fall.
Prerequisites: LSA 327, with a minimum grade of C, and LSA 330.

423. Landscape Design Studio IV **(4)**
Twelve hours of studio. This course emphasizes skill development, theory, and strategy as they relate to large-scale site design situations. Continues prior courses emphasis on design process and form manipulation. Occasional field trips to illustrate and inspect design form. Spring.
Prerequisite: LSA 422, with a minimum grade of C.

425. Orientation for Experiential Studio **(2)**
Three hours of lecture and recitation. Investigation and documentation of an area of specialty, discussion, readings, and research. Fall and Spring.
Prerequisite: Permission of the instructor.

433. Plant Materials **(2)**
Three hours of lecture and field work for first one-third of semester. Two hours of lecture for second one-third of semester. This course concentrates on woody plant materials used in landscape architecture, the ecological relationships of plants, ornamental plant materials use and identification, plant culture propagation, transplanting, planting plans and specifications. Fall.
Prerequisite: Permission of instructor.

434. Design Materials **(1)**
Three hours of lecture for last one-third of semester. An introduction to wood, concrete, masonry, asphalt, stone, and synthetic materials intended to provide students with an understanding of the basic visual, structural, and maintenance principles of each, in order to both use the materials in design and prepare written specifications. Fall.

442. Site Grading **(2)**
Two hours of lecture and three hours of studio during first two-thirds of semester. Lectures, projects, and assigned readings. The study of grading as the primary means of landform modification in landscape architectural design. Primary emphasis will be given to principles of grading, including contour manipulation, sections, profiles, and computations. Concepts of establishing acceptable slopes and positive surface drainage will be introduced. Enrollment limited to BLA or MLA students. Fall.
Prerequisite: LSA 330, Site Research and Analysis.

443. Site Drainage Systems **(1)**
Three hours of lecture for last one-third of semester. Lectures, projects, and assigned readings. Provides a basis for the design of drainage systems. Coverage includes concepts relevant to understanding precipitation, methods of run-off quantification, open channel flow, systematic pipe network analysis. Enrollment limited to BLA or MLA students. Fall.
Prerequisite: LSA 330, Site Research and Analysis.

444. Vehicular Circulation Design (1)
Three hours of lecture for first one-third of semester. Lectures, projects, and assigned readings. Must be taken concurrently with LSA 423. Introduces the circular geometry of horizontal curves and the parabolic geometry of vertical curves, curve coordination based on safety and aesthetic relationships, road grading. Enrollment limited to BLA or MLA students. Spring.
Prerequisites: Computer Programming and Surveying.

445. Elements of Structures (1)
Three hours of lecture during the second one-third of the semester. Lectures, projects, and examinations. An introduction to the concepts of assembling engineering materials into structure. All common building systems will be surveyed and emphasis will be placed on fundamentals rather than on detailed mathematical design procedures.
Prerequisite: Non-School of Landscape Architecture students by permission of the instructor. Not open to engineering majors. Spring.

455. Professional Practice in Landscape Architecture (2)
Two 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. Occasional field trips will be utilized. Spring.
Prerequisites: Senior status in landscape architecture or permission of the instructor.

456. Introduction to Design Implementation (2)
Two credit hours. One hour of lecture and three hours of laboratory per week. Introduction to drawing, grading, layout, planting, details, specifications, and estimating. Spring.
Prerequisite: Permission of the instructor and concurrent enrollment in LSA 521.

495. Selected Readings in Environmental Studies (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 the instructor.

496. Special Topics in Landscape Architecture (1-3)
One to three hours of class meetings. 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 the instructor.

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 the instructor.

520. Design Analysis Studio I (3)
Six 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.
Prerequisites: First-year MLA standing or permission of the instructor. Not open to BLA students.

521. Design Analysis Studio II (3)
Six hours of studio and one hour of lecture. The second in a sequence of studio 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 in the ordering of a variety of land use activities, with special emphasis on the functional and spatial quality of built environments. The requirements for this course include readings, examinations, field trips, design exercises, and projects. Spring.
Prerequisites: LSA 520, CMN 382, or permission of the instructor.

522. Landscape Design Studio VI (4)
Twelve hours of studio. Studio problems, research, drafting and field trips. Concentration on complex urban problems. Concern for social and psychological considerations of the individual and large groups of people, their interaction and resultant forms of the environment. Spring.
Prerequisite: Permission of the instructor.

524. Experiential Landscape Studio Design (16)
Forty-eight hours per week. The articulation of the study proposal established in LSA 425, as approved by faculty, through research, readings, field study with graphic and written documentation, and group discussion. Academic study in an off-campus location in an area of landscape architectural significance, as described and delineated in a student-prepared proposal approved by the faculty. Fall or Spring.
Prerequisites: LSA 425 and LSA 423, with a minimum grade of C.

525. Landscape Design Studio VI (4)
Twelve hours of studio. Investigation of a problem in landscape architecture as proposed by the student and conducted in conjunction with faculty advisor. Spring.
Prerequisite: Permission of the instructor.

527. Landscape Design Studio VI (4)
Twelve hours of studio. Studio problems, research, reports, and field trips. Concentration on regional landscape problems, the techniques of their analysis and derivation of their significance to the practice of landscape design. Spring.
Prerequisite: Permission of the instructor.

533. Plant Materials (2)
Field trips and discussion. Ornamental woody plant identification. Observation and sketches of outstanding examples of planting design. Two weeks. Summer.
Prerequisite: Permission of the instructor.

545. Professional Practice Studio II (2)
Three hours of studio, one hour of recitation. Studio problems, research, discussion and recitation sessions on the processes and methods of office practice. Emphasis on all aspects of site development. Spring.
Prerequisite: Permission of the instructor.

595. 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: Fifth-year status or permission of the instructor.

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 the instructor.

598. Research Problem (1-3)
Independent study of selected areas of environmental interest. Emphasis on a self-disciplined study, development of procedures and techniques to be employed in environmental design and planning. Engagement with specific sites and problems as proposed for study by individual communities. Enrollment at periodic intervals throughout the semester. Fall, Spring, and Summer.
Prerequisite: Permission of the instructor.

620. Community Design Studio I (3)
Six hours of studio and one lecture-seminar hour. An examination and evaluation of the landscape architectural design process with an emphasis on the methodological variations which occur in its definition and application. A variety of projects, scales, and programs are employed as a vehicle for study of the design process. Fall or Spring.
Prerequisite: Permission of the instructor.

621. Community Design Studio II (3)
Six hours of studio and one lecture-seminar hour. An examination and evaluation of the landscape architectural design process with an emphasis on the methodological variations which occur in its definition and application. A variety of projects, scales, and programs are employed as a vehicle for study of the design process. Fall or Spring.
Prerequisite: Permission of the instructor.

643. Ethical Issues in Community Design and Planning (1)
Three hours of lecture-discussion for one-third of a semester. Status and role of the profession in society, standards of professional conduct and responsibility, ethical responses to a variety of professional situations is the focus of the course. Fall or Spring.
Prerequisites: MLA status or permission of the instructor.

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 to familiarize the student with basic behavioral science methods including questionnaires, observations, and interviews. A final project provides an opportunity to synthesize course materials. Fall.
Prerequisites: MLA status or permission of the instructor.

651. Process of City/Regional Planning (3)
Three hours of seminar. The purpose of this course is the introduction of planning as a process of decisionmaking and to familiarize graduate students with its scope and content. The course relies upon lectures and readings to develop introductory knowledge as well as seminars and discussions to cover the constitutional basis, tools, and techniques and the current directions of planning. Fall or Spring.
Prerequisite: Permission of the instructor.

652. Community Development Process (3)
Discussion and analysis of the elements of community development process: private sector development, public sector initiatives and programs aimed at community development; and role of planning design in coordinating public and private sector initiatives.

653. Visual Landscape Analysis (2-3)
Three hours of lecture and discussion weekly during the first three quarters of the semester will cover aspects of landscape perception; introduction to methods of visual landscape inventory and evaluation, visibility determination, psychometric assessment, and visual impact assessment; and visual resource management strategies. Problems and exams will be required. Optional third credit entails four hours weekly of laboratory or field projects applying analysis methods and techniques during last quarter of semester.

656. Environmental Factors, Community Response, and Form (3)
Two and one-half hours of lecture and six studios per semester. The course presents an introduction to a comprehensive process for the integration of environmental phenomena, such as solar access, visual access, noise, and wind into community design. The process includes data gathering and analysis, prediction methods, objective criteria, and implementation. Fall.
Prerequisites: Second year MLA status, or permission of the instructor.

671. History of Landscape Architecture (3)
Three hours of lecture-seminar. Regular use of slides and other projected lecture material; assigned texts as a basis for lecture; supplemental readings, assigned and individually researched; class discussion from readings and lecture; and student presentations and term paper. Historical study and style analysis of Western man's efforts to design his environment and his changing attitudes and relationships to environment. Also, non-Western coverage where significant or influential on Western man. Study of historical personalities as well as periods that are of environmental concern up into the modern periods. Fall.
Prerequisites: MLA standing or permission of the instructor.

696. 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 the instructor.

697. Topics and Issues of Community Design and Planning(2)
Two hours of lecture and discussion. Topics for discussion are selected to acquaint the entering graduate student with a generalized view of current issues facing landscape architects in community design and planning. Readings and papers are regularly assigned. Fall.
Prerequisites: MLA students or permission of the instructor.

752. Urban and Regional System Dynamics (3)
Lectures and workshop. The major concerns of this course are application of system dynamics; basic principles of system dynamics; and system dynamics modeling. This method is investigated as a useful tool in modeling many landscape architectural and planning problems. No prior computer experience is necessary. Spring.
Prerequisite: Permission of the instructor.

796. Special Topics in Landscape Architecture (1-3)
One to three hours of class meetings. 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. Fall and Spring.
Prerequisite: Permission of the instructor.

798. Research Problem
(Credit hours to be arranged according to nature of problem)
Special study of assigned problems relating to landscape architecture or planning, with emphasis on critical thinking. Fall, Spring, and Summer.
Prerequisite: Permission of the instructor.

799. Thesis Project Proposal Development (1)
One hour of lecture and workshop. During this course, a student will prepare a proposal for a thesis/project in the MLA program. Fall.
Prerequisites: LSA 699 and permission of the instructor.

898. Professional Experience (1-12)
A supervised external professional work experience which satisfies Option 2 of the master's study integration requirement. Graded on an "5/4" basis. Fall, Spring, and Summer.
Prerequisite: Formation of committee, approval of proposed experience by committee, and the sponsor of the professional experience.

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.

PSE—PAPER SCIENCE AND ENGINEERING

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.

301. Pulp and Paper Processes (3)
Three hours of lecture. Technological consideration of pulping and bleaching of woody raw material. Includes consideration of wood procurement and preparation, pulping and bleaching processes,

recovery of secondary fibers, pollution abatement and other ancillary operations. Spring.
Prerequisites: FCH 571 and 572, PSE 300 (or concurrent).

302. Pulp and Paper Processes Laboratory (1)
One three-hour laboratory. Study and practice in the techniques of laboratory procedures normally encountered in the pulp and paper industry. Laboratory exercises selecting and using standard testing methods. Field trips to observe commercial equipment of the pulp and paper industry. Spring.
Prerequisite: PSE 301 (or concurrent).

304. Mill Experience (2)
Twelve weeks full-time pulp or paper mill employment approved by the department between the junior and senior years. The student must submit a comprehensive report to fulfill this requirement. Summer.

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.
Prerequisites: Calculus, physics, and FCH 360 (or concurrent).

371. Fluid Mechanics (3)
Three hours of lecture and/or demonstrations. The study of momentum transfer. Steady and unsteady flow of liquids and gases in pipelines, ducts, open channels, and porous media. Movement of particles in fluid media. Newtonian and non-Newtonian flow and flow of suspensions. Filtration, sedimentation, centrifugation, agitation and mixing. Characteristics and selection of pumps, blowers, agitators and other equipment. Flow measurement and flow system design with economic considerations. Fall.
Prerequisites: College level physics and chemistry, calculus.

372. Heat Transfer (2)
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 and 371 or equivalent.

461. Pulping Technology (3)
One hour of lecture and six hours of laboratory. Discussion of pulping and bleaching processes: effect of chemical and physical variables on the wood components and pulp properties; chemistry involved. Experiments in pulping and bleaching, and pulp evaluation. Fall.
Prerequisites: PSE 301, CHE 346 and CHE 356.
Note: A student may not enroll in or receive credit for both PSE 461 and ERE 671.

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 between paper manufacturing methods, papermaking additives, test results and the ultimate properties desired in the finished paper. Fall.
Prerequisites: PSE 301 and PSE 302.
Note: A student may not enroll in or receive credit for both PSE 465 and ERE 677.

466. Paper Coating and Converting (2)
Two hours of lecture. 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: A student may not enroll in or receive credit for both PSE 466 and ERE 678.

468. Papermaking Processes (3)
Two hours of lecture and three hours of laboratory. Study of the papermaking process, featuring operation of the pilot 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 balance. Results of each paper machine run are evaluated in seminar-type discussions. Spring.
Prerequisites: PSE 461 and PSE 465.

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, 371, and 372 or equivalent.

491. Paper Science and Engineering Project I (1)
Student makes a systematic survey of all available literature on the problem assigned him and incorporates it in a formal, typewritten report. An essential part of this report is a detailed outline of a research project which the student proposes to undertake during the next semester (PSE 492). Fall.
Prerequisites: PSE 300 and PSE 301.

492. Paper Science and Engineering Project II (3)
The analysis of a problem, the synthesis of a solution and the basic design of the facilities needed to solve a problem. Laboratory research, field work, and consulting as needed in addition to the literature survey completed in PSE 491. Progress reports and a final report and seminar-style presentation. Spring.
Prerequisite: PSE 491.

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.

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.
Prerequisite: PSE 461 and PSE 465.

RMP—RESOURCE MANAGEMENT AND POLICY

529. Environmental Impact: Principles and Strategies (3)
Three hours of lecture and discussion. Principles and theory of environmental impact and statements of impact as required by federal law. Administrative procedures for review and evaluation. Procedural strategy and effective constitution of statements for various governmental levels. Means of obtaining sources of authoritative information. Fall.
Prerequisite: Senior standing.

560. Nonindustrial Private Forest Management (3)
Three hours of lecture and discussion. Resource conditions and management issues associated with private nonindustrial private forest lands. Special attention is given to owner characteristics and objectives, public and private programs which directly or indirectly influence management decisions and the role of foresters in relation to the above. Spring.
Prerequisite: Senior or graduate student standing in forestry.

561. Land Use Economics (3)
Three hours of lecture-discussion. Study of the theory and methods of land use economics and the application of economic analysis to open space and regional planning. Emphasis is on understanding basic concepts; development of operational methods and data sources. Case studies, outside readings, and guest speakers are utilized. Spring.
Prerequisites: One course in macroeconomics and one in microeconomics and permission of the instructor.

562. International Timber Trade (3)
Three hours of lecture. Basic principles of international trade. Structure and procedures of international timber trade. Major trade regions and their relationships. Economic context of timber trade. Emphasis is placed upon methods of analyses for understanding both opportunities and limitations of timber products exports and imports. Fall.
Prerequisites: Two semesters of undergraduate economics, and senior standing in forestry or wood products engineering.

572. Outdoor Recreation (3)
Three hours of lectures per week. Description of specific methods and techniques used in outdoor recreation management. Discussion of practices applicable to resource, visitor, and service management. Spring.
Prerequisite: FOR 472, or equivalent, and FOR 360, or equivalent.

587. Environmental Law (3)
Three hours of lecture and discussion. Studies in Environmental Law designed for resource managers. Review of structure and processes of American legal system, constitutional framework of environmental law, The National Environmental Policy Act, legal framework for management of federal lands, focus on legal aspects of common property resource management, land, water, and air. Fall.

588. The Law of Natural Resource Administration (3)
Three hours of lecture and discussion. An introduction to the law concerning the procedures, powers, and judicial review of public agencies responsible for the management of natural resources. Topics will include the extent of an agency's rule-making power and the rights of aggrieved parties to appeal from agency decisions. Spring.
Prerequisite: FOR 360 or equivalent course in public administration.

602. Resource Economics (3)
Three hours of lecture and discussion. Economic theory and analysis in resource management and use decisions. Study and application of economic models to land, water, forest, wildlife, and recreational resources. Relationships and interactions of public and private sector in resource management. Fall.
Prerequisite: Two semesters of undergraduate economics.

664. Soil and Water Conservation Policy (3)
One three-hour meeting per week. An integrated, historical survey of water and related land resource conservation in the United States. Interrelationships of governments and private organizations in their functions of policy-setting and planning, administration of programs, and evaluation of projects. Fall.

670. Economics of Nonmarket Goods (3)
Group discussion, lectures, guided readings, case studies, and student projects on the economic aspects of watershed management, fish and wildlife management, and outdoor recreation. Major topics include theories of valuation and application to nonmarket goods, cost analysis for nonmarket goods, and measurement of regional impacts. Spring.
Prerequisites: Microeconomics, knowledge of basic statistical analysis, and six hours or more of resource management coursework.

672. Open Space Planning (Recreation) (3)
Three hours of lecture and discussion; one overnight field trip required. Study of methods and techniques applicable to open space planning in nonurban areas. Survey of literature and current research. Open space standards, classification systems, and inventory methods. Development of plans for large scale recreation areas, and inclusion of recreation into regional plans. The interrelationship and conflicts between resource utilization/development and recreation/aesthetics reviewed through case studies. Fall (odd years).

675. Psychology of Leisure Behavior (3)
Three hours of lecture and discussion. Introduction to theory and research findings dealing with the sociological and psychological of leisure behavior: field work and lectures demonstrate applications, particularly in outdoor recreation. Fall.

676. Regional Development and Tourism (3)
Three hours of lecture/discussion per week. Study of the basic concepts of tourism as an important economic and social activity, and its place in regional resource development plans. Overnight field trip required. Spring (odd years).
Prerequisite: Permission of the instructor.

751. World Forestry (3)
Three hours of lecture and discussion. World forest distribution and types; regional production and consumption of forest products; international trade in timber and related products; the role of forest resources in development; and special topics; tropical forestry, comparative forest policies and programs, forestry education, the problems of developing countries, international cooperation in forestry development, the role of the United States in world forestry, etc. Spring.

753. Resources Policy (3)
Three hours of lecture and seminar. Evaluation of basic environmental and resource issues and their evolvement in public and institutional policies. Exploration of alternative resource goals, policies, and program approaches and their implications. Analysis of processes for policy delineation and modification. Fall.

754. Advanced Forest Administration (3)
Critical appraisal of existing public, semipublic and private forestry agencies in the United States, and the comparative study of major administrative organizations and practices. Occasional inspection trips to forestry headquarters and field units and discussion of internal administrative problems with forest officers. Fall or Spring.
Prerequisite: FOR 360 or equivalent.

796. Special Topics in Resource Management and Policy (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.

797. Seminar (1)
Group discussion and individual conference concerning current topics, trends, and research in management. Fall and Spring.

798. Research Problems in Resources Management and Policy (1-12)
(Credit hours arranged according to nature of problem)
Special investigation and analysis of resources management problems where integrative relationships of several subject aspects of forestry are a major consideration. Fall, Spring, and Summer.

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.

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.

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.

SCE—SCHOOL OF CONTINUING EDUCATION

510. Creative Problem Solving Seminar (3)
Three hours of lecture and discussion. A course designed to extend the students' understanding and application of creative problem solving processes. One requirement will be to select and carry out an application of the techniques to a particular problem, with consultation and guidance from the instructor. Critique and survey of the literature on creativity, in-depth analysis of the synetics process and various procedures which have been developed for nurturing creative behavior comprise the essence of the program. Fall.
Prerequisite: Undergraduate degree or permission of the instructor.
Note: Also listed as EIN 510.

576. Special Topics Course: Environmental Education Processes and Strategies (1-3)
Lectures, discussions, field problems, and structured outdoor laboratory assignments in environmental education processes and strategies for professional educators in elementary and secondary schools who are part-time, nonmatriculated at ESF. Summer.
Prerequisite: Permission of the instructor. Not acceptable for credit in graduate programs of the School of Forestry.

596. Special Topics in Resource Management (1-3)
Lectures, field exercises, guided readings and discussions, in a short-course format. The study of recent developments and applications in resource management. Illustrative topics include management of forest stands, resource economics, land planning or recreation planning and site development. Not acceptable for credit in graduate programs of the School of Forestry. Summer.
Prerequisite: Permission of the instructor.

SIL—SILVICULTURE

520. Application of Ecology (3)
Two hours of lecture and discussion and one to three hours seminar, workshop, or field trip. Exploration of use and implications of ecological concepts for practices modifying terrestrial ecosystems for human benefit. Discussion of ecological writings in relation to applied problems; workshops, field trips and student presentations exploring ecological implications of specific situations. Course designed for interdisciplinary participation. Spring (even years).

535. Advanced Forest Soils (3)
Three hours of lecture-discussions 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 331, 332 or beginning courses in soils and silviculture.

540. Forest Hydrology (3)
Two hours of lecture and three hours of laboratory. The relation of forest and range vegetation to its environment, and its effect upon soil and water. Measurement of precipitation, runoff, erosion, and other variables. Fall and Spring.

542. Practice of Watershed Management (3)
Two hours of lecture and three hours of laboratory. The impact of the multiple use of forest and range lands on water yield and soil stability. Regional problems and potential solutions. Spring.
Prerequisite: SIL 540.

553. Energy Exchange at the Earth's Surface (3)
Two hours of lecture and three hours of laboratory. A comprehensive study of the physical processes taking place in the lowest layer of the atmosphere. Primary emphasis on the turbulent transfer of heat, momentum, and water vapor and the expression of these fluxes in the microclimate. Spring.
Prerequisites: FOR 452, physics, and calculus.

620. Silvicultural Concepts and Applications (3)
Six hours of lecture, study, or field work. Classroom instruction and exercises introduce topics important to silvicultural practice. Students explore these in depth through independent study and the solving of assigned problems. Field exercises will serve as a means to apply concepts, primarily in hardwood stands. Topics include concepts, techniques, diagnostic methods, and formulation and application of silvicultural prescriptions. Offered one day per week as a block of instruction. Spring.
Prerequisite: Previous undergraduate study of silviculture.

625. Productivity of Forest Stands (3)
In two hours of lecture and three hours of laboratory, whole tree, stand, and forest community productivity are studied from an eco-physiological viewpoint. Quantitative techniques and methods used to evaluate biological as well as economic forest production are learned and utilized. From the perspective established, new trends and developments in silvicultural practice are critically examined. Spring.
Prerequisite: Permission of the instructor.

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).
Prerequisites: FOR 446; background in physical and biological sciences recommended.

640. Advanced Wildland Hydrology (3)
Lecture, discussion, and laboratory sessions in advanced problems of forest and range hydrology, watershed management methods, and techniques and evaluation of new methods of hydrologic data collection and analysis. Fall.
Prerequisite: SIL 540 or FEG 340.

642. Snow Hydrology (3)
Three one-hour lectures and two three-day field trips. Physical characteristics of snow and the energy relations important in its accumulation and dissipation. Problems of measurement and prediction of runoff and melt. Potentials for management. Spring.
Prerequisite: SIL 540 or FEG 340.

677. Advanced Forest Tree Improvement (3)
Two hours of lecture and discussion and three hours of laboratory. A study of advanced principles and techniques for genetic improvement of forest trees. Special emphasis is placed on selection and breeding for growth rates, wood quality, and insect and disease resistance. Problems of tree hybridization, racial variations, sexual reproduction, and quantitative genetics in forest trees. Laboratory training in cytology and cytogenetics, pollen germination, vegetative propagation and other problems. Independent research problems will be undertaken by the student. Fall.
Prerequisites: FBL 470 and 471, FOR 455.

735. Forest Soil Fertility (Applied Studies) (2-4)
Two hours of lecture and one hour of discussion. Up to six hours of laboratory depending on number of credit hours. Influence of soil fertility on development and growth of seedlings and trees, and techniques involved to determine this influence. Chemical and biological analysis to determine levels of soil fertility. Nutrient element deficiencies and their correction by soil amendments and fertilizers. Term projects by the student will be undertaken. Spring (even years).
Prerequisites: CHE 332 and 333, FBO 530, FOR 446 and SIL 635, or equivalent.

737. Forest Soil Physics (4)
Three hours of lecture and discussion and three hours of laboratory. Presentation of principles of soil physics including water flow, storage and availability, soil permeability, heat transfer, and their consideration as root environmental factors. Analytical procedures are introduced and evaluated. Applications of soil physics to silvics, soil fertility, watershed management and hydrology, soil biology and land-use. Spring.
Prerequisites: FOR 345, 446, or their equivalents. Physical chemistry and integral calculus strongly recommended.

796. Special Topics in Silviculture (1-3)
Lectures, seminars, and discussion. Advanced topics in silviculture. Check schedules of classes for details of subject matter. Fall and/or Spring.

797. Graduate Silviculture Seminar (1)
Three-hour class discussion. Assigned reports and discussion of silvicultural topics. Spring.

798. Research Problems in Silviculture (1-12)
(Credit hours arranged according to nature of problem)
Fall, Spring, and Summer.

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.

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.

WPE—WOOD PRODUCTS ENGINEERING

300. Properties of Wood for Designers (2)
Two hours of lecture. An introduction to the basic structure and properties of wood for the designer. Discussion of the effects of wood structure and properties on practical woodworking techniques. Fall.

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. Spring.

326. Fluid Treatments (2)
Two hours of lecture. An introduction to wood-moisture relationships, wood permeability and pressure treatments, thermal conductivity, water-vapor movement, and drying and fire retardancy. The flow of fluids, heat and water vapor are treated as analogous phenomena and are related to the cellular structure of wood. Unsteady-state flow of gases, heat and water vapor are introduced. Spring.

327. Fluid Treatments Laboratory (1)
Three hours of laboratory. Laboratory studies in relative humidity measurement, wood-moisture relationships, the relationship between permeability and treatability, wood-preservative treatments, wood drying and flame testing. Spring.
Prerequisite: WPE 326 (or concurrent).

361. 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.

386. Structure and Properties of Wood (3)
Two hours of lecture and three hours of laboratory. Structure of wood in relation to defects, properties and uses. The variability of wood. Identification of major U.S. timber by gross features. Spring.

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.
Prerequisite: FBO 300 or equivalent is recommended.

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.

389. Wood Identification Laboratory (1)
Three hours of laboratory. Identification of principal commercial timbers of United States on gross characteristics. Spring.
Prerequisite: WPE 387.

390. Fiber Identification Laboratory (1)
Three hours of laboratory. Identification of woody and nonwoody papermaking fibers. Spring.
Prerequisite: WPE 387.

399. Field Trip (2)
Two weeks supervised study and reporting of representative wood products industries. Required of all students in WPE. Estimated individual expenses are $200-$250 while on the trip. Spring.

400. Introduction to Forest Products (2)
Two hours of lecture. Characteristics of the products of the forest tree and manufacture of wood products. Spring.

401. Creative Approaches to Management (3)
Three hours of lecture and recitation with a workshop/seminar emphasis. Provides practical guidelines for dealing effectively with modern managerial problems that require new thinking. This course uses relevant, real-life examples, practical applications, and develops creative approaches. It is designed for individuals who intend to or are engaged in managing people and activities in achieving both organizational and personal goals.

404. Design of Wood Structural Elements (3)
Lectures. A development of the principles involved in designing structural elements in wood and practice in their application. Fall or Spring.

420. Adhesives, Sealants, and Coatings (3)
Two hours of lecture and three hours 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 when used with wood systems. Emphasis will be placed on knowing how to apply this knowledge to understand current practice and to solve problems that may occur. Laboratory demonstrations to identify materials, methods of application, and methods of evaluating these materials. Fall.
Prerequisite: Junior standing.

422. Composite Materials (3)
Two hours of lecture and three hours of laboratory. Manufacturing methods, physical and mechanical properties, and major uses of each of the following products will be examined—decorative plywood, construction and industrial plywood, particleboards, waferboards, fiberboards, laminated beams, laminated-veneer lumber, wood polymer composites, and paper overlays. 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.
Prerequisites: WPE 320. Concurrent or prior registration in ERE 362.

442. Light Construction (3)
Two hours of lecture and two hours of discussion. Elements of light frame construction, blueprint reading, and estimating. Fall.

450. Construction Equipment (3)
Three hours of lecture. Principles of selection, operation, and maintenance of construction equipment. Primary types of site preparation, handling and assembly devices and their efficient utilization will be examined. Spring.
Prerequisite: Senior standing.

454. Construction Management (3)
Three hours of lecture. Fundamental concepts of construction management activities. Topics include construction contracts, scheduling, project planning, estimating and bidding. Fall.
Prerequisite: OPM 365 or permission of the instructor.

497. Senior Seminar for Wood Products Engineering Majors (2)
Discussion and assigned reports in current problems and new developments in Wood Products Engineering. Spring.

498. Research or Design Problem (1-3)
Conferences, library, laboratory and/or field research on a specific problem in Wood Products Engineering. Typewritten report (original and one copy) required. Fall, Spring, and Summer.
Prerequisite: Permission of the instructor and advisor.

State University of New York

STATE UNIVERSITY OF NEW YORK

Chancellor of the University ... CLIFTON R. WHARTON, JR., B.A., M.A., Ph.D.

Secretary of the University ..... MARTHA J. DOWNEY, B.S., M.A.

BOARD OF TRUSTEES

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

When founded in 1948, the University consolidated 29 State-operated, but unaffiliated, institutions. In response to need, the University has grown to a point where its impact is felt educationally, culturally, and economically the length and breadth of the state.

More than 370,000 students are pursuing traditional study in classrooms or are working at home, at their own pace, through such innovative institutions as Empire State College, whose students follow individualized and often nontraditional paths to a degree. Of the total enrollment, more than 100,000 students are 24 years or older, reflecting State University's services to specific constituencies, such as refresher courses for the professional community, continuing educational opportunities for returning service personnel, and personal enrichment for the more mature persons.

State University's research contributions are helping to solve some of modern society's most urgent problems. It was a State University scientist who first warned the world of potentially harmful mercury deposits in canned fish, and another who made the connection between automobile and industrial exhaust combining to cause changes in weather patterns. Other University researchers continue important studies in such wide-ranging areas as immunology, marine biology, sickle-cell anemia, and organ transplantation.

More than 1,000 Public Service activities are currently being pursued on State University campuses. Examples of these efforts include: special training courses for local government personnel, State civil service personnel, and the unemployed; participation by campus personnel in joint community planning or project work, and campus-community arrangements for community use of campus facilities.

A distinguished faculty includes nationally and internationally recognized figures in all the major disciplines. Their efforts are recognized each year in the form of such prestigious awards as Fulbright-Hays, Guggenheim, and Danforth Fellowships.

The University offers a wide diversity of what are considered the more conventional career fields, such as business, engineering, medicine, teaching, literature, dairy, farming, medical technology, accounting, social work, forestry, and automotive technology. Additionally, its responsiveness to progress in all areas of learning and to tomorrow's developing societal needs has resulted in concentrations which include pollution, urban studies, computer science, immunology, preservation of national resources, and microbiology.

SUNY programs for the educationally and economically disadvantaged have become models for delivering better learning opportunities to a once-forgotten segment of society. Educational Opportunity Centers offer high school equivalency and college preparatory courses to provide young people and adults with the opportunity to begin college or to learn marketable skills. In addition, campus based Educational Opportunity Programs provide counseling, developmental education and financial aid to disadvantaged students in traditional degree programs.

Overall, at its EOC's, two-year colleges, four-year campuses and university and medical centers, the University offers 3,600 academic programs. Degree opportunities range from two-year associate programs to doctoral studies offered at 12 senior campuses.

The 30 two-year community colleges operating under the program of State University play a unique role in the expansion of educational opportunity. They provide local industry with trained technicians in a wide variety of occupational curriculums, and offer transfer options to students who wish to go on and earn advanced degrees.

During its brief history, State University has graduated more than 955,000 alumni, the majority of whom are pursuing their careers in communities across the state.

State University is governed by a Board of Trustees, appointed by the Governor, which directly determines the policies to be followed by the 34 state-supported campuses. Community colleges have their own local boards of trustees whose relationship to the SUNY board is defined by law. The State contributes one-third to 40 percent of their operating cost and one-half of their capital costs.

The State University motto is: "To Learn—To Search—To Serve."

STATE UNIVERSITY OF NEW YORK

UNIVERSITY CENTERS

State University of New York at Albany
State University of New York at Binghamton
State University of New York at Buffalo
State University of New York at Stony Brook

COLLEGES OF ARTS AND SCIENCE

Empire State College
State University College at Brockport
State University College at Buffalo
State University College at Cortland
State University College at Fredonia
State University College at Geneseo
State University College at New Paltz
State University College at Old Westbury
State University College at Oneonta
State University College at Oswego
State University College at Plattsburgh
State University College at Potsdam
State University College at Purchase

COLLEGES AND CENTERS FOR THE HEALTH SCIENCES

Downstate Medical Center at Brooklyn
Upstate Medical Center at Syracuse
College of Optometry at New York City
Health Sciences Center at Buffalo University Center*
Health Sciences Center at Stony Brook University Center*

AGRICULTURAL AND TECHNICAL COLLEGES

Agricultural and Technical College at Alfred
Agricultural and Technical College at Canton
Agricultural and Technical College at Cobleskill
Agricultural and Technical College at Delhi
Agricultural and Technical College at Farmingdale
Agricultural and Technical College at Morrisville

SPECIALIZED COLLEGES

College of Environmental Science and Forestry at Syracuse
Maritime College at Fort Schuyler
College of Technology at Utica/Rome
Fashion Institute of Technology at New York City**

STATUTORY COLLEGES***

College of Agriculture and Life Sciences at Cornell University
College of Ceramics at Alfred University
College of Human Ecology at Cornell University
School of Industrial and Labor Relations at Cornell University
College of Veterinary Medicine at Cornell University

COMMUNITY COLLEGES

(Locally-sponsored, two-year colleges under the program of State University)

Adirondack Community College at Glens Falls
Broome Community College at Binghamton
Cayuga County Community College at Auburn
Clinton Community College at Plattsburgh
Columbia-Greene Community College at Hudson
Community College of the Finger Lakes at Canandaigua
Corning Community College at Corning
Dutchess Community College at Poughkeepsie
Erie Community College at Williamsville, Buffalo and Orchard Park
Fashion Institute of Technology at New York City**
Fulton-Montgomery Community College at Johnstown
Genesee Community College at Batavia
Herkimer County Community College at Herkimer
Hudson Valley Community College at Troy
Jamestown Community College at Jamestown
Jefferson Community College at Watertown
Mohawk Valley Community College at Utica
Monroe Community College at Rochester
Nassau Community College at Garden City
Niagara County Community College at Sanborn
North Country Community College at Saranac Lake
Onondaga Community College at Syracuse
Orange County Community College at Middletown
Rockland Community College at Suffern
Schenectady County Community College at Schenectady
Suffolk County Community College at Selden, Riverhead and Brentwood
Sullivan County Community College at Loch Sheldrake
Tompkins Cortland Community College at Dryden
Ulster County Community College at Stone Ridge
Westchester Community College at Valhalla

*The Health Sciences Centers at Buffalo and Stony Brook are operated under the administration of their respective University Centers.

**While authorized to offer such baccalaureate and master's degree programs as may be approved pursuant to the provisions of the Master Plan, in addition to the associate degree, the Fashion Institute of Technology is financed and administered in the manner provided for community colleges.

***These operate as "contract colleges" on the campuses of independent universities.

College of Environmental Science and Forestry

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VANCE A. BARR
Student Representative ..... Syracuse

COLLEGE ADMINISTRATION

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Director of Development ..... ARTHUR J. FRITZ, JR.

Vice President for Academic Affairs ... DONALD F. BEHREND
Assistant Vice President for Research Programs ..... JAMES W. GEIS
Assistant Vice President for Academic Programs ..... ROBERT H. FREY
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Coordinator of Demonstration and Information, IEPA ..... ROLLA W. COCHRAN

Vice President for Student Affairs ..... HARRISON H. PAYNE
Director of Financial Aid ..... JOHN E. VIEW
Registrar ..... ROBERT S. NORTH
Advisor, Foreign Student Exchange Visitor Programs ..... VIRGINIA T. TORELLI

Vice President for Administration and Institutional Planning ..... DAVID G. ANDERSON
Director of Business and Fiscal Affairs ..... HARRY J. CORR
Librarian ..... DONALD F. WEBSTER
Director of Educational Communications ..... BERNARD T. HOLTMAN
Director of Academic Computing ..... CHARLES N. LEE
Assistant Director of Personnel and Affirmative Action ..... JUDITH J. KIMBERLIN
Director of Physical Plant ..... BRUCE E. REICHEL
Acting Director of Public Safety ..... CARL F. BRAENDLE
Director of Analytical and Technical Services ..... ROWENA V. KATHER
Director of Administrative Data Processing and Institutional Research ..... SHEILA M. NORTH
Director of Forest Properties ..... RICHARD A. SCHWAB
Dean, School of Biology, Chemistry and Ecology ..... STUART W. TANENBAUM
Director, Office of Continuing Education and Extension and Assistant Vice President for International Programs . VACANT
Dean, School of Environmental and Resource Engineering ..... WILLIAM P. TULLY
Dean, School of Forestry ..... JOHN V. BERGLUND
Director, Forest Technician Program ..... WESLEY E. SUHR
Acting Dean, School of Landscape Architecture ..... RALPH A. SANDERS
Director, Graduate Program in Environmental Science ..... MOHAN K. WALI
Director, Adirondack Ecological Center .. WILLIAM F. PORTER
Director, Empire State Paper Research Institute ..... BENGT LEOPOLD
Acting Director, Polymer Research Institute . ISRAEL CABASSO
Director, Ultrastructure Studies Center WILFRED A. CÔTÉ, JR.
Director, Tropical Timber Information Center ..... ROBERT W. MEYER
Director, Cellulose Research Institute ..... TORE E. TIMELL
Project Leader, U.S. Forest Service Cooperative Research Unit ..... ROWAN A. ROWNTREE
Director, Renewable Materials Institute WILFRED A. CÔTÉ, JR.

COLLEGE FACULTY AND PROFESSIONAL STAFF

DISTINGUISHED TEACHING PROFESSOR

GEORGE W. CURRY, *Distinguished Teaching Professor*, School of Landscape Architecture

THEODORE J. STENUF, *Distinguished Teaching Professor*, Department of Paper Science and Engineering

DISTINGUISHED ADJUNCT PROFESSOR

HARRY L. FRISCH, *Distinguished Adjunct Professor*, Department of Chemistry

DISTINGUISHED TEACHING PROFESSOR EMERITUS

EDWIN H. KETCHLEDGE, *Distinguished Teaching Professor Emeritus*, Department of Environmental and Forest Biology

DISTINGUISHED PROFESSOR EMERITUS

CONRAD SCHUERCH, *Distinguished Professor Emeritus*, Department of Chemistry

MICHAEL M. SZWARC, *Distinguished Professor Emeritus*, Polymer Research Institute

This listing represents an official record of the State University of New York College of Environmental Science and Forestry faculty and professional staff for 1985. It is designed for use in 1985-86.

The date in parentheses after each name denotes the first year of service, two or more dates, the term of service.

LAWRENCE P. ABRAHAMSON (1977), *Senior Research Associate*, School of Forestry and Department of Environmental and Forest Biology; B.S., Michigan Technological University, 1964; M.S., University of Wisconsin, 1967; Ph.D., 1969

JUDD H. ALEXANDER (1979), *Adjunct Professor*, Graduate Program in Environmental Science; B.A., Carleton College, 1949; P.M.D., Harvard Business School, 1967

DOUGLAS C. ALLEN (1968), *Professor*, Department of Environmental and Forest Biology; B.S., University of Maine, 1962; M.S., 1965; Ph.D., University of Michigan, 1968

WAYNE ALLEN (1979), *Technical Assistant*, Forest Technician Program of the School of Forestry

IRA H. AMES (1972), *Adjunct Professor*, Department of Environmental and Forest Biology; B.A., Brooklyn College, 1959; M.S., New York University, 1962; Ph.D., 1966

DAVID G. ANDERSON (1959), *Vice President for Administration and Institutional Planning; Professor;* A.A.S., State University of New York College of Forestry (Ranger School), 1950; B.S., State University of New York College of Forestry, 1953; M.S., University of Utah, 1958; M.P.A., Syracuse University, 1974

ROBERT E. ANTHONY (1953), *Technical Specialist*, Department of Environmental and Forest Biology; A.A.S., State University of New York Agricultural and Technical College at Morrisville, 1952

RAYMOND J. APPLEBY (1982), *Technical Assistant*, Department of Paper Science and Engineering; A.S., State University of New York Columbia-Greene, 1980

ROBERT W. ARSENEAU (1972), *Programmer/Analyst*, Administrative Data Processing, Office of the Vice President for Administration and Institutional Planning; A.A.S., Mohawk Valley Community College, 1967; B.S., Syracuse University, 1978

CAROLINE B. BAILEY (1978), *Technical Assistant*, School of Landscape Architecture

JAMES P. BAMBACHT (1967), *Professor*, Department of Paper Science and Engineering; A.B., Kalamazoo College, 1954; M.S., The Institute of Paper Chemistry, 1956; Ph.D., State University of New York College of Environmental Science and Forestry, 1973

DONALD F. BEHREND (1960-67) (1968), *Vice President for Academic Affairs; Professor*, Department of Environmental and Forest Biology and Graduate Program in Environmental Science; B.S., University of Connecticut, 1958; M.S., 1960; Ph.D., State University of New York College of Forestry, 1966

JOHN D. BENNETT (1960), *Associate Professor*, School of Forestry; B.A., Ohio Wesleyan University, 1954; Ph.D., Syracuse University, 1968; *Chancellor's Award for Excellence in Teaching* (1973)

CAMILLO A. BENZO (1975), *Adjunct Associate Professor*, Department of Environmental and Forest Biology; B.A., Utica College of Syracuse University, 1964; Ph.D., University of Pennsylvania, 1969

JOHN V. BERGLUND (1965), *Dean and Professor*, School of Forestry; B.S., Pennsylvania State University, 1962; M.S., 1964; Ph.D., State University of New York College of Forestry, 1968

DONALD H. BICKELHAUPT (1969), *Research Assistant*, School of Forestry; B.S., State University of New York College of Forestry, 1970; M.S., State University of New York College of Environmental Science and Forestry, 1980

ARTHUR J. BILCO (1983), *Assistant Director of Physical Plant*, Office of the Vice President for Administration and Institutional Planning

PETER E. BLACK (1965), *Professor*, School of Forestry; Graduate Program in Environmental Science; B.S., University of Michigan, 1956; M.F., 1958; Ph.D., Colorado State University, 1961; *Executive Chairman of the Faculty* (1974-78)

RAYMOND W. BLASKIEWICZ (1982), *Assistant Registrar*, Registrar's Office; B.S., State University of New York College of Environmental Science and Forestry, 1979

CONSTANCE H. BOBBIE (1982), *Associate Librarian*, F. Franklin Moon Library; B.S., Bemidji State College, 1956; M.A., University of Minnesota, 1962

WILLIAM R. BORGSTEDE (1971), *Technical Assistant*, Department of Environmental and Forest Biology; A.A.S., Miner Institute, 1966; A.A.S., State University of New York College at Delhi, 1970; B.S., State University of New York College of Environmental Science and Forestry, 1975; M.S., Syracuse University, 1978

GREGORY L. BOYER (1985), *Assistant Professor*, Department of Chemistry; A.S., Reedley College, 1973; A.B., University of California, 1975; Ph.D., University of Wisconsin, 1980

CARL F. BRAENDLE (1976), *Assistant Director of Campus Public Safety*, Office of the Vice President for Administration and Institutional Planning

WILLIAM C. BRAGG (1984), *Visiting Instructor*; School of Forestry; B.S., State University of New York College of Environmental Science and Forestry, 1972

STEPHEN B. BRANDT (1983), *Research Associate Professor*, Department of Environmental and Forest Biology; Graduate Program in Environmental Science; B.A., University of Wisconsin, 1972; M.S., 1975; Ph.D., 1978

BRUCE W. BREITMEYER (1983), *Forest Property Manager*, Warrensburg and Newcomb Campuses, B.S.F., University of Michigan, 1975; M.F., 1982

JEROME BREZNER (1961), *Professor, Curriculum Director*, Department of Environmental and Forest Biology; A.B., University of Rochester, 1952; A.M., University of Missouri, 1956; Ph.D., 1959; Postdoctoral, Dartmouth Medical School, 1960; Executive Chairman of the Faculty, (1974-76); SUNY Senator, (1984-87)

KENNETH W. BRITT (1971), *Senior Research Associate*, Department of Paper Science and Engineering; B.Chem., Cornell University, 1929

ROBERT H. BROCK, JR. (1967), *Chairman and Professor*, Department of Forest Engineering; B.S., State University of New York College of Forestry, 1958; M.S., 1959; Ph.D., Cornell University, 1971

RAINER H. BROCKE (1969), *Associate Professor*, Department of Environmental and Forest Biology; Graduate Program in Environmental Science; *Director*, Cranberry Lake Biological Station; B.S., Michigan State University, 1955; M.S., 1957; Ph.D., 1970

DAVID F. BRODOWSKI (1977), *Technical Specialist*, Department of Environmental and Forest Biology; B.S., Cornell University, 1975

ALTON F. BROWN (1963), *Technical Specialist*, Empire State Paper Research Institute

THOMAS E. BROWN (1977), *Adjunct Assistant Professor*, Department of Environmental and Forest Biology; B.S., Niagara University, 1957; M.S., State University of New York College of Forestry, 1968

PATRICIA BURAK (1983), *Adjunct Associate Foreign Student Counselor*, Office of Student Affairs; B.A., State University of New York College at Oswego, 1973; M.A., State University of New York College at Albany, 1974

ROBERT L. BURGESS (1981), *Chairman* and *Professor*, Department of Environmental and Forest Biology; Graduate Program in Environmental Science; B.S., University of Wisconsin (Milwaukee), 1957; M.S., University of Wisconsin (Madison), 1959; Ph.D., 1961

KENNETH F. BURNS (1970), *Technical Assistant*, School of Forestry; A.A.S., Paul Smith's College, 1969

HARRY W. BURRY (1962), *Senior Research Associate and Extension Coordinator*; *Associate Professor*, School of Forestry; B.S., New York State College of Forestry, 1941; M.F., State University of New York College of Forestry, 1964

ISRAEL CABASSO (1981), *Professor*, Department of Chemistry; *Acting Director*, Polymer Research Institute; B.S., Hebrew University, 1966; M.S., 1968; Ph.D. Weizmann Institute of Science, 1973

PAUL M. CALUWE (1969), *Associate Professor*, Department of Chemistry; *Associate Member*, Polymer Research Institute; Ph.D., University of Leuven, Belgium, 1967

ROBERT W. CAMPBELL (1984), *Adjunct Professor and Research Associate*, Department of Environmental and Forest Biology; B.S., New York State College of Forestry, 1953; M.F., University of Michigan, 1959; Ph.D., 1961

HUGH O. CANHAM (1966), *Associate Professor*, School of Forestry; B.S., State University of New York College of Forestry, 1960; M.S., 1962; Ph.D., 1971

COSTAS A. CASSIOS (1978), *Adjunct Professor*, School of Landscape Architecture; B.S., University of Thessaloniki, 1965; M.S., Graduate Industrial School, 1969; M.S., University of Wisconsin, 1972; Ph.D., 1976

JOHN D. CASTELLO (1978), *Assistant Professor*, Department of Environmental and Forest Biology; B.A., Montclair State College, 1973; M.S., Washington State University, 1976; Ph.D., University of Wisconsin, 1978

THOMAS M. CATTERSON (1982), *Senior Research Associate*, Office of Research Programs; B.S., State University of New York College of Environmental Science and Forestry, 1967; M.S., 1973

ROBERT E. CHAMBERS (1967), *Professor*, Department of Environmental and Forest Biology; Graduate Program in Environmental Science; B.S., Pennsylvania State University, 1954; M.S., 1956; Ph.D., Ohio State University, 1972

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Campus Locator

Admissions	110 Bray
Affirmative Action	218 Bray
Alumni	320 Bray
Analytical and Technical Services	139 Baker
Assistant Vice President for Academic Programs	227 Bray
Assistant Vice President for Research	200 Bray
Auto-tutorial Center	16 Moon
Business and Fiscal Affairs	100 Bray
Career Services	108 Bray
Cellulose Research Institute	314 Baker
Computer Services	320 Baker
Counseling Services	107 Bray
Educational Communications	302 Illick
Empire State Paper Research Institute	317 Walters
Facilities	Maintenance Building
Film Library	104 Moon
Financial Aid	111 Bray
Graduate Program in Environmental Science	217 Bray
International Forestry	205 Marshall
Institute of Environmental Program Affairs	200 Bray
Institutional Research	206 Bray
Library	Moon Library
Maintenance and Operations	Maintenance Building
Office of Continuing Education and Extension	231 Baker
Personnel	224 Bray
Polymer Research Institute	215 Baker
President	204 Bray
Publications	123 Bray
Public Relations	123 Bray
Public Safety Department	8 Bray
Registrar	113 Bray
School of Biology, Chemistry and Ecology	311 Baker
School of Environmental and Resource Engineering	208 Walters
School of Forestry	106 Marshall
School of Landscape Architecture	331 Marshall
Student Council	19 Marshall
Ultrastructure Studies Center	417 Baker
U.S. Forest Service Cooperative Research Unit	5 Moon
Veterans' Affairs	107 Bray
Vice President for Administration and Institutional Planning	208 Bray
Vice President for Program Affairs	227 Bray
Vice President for Student Affairs	107 Bray

Coordinator for 503-504 Programs—David G. Anderson, Vice President for Administration and Institutional Planning, 209 Bray Hall.

Affirmative Action Officer—Judith J. Kimberlin, Personnel Associate, 224 Bray Hall.

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STATE UNIVERSITY OF NEW YORK
COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY
SYRACUSE, NEW YORK 13210

State University of New York

COLLEGE OF

ENVIRONMENTAL SCIENCE AND FORESTRY

1986-87 CATALOG

CORRESPONDENCE DIRECTORY

Detailed information about the College may be obtained by addressing inquiries to:

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Syracuse, New York 13210
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Director of Admissions
106 Bray Hall
470-6600

Admission (Graduate)
Office of Instruction and Graduate Studies
227 Bray Hall
470-6599

Financial Assistance
Coordinator of Financial Aid
113 Bray Hall
470-6670

Transcripts and Academic Records
Registrar
111 Bray Hall
470-6655

Housing
Coordinator of Undergraduate Housing
Office of Residential Life
Steele Hall
Syracuse University
Syracuse, New York 13210
423-2720

The State University of New York College of Environmental Science and Forestry is accredited by the Middle States Association of Colleges and Secondary Schools: the B.S. degree program in Forestry is accredited 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; and the B.S. degree program in forest engineering is accredited by the Accreditation Board for Engineering and Technology.

Additional information is available upon request from any of the above addresses. This undergraduate/graduate catalog was published by the College of Environmental Science and Forestry June 1986.

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 College of Environmental Science and Forestry.

State University of New York

COLLEGE OF

ENVIRONMENTAL SCIENCE AND FORESTRY

1986-87 General Catalog

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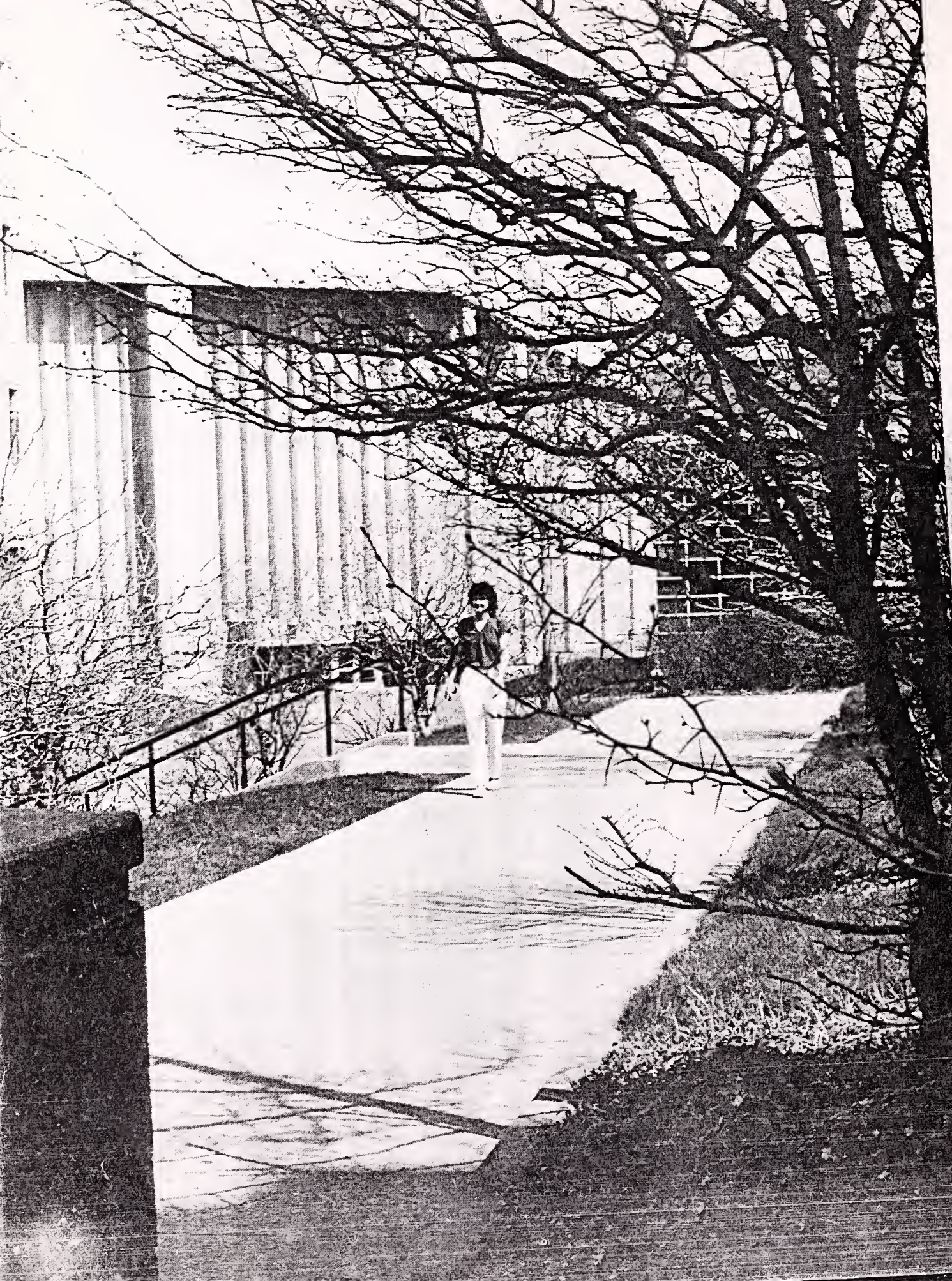


Academic Calendar

SYRACUSE CAMPUS

FALL 1986

New Student Orientation Program	Aug. 31	Sunday
Academic Advising	Sept. 1	Monday
Registration for New Students	Sept. 1	Monday
Classes Begin	Sept. 2	Tuesday
Early Registration	Nov. 18-25	Tuesday-Tuesday
Thanksgiving Recess	Nov. 26-30	Wednesday-Sunday
Early Registration	Dec. 1-5	Monday-Friday
Last Day of Classes	Dec. 12	Friday
Exam Period	Dec. 15-19	Monday-Friday

SPRING 1987

Orientation and Advising for New Students	Jan. 12	Monday
Registration for New Students	Jan. 12	Monday
Classes Begin	Jan. 13	Tuesday
Spring Recess	Mar. 7-15	Saturday-Sunday
Early Registration	Mar. 30-Apr. 10	Monday-Friday
Last Day of Classes	Apr. 29	Wednesday
Reading Day	Apr. 30	Thursday
Exam Period	May 1-7	Friday-Thursday
Commencement	May 10	Sunday

ESF: What's In A Name?

1911. Governor John A. Dix signed a bill establishing the New York State College of Forestry at Syracuse University.

1948. Legislative action incorporated into State University of New York all state-supported higher education. Thus, the State University College of Forestry at Syracuse University.

1972. By special legislative act, the College was renamed the State University of New York College of Environmental Science and Forestry.

Why, in the first place, all the name changes? And, secondly, what difference do they make? What, really, is in our name?

ESTABLISHING A TRADITION

The beginnings and early development of the New York State College of Forestry were largely due to James R. Day, chancellor of Syracuse University, and community leader who were attuned to the growing national sentiment favoring forest conservation and who sensed the need for a professional school of forestry. The legislative act which created the College instructed that the institution "conduct such special research in statewide investigations in forestry as will throw light upon and help in the solution of forestry problems. . ." and that it be "the institution for educational work in forestry in the State."

From the very first years of its existence under the first dean, Hugh P. Baker, the College responded to the broad needs of environmental professionalism. While other schools and colleges of forestry became more specialized, the College at Syracuse broadened to include the essentials of environmental science: design, engineering, and the life sciences, as well as resource management.

With the formation of the State University of New York in 1948, coordination and systematization came to higher education in the state. The University, according to its chapter, was to "supplement, not supplant, the great network of private colleges and universities." The College of Forestry, which from its beginning had been state-supported and governed by a Board of Trustees currently made up of nine members appointed by the Governor and six *ex officio* members, was recognized as a specialized college within the State University system.

Stemming from Chancellor Day's early sponsorship of the College, Syracuse University and ESF have long been engaged in numerous fruitful devices of institutional cooperation. This relationship is probably the most outstanding example in this country of collaboration between public and private institutions of higher education. Even as a part of State University, the College maintains this unique position. The major character of the relationship stems from the fact that since its beginning, the College purchased from Syracuse University the major portion of its supportive and enrichment instruction, thus allowing the College to more fully develop its professional upper division and graduate level instruction.

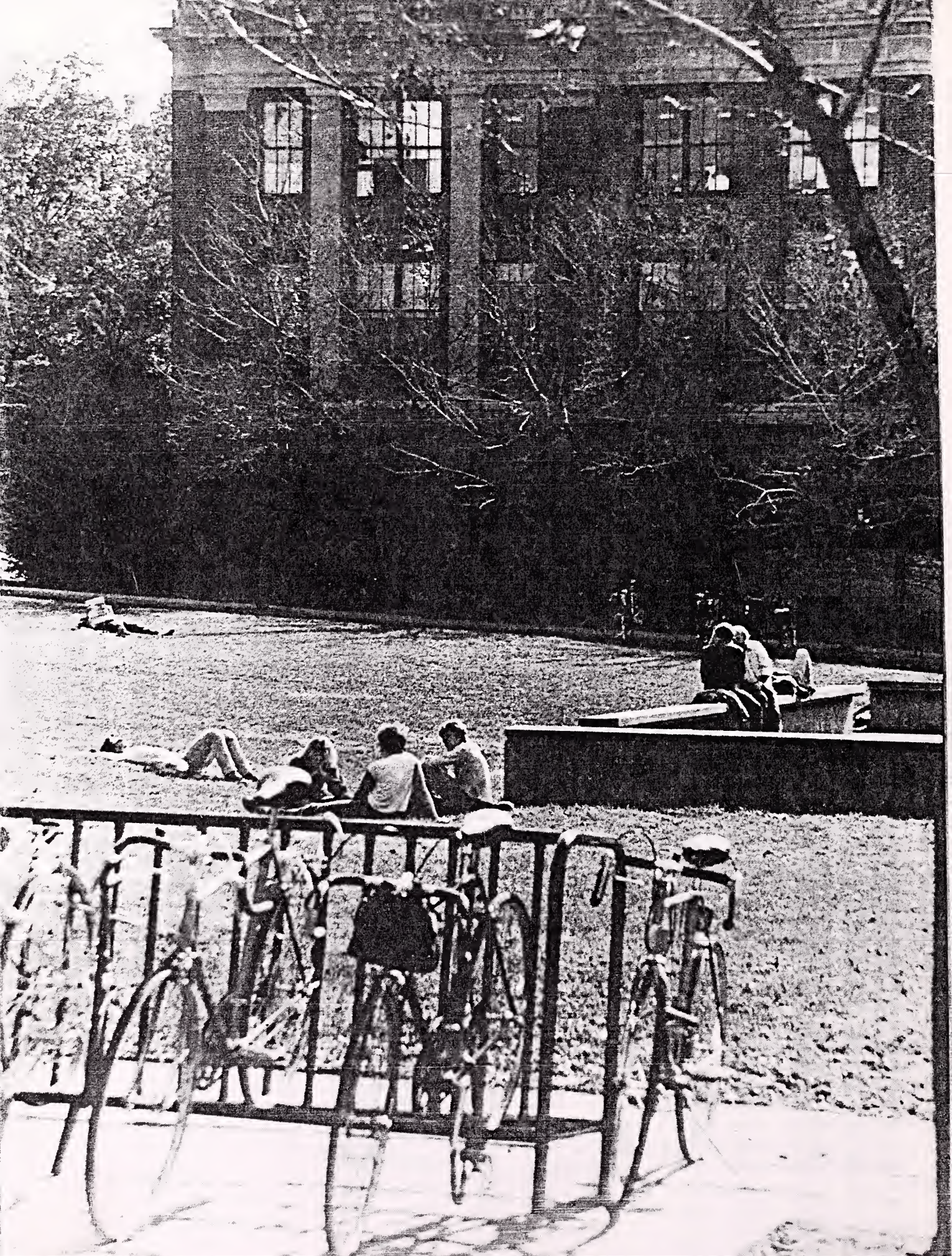
Other cooperative areas are living centers and dining facilities, athletic programs, the use of the University's infirmary and health counseling services, the bookstore facilities, the University library system, joint Commencement ceremonies held in the Carrier Dome, and participation in numerous social activities including the elaborate religious, dramatic, and cultural benefits of a large university.

ESF TODAY

The third phase in the evolvement of the College's name came in 1972 when it was rechartered as the State University of New York College of Environmental Science and Forestry. Thus, the name reflects more deeply the traditional grounding and concern of forestry in the environment; it illuminates more clearly the capabilities of its program.

The College of Environmental Science and Forestry is an Upper Division/Graduate Center with highly focused professional programs. Undergraduate students wishing to embark upon a career in the environmental sciences and forestry will enroll for two years at a junior college or four-year institution, studying an ESF prescribed program and transfer to this college as juniors. The move to upper division/graduate college status marked another step in the College's long-standing commitment to educate professionals capable of facing the complex environmental problems of today and of the future.

For 75 years, the full thrust of the State University of New York College of Environmental Science and Forestry has been focused on the environment on all of its six campuses and in each of its three mission areas—instruction, research, and public service. The College has been, and continues to be, devoted to the advancement of environmental science and forestry.



The Mission: Instruction, Research, and Public Service

INSTRUCTION

In the fall of 1985, student enrollment reached 1,381. Of this number, 902 were undergraduates and 479 were graduate students. In addition, there were 13 students engaged in postdoctoral work.

Undergraduate Education

At the baccalaureate level, the College offers professional study in eight areas: *chemistry; environmental and forest biology; environmental studies; forest engineering; paper science and engineering; wood products engineering; resource management;* and *landscape architecture.* These programs are registered with the New York State Education Department.

Each of these curricula leads to the bachelor of science degree. In the case of landscape architecture, an additional year of study results in a bachelor of landscape architecture degree, and in the forest engineering program, a fifth year leading to a bachelor's degree in civil engineering can be taken at Syracuse University or State University at Buffalo.

SCIENCE TEACHER CERTIFICATION

ESF, in cooperation with the School of Education at Syracuse University, provides the opportunity for selected undergraduate students to prepare for New York State provisional science teacher certification. Transfer students who maintained a 3.000 or greater cumulative grade point average at their pre-ESF institution or who earned a 2.500 grade point average or greater during their first semester at ESF are eligible for acceptance into the program. To receive provisional certification to teach secondary (grades 7 through 12) science in New York State, students must complete the following requirements.

1. A minimum of 36 credit hours in science (both lower and upper division courses), including

2. 15 credit hours in each science for which certification is sought (Only biology and chemistry may be certified through this program, however, if students have taken at least 15 credits in physics or earth science independent of ESF, they can also be certified in these areas. Certification for teaching general science will be included when the total shows college-level study in at least two sciences.), and

3. 18 credit hours in education at S.U. distributed as follows:

EDU 207	Study of Teaching (Secondary)	3
EDU 307	Personalizing Learning and Teaching	3
EDU 308	Strategies of Teaching (Secondary)	3
SCE 535	Practicum in Science Teaching	3
EDU 508	Student Teaching	6
		18

EDU 308, SCE 535, and EDU 508 are normally taken together as a block in the fall of the senior year, with SCE 535 and EDU 308 meeting for the first half of the semester and EDU 508 meeting the second half. EDU 508 is a full-time commitment for about eight weeks, so other courses must be scheduled with this in mind. SCE 535 is normally offered only in the fall.

4. New York State also requires successful completion of the National Teacher Examination (NTE) for provisional certification.

ESF students who complete these requirements may then apply directly to the State Education Department for provisional certification.

Graduate Education

The College awarded its first graduate degree in 1913. Today the College offers advanced degrees in six major program areas: *environmental and forest biology; forest chemistry; forest resources management; environmental and resource engineering; landscape architecture;* and *environmental science.* These programs are registered with the New York State Education Department.

Graduate study leads to the master of science degree, the master of landscape architecture degree, and the doctor of philosophy degree. A postdoctoral study program, closely related to the College's research effort, is also available.

CONCURRENT GRADUATE DEGREES

ESF and Syracuse University provide the opportunity for graduate students to complete concurrently a degree at ESF and, at Syracuse University, either the J.D. degree in the College of Law, the M.P.A. degree in the Maxwell School of Citizenship and Public Affairs, the M.A. or M.S. degree in the S.I. Newhouse School of Public Communica-

tions, the M.S. degree in the School of Education, or the M.B.A. degree in the School of Management. Students must complete at least one semester of graduate level coursework and earn a 3.500 or greater grade point average at ESF before being considered for a concurrent degree program at Syracuse University.

INTERCAMPUS DOCTORAL EXCHANGE

There is an opportunity for doctoral students at ESF to study for one or two semesters at the following schools: State University Centers at Albany, Binghamton, Buffalo, or Stony Brook; City University of New York; or New York University.

This exchange program provides students with an opportunity to take advantage of over 160 faculty, specialized research laboratories and equipment, technical libraries, and field study areas which complement the extensive programs and resources at ESF which are discussed throughout this catalog.

COLLEGE OF AGRICULTURE AND LIFE SCIENCES AT CORNELL UNIVERSITY

The State University of New York College of Environmental Science and Forestry and the New York State College of Agriculture and Life Sciences at Cornell University provide an opportunity to exchange graduate students so they can take advantage of special courses, faculty, and research facilities.

Technical Education

At the paraprofessional level, the College has been training forest technicians since 1912 at its Wanakena Campus in the Adirondack Mountains. It is the oldest Ranger School in the United States and offers a two-year *forest technology* curriculum. Graduates are awarded an associate in applied science degree. In this curriculum, students take their first year of general education at a two- or four-year college. The second year, with its emphasis on practical field training in the relationships between forest technology and managerial needs, is taken at Wanakena with its 2,800 acres of forested land. Graduates of this degree program in practical forestry are prepared for positions as forest rangers; federal, state, and private industry forest technicians and forestry aides; district forest supervisors; timber inventory specialists; timber sales supervisors; forest surveyors and engineering aides; and forest protection technicians.

Continuing Education

The philosophy that education is a lifelong pursuit is an ancient one and was written into the law creating the College. This concept is doubly important to the sciences and professions in this technological age when, with knowledge expanding in all directions, major environmental problems still remain to be resolved. The informational needs of New York's citizens also are undergoing change. The increasing urban character of our population; the changing pattern of agricultural and forest land ownership and use; the rise in level of education and sophistication in a more efficient society; and the increase in leisure time, travel mobility and need for recreational facilities and pursuits all contribute to a growing need for educational opportunities in environmental science and forestry for adult audiences.

The College has, over the years, succeeded in communicating knowledge on forest resources management, utilization, and conservation to a variety of off-campus publics. The entire College faculty has contributed to these programs. To reinforce this commitment, the College established the Office of Nonresident Programs upon which to base expanded educational opportunities at both the undergraduate and graduate course levels.

Conferences, symposia, seminars, and shortcourses on various aspects of forestry and the related sciences are conducted at both the basic and applied levels. Audiences include forest owners, managers, and operators; wood engineers and forest industries personnel; academic and scientific groups; conservation and recreation personnel from local and other public and private planning groups; and citizen-action committees. Upon request, continuing education programs can be designed to meet specific needs of professional organizations, agencies, and industry. Credit or noncredit courses, at campus or off-campus sites, can be arranged.

Expansion of in-service training courses, establishment of environmental learning centers on College forest properties, and production of media materials for public information and education are examples of activities directed toward updating and upgrading professional clients and broadening the public's awareness and appreciation of New York's forestlands and other natural resources.

For information on specific continuing education projects, inquiries should be sent to Dean, Office of Nonresident Programs..

RESEARCH

The College's commitment to scientific inquiry stretches far back to its second year of existence. In 1912, Dean Hugh P. Baker initiated the first research project of the College by joining forces with the U.S. Forest Service in an industry study designed to show what kinds of firms were using wood in New York State and the species and quantities used.

In the 1980's, the College's research program has attracted a worldwide clientele of industrial, governmental, professional and scientific groups, and through liaison with them, the program maintains its vigor and relevancy to the important environmental issues. Support from this clientele amounts to more than $4 million a year, a two-fold increase in the last decade.

Students and faculty from across the College contribute to the depth and diversity of the research program. Findings from these studies are applied to a host of issues and

problems through various demonstrations and information devices. Recent examples include studies of limestone quarry reclamation; the development of polymeric materials for artificial human organs; nonchemical control measures for insect pests, e.g., the gypsy moth; studies of the ecology of Antarctic birds; new wood pulping processes leading to pollution-free water and air effluents; and the ecological effects of winter navigation in the Great Lakes and the St. Lawrence River.

Institute of Environmental Program Affairs

Research and public service programs at the College of Environmental Science and Forestry are given additional emphasis through the Institute of Environmental Program Affairs (IEPA). This Collegewide coordination vehicle was initiated in 1972 in recognition of the College's traditionally broad and integrated approach to natural resources science and in response to new perceptions of the relationship between human endeavors and environmental quality. The Institute, which is staffed by the Office of the Dean of Research, functions to bring together groups of faculty scientists to explore research and public service needs and opportunities which transcend the programs of the schools, departments, and organized research centers and institutes of the College.

Study teams of scientists and graduate students from many disciplines have collaborated with external program cooperators from governmental agencies, citizens' groups, and private industry to pursue multidisciplinary research and public service programming as part of the IEPA program. Early efforts were focused on regional natural resource and environmental studies conducted at the request of New York State agencies such as the St. Lawrence-Eastern Ontario Commission, the Tug Hill Commission, the Catskill Study Commission, and the Adirondack Park Agency. Other studies which transcend regional problems and issues have been conducted with diverse sponsorship, including environmental service systems, leisure time and recreational activities appropriate to the Hudson River Basin; solid waste processing and heavy metals recovery from processing residues from the forest products industry; wetlands evaluation studies; remote sensing techniques to facilitate environmental monitoring of coastal water quality and land use patterns; reclamation of open pit limestone quarries; the siting of nuclear power generation facilities; and environmental assessment studies associated with proposals for extended season navigation in Lake Ontario and the St. Lawrence River.

More recently, IEPA has provided a focus for faculty interested in pursuing research and public service programming through diverse sponsorships in particular areas of high public concern. Three task forces are currently operating in these areas to develop new project activity and coordinate the Collegewide research focus in bioenergy projects, acid precipitation and atmospheric deposition, and sludge and sludge management concerns.

Empire State Paper Research Institute

The Empire State Paper Research Institute (ESPRI) is the only worldwide basic research organization in the pulp and paper field. It performs investigations in cooperation with the Empire State Paper Research Association (ESPRA), which is comprised of 78 pulp and paper companies in 14 countries. The Institute was established in 1945 when the members of ESPRA recognized the need for new scientific and technical knowledge and methods, and since then ESPRI has been able to maintain an efficient balance between the practical and theoretical bases of the pulp and paper industry.

Housed in the modern J. Henry Walters Hall with its own pilot paper mill, and staffed by scientists who are internationally recognized for their accomplishments, ESPRI provides a research base for long-range industry development. Its program has widened in scope to cover almost all aspects of pulping and papermaking, including additive retention, oxygen pulping and bleaching, effluent control, sheet drying, printability, and energy efficiencies.

Polymer Research Institute

Scientists at the College have made many original contributions to the field of pure and applied polymer chemistry, including the development of living polymers, the study of anionic polymerization and electron-transfer initiation, and work on the permeation of gases and films through polymeric films.

College faculty specializing in polymer chemistry have trained hundreds of graduates and postdoctoral researchers, many of whom now hold leading positions in universities and industrial and governmental laboratories.

Nelson Courtland Brown Laboratory for Ultrastructure Studies

This Center, located in Baker Laboratory, is a teaching, research, and service facility of the College. It is equipped to handle virtually every type of modern microscopy. This includes light, scanning electron, and transmission electron microscopy. Among the major items of equipment are: two RCA EMU-3 transmission electron microscopes; an RCA EMU-4, an ETEC Autoscan scanning electron microscope, energy dispersive X-ray analyzer, several types of light microscopes, high vacuum evaporators, microtomes and ultramicrotomes. The laboratory resources include specimen preparation rooms, several photographic darkrooms, three electron microscope laboratories and other supporting facilities.

The primary service of the Center is teaching; course offerings include photomicrography, scanning electron microscopy, and interpretation of cellular ultrastructure. Research is a second major activity since support is provided for students, faculty, and research staff who have projects involving structural studies. Public service is extended to local high school groups, medical facilities, other regional colleges and universities, and industry.

Adirondack Ecological Center

The Adirondack Ecological Center (AEC) is located on the College's Newcomb Campus in the center of the Adirondack Mountains. Staffed by resident scientists, technicians, and support staff, the AEC conducts studies of the Adirondack region year-round. Research includes studies of managed and unmanaged forest lands, wildlife populations and habitats, terrestrial and aquatic ecology, and wilderness management. There is close collaboration with the New York State Department of Environmental Conservation, the U.S. Fish and Wildlife Service, the U.S. Department of Agriculture, and forest industries.

The vigorous research program of the Center provides excellent opportunities for collaboration by Syracuse-based faculty and students. Several graduate students are regularly in residence at Newcomb pursuing their thesis research.

Renewable Materials Institute

The Renewable Materials Institute (RMI) has as its principal goal research on wood and other renewable materials such as agricultural waste products, which would include straw, rice hulls, and bagasse. To meet its mission, research on the characterization of the material itself is primary. Closely related with it is the determination of physical properties which control the behavior of the material during utilization as well as in use in consumer products. In exploring renewable materials, strong emphasis is placed on energy considerations. This can be in terms of energy savings during production or economies of energy because of the use of the end product in housing or in some other application. Also included are related studies in the combustion of wood, the efficiency of heating with wood and the emissions resulting from wood combustion.

The principal facilities for the materials characterization are found in the Center for Ultrastructure Studies and include the transmission electron microscopes, a scanning electron microscope with EDXA and rapid particle analysis. All of the facilities of the Department of Wood Products Engineering are also available, including a sawmill, veneer and plywood manufacturing facility, dry kilns, wood machining equipment, and timber testing laboratory. The facilities of other research institutes and Departments in the College are also available for special projects.

Tropical Timber Information Center

The Tropical Timber Information Center (TTIC) provides identifications of wood samples and information about tropical woods for both general characteristics and technical properties. These services are oriented toward importers and users of tropical woods. The Center began operation in 1975 as part of the Department of Wood Products Engineering and is one of only two such sources of information in the western hemisphere. The Center also carries out special studies under contract for production of data that is not available in the literature. The technical base for operation of the Center is a large, worldwide collection of authenticated wood samples and an extensive collection of reference materials in Moon Library and the Department of Wood Products Engineering. Both of these resources have been built up over the past 60 years by close cooperation with institutions throughout the world. Activity is oriented toward requests for services from importers and users of tropical woods and to expanding the collections.

Cellulose Research Institute

Research at the Cellulose Research Institute is at present centered on the fine structure of native cellulose and its transformations into other commercially important forms of cellulose. For example, the structural differences between native and regenerated celluloses have been determined, for the first time, through X-ray crystallographic studies. The same techniques are now being used to study the structural aspects of cellulose mercerization, an important commercial process in cellulose chemistry. Other recent research has been concerned with the organization, chemical composition, and function of the vascular cambium in trees, the ultimate source of all wood and bark produced in nature.

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

The Northeast Forest Experiment Station of the U.S. Department of Agriculture-Forest Service maintains a research center at the College. Until 1977, this unit pursued studies of forest-centered recreation with the aim of developing methods for integrating recreation and other uses of forests.

Beginning in 1978, the Cooperative Research Unit was re-oriented to research on urban environmental forestry problems. This provides increased opportunities for faculty and students to collaborate with Forest Service scientists in studies of urban and environmental problems.

PUBLIC SERVICE

The College, throughout its 75-year history, has continued to respond to its specific legislative mission prescribing major responsibilities in the area of public service. Public education and information, technical advice and guidance to cooperating local, state, and federal agencies and organizations, and technical assistance to the forest and wood-using industries constitute the principal formal public service activities. The Institute of Environmental Program Affairs (described in the Research section) coordinates the College's public service activities on the professional level.

While the list of public service contributions is lengthy, a few examples include: the College's Film Library; the Tree Pest and Disease Service, which provides technical advice to private citizens and to governmental agencies; and the participation of ESF faculty members in Central New York's Poison Control Center. Altogether, the public service programs of the College reach approximately one million New York State residents each year.

The Campuses

The College operates a multiple campus system with regional campuses and field stations located at Syracuse, Tully, Wanakena, Warrensburg, Cranberry Lake, Newcomb, and Clayton. This system, composed of about one million square feet of facilities in 186 buildings on 25,000 acres of land, represents the largest fully-utilized campus in the world.

THE SYRACUSE CAMPUS

The main campus is in Syracuse and lies on 12 acres adjacent to Syracuse University in an area that traditionally has been known as "The Hill." Located here are the Schools of Biology, Chemistry and Ecology; Environmental an Resource Engineering; Forestry; Landscape Architecture; and Continuing Education. In addition, the main campus houses the Institute of Environmental Program Affairs, the Empire State Paper Research Institute, the Polymer Research Institute, a cooperative research unit of the USDA Forest Service, the Ultrastructure Center, the Graduate Program in Environmental Science, and the Renewable Materials Institute.

These program units are housed in five major academic buildings (Baker Laboratory, and Walters, Bray, Marshall, and Illick Halls). The main campus also includes Moon Memorial Library, the Maintenance Building, and several other small service and storage facilities.

Specialized facilities at the Syracuse campus include electron microscopes, plant growth chambers, air-conditioned greenhouses, a bio-acoustical laboratory, a 1,000-curie cobalt-60 radiation source, radioisotope laboratory, computing center, and specialized instrumentation including nuclear magnetic resonance spectrometers, electron spin resonance spectrometer, gas chromotography, mass spectrometer, ultracentrifuge, and X-ray and infrared spectrophotometer. Photogrammetric and geodetic facilities of the forest engineering department include one of the most extensive arrays of equipment in the United States, with a Nistri TA-3 stereocomparator, Mann comparator, computerized Nistri photocartograph, and nine other varieties of plotters. The paper science and engineering laboratory has a semicommercial paper mill with accessory equipment. The wood products engineering department has a complete strength-of-materials laboratory as well as a pilot scale plywood laboratory and a machining laboratory. The greenhouses and forest insectary are used to produce plant and insect material for classroom and laboratory. Extensive collections are available for study, including wood samples from all over the world, botanical materials, insects, birds, mammals, and fishes.

The **F. Franklin Moon Library** and **Learning Resources Center** contains more than 90,000 cataloged items and over 900 journals are currently received. The collection constitutes a specialized information source for the forestry, environmental science, and landscape architecture programs of the college, and it 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 and engineering, photogrammetry, silviculture soil science, water resources, world forestry, wildlife biology, wood products engineering, and zoology.

The collections of Syracuse University libraries (SU's Science and Technology Library is immediately adjacent to the ESF campus), and SUNY Health Science Center at Syracuse are within walking distance. These libraries may be used by all members of the College of Environmental Science and Forestry. Other collections located throughout New York State and the United States are readily accessible through Inter-library loan. All Syracuse University collections may be searched by using the SULIRS on-line catalog located in Moon Library.

The library building, opened for service in 1968, can accommodate 132,000 volumes and can seat 575 persons. The main reading areas are located on the upper level adjacent to the open stacks and are divided by the card catalog and reference service area. The library contains a current periodical room, a bibliographic center containing indexes and abstracts, individual study carrels an library faculty offices, the Hoverter Archives and special collections, conference room, audio tutorial center, Directed Studies Center and computer terminal room are located on the lower level.

The archives consists of historical items relevant to the college and forestry development in New York State. The special collections area of the archives contains rare, scarce, and valuable books, and folios as well as the Fletcher Steele collection on landscape architecture, and the Thomas Cook collection on papermaking.

Public services provided by the library faculty includes a credit course, orientation, class lectures, study guides, user aids, and reference desk service. Moon Library is a member of the SUNY OCLC network.

The **Educational Communications** unit of the **Learning Resources Center** directly supports the pro-

gram areas of the College through instructional development and application of media materials and instruction for the classroom, for the presentation of research findings, and for public service endeavors. These include television programming, slide/tape and motion picture production and photographic services. Other services to the College community include engineering, audio-visual equipment distribution, and maintenance and support functions. The Educational Communications staff also participates directly and actively in instructional programs in environmental communication at both the undergraduate and graduate levels.

The College provides *academic computer services* in several forms. Remote communication facilities are available for both batch and interactive processing on the Syracuse University systems, and local/stand-alone facilities are available in the form of micro-computers dispersed about the ESF campus. Syracuse University operates an academic computer center consisting of two IBM 4341's and one DEC-KL10, all of which are accessible via terminals (20 public access and 60 restricted access) on the ESF campus. Clusters of micro-computers have been established by each of the academic divisions of ESF for purposes of faculty-staff-student use and education. Computer applications take advantage of extensive software on the Syracuse University systems including packages for statistics, graphics text editing, and general mathematical functions as well as most of the major programming languages—FORTRAN, APL, BASIC and PASCAL finding the heaviest usage. In addition, a color graphics facility is being developed at ESF to satisfy the many needs for graphics analysis, design, and communication.

THE TULLY CAMPUS

Located about 25 miles south of Syracuse is the Tully Campus which is composed of the Heiberg Memorial Forest and the Genetic Field Station.

Heiberg Memorial Forest is located on the northern escarpment of the Allegheny Plateau. It includes 3,800 acres of diverse terrain and forest growth. The Forest is utilized both as an extensive outdoor teaching laboratory and as a site for intensive research. The **Forest Ecosystem Lab,** which is highly instrumented outdoor teaching laboratory, a large complex of all-weather classrooms, many experimental plantings from throughout the world, and a commercial-scale maple syrup operation are among the developments on this forest. Each fall the Heiberg Memorial Forest is the site of an intensive program for environmental and resource management students in a total ecosystem approach to forest community management instruction.

THE WANAKENA CAMPUS

The Wanakena Campus, located on the Oswegatchie River, 65 miles northeast of Watertown and 35 miles west of Tupper Lake, is the site of the **James F. Dubuar Forest** and the **School of Forestry's Forest Technician Program.** This campus, with its large instructional and demonstration forest of 2,800 acres, supports the College's associate degree program for the training of forest technicians. This is the oldest forest technician school in the country. This campus is situated on the western plateau of the "lakes region" of the Adirondacks.

In addition to its full academic program, this campus hosts various summer short courses in forest biology and forest technology.

THE WARRENSBURG CAMPUS

The Warrensburg Campus is located in the southeastern Adirondack region and encompasses the **Charles Lathrop Pack Demonstration Forest,** an area of roughly 2,800 acres of heavily forested land noted for its white pine. The Forest has been under intensive management since 1927 for the combined purpose of instruction, research, and demonstration in forestry and allied fields.

Each year this campus hosts the Summer Session in Field Forestry, a seven-week course devoted to introductory instruction in field forestry principles and techniques. The course is required of all entering students in Environmental and Resource Management and is open to election by students in Environmental and Forest Biology.

Formal offerings in Continuing Education and various meetings and conferences are also held here for practicing professionals and organizations directly associated with forestry and allied environmental fields.

THE CRANBERRY LAKE CAMPUS

The Cranberry Lake Campus, approximately 1,000 acres of forested property situated in the northwestern section of the Adirondack Mountains of northern New York State, is the site of the College's **Biological Station** where the College operates an eight-week summer field program in environmental biology. The campus is bounded by 150,000 acres of New York State forest preserve lands, by Cranberry Lake and by isolated forest bogs and beaver meadows.

The extensive facilities are intensely utilized in a comprehensive curriculum of upper-level and graduate courses.

Use of this campus before and after the summer session program varies to include individual research projects, cooperative studies with other agencies and visits by large groups from both the College and outside institutions.

THE NEWCOMB CAMPUS

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

Adirondack Ecological Center where extensive studies of animal biology and ecology are carried out. Also located there is **The Archer and Anna Huntington Wildlife Forest** which is about 15,000 acres in size.

This campus is of mountainous terrain and contains a variety of vegetative types and wildlife. The campus is used year round for a general research and forest management program participated in by faculty, graduate students, and visiting scientists.

FIELD STATIONS

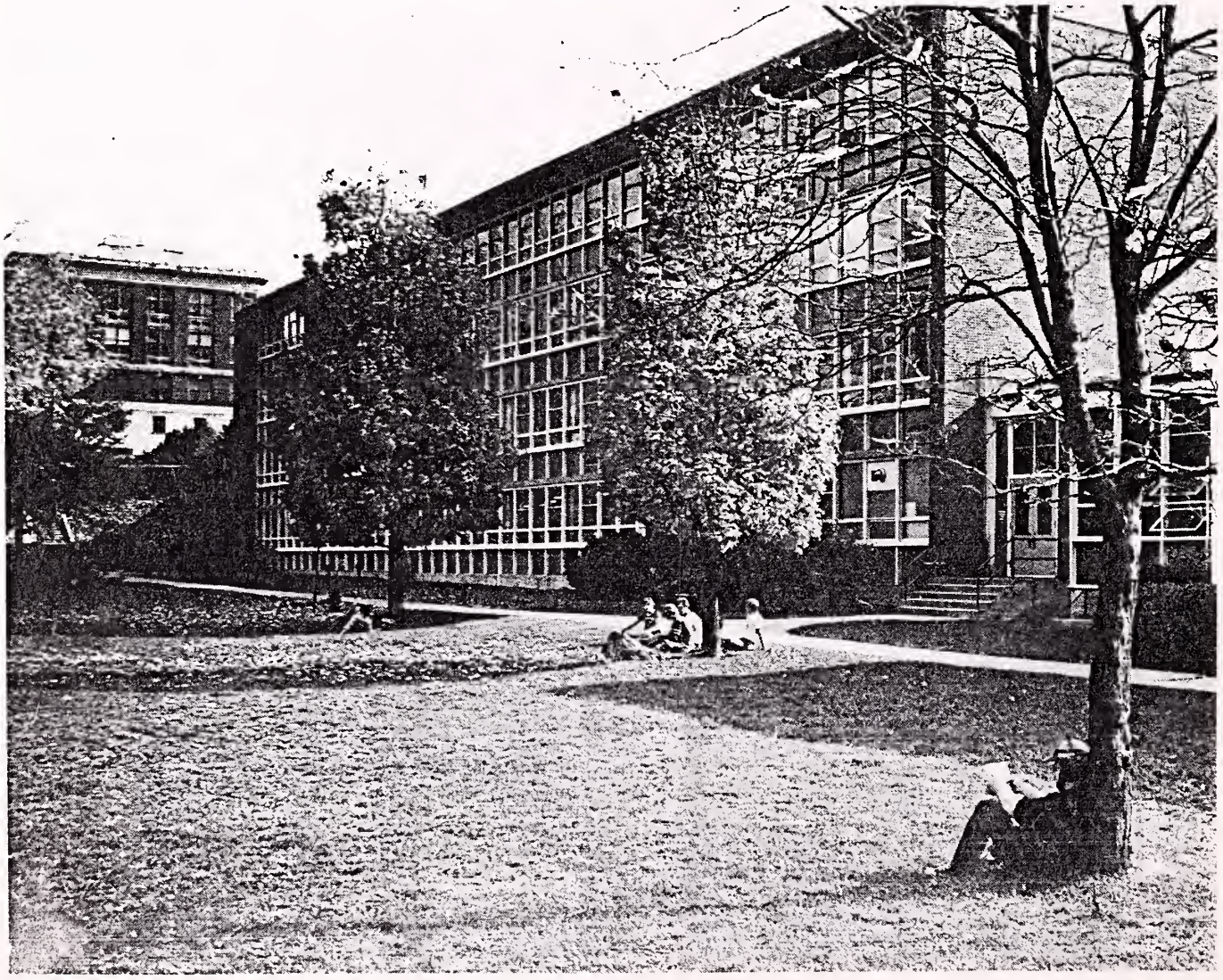
In addition to its regional campus system, the College operates several field stations which directly support the instruction, research, and public service programs of the institution. The 44-acre **Forest Experiment Station,** located only a few minutes' drive from the main campus in Syracuse, is used to support main campus academic programs. Located at the Station are a large arboretum, tree nursery, and experimental greenhouse facility. Adjacent to the Tully Campus is the College's **Genetic Field Station.** It is a 59-acre area devoted to relatively short-term outplantings of plant materials developed in the various genetic research projects of the College. With its irrigation system and layout of level blocks, it is an excellent facility for developing hybrids, for grafting, doing experiments, and for research in heritability. A magnificent island, the **Ellis International Laboratory,** is situated in the heart of the Thousand Islands-St. Lawrence River area off the village of Clayton. Accessible only by boat, this laboratory is an unusually appropriate site for the Collegewide, cooperative and international, environmental monitoring and research activities of the St. Lawrence Seaway area. The College's most recent acquisition is a 15.2-acre facility on **Wellesley Island.** This island property, formerly a Coast Guard Station, has shore frontage on the American channel of the St. Lawrence Seaway. It is ideally suited for aquatic studies of many types.

The Syracuse Metropolitan Area

The College of Environmental Science and Forestry is located on one of several hills that overlook Syracuse, a growing metropolitan area of nearly 500,000. Known as the "Salt City" because of the great salt industry which was centered here for more than seventy years, Syracuse is today a city of diversified industry and commerce. The area is a leader in the manufacture of china, air conditioning equipment, medical diagnostic equipment, drugs, automotive parts, and lighting equipment.

The City of Syracuse offers students many cultural, recreational, and educational opportunities, including a symphony orchestra, several museums, live theater, and historical points of interest.

Called the "Crossroads of New York State," Syracuse is one of the few cities in the nation situated at the crossing point of two major superhighways. It is located at the intersection of the 500-mile east-west New York State Thruway and the north-south Penn-Can Highway. Driving time from New York City, Philadelphia, Boston, Toronto, and Montreal is about five hours; from Buffalo and Albany about three hours. The city is served also by a modern international airport and major bus and rail lines.



Academic Life

Society is increasingly in the hands of those who have broad foresight and a balance of judgment in applying scientific, sociological, and technical knowledge to guide human and environmental forces. Modern civilization—with its compelling demands from industry, government, and educational institutions—requires people who think objectively and constructively, and who act creatively and responsibly.

From its beginnings in 1911, the State University of New York College of Environmental Science and Forestry has served New York State and the nation in meeting the needs of its citizens in regard to the environment through education, research, and public service. The faculty and students of the institution are committed to the resolution of immediate environmental problems, the development of the knowledge necessary to predict occurrences in the future, and the presentation of public policy alternatives that will both protect the environment and accommodate the real needs of society.

At the undergraduate level, ESF offers curricula in the general areas of resource management, engineering, environmental design, and the physical and life sciences that prepare graduates to enter and contribute to the professional world or to continuing their education at the graduate level, at ESF or elsewhere.

Graduate years are a time of discovery and excitement, a time of answers and new insights, a time of personal productivity and contributions to scholarship. It is during graduate education that the student sharpens the ability to think critically and analytically, to plan research to design experiments, to work effectively with the basic research tools as well as specialized equipment, and to undertake the discipline of purposeful study toward a specific goal.

The College currently supports significant graduate degree programs in six discipline areas and in its broad program in Environmental Science, which encourages multidisciplinary study. Both undergraduate and graduate programs of the College reflect the work of its faculty and their student colleagues, who, together, utilizing some of the most modern facilities and laboratories in the country, maintain a long-standing tradition of academic and professional excellence.

This catalog provides an introduction to the College and its programs of undergraduate and graduate study and research. It only begins to suggest the diversity and depth of the existing and potential programs that make environmental science and challenge of the 1980's and beyond.

UNDERGRADUATE ADMISSION

The College of Environmental Science and Forestry is an upper division/graduate center, enrolling at the undergraduate level transfer students who have completed some postsecondary coursework. Outstanding high school seniors can assure their acceptance by the College as transfer students by applying to the Advanced Early Admission program.

Freshman and sophomore level courses may be taken at any two- or four-year college or university; all students considering transfer to ESF should follow the prescribed program appropriate to their intended major at the College. Each curriculum offered at the College of Environmental Science and Forestry and listed in this catalog defines the required lower division courses necessary for admission. These requirements are listed in the Areas of Study section of the catalog.

Students who are certain they intend to transfer to ESF may enroll in established pre-environmental science programs organized by the College in cooperation with a number of two- and four-year colleges in and out of New York State. Students who attend these colleges will find a smooth articulation has been established and upon successful completion of these prerequisites will generally gain admission to the college. It is not required to specifically attend one of these colleges; a student may obtain the necessary lower division courses at almost any college or university in the country.

Application to ESF's associate degree program in Forest Technology at the Wanakena Campus must be made one year in advance. Therefore, high school students desiring to attend the Wanakena program in 1988 must apply this year. For further information on ESF's Faculty of Forestry's Forest Technology Program, see page 53, or contact the Office of Admissions.

ADVANCED EARLY ADMISSION PROGRAM

High school students who are strongly motivated toward attending ESF may apply to the College of Environmental Science and Forestry during their senior year under the *Advanced Early Admission Program*.

Those seniors whose academic background is successfully competitive will receive a letter of acceptance to the College for entrance after some postsecondary coursework is completed. Contained in a student letter of acceptance will be a list of prerequisite courses necessary to transfer to ESF.

This early acceptance will alleviate much of the anxiety about admissibility. High school seniors will know prior to graduation if they have been accepted to the College. It affords those accepted students the opportunity to attend any college of their choice that offers the appropriate lower division courses. SUNY applications for the Advanced Early Admission Program may be obtained from high school guidance offices in New York State or directly from the Office of Admissions at ESF.

TRANSFER ADMISSIONS

For those students not accepted under the Advanced Early Admission Program, admission to the College of Environmental Science and Forestry is based on the student's previous college coursework, overall academic aptitude, and interest in the programs offered at this College. Consideration is given to both the quality and appropriateness of the student's prior academic experience. The minimum grade point average for consideration is 2.000 (4.000=A).

PRE-ESF COOPERATIVE TRANSFER PROGRAMS

The College, working in cooperation with other collegiate institutions, both in and out of New York State, has developed 55 pre-environmental science and forestry programs. The development of these programs illustrates that high school students can look forward to a wide selection of colleges in which they can obtain the necessary lower division courses and appropriate advisement to transfer to ESF.

These colleges represents the total spectrum of higher education (private, public, 4-year, 2-year) and are located in New York, Connecticut, Massachusetts, New Jersey, Pennsylvania, Rhode Island, Iowa, and Maryland. Students who attend these colleges will find a smooth articulation has been established and once they transfer to ESF will share a common academic background with other transfer students.

Currently, the list of cooperative colleges includes:

New York State Colleges

Adirondack Community College, Glens Falls
Broome Community College, Binghamton
Canisius College, Buffalo
Cayuga County Community College, Auburn
Columbia-Greene Community College, Hudson
Community College of Finger Lakes, Canandaigua
Corning Community College, Corning
Dutchess Community College, Poughkeepsie
Erie Community College, Buffalo
Herbert H. Lehman College, Bronx
Herkimer Community College, Herkimer
Hudson Valley Community College, Troy
Jamestown Community College, Jamestown
Jefferson Community College, Watertown
LeMoyne College, Syracuse
Mohawk Valley Community College, Utica
Monroe Community College, Rochester
Nassau Community College, Garden City
Niagara County Community College, Sanborn
North Country Community College, Saranac Lake
Onondaga Community College, Syracuse
Orange Community College, Middletown
Paul Smiths College, Paul Smiths
Rockland Community College, Suffern
Siena College, Loudonville
Suffolk County Community College, Selden
Sullivan County Community College, Loch Sheldrake
SUNY Alfred Agricultural and Technical College, Alfred
SUNY Canton Agricultural and Technical College, Canton
SUNY Cobleskill Agricultural and Technical College, Cobleskill
SUNY College at Cortland, Cortland
SUNY Delhi Agricultural and Technical College, Delhi
SUNY College at Geneseo, Geneseo
SUNY Morrisville Agricultural and Technical College, Morrisville
SUNY College at New Paltz, New Paltz
SUNY College at Oneonta, Oneonta
SUNY College at Oswego, Oswego
Syracuse University, Syracuse
Tompkins Cortland Community College, Dryden
Ulster County Community College, Stone Ridge
Westchester Community College, Valhalla

Out-of-State Colleges

Allegany Community College, Cumbeland, MD
Berkshire Community College, Pittsfield, MA
Camden County College, Blackwood, NJ
Garrett Community College, McHenry, MD
Holyoke Community College, Holyoke, MA
Housatonic Community College, Bridgeport, CT
Keystone Junior College, LaPlume, PA
Kirkwood Community College, Cedar Rapids, IA
Middlesex Community College, Edison, NJ
Montgomery Community College, Rockville, MD
Morningside College, Sioux City, IA
Ocean County College, Toms River, NJ
Roger Williams College, Bristol, RI
Union College, Cranford, NJ

ADMISSION POLICY

Criteria for Admissions

Admission to the College of Environmental Science and Forestry as a transfer student is based on the student's previous college coursework, overall academic aptitude, and interest in the progams offered at ESF. Consideration is given to both the quality and appropriateness of the student's prior academic experience. The *General Catalog* provides detailed lower-division course requirements. The minimum *cumulative* grade point average for consideration for admission is 2.000 (4.000 = A).

ESF also provides an advanced early admission opportunity for high school seniors which ensures admission to the College when the student completes the appropriate lower-division college coursework with a minimum cumulative grade point average of 2.000. Admission to this program is based on high school average, the completion of at least three units of high school mathematics and three in science, and the results of the SAT or ACT examinations.

Transfer Credit

Courses transferred for credit must be appropriate to the student's curriculum choice. Credit will be awarded for *appropriate* courses completed with a passing grade of "D" or better.

Furthermore, courses to be transferred as required courses in a curriculum must be acceptable in content. Course credit hours are transferred, but grades and grade points are not.

All transfer credit will be tentative until all official, final transcripts are received. It is the student's responsibility to see that this is done.

International Students

ESF accepts international students on the undergraduate level, if they satisfy all regular admission requirements. International students applying for admission must satisfy all of the course prerequisites for their intended major. In addition, they must:

1. Demonstrate proficiency in the English language through acceptable performance on the Test of English as a Foreign Language (TOEFL) *(usually 550 or better)* or the College Entrance Board (CEEB) Achievement Test in English *(usually 550 or better) or by completing the first two years of college at an institution where the courses were taught in English;* and
2. Produce evidence of their ability to meet all their financial obligations.

Undergraduate international students must file official State University of New York foreign student admission forms. No fee is required for processing these forms. After acceptance, health and accident insurance must be obtained before the student will be allowed to register at ESF.

International students who are currently enrolled at an American college may apply for transfer to ESF. *In addition to the entrance requirements for other international students, they must also obtain permission* from the U.S. Immigration and Naturalization Service district office having jurisdiction over the college in which the student is currently enrolled.

COLLEGE PROFICIENCY EXAMINATIONS

The College recognizes that an increasing number of students are obtaining college-level credit through examination and/or completion of College credit while in high school. The College's policy on this, and other forms of nontraditional credit, is to grant the same amount of credit in parallel courses as the student's previous collegiate institution granted. It becomes the student's responsibility to be sure that *all* earned credits are on the previous college transcript and clearly identified by academic discipline.

EDUCATIONAL OPPORTUNITY PROGRAM

The basic goal of the Educational Opportunity Program at the College is to provide qualified students with a college education—the opportunity for personal growth and professional development. Upon completion of the program, graduates will be provided access to jobs in professional fields. The program is not designed for students who need only financial assistance. It serves students who ordinarily would not be able to attend college because of a lack of financial resources and insufficient academic preparation. To qualify, students must be New York State residents and demonstrate the potential to successfully complete the courses of study at the College.

Counseling, financial assistance and tutoring are provided on an individual basis. In order for students to be on the EOP program at ESF, they must have been an EOP student at their prior institution. Therefore, students who are applying to ESF as high school seniors (via Advanced Early Admission), should also apply for EOP at the lower division college.

Further information regarding the Educational Opportunity Program may be obtained by contacting the EOP Director.

HEALTH EXAMINATION BOARD

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

GRADUATE ADMISSION

Admission to graduate study may be granted only to applicants with at least a bachelor's degree from a recognized institution and whose preparation has been suitable in quality and content for the proposed field of major study. Applicants will be evaluated on the basis of the following: (1) their academic record should show at least a B or 80 percent average for the junior and senior years; (2) Graduate Record Examination aptitude scores, and, in some cases, subject matter (advanced) tests indicative of graduate study ability (see below); (3) supporting letters of recommendation; (4) a statement of specific educational and professional goals which describes the choice of degree program and the students' plan for the pursuit of the objectives in the program; and (5) other evidence of scholarly achievement and potential. Admission is selective with priority given to applicants who have high scholastic standing.

ADVANCED TESTS

Subject matter (advanced) test scores are required by the following programs:

Graduate Programs	*Advanced Test*
Chemistry	Chemistry
Environmental and Forest Biology	Biology

PROCEDURE

All applicants are required to submit Graduate Record Examination aptitude scores. This examination is offered several times each year in major cities of the world. For information on registration and scheduling write to the Educational Testing Service, Princeton, New Jersey 08540. Test scores should be sent to the Office of Academic Programs (Institutional number R2530).

The College provides a special application form for graduate work. Requests for information and applications should be addressed to the Office of Instruction and Graduate Studies.

EXPENSES

APPLICATION FEE

When a student applies for admission to an undergraduate program at any of the State University of New York units, a nonrefundable application fee is required. More information about fee and guidelines for exemptions is provided in the "Application Guidebook" for the State University of New York. There is a $35 application fee for those applying for graduate study.

ADVANCED PAYMENT DEPOSIT

All admitted undergraduate students pay a deposit of up to $100 which is credited to the students' first semester tuition. The students will be notified at the time of acceptance of the amount and when the deposit is due, as well as the refund guidelines for this deposit. There is no advance payment deposit required for those accepted for graduate study.

TUITION AND COLLEGE FEE (Effective Fall 1986)

The Tuition and College Fee structure of the College is set by the Board of Trustees, State University of New York, and covers usage of library, infirmary, physical education facilities, ROTC, special testing, charges for expandable supplies, and other College services.

The current tuition schedule per semester is:

Tuition Type	NYS Resident Students	Out-of-State Students
Undergraduate Matriculated		
Full-Time	$ 675.00	$1,600.00
Part-Time	$ 45.00/credit hour	$ 107.00/credit hour
Graduate Matriculated		
Full-Time	$1,075.00	$1,867.50
Part-Time	$ 90.00/credit hour	$ 156.00/credit hour
Continuing Education—Non-Degree		
Students who do not hold a Baccalaureate Degree		
Course Nos. 0-599	$ 45.00/credit hour	$ 107.00/credit hour
Course Nos. 600-999	$ 90.00/credit hour	$ 156.00/credit hour
Students who do not hold a Baccalaureate Degree		
Course Nos. 0-499	$ 45.00/credit hour	$ 107.00/credit hour
Course Nos. 500-999	$ 90.00/credit hour	$ 156.00/credit hour
Maximum Total Tuition for 12 credit hours or more	$1,075.00	$1,867.50

The College Fee is $12.50 per semester for full-time students and $.85 per credit hour for part-time students.

RESIDENCY

'Residence' for purposes of this (tuition payment) question refers to the principal or permanent home to which the student returns. If the principal or permanent home has not been located in New York State for a twelve-month period prior to the date of registration for the academic term for which this application is made, the student will be presumed to be an Out-of-State resident for purposes of tuition.

STUDENT ACTIVITY FEES

In addition to tuition, the student body has voted to assess each full-time undergraduate student $38 per year to cover the cost of student activities. Full-time, non-matriculated students are charged a fee of $19 per semester, and part-time matriculated students $1.50 per credit hour. Full-time graduate students likewise have a mandatory activity fee of $20. ESF students also pay an activity fee to Syracuse University to cover SU-sponsored activities and services available to ESF students, not duplicated by College organizations. These fees are $26.75 for full-time undergraduate and $15 for full-time graduate students. Part-time matriculated students are charged $17.50 per year payable at fall registration; part-time matriculated graduate students are charged $10 per year.

COMMENCEMENT FEE

A commencement fee of $15 is required at the beginning of the semester in which the degree is expected. Additional costs are incurred by graduate students for the binding, abstracting, and microfilming of theses.

TERMS OF PAYMENT

The College sends each student expected to register for the upcoming semester, at their permanent address, a detailed invoice indicating amounts due six weeks prior to the start of the semester. This invoice includes *only* ESF charges. See below Housing and Board Costs at Syracuse University. Payment is encouraged prior to the one-day-scheduled registration period and *MUST* be made prior to the first day of classes. Detailed instructions are included with the invoice. The College participates in the ARS payment plan.

HOUSING AND BOARD COSTS

ESF does not operate student residences or dining halls. These facilities are offered by Syracuse University. Specific information about available housing and board plans is available from the Office of Residence and Dining Services, Syracuse University, Syracuse, New York 13210.

In general, housing costs at SU range from $1,920 to $2,500 for an academic year, reflecting the diversity of available accommodations for graduate or undergraduate, single or married students. Most dormitory rooms accommodate two students and are furnished with beds, mattresses, desks, chairs, study lamps and dressers. A commercial linen service is available to those who order it. Separate dormitories are maintained for graduate students.

Furnished and unfurnished apartments are also available for both single and married students. These are located in a housing complex approximately two miles from the main campus, and are regularly serviced by a free shuttle-bus.

A variety of options on board offerings are available for all students, whether or not they reside in University dormitories. Costs range from $1,060 to $1,990 for an academic year.

In addition, a wide variety of living arrangements in private homes and apartment complexes is available in the Syracuse metropolitan area.

Payment for housing and board is made directly to Syracuse University.

OTHER COSTS

Students majoring in resource management attend a seven-week Summer Session in Field Forestry at the Warrensburg Campus between the sophomore and junior years. Forest biology majors have the option of attending this session or the Summer Session in Environmental Biology at the Cranberry Lake Biological Station at the end of the junior year. Cost for the Warrensburg session is approximately $800 and $650 for the four-week program at Cranberry Lake, plus travel and personal expenses.

An extended field trip of up to two weeks at the end of the junior year costs approximately $250 for Wood Products Engineering students.

Field trips for Landscape Architecture students range between $125 and $150. In addition, students enrolled in the five-year Landscape Architecture program are required to spend one semester off campus. **This is a self-described 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.**

The cost of books and supplies is approximately $300 a year. Additional costs for personal expenses, recreation, clothes and travel depend on the individual, and they may range from $600 to $800 a year.

REFUNDS

The following policies apply to tuition liability and refunds for students canceling their registration.

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%

Application for refund must be made within one year after the end of term for which the tuition was paid to State University. The first day of class session is considered the first day of the semester, and Saturday of the week in which this first session occurs is considered the end of the first week for refund purposes. It is interpreted that a student who does not attend any class sessions after Saturday of the first week and who notifies the College of his intent to cancel registration on or before the second Saturday following the first day of classes will be considered to have canceled his registration during the first week.

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

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

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

Notwithstanding any other provisions for refund, when a student has withdrawn through circumstances beyond the student's control, under conditions in which the denial of refund would cause undue hardship, the Chief Administrative Officer of the unit may, at his discretion, determine that no liability for tuition has been incurred by the student, provided the student has not completed more than one half of the term and has not received or will not receive academic credit for the term. Such action, including the reason for withdrawal, must be in writing.

FINANCIAL ASSISTANCE

The College of Environmental Science and Forestry offers five basic forms of student financial assistance: scholarships or grants, part-time employment, long-term loans, assistantships for graduate students, and a deferred tuition payment plan. Federal and state financial aid programs are for U.S. citizens, permanent residents, or holders of I-151 cards. These 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 *Financial Assistance at ESF*, a separate publication which is mailed to all applicants, and is available to the public by contacting the Office of Financial Aid.

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 student problems. All students are encouraged to apply for financial aid.

HOW TO APPLY

Each year students interested in receiving financial assistance, *except for graduate assistantships*, must complete the application process. (Graduate students who wish to be considered for a graduate assistantship refer to page 25, and follow those instructions.) *Two forms are necessary to apply:*

1. The candidate must complete a College Aid Application and Financial Aid Transcript and return it to the Office of Financial Aid by the following dates: February 15 for early consideration; March 15 for regular consideration. The application is included in the publication, *Financial Assistance at ESF*. Applications will be accepted after March 15; it should be noted, however, that available funds may already be committed to other students. Applicants need not wait for notification of acceptance to the College before applying for financial aid.

2. The candidate must also complete and submit after January 1 the Family Financial Statement (FFS) to the American College Testing Co., Iowa City, Iowa. The FFS is available in the College's Office of Financial Aid, high school guidance offices, and most college financial aid offices.

Students are invited to discuss with the professionals in the Financial Aid Office any problems in financing their education.

This application information is based on current requirements, and financial aid systems and forms are undergoing constant change. Applicants are urged to contact the Office of Financial Aid for the latest information and requirements.

SELECTION OF RECIPIENTS

In making award decisions, consideration is given primarily to comparative financial need; however, scholastic standing, character, and potential contribution to the College community are also factors in making certain awards.

VERIFICATION OF INFORMATION

All students who request financial assistance will be required to submit information on their family's financial situation prior to aid disbursement. The College will normally request copies of parents' and students' federal tax forms, along with other statements which verify other sources of income, family size, number in college, etc.

Failure to comply with a request to verify information will result in a cancellation of any aid offered and the potential of legal action by the U.S. Department of Education.

Standard of Satisfactory Academic Progress for Purpose of Determining Eligibility for State Student Aid
All Campuses—State University of New York

Calendar: Semester — Programs: Associate Degrees and Certificate Programs

Before being certified for this payment,	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
a student must have accrued at least this many credits,	0	3	9	18	30	45	60	75
with at least this grade point average.	.000	.500	.750	1.300	1.500	1.700	2.000	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.

Calendar: Semester — Program: Baccalaureate Degree

Before being certified for this payment,										
a student must have accrued at least this many credits,	0	3	9	18	30	45	60	75	90	105
with at least this grade point average	.000	.500	.750	1.200	1.400	1.500	1.600	1.700	1.800	1.900

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.

Calendar: Semester — Programs: All Graduate Level Programs except Professional

Before being certified for this payment,	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
a student must have accrued at least this many credits,	0	6	12	21	30	45	60	75
with at least this grade point average.	.000	2.000	2.500	2.750	3.000	3.000	3.000	3.000

Retention of Awards—State

All students who are awarded financial assistance will be required to maintain satisfactory academic progress each semester in order to keep their awards. Satisfactory academic progress for all programs, *except* New York State (TAP, Regents, etc.), is defined on page 23 of this catalog.

Recipients of a New York State award must adhere to the following State requirements:

(1) Academic Progress—A student will need to read the stated minimums on the following charts to be eligible for the next semester award.

(2) Program Pursuit—Students must complete a minimum number of semester hours each semester. *A.A.S. Degree students* are required to complete 75 percent of the full-time load. Full-time is defined as 12 credit hours. Therefore, .75×12=9. Nine credit hours must be completed each semester.

Calendar: Academic Year — Program: Associate Degree

Academic years completed at ESF	2	3
A student must have successfully completed this number of credit hours	45	76
with at least this cumulative grade point average	2.000	2.000

Calendar: Academic Year — Program: Baccalaureate Degree

Academic years completed at ESF	3	4	5	6
A student must have successfully completed this number of credit hours	70	100	130	160
with at least this cumulative grade point average	2.000	2.000	2.000	2.000

Calendar: Academic Year — Program: All Master Level Programs

Academic year completed at ESF	1	2	3
A student must have successfully completed this number of credit hours	15	27	42
with at least this cumulative grade point average	3.000	3.000	3.000

Calendar: Academic Year — Program: All Ph.D. Level Programs

Academic year completed at ESF	1	2	3	4	5	6	7
A student must have successfully completed this number of credit hours	15	27	42	54	66	75	90
with at least this cumulative grade point average	3.000	3.000	3.000	3.000	3.000	3.000	3.000

Bachelor, Master, and Ph.D. students must complete 100 percent of full-time load each term. Full-time is 12 credit hours. Therefore, students must register for and complete at least a minimum of 12 credit hours each term.

Waivers

Should a student fall below the requirement, he/she may apply for a waiver. Students are allowed *only one* waiver during undergraduate work and *only one* during graduate work. The issuance of the waiver will be granted only after the student and the institutional waiver designee have mutually concurred that such issuance is in the best interest of the student. Request for a waiver is made through the Director of Financial Aid.

Retention of Awards—Title IV

In order for students to be eligible for Title IV Federal Student Assistance (Pell Grants, Supplemental Educational Opportunity Grant, National Direct Student Loan, Guaranteed Student Loan, College Work-Study Program, PLUS), both undergraduate and graduate students must meet specified criteria.

The criteria that students must meet to be eligible for Title IV student aid is the same criteria *all ESF* students must adhere to with regards to institutional academic policies, and specifically academic progress towards their degree. The evaluation criteria are:

(1) Appropriate grade point average for satisfactory academic progress.
(2) Successfully accumulate credits towards their degree.
(3) Obtain their degree within the prescribed degree time limit. Time limits vary for individual programs and are illustrated on the adjacent charts.

Appeal/Probation/Reinstatement

Students who fall beneath the minimum standards may appeal through the College Academic Affairs Committee to retain their eligibility for receipt of Title IV Federal Student Assistance. (See Academic Dismissal p. 27.)

These appeals should be evaluated for mitigating circumstances such as injury, illness, etc., and the reasonableness of the student's ability to move back up to the appropriate standard. If the College Academic Affairs Committee places a student on "academic probation," the student is still eligible for Title IV aid as defined by the statement of "Good Academic Standing" (p. 25).

Notification

Students will be notified via certified mail of their individual circumstances if they fall below the standards, appeal loss of eligibility, or reinstatement of eligibility.

SCHOLARSHIP AND GRANT PROGRAMS

Supplemental Educational Opportunity Grants (SEOG)

The College is the recipient of funds authorized under Title IV-A of the Higher Education Act of 1965, as amended. These funds enable the College to award grants to undergraduate students who have financial need. Grants range from $200 to $2,000 per year.

ESF Educational Opportunity Grant Program (EOP)

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

Prospective Educational Opportunity Program students must apply for financial aid when submitting their admissions applications.

Pell Grants (Formerly Basic Educational Opportunity Grants)

The Pell (BEOG) Program was authorized in the Educational Amendments of 1972. Grants are available to eligible full-time and half-time undergraduate students. The amount of the award can vary from $250 to $2,100.

Applications are available from high school guidance offices or any college office of financial aid. Students should submit the Student Aid Report (SAR) to the Office of Financial Aid as soon as it is received from the processor.

Regents Programs

Additional information and applications for the following programs are available from the College or:

New York Higher Education Services Corporation
Tower Building
Empire State Plaza
Albany, New York 12255

REGENTS COLLEGE SCHOLARSHIPS

High school students who are New York State residents may qualify for a $250 annual scholarship by taking a competitive exam during their senior year.

TUITION ASSISTANCE PROGRAM

These awards are available to New York State residents who are enrolled in full-time degree programs. Based on income, awards range from $300 to full tuition. Separate application is necessary.

REGENTS GRANTS OR CHILDREN OF DECEASED OR DISABLED VETERANS

These 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 dis-

ability of at least 50 percent. The award entitles a New York State resident to $450 per year.

Vocational Rehabilitation Grants

Financial assistance and program counseling are provided by New York State for students with disabling handicaps. Information is available from any Office of Vocational Rehabilitation.

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.

Additional information and counseling are available from the Veterans' Affairs Counselor at the College Local veterans' administrations offices, or the State Regional Office, 111 West Huron Street, Buffalo, New York 14202, can provide information and application forms.

Social Security Benefits

The 1965 amendments to the Social Security Act extended the age limit for a child's benefits from 18 to 22, providing the child is a full-time student. Local Social Security offices have additional information. These benefits are slated to expire in 1985.

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 about the programs, 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, New York 12234.

Private Fellowships, Scholarships, and Grants

The College administers a number of programs which have been established by private individuals, companies, organizations and foundations. These scholarships and grant programs have varying eligibility requirements and are awarded to students according to their respective guidelines which are described in more detail in *Financial Assistance at ESF.* The following is a list of the programs: Alumni Memorial Awards; Alumni Educational Grants; Nelson Courtlandt Brown Scholarship Fund; Henry H. Buckley Student Aid Award; Simeon H. Bornt III Scholarship Award; Eugene C. Reichard Scholarship Award; Walter Tarbox Memorial Scholarship; Warren Bennett Memorial Award; Wilford A. Dence Memorial Award; Meyer Environmental Chemistry Scholarship Award; Meyer Wood-Plastic Scholarship Award; Edward Aalbue Memorial Scholarship; Lt. Gary Scott Memorial Scholarship; Gerald H. Williams Scholarship; Mary E. Palmer Memorial Scholarship; Portia Farrell Morgan Scholarship; Phyllis Roskin Memorial Award; and Student Association Grants.

Syracuse Pulp and Paper Foundation, Inc. Scholarships

Scholarships from this foundation are awarded to United States citizens who are students in paper science and engineering and have a 2.500 grade point average (out of a 4.000). The scholarship may amount to the recipient's annual tuition charge. Incoming transfer students entering the program may ascertain the award amounts currently being offered and request a Pulp and Paper Scholarship application from the Office of Financial Aid. It is necessary to reapply each year for the scholarship.

State University Supplemental Tuition Assistance

A limited number of small grant awards are determined annually by the College for students with financial need.

EMPLOYMENT OPPORTUNITIES

College Work-Study Program (CW-SP)

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 minimum wage and increase as duties and responsibilities increase.

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.

A part-time employment program is available to qualified veterans. More information is available from the Veterans' counselor at the College.

LOANS

National Direct Student Loans

These loans are available to students with financial need who are enrolled at least half-time. Amounts which can be borrowed are $3,000 for 2 years and $6,000 for 4 years with a maximum of $12,000, including graduate study. Repayment and 5 percent interest begin 6 months after leaving college. Deferment and cancellation benefits are available for certain situations.

Guaranteed Student Loans

This program is administered by the New York Higher Education Services Corporation (NYHESC) for New York State residents. These loans are available from a bank or other lending agent to students who are registered at least

half-time. Undergraduates can borrow an aggregate of $12,500 for their undergraduate studies, and a graduate student can borrow an aggregate of $25,000. Repayment and 8 percent interest begin 6 months after leaving college (an additional 1 percent interest is paid at the time the loan is received). Applications are available at local banks.

Parent's Loan (PLUS)

Parents of students may borrow up to $3,000 annually and $15,000 overall, at an interest rate of 12 percent. Loan repayment begins 60 days after receipt of the loan. Total loans to parents and students cannot exceed total cost of education. Applications are available at local lending institutions.

Emergency Loans

The College is able to provide registered students interest-free, short-term loans (30 days). These loans are available because of the interest and support of the following donors: Alumni Association Short-term Loan Fund; David B. Schorer Memorial Fund; and Edward Vail Emergency Fund.

Students should contact the Office of Financial Aid when need arises for a short-term loan.

INTERNATIONAL STUDENTS

Citizens of other countries with special educational objectives are accepted for graduate study in all programs. They must show satisfactory evidence that they have completed studies in their major field equivalent to those at a recognized American institution with a scholastic record equivalent to a B average in their junior and senior years. They must submit Graduate Record Examination scores as explained in the section on Admission Requirements. Also, applicants whose native language is other than English must submit scores on the Test of English as a Foreign Language (TOEFL). This requirement may be waived if the student has received a degree from an American institution. This examination is offered several times each year in major cities of the world.

For information on registration and scheduling, write to the Educational Testing Service, Princeton, New Jersey 08540, U.S.A. In submitting test scores, request that they be sent to the Office of Academic Programs.

GRADUATE ASSISTANTSHIPS

Assistantships are awarded to students of demonstrated scholarship and whose education and experience enable them to assist in laboratory instruction and research. The amounts of the assistantships range from $4,800 to $9,000 per year. In addition, tuition may be waived. Students who hold an assistantship must be enrolled for full-time study.

Beginning graduate students may apply for assistantships on their application for admission, and continuing graduate students should consult with their major professors.

ACADEMIC POLICIES

EDUCATION 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:

"1. No person shall be expelled from or be refused admission as a student to an institution of higher education for the reason that he is unable, because of his religious beliefs, to attend classes or to participate in any examination, study or work requirements on a particular day or days.

"2. Any student in an institution of higher education who is unable, because of his 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.

"3. 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 his religious beliefs, an equivalent opportunity to make up any examination, study or work requirements which he may have 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.

"4. 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.

"5. 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 his availing himself of the provisions of this section.

"6. 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 his rights under this section."

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 merely as an educational device designed to encourage greater effort on the part of students who appear to be having difficulty in meeting certain academic standards. 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 College Academic Affairs Committee.

UNDERGRADUATE POLICIES

General Requirements

A student seeking a degree must be in matriculated status. All degree requirements *must* be completed through a combination of formally accepted transfer credits and courses generally at the upper-division level taken at ESF and Syracuse University. 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.

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.

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

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 or in the professional program leading to the Bachelor of Landscape Architecture. Undergraduate students with superior academic records may register for these courses.

600-699—Graduate courses which permit undergraduate students to enroll only by petition with a well-documented justification approved by the *student's advisor, Faculty chairperson*, and course instructor.

700-999—Graduate courses for which no undergraduates may enroll.

Physical Education and R.O.T.C.

Physical Education and R.O.T.C. course credits may be used to satisfy elective requirements with the permission of the student's academic advisor.

Audits

Students may informally audit ESF courses 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 formally audit courses with the permission of their academic advisor and the course instructor. They may not be used to satisfy any 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.

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's approval and notification to the course instructor* via an appropriate drop/add form until the last day for program adjustments as listed in the ESF 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 half way through the course. In either case, the student must submit a completed add-drop form.*

Repeating Courses

Students may repeat any course previously taken either to earn a higher grade or because of a previous failure. However, the credit hours for the course repeated may be counted only once toward meeting graduation requirements. Credit hours carried and grade points earned will be included in the semester and cumulative grade point averages each time the course is completed.

Withdrawal from ESF

Students who withdraw on or before the "drop date" 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 date" 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 of "A - F," "I,"* or "I/F" 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.

Curriculum Requirements

The development and administration of course offerings, prerequisites, sequencing, and program requirements are primarily the responsibility of *each program Faculty* 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 matriculate at ESF*. Students may graduate under the requirements stated in any catalog issued subsequent to the one in effect *the date they matriculate*, but they may not use a prior catalog.

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.

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*
W	Withdraw
WP	Withdraw Passing
WF	Withdraw Failing
SAU	Audit (Satisfactory)
UAU	Audit (Unsatisfactory)
I	Incomplete

Grade Point Averages

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

Incomplete Courses

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. The incomplete grade must be resolved prior to the end of the semester following that in which the incomplete was received. At the request of the *student and with a petition approved by the course instructor only*, the incomplete may be extended one additional semester. If the incomplete is not resolved by the appropriate deadline, it will be changed to a grade of "I/F."

Academic Honors

PRESIDENT'S HONOR LIST

Students who carried 12 or more credits of coursework graded "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 Honor List for that semester.

GRADUATION HONORS

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

A minimum of 30 credits of ESF and Syracuse University courses have been completed as a matriculated, upper-division student.

A *cumulative* grade point average of: 3.000 - 3.333, *cum laude*; 3.334 - 3.829, *magna cum laude*, 3.830 - 4.000, *summa cum laude*.

Academic Dismissal

Students who earn less than a 2.000 cumulative grade point average shall have their records reviewed by the *Faculty Subcommittee on Academic Standards*. Based on this review, *the Subcommittee shall recommend to the President or his or her designee that each* student with less than this minimum cumulative grade point average be either placed on academic probation or dismissed from ESF. The *recommendation* on probation or dismissal will be based upon an overview of the total academic record and the mathematical possibility for attaining a 2.000 cumulative average by the projected graduation date. *The President or his or her designee will take final action and so inform each student in writing.*

Each student dismissed will be given the opportunity to appeal that decision based on any extraordinary conditions which may have contributed to the student's unsatisfactory performance. This appeal must be made in writing and submitted to the Office of the Dean 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 President or his or her designee either to sustain the dismissal or place the student on probation. *The President or his or her designee will take final action and so inform each student in writing.* There is no appeal beyond this process.

Students who have been dismissed for academic performance may not reapply until at least one semester has elapsed. *Courses taken during the dismissal period may not be applied to the student's academic program.*

Students dismissed a second time for academic performance may not again be considered for readmission.

Graduation Requirements

Students are responsible for meeting the following requirements for graduation:

1. Matriculated status as an undergraduate student.
2. All course requirements must be satisfied.
3. A minimum cumulative grade point average of 2.000 (4.000 = A) for all courses taken as a matriculated student at ESF.
4. At least 24 of the last 30 credits must be registered for through ESF.
5. Consistent with the State Education Department requirements, a total of at least 120 credits from courses accepted as transfer credit by ESF and courses successfully completed while a matriculated student at ESF.

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 may delegate this authority. Exceptions may not violate standards established by the State University of New York or the State Education Department.

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

Graduation Rate

Of the transfer students who began their studies in the fall of 1983 at ESF, 78 percent received their degree, or continued in a five-year program, after four semesters of study. For those who began in the fall of 1984, approximately 81 percent received their degree, or are continuing in a five-year program, after four semesters of study. Further information on student retention is available from the Office of Instruction and Graduate Studies.

GRADUATE POLICIES

Master's Credit Hours

A minimum of 30 credit hours of graduate level work is required for the master's degree. This degree shall represent completion of at least one academic year of graduate-level study or an equivalent that can be shown to accomplish the same goals.

Doctoral Credit Hours

For the doctorate, credit hour requirements vary depending on the student's background and specific degree program. Early in a student's program the coursework requirement will be established which is intended to provide the student with the required level of competency to satisfactorily complete the doctoral candidacy examination. The doctorate shall represent completion of at least three full-time academic years of graduate study beyond the baccalaureate degree or an equivalent that can be shown to accomplish the same goals.

Doctoral Research Tool Requirement

There is no Collegewide requirement for languages or other tools of research for doctoral students. However, the faculty of any program may establish such requirements.

Time Limit

Students must complete all requirements for the master's degree within three years of the first date of matriculation. For the doctoral degree, students must complete all requirements for their degree within three years of satisfactory completion of the doctoral candidacy examination or they will be required to retake the candidacy examination.

Credit Hour Load

A graduate student must be registered for at least one credit each semester, excluding summers, from the first date of matriculation until all degree requirements have been completed. Failure to register will indicate the student no longer wishes to pursue a graduate degree.

Although there is no full-time requirement for degree purposes, there is such a requirement for those who qualify for a tuition waiver and for some other forms of financial support. For these students the following definition applies:

With a master's degree, or the completion of 24 or more credits after the bachelor's degree, students holding an assistantship are considered full-time if they are registered for nine or more credits. All other students are considered full-time if they carry 12 or more credits. All graduate students in landscape architecture must carry 12 or more credits to be considered full-time.

Evaluation

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

Grade	*Definition*	*Grade Points*
A		4.000
A −	Excellent	3.700
B +		3.300
B	Passing	3.000
B −		2.700
C +		2.300
C	Minimum Passing	2.000
C −		1.700
F	Failure	0
I/F, I/U	Unresolved Incomplete	0

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
U	Unsatisfactory
SAU	Audit (Satisfactory)
UAU	Audit (Unsatisfactory)
I	Incomplete

Grade Point Averages

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, i.e., all courses graded "A - F."

Master's Study Integration

Students enrolled in a master's degree program are required to demonstrate the ability:

A. to critically evaluate, organize, analyze, and synthesize the coursework and other components of their program of study;
B. to relate these components to current concepts and issues in their chosen field and associated disciplines;
C. to work logically and independently; and
D. to communicate effectively.

Master's study integration requirements may be met by successful completion of one of the following three options. The faculty of any program may limit the number of permissible options for its students. As permitted by their program, students will choose and follow one option with the approval of their major professor and with the guidance of their steering committee. Each option must be designed to satisfy the above requirements.

OPTION 1. THESIS OR PROJECT AND DEFENSE

Scope. Under this option, in addition to completion of necessary coursework, students must prepare either:

1. a research-oriented thesis which investigates a problem that expands or clarifies knowledge in the field, with generalizable results, or
2. an application-oriented project which applies skills or techniques from the field to a specific problem.

Whichever is chosen, students are required to define an appropriate problem for investigation; review relevant information sources; develop a study design; collect, organize, analyze, and interpret data; and draw conclusions.

Product. The thesis or project must be documented in a thorough and appropriate format and style. It must be in a permanent form, which may consist of print or nonprint materials.

Credits. Students must satisfactorily complete 6 to 12 credits for the investigation leading up to completion of the document. These credits will be graded on an "S/U" basis. Students must register for the approved number of credits for their investigation sometime during the three-year limit for the master's degree. They may register for more than the approved number of credits for their investigation, but the excess credits may not be used to fulfill the minimum 30 credits required for the master's degree.

Defense Examination. The thesis or project must be successfully defended.

OPTION 2. ACADEMIC OR PROFESSIONAL EXPERIENCE AND MASTER'S COMPREHENSIVE EXAMINATION

Scope. Under this option, in addition to completion of necessary coursework, students must engage in an academic or professional experience which applies, enriches, and/or complements the more formal coursework of their plan of study. This option might include, but not be limited to, an internship or an independent study experience. Whatever the form of the option, its objectives, organization, procedure, and manner of documentation must be submitted in writing and be approved by the student's major professor and steering committee before the experience is begun.

Product. This experience must be reported in a thorough and appropriate format and style. It need not be in a permanent form.

Credits. Students must satisfactorily complete 6 to 12 credits for this experience. These credits will be graded on an "S/U" basis. Students must register for the approved number of credits for their experience sometime during the three-year time limit for the master's degree. They may register for more than the approved number of credits for their experience, but the excess credits may not be used to fulfill the minimum 30 credits required for the master's degree.

Master's Comprehensive Examination. At the completion of their plan, students must successfully pass a comprehensive examination covering the major field, allied fields, and the content of their completed experience.

OPTION 3. COURSEWORK AND MASTER'S COMPREHENSIVE EXAMINATION

Scope. Under this option, students must satisfactorily complete a minimum of 42 hours of graduate level coursework appropriate to their field of study. As in other options, the design and sequencing of the coursework plan must be conducted with the guidance and approval of the student's major professor and steering committee.

Product. No product is required beyond that required for individual courses.

Credits. Students must satisfactorily complete a minimum of 42 credits of graduate level coursework. Students must complete these required credits sometime during the three-year time limit for the master's degree.

Master's Comprehensive Examination. At the completion of their plan, students must successfully pass a comprehensive examination covering the major field and allied fields.

Doctoral Thesis

Nature and Purpose

A thesis must be completed and successfully defended in order for the doctoral degree to be awarded. The doctoral thesis is the final and most important component of the series of academic experiences which culminate in the awarding of the Ph.D. degree. Three major functions are fulfilled by the thesis experience: (1) It is a work of original research or scholarship which makes a contribution to existing knowledge; (2) It is an educational experience which demonstrates the candidate's mastery of research methods and tools of the specialized field; and (3) It demonstrates the student's ability to address a major intellectual problem and arrive at a successful conclusion.

Examinations

Doctoral Preliminary Examination

An examination may be required of those admitted into a doctoral program to ascertain their level of understanding of the basic principles and techniques necessary to function effectively in that program. The results of the preliminary examination will be used to guide the major professor and the student in determining the appropriate coursework necessary to complete that requirement for the doctorate.

The format for the examination will be determined by the faculty in the program involved. It is recommended that the examination be primarily written with a supplemental oral presentation. When a preliminary examination is required, it should be conducted as early as possible in a student's program, at least before the completion of the student's second semester.

Doctoral Candidacy Examination

A student admitted into a doctoral program must satisfactorily complete a candidacy examination covering the major field and, in a broader manner, allied fields in order to be advanced into the status of doctoral candidate.

The purposes of the doctoral candidacy examination are to determine the student's knowledge of factual material and ability to use this knowledge creatively and intelligently.

The doctoral candidacy examination must be taken when the majority of coursework is completed but before the student begins serious thesis investigation. The candidacy examination must be passed at least one year before the student may present a thesis for defense.

Defense Examination for Thesis or Project

All graduate students who are required to complete a thesis or project must successfully defend it and have it accepted by the College.

The purposes of the defense examination are to determine the validity and significance of the data; and evaluate the student's understanding of investigative methods, ability to critically analyze data, and ability to relate the study results to the appropriate field and to more general scientific principles and knowledge.

Academic Dismissal

Graduate students who earn less than a 3.000 cumulative grade point average or who earn two grades of "U" shall have their records reviewed by the College Academic Affairs Committee, which may delegate this authority. Based upon this review, students either will be placed on academic probation or will be dismissed from ESF. The decision on probation or dismissal will be based upon an overview of the total academic record, the mathematical possibility for attaining a 3.000 cumulative average by the projected graduation date, and the recommendation from the major professor, program coordinator, and school dean or program director.

When extraordinary conditions contributed to the academic dismissal of students, such students may submit a written appeal to the dismissal decision to the Office of Academic Programs These appeals will be reviewed by the College Academic Affairs Committee, which will decide either to sustain the dismissal or place the students on probation. There is no appeal beyond this committee.

Students who have been dismissed for academic performance may not reapply until at least one semester has elapsed.

Students dismissed a second time for academic performance may not again be considered for readmission.

Graduation Requirements

Graduate students are responsible for meeting the following requirements for graduation:

A. The student must be in a matriculated status as a graduate student.
B. The approved academic plan for each student must be completed within the applicable time limit.
C. For the doctoral degree, the student must be admitted to candidacy and a thesis completed and successfully defended.
D. A minimum cumulative grade point average of 3.000 (4.000=A) for all graduate level courses taken during the program of study at ESF must be achieved.
E. Consistent with the State Education Department requirements, a total of at least 30 graduate credits is required for the master's degree and, for the doctorate, at least three full-time academic years of graduate study beyond the baccalaureate degree or an equivalent that can be shown to accomplish the same goals.

STUDENT LIFE

HOUSING

The College of Environmental Science and Forestry does not operate its own residence facilities or food service. Students enter into a Room and Board Contract with Syracuse University, which has housing facilities available adjacent to the State-operated College. Contracts for room and board made with Syracuse cover a *full academic year* (both fall and spring semesters) and are not normally renegotiable during that time period.

Students have a choice of living centers at Syracuse University—large halls, apartment houses, cottages, fraternities and sorority houses, or cooperative units. Student resident advisors live on each floor or in each unit and are available for counseling, advisement, and referral services.

Syracuse University also has housing units available for married students and their families.

Students who wish to live off campus may contact Alternative Action Services (ALTERACTS), a student-run housing organization at Syracuse University. An extensive listing of available housing in the Syracuse area is provided free of charge.

FOOD SERVICE

Syracuse University offers different meal plans to help meet the varying nutrition needs and interest of individual students. Students living in University apartments, co-ops, fraternities and sororities or off-campus can take advantage of the board plans available. Students living in dormitories and area housing without full kitchen services are required to subscribe to a board plan.

The College does not provide a food service program. However, a snack bar, located in the basement of Marshall Hall, is open 8 a.m. to 3:30 p.m. weekdays during the academic year.

EXTRACURRICULAR ACTIVITIES

Students at the College of Environmental Science and Forestry have many extracurricular activities to choose from, both on campus and in the community.

At the College

The *Undergraduate Student Association* (USA) and the *Graduate Student Association* (GSA) are the official representative bodies on campus governing student activities. Undergraduate and graduate students elect representatives from each Faculty to manage the affairs of their respective organizations and the concerns of their constituents.

Campus organizations offer students an opportunity to broaden their knowledge and meet other students with similar personal and academic interests. These include such groups as: the *Bob Marshall Club*, an organization of students concerned about the future of the Adirondack Mountains; the *Forestry Club*, the traditional sponsor of the intercollegiate Woodsmen's Team; *Botany Club*; *Forest Engineers Club*; *Mollet Club* , an organization of landscape architecture students; *Papyrus Club*; and the *Recycling Club*.

Other groups on campus include *Saengerbund*, the College singing group; and *Alpha Xi Sigma*, senior honorary society. There are also student chapters of the *Wildlife Society*, the *Society of American Foresters*, the *American Chemical Society*, the *American Fisheries Society*, the *American Water Resources Association*, the *Forest Products Research Society*, the *American Society of Landscape Architects*, the *Associated General Contractors*, *Society of Wood Science and Technology*, and the *Technical Association of Pulp and Paper Industries (TAPPI)*.

The two major student publications at ESF are the *Knothole*, a weekly newspaper, and the *Empire Forester*, an annual yearbook which has won several awards in past years.

Recent GSA-sponsored activities include a lecture series, a traditional fall picnic, and various social functions designed to encourage interaction between graduate students and College faculty.

At Syracuse University

Students at the College of Environmental Science and Forestry have all the privileges of Syracuse University students: participation in student government, organizations, sports, and other extracurricular activities.

Men and women at the College participate in all Syracuse University intercollegiate sports, club sports, and intramurals. Archbold Gymnasium on the Syracuse University campus is the center of athletics and physical education. Additional indoor facilities are provided through Manley Field House and the Carrier Dome which is the site of Syracuse University home football and basketball games. Facilities at Skytop recreation area include a lodge, and 22 tennis courts. The Women's Building offers instructional, social, and recreational facilities. All full-time undergraduate women are eligible to participate in intercollegiate competition in tennis, field hockey, volleyball, basketball, swimming, and diving.

Students are provided with many opportunities for acquiring musical training and performing experience through the Syracuse University Band, (Symphonic Band, Wind Ensemble, Stage Band, Concert Band and Jazz Workshops), the Syracuse University Orchestra, and the Syracuse University Chorus.

Membership is allowed in all Syracuse University student groups, including a wide variety of clubs, the International Student Association, religious and military organizations, and professional and honor societies.

In the Syracuse Area

The City of Syracuse and its surrounding countryside offer many cultural, educational, and recreational opportunities. The city has several fine museums, including the

Everson with its outstanding collection of works by local, regional, and international artists; a local repertory theater; several points of historical interest; a professional symphony orchestra; and a Civic Center which attracts artists from around the world.

Eight parks lie within the city limits, numerous county and state parks, including Beaver Lake Nature Center and Montezuma National Wildlife Refuge are within a short drive.

COLLEGE SERVICES

Career and Counseling Services

The Office of Career and Counseling Services is available throughout the students' college career as a place where at any time they may seek the advice of experienced counselors. This office should be the first contact when questions or personal problems arise. Most student problems can be dealt with in one or two brief contacts. Severe problems requiring extensive assistance are referred to the cooperative facilities at Syracuse University and/or specialized agencies in Syracuse.

The Office is designed to provide assistance to students throughout the year to help them adjust to and successfully graduate from ESF. Through various presentations, counseling sessions, group activities and workshops, students are given the opportunity to develop such skills as decisionmaking, studying, and test taking. Additional programs deal with adjustments related to transferring colleges and exploring relationships between academic difficulties, learning disabilities, or adjustment problems. A key component of this office is to provide a variety of opportunities through resource materials, presentations, job development, and counseling to meet the individual needs of each student at his/her various stages of career readiness. Some career services offered through this Office are skills development workshops; list of full-time, part-time, and summer jobs; on campus recruiting; company literature; career newsletters; reference information; and an alumni job list.

Each year this office conducts a Placement Survey to monitor the success and progress of our college graduates. The reports are shared with the college community and made available to the public upon request.

Since 1983, placement statistics for ESF graduates, 6-9 months past graduation, have not varied significantly. On the average 78 percent of the graduates are employed, 14 percent are continuing their education, and 8 percent are available for employment.

More detailed information is available in the Office of Counseling and Career Placement in Room 110, Bray Hall.

Services for the Handicapped

Students who experience short-term handicaps and/or incapacitating injuries that need special transport or classroom assistance should contact the Office of Student Affairs.

The Office of Administration and Services, assisted by Student Affairs, also provides specialized support services and adapts general resources to assist more permanently handicapped students to obtain maximum academic, social, and cultural benefits within the College community. Some of the specific services provided or made available include: pre-admissions guidance, orientation, mobility training, reader recruitment, preferential housing assignments, tutoring and other supportive services as required to meet individual living/learning needs. The College is also prepared to respond to handicapped students' needs for personal and career counseling and job placement assistance.

For further information, contact the ESF 504 Coordinator, Mr. David G. Anderson, Office of Administration and Services, Room 209, Bray Hall (315) 470-6622. The College maintains liaison relationships with rehabilitation agencies within the local community and the state, including the Office of Vocational Rehabilitation and the Commission for the Visually Handicapped. For specific information regarding their own eligibility, students should contact the respective agency directly.

Health and Medical Facilities

Students may consult a physician for medical care or health advice at the Syracuse University Student Health Service. Full-time students are entitled to unlimited visits to the out-patient clinic and also 10 days of confinement per college year with ordinary medical care in the infirmary. Infirmary usage over 10 days will be at prevailing infirmary rates. Some laboratory examinations, if necessary for treatment or diagnosis of common illness, are provided without cost. Most common legal drugs are provided at a minimal charge.

A student accident or sickness insurance plan, available at fall registration, not only supplements the usual infirmary privileges, but is also a health protection plan during the summer months when students are not under the care of the Health Service. Married students with dependents who are not covered by Health Service privileges are strongly urged to provide themselves and their families with special insurance made available to University students. *All international students are required to carry health and accident insurance.*

SU Speech and Hearing Clinics

The Gebbie Speech and Hearing Clinics provide remedial assistance to all regularly enrolled students who may be handicapped by hearing, speech, and voice disorders. This service is free to students.

SU Psychological Services and Research Center

Students desiring an analysis of their aptitudes, abilities and interests may secure special testing programs at the Testing and Evaluation Service Center on the Syracuse University campus.

SU ROTC Opportunities

Students attending the College are eligible to participate in the Army or Air Force ROTC Program at Syracuse University.

ROTC at Syracuse University consists of both 4- and 2-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 six-week and four-week camps and on-campus programs are available to suit individual needs.

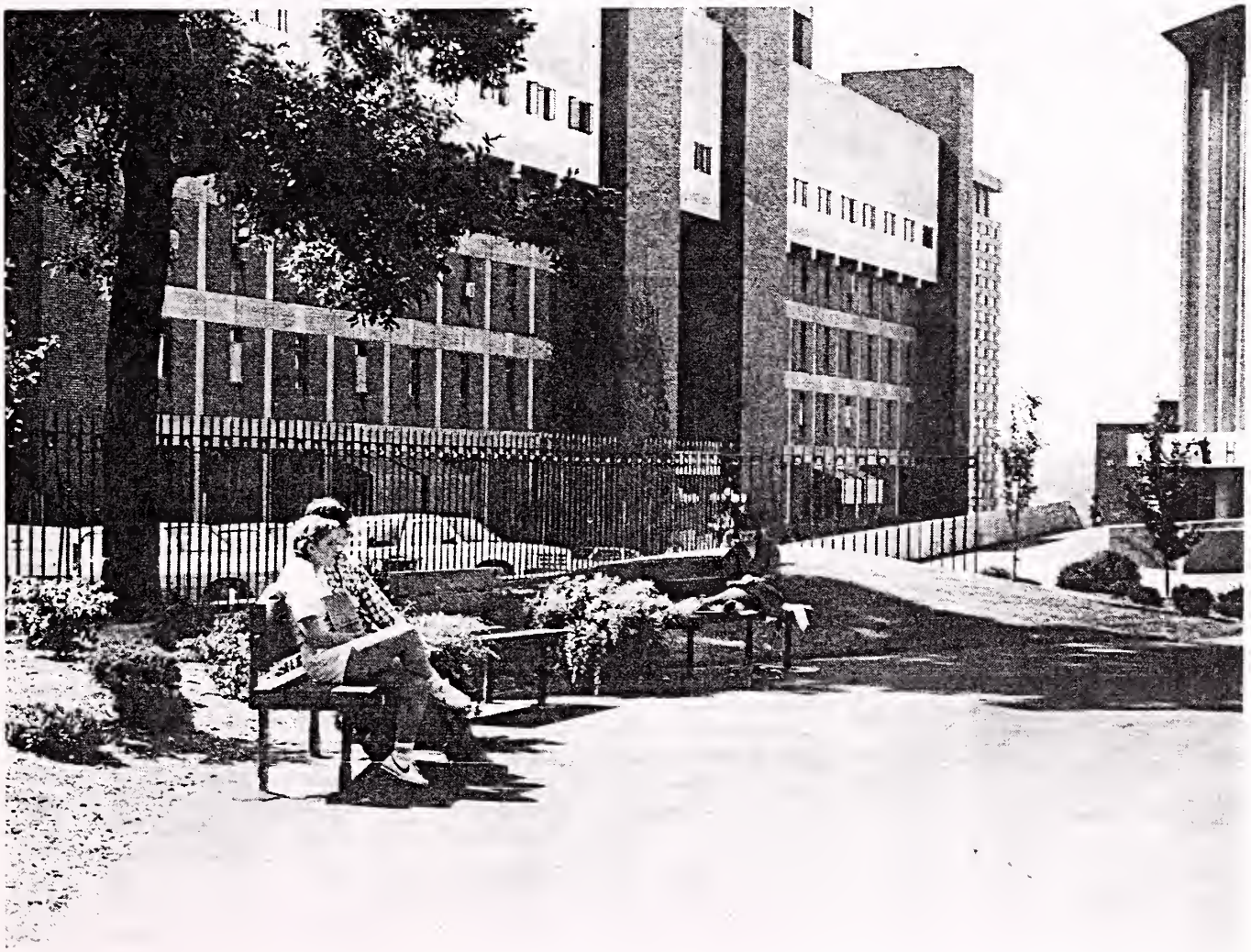
The ROTC programs offer academic instruction, alternate and supplementary career opportunities, leadership experience and financial aid.

ESF Alumni Association

The Alumni Office serves as the liaison between the College, the Alumni Association Board of Directors and more than 9,000 alumni. The Association supports education programs through scholarships, publishes a quarterly newsletter and represents alumni concerns.

ESF Student Rules and Regulations

The complete listing of guidelines for all students attending ESF is found in a separate publication, the *Student Handbook*, which is distributed at registration. "Rules and Regulations of Conduct and Behavior" which pertains to all students is included in the *Handbook*. It is the student's responsibility to be familiar with these regulations and abide by them.



Degree Programs and Areas of Study

The College is authorized to award degrees in the following programs. Enrollment in other than registered or otherwise approved programs may jeopardize a student's eligibility for certain financial aid programs.

Faculty of Chemistry

Chemistry; B.S., with areas of study in biochemistry, natural products chemistry, environmental chemistry, or natural and synthetic polymer chemistry. (HEGIS Code 1905)

Forest Chemistry; M.S., Ph.D., with areas of study in biochemistry, natural products chemistry, environmental chemistry, or natural and synthetic polymer chemistry. (HEGIS Code 1905)

Faculty of Environmental and Forest Biology

Environmental and Forest Biology; B.S., M.S., Ph.D., with areas of study in ecology, entomology, environmental physiology, fish and wildlife biology and management, pathology and mycology, pest management, plant science and biotechnology, soil ecology, or zoology. (HEGIS Code 0499)

Interdepartmental area of study in chemical ecology; M.S., Ph.D.

Faculty of Forestry

Forest Technology Program; A.A.S. (HEGIS Code 5403)

Resource Management—General Forestry; B.S. (HEGIS Code 0115)

Forest Resources Management; M.S., Ph.D., with areas of study in policy and administration, forestry economics, forest management, recreation management, silviculture, silvics, forest soil science, tree improvement, forest influences, international forestry, urban forestry, and quantitative methods. (HEGIS Code 0115)

Faculty of Forest Engineering

Forest Engineering; B.S. (HEGIS Code 0999)

Faculty of Paper Science and Engineering

Paper Science and Engineering; B.S. (HEGIS Code 0999)

Faculty of Wood Products Engineering

Wood Products Engineering; B.S., with options in building construction, or forest products in which emphasis may be chosen in marketing, production systems engineering, or wood science. (HEGIS Code 0999)

Division of Engineering

Environmental and Resource Engineering; M.S., Ph.D., with areas of study in forest engineering, paper science and engineering, or wood products engineering. (HEGIS Code 0999)

Division of Forest Resources

Dual Program in Environmental and Forest Biology/Resource Management (HEGIS Codes 0999 and 0115)

Faculty of Landscape Architecture

Landscape Architecture; B.L.A. (HEGIS Code 0204)

Landscape Architecture; M.L.A., with areas of study in social/behavioral studies, natural/physical applied sciences, or design process, methods and management. (HEGIS Code 0204)

Faculty of Environmental Studies

Environmental Studies; B.S. (HEGIS Code 0201)

Graduate Program in Environmental Science; M.S., Ph.D., with areas of study in energy, environmental communications, land use, urban ecosystems, waste management, and water resources. (HEGIS Code 0420)

THE FACULTY OF ENVIRONMENTAL AND FOREST BIOLOGY

ROBERT L. BURGESS, *Chairman*

Programs in Environmental and Forest Biology provide students with a firm foundation in basic biology, forest ecosystem dynamics, and environmental science. They 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.

The critical importance modern society places upon the utilization of natural resources and the quality of our environment adds new and increasingly diverse dimensions to the services a well-trained biologist can render. The faculty is committed to meet this dynamically changing array of opportunity through coursework enriched by an active program of research that focuses upon upper-level undergraduate and graduate study. Through the addition of selected electives to a required core, undergraduates may focus their program toward a special biological field (see p. 36) or toward future graduate study. Graduate students may develop a course of study under the guidance of a major professor and graduate committee within any of several study concentrations (see p. 36).

The academic programs stimulate interest in the recognition and understanding of plants, animals, and protists, and deal with an understanding of the dynamic changes in biological systems in the context of the broad fields of ecology, physiology, genetics, and evolution. This is accomplished by an integration of course

work with a strong research program, much of which is concerned with natural resource management and improvement of the quality of our environment.

Undergraduate Program

The curriculum for the Bachelor of Science degree is built around a core of required courses which provide the student with a general education, a basic background in the principles of the biological and the physical sciences, and an orientation to forest resources. Its design develops breadth in biology as well as depth in a selected biological field. Thus, although individual course selections may vary, all students major in environmental and forest biology and each, with an assigned advisor, develops a special plan of study.

A dual-major program is available that meets the undergraduate requirements of both Environmental and Forest Biology and of Forestry (see p. 56).

A total of 125 credit hours, 60 of them prior to matriculation, is required for the Bachelor of Science degree. In addition to the core courses specified below, at least 21 hours in biology must be completed and, of these, at least 15 must be from courses in the College of Environmental Science and Forestry. Six of the 21 credit hours must involve subject matter in plant science and six in animal science, both exclusive of the five-hour summer field requirements. The balance of the required hours is chosen in consultation with the advisor.

Lower Division Courses

The curriculum facilitates transfer of freshman and sophomore credits from other institutions. To assume training in residence at the junior level, entering students must have successfully completed a minimum of 60 credits which include:

Course Area	*Credit Hours*
General Chemistry with Laboratory	8
Organic Chemistry with Laboratory	8
General Physics with Laboratory	8
Mathematics proficiency, through Integral Calculus	4-8
English	6
*Social Sciences—Humanities	9-12
General Botany and Zoology **OR** General Biology with Laboratory	8
Electives (recommended in Biology, if available)	3-6
TOTAL MINIMUM LOWER DIVISION CREDITS	60

*A course in technical writing and/or speech is recommended as part of the Social Science—Humanities group.

Upper Division Courses

Junior Year			*Credit Hours*
First Semester	EFB 336	Dendrology I	3
	EFB 320	General Ecology	3
	EFB 352	Elements of Forest Entomology	3
	Electives		6
			15
Second Semester	APM 491	Introduction to Probability and Statistics	3
	FOR 345	Soils **OR** GOL 105 Earth Science	3
	EFB 325	Cell Physiology	3
	Electives		6
			15
SUMMER FIELD EXPERIENCE—Must be met as described on page 35			5

Senior Year			*Credit Hours*
First Semester	Electives		15
Second Semester	EFB 407	Principles of Genetics	3
	EFB 408	Genetics Laboratory	1
	Electives		11
			15
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

A total of 125 credit hours is required to complete the B.S. degree in Environmental and Forest Biology.

SUMMER FIELD EXPERIENCE

Between the junior and senior year, each student completes a minimum of five semester credit hours (or equivalent) during residence in an approved academic program in field biology. This requirement is usually met by the appropriate selection of courses at the Cranberry Lake Biological Station (CLBS) where courses are offered during each of two sessions. Earning five credits at one session satisfies the requirement; any additional courses taken in the other session count as elective credits.

Cranberry Lake Biological Station

Cranberry Lake and its environs are ideally suited for an advanced biology summer program. The surrounding topography is rolling hill and lake country dotted with numerous small ponds, closed bogs, and stream drainages. The lake is the third largest body of water in the Adirondacks. Because 80 percent of the shoreline is in State ownership, the lake remains relatively unspoiled by recreational developments and pollution problems. Much of the original forest cover in the region was harvested years ago; today a rich variety of community types occupies those sites as the vegetation reverts to natural conditions. The remaining virgin forests also provide students with many examples of stable forests, each type reflecting the particular environmental conditions controlling forest development. A wealth of wildlife parallels the variety of cover types over the region. The area provides easy access to a wide range of additional ecosystems ranging from bog to alpine types.

Facilities include four classroom-laboratories; dining facilities capable of serving 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 field trips each day into the surrounding forest and aquatic ecosystems.

Students wishing more information about the Summer Program, including courses and fees, may write to the Director, Cranberry Lake Biological Station, State University of New York College of Environmental Science and Forestry, Syracuse, New York 13210.

Alternatively, other biological field stations may be attended to earn the minimum five semester hours credit (or equivalent). Petitions requesting this alternative must include course descriptions and the program contemplated and be submitted at least one month prior to the end of the spring semester preceding the summer program. A current file of alternative stations and course descriptions is maintained by the director of the Cranberry Lake Biological Station.

Electives

The curriculum meets general requirements for graduate study and for a wide range of federal, state, municipal, and private biology positions. Those training for biological positions in federal and state service should review Civil Service publications and become familiar with specific course requirements early enough to make timely elective choices. Students are urged to use some elective time to enhance their communications skills. Courses in technical writing, applied communications or a language (as approved by their faculty advisor) are useful.

Special Biological Fields

Animal Physiology. Without further specialization, job opportunities in this field are limited, but those at the bachelor level include technician work in laboratories, medical schools, hospitals, museums, and in liberal arts colleges; clerical work in government information agencies such as at the National Medical Library, and the Smithsonian Institution; and sales opportunities with the pharmaceutical and chemical industries.

Entomology. Insects play significant roles, both beneficial and detrimental, in their interactions with man, natural resources, and environment. Courses are available that enable a student to fulfill requirements of Civil Service and a variety of other employers. Program strengths are in forest entomology, medical entomology, pest management, and environmental toxicology.

Environmental Microbiology. Microbiology is a dynamic and exciting science that deals with bacteria, molds, algae, yeasts, protozoa, rickettsiae, and viruses: their roles in industry, disease, the environment, and everyday life. Careers in microbiology are available throughout the public and private sectors, and related to many different professions and industries.

Fish and Wildlife Biology and Management. A basic and applied program in fish and wildlife biology, including management and behavior, is provided for students whose objectives are to develop professional skills in the biology and management of these natural resources.

Forest Pathology and Mycology. Protection of vascular plants and wood products from invading organisms, such as fungi, is basic to forest productivity, effective wood product use, and the maintenance of environmental quality. Program strength is in the ecological, physiological, genetic, and environmental aspects of disease. Students may train for positions in forest pathology, mycology, pest management, plant quarantine, or diagnostic laboratories. Opportunities for employment exist with federal, state, and private agencies.

Pest Management. Modern control of insects and disease dictates practices appropriate to maintaining an acceptable environmental quality. Through proper course selection, students are able to achieve training in wise selections of methods for an integrated approach to pest management. Training is more than adequate to prepare students for state examinations required for pesticide applicator's certification.

Plant Physiology. Plant physiology, part of the broader science of botany, concerns the life processes that occur in plants. Career opportunities are available in federal, state, and local governments through their extensive testing and monitoring programs. Additionally, positions are available in agriculture and forestry concerning pathogenic micro-organisms and physiological mechanisms of infection.

Plant Science. Students may prepare for a wide variety of opportunities in the botanical professions. Essential to understanding plants are their biochemical and physiological processes; their interactions with the environment and with one another; with animals and other organisms; their genetic makeup, evolution and classification. Requirements may be satisfied for technical positions in areas such as botany, plant ecology, tree genetics, plant physiology, horticulture, tree maintenance, or plant quarantine.

Zoology. A broad program is provided for the student whose objectives are to go on for graduate study or to further training in physiology, soil invertebrate ecology, animal behavior, or animal ecology. Some opportunities with federal and state agencies are available at the baccalaureate level.

Graduate Program

The graduate program in Environmental and Forest Biology is organized in eight interdependent concentrations that provide comprehensive coverage within specific interest areas. Faculty in each concentration define the scope of subject matter, recommend acceptance of students and guide them in a course of study. Some concentrations follow taxonomic lines while others are broad unifying areas basic to all taxa. Students choosing to emphasize a taxonomic category should explore the desirability of engaging to some extent in broader interdisciplinary areas. Similarly, it is opportune for students enrolled in the latter to develop a degree of specialization in at least one taxon to assure a useful mix of talents.

Most students seeking the M.S. degree include a research thesis and its defense (see p. 29). There also is an option to earn the degree with 42 hours of coursework specified by the student's advising faculty according to concentration core requirements. All who seek the Ph.D. must include original research and dissertation or its equivalent in the form of refereed publications.

The major center of activity 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 and temperature-humidity controlled, and one sound-controlled, are provided for study and research in plant development, physiology, tissue culture, biochemistry and toxicology, ecology, and animal behavior. An herbarium, mycological collections, insect and other arthropod collections, and the Roosevelt Wildlife Collection of vertebrates are maintained in archival condition as useful 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.

Also available to students and faculty is a variety of sophisticated instrumentation: convenient access to a computer center; radioisotope counting equipment, including liquid scintillation spectrometer and Cobalt-60 source; diverse analytical equipment and measuring devices; gas-liquid chromatography; and, in collaboration with Chemistry, a comprehensive analytical expertise. The Nelson C. Brown Center for Ultrastructure offers scanning and transmission electron microscopy capability.

Supportive to the program are the academic resources, including courses, of Syracuse University, SUNY's Health Science Center and the several campus facilities described elsewhere in this catalog. Our students participate as well in courses and utilize faculty and facilities at Cornell University in cooperative exchanges.

Excellent field sites and facilities are available for research in all aspects of the program in nearby or moderately distant locations from the Syracuse campus. 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 that collectively offer a variety of habitat diversity from highlands to aquatic-terrestrial zones. The ponds, streams, and lakes in Central New York and the St. Lawrence River are regularly used by graduate students in wetlands and aquatic ecology and fishery biology.

Further academic advantages stem from the urban setting of the Syracuse campus. The Greater Syracuse area provides a convenient laboratory for studies basic to urban ecology: 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 micro-organisms 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 study-in-depth of many elements of basic biology offering substantial assistance toward the solution of pressing human problems.

Eight study concentrations are available: *Ecology*, *Entomology*, *Environmental Physiology*, *Fish and Wildlife Biology and Management*, *Pathology and Mycology*, *Plant Science and Biotechnology*, and *Soil Ecology*. One concentration, *Chemical Ecology*, is shared with the faculty of Chemistry.

Ecology

ALEXANDER (Vertebrates, Wetlands), ALLEN (Forest Insects), BRANDT (Fisheries Biology), BROCKE (Wildlife, Bioenergetics), BURGESS (Forest Ecology), CHAMBERS (Wildlife), DINDAL (Invertebrates), KURCZEWSKI (Insect Behavior), LEOPOLD (Dendrology, Community Ecology), MITCHELL (Invertebrates, Bioenergetics), MÜLLER-SCHWARZE (Vertebrates, Behavior), NAKAS (Microbiology), PORTER (Vertebrate Ecology), RAYNAL (Physiological Ecology, Demography), RINGLER (Aquatic Ecology), SCHAEDLE (Plant Nutrition), SHIELDS (Vertebrate Behavior), SIMEONE (Forest and Wood-boring Insects), VANDRUFF (Wildlife), WALI (Forest Ecology), WERNER (Limnology).

Ecology is an integrative science which depends on an understanding of ecological theory, habitat characteristics, and the basic biological attributes of organisms. This concentration incorporates this knowledge into areas of practical concern. Specific research may entail the study of distribution and abundance of organisms, community structure including trophic relationships, diversity or succession, and ecosystem properties such as patterns of energy transfer and biogeochemical cycling.

Entomology

ABRAHAMSON (Forest Insects, Pest Management), ALLEN (Forest Insects, Population Ecology), BREZNER (Physiology), CASTELLO (Virology, Insect Vectors), KURCZEWSKI (Morphology, Taxonomy, Behavior), LANIER (Forest Insects, Pheromones, Cytotaxonomy), MILLER (Pest Management), MITCHELL (Population Ecology), NAKATSUGAWA (Toxicology), NORTON (Spiders and Mites, Insect Larval Taxonomy), RINGLER (Aquatic Entomology), SIMEONE (Forest and Wood-inhabiting Insects).

Adjunct Faculty

CAMPBELL (Forest Entomology) HOWARD (Medical Entomology).

Graduate study opportunities prepare students in the basic aspects of insect life and the role of insects in relation to man and his 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 man and those playing key roles as parasites and predators of pest species. Current research areas include population dynamics of forest defoliators, pheromone communications among beetles and moths, speciation of insects as understood through behavioral and cytogenetic study, natural control of insects in forest systems and basic biochemistry of insect detoxification mechanisms.

Environmental Physiology

BREZNER (Insect Physiology), CASTELLO (Plant Virology), GRIFFIN (Fungus Physiology), HARTENSTEIN (Invertebrate Physiology), MITCHELL (Environmental Energetics), NAKAS (Microbial Physiology), NAKATSUGAWA (Insect and Vertebrate Toxicology), SCHAEDLE (Plant Physiology), WALTON (Plant Physiology), WILCOX (Plant Physiology).

The Environmental Physiology Concentration provides students with advanced training in the nature and control of biological processes. Current interests include mechanisms of action of plant growth hormones; biochemical regulation of seed germination; plant and microbial enzymology; virology; toxicity and disposition of insecticides and environmental toxicants in vertebrates; production and action of plant phytoalexins and antibiotics; plant defenses against phytophagous invertebrates; mycorrhizae, ion transport; mineral nutrition, cambial physiology and photosynthesis.

Fish and Wildlife Biology and Management

ALEXANDER (Vertebrates, Herpetology), BRANDT (Fisheries Management), BROCKE (Vertebrates), CHAMBERS (Vertebrates), MÜLLER-SCHWARZE (Vertebrate Behavior), PAYNE (Ornithology), PORTER (Vertebrate Ecology), RINGLER (Fisheries, Aquatic Ecology), SHIELDS (Vertebrate Behavior), VANDRUFF (Vertebrates, Ornithology), WERNER (Limnology, Fisheries).

Study in this area provides students with advanced preparation in biological concepts of fish and wildlife populations as

they relate to proper management. Increasing concern for these wild animal resources has been matched by strong student interest in educational programs which 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.

Areas of research include population-habitat relationships, predator ecology, wildlife in Adirondack ecosystems, urban wildlife relationships, endangered species studies, feeding ecology of fishes, stream ecology, ecology of larval fishes and homing behavior of fishes.

Forest Pathology and Mycology

ABRAHAMSON (Forest Pathology, Entomology), CASTELLO (Forest Pathology), GRIFFIN (Fungus Physiology), MANION (Forest Pathology), NAKAS (Microbiology), VALENTINE (Genetics), WANG (Mycology), WILCOX (Mycorrhizae), WORRALL (Forest Pathology).

Forest Pathology and Mycology train students to develop an expertise responsive to the increasing pressures on forest and shade tree systems for wood fiber, public services, and amenities. This requires new sophisticated levels of disease understanding, disease control, a broad knowledge of fungi, bacteria and viruses, their environmental impacts and their roles in biodeterioration. Areas of interest include: environmental, fungal and viral tree diseases; mycorrhizae; wood decay and biodegradation processes; monitoring and impact assessment of disease in forest and urban tree systems; chemical and biological control of tree diseases; epidemiology of tree diseases and the genetics of resistance to tree diseases and to pathogen variability; physiology of fungus growth and development; taxonomy and biology of decay and imperfect fungi; and fungus ultrastructure.

Plant Science and Biotechnology

BURGESS (Ecology), CASTELLO (Virology), GRIFFIN (Mycology, Fungus Physiology), LEOPOLD (Dendrology, Community Ecology), LOWE (Mycology), MANION (Pathology), NAKAS (Microbiology), RAYNAL (Ecology, Taxonomy), SCHAEDLE (Physiology), SILVERBORG (Pathology), TEPPER (Anatomy, Morphogenesis), VALENTINE (Genetics), WALTON (Physiology), WANG (Mycology), WILCOX (Physiology, Mycorrhizae).

Adjunct Faculty

FAUST (Taxonomy), GOULD (Environmental Microbiology), ZABLOTOWICZ (Microbiology).

Plants, as the principal energy source for ecological food chains, serve as the structural and functional foundation of natural and managed systems. The Plant Science and Biotechnology Concentration provides opportunity for study 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 forest 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; decay, discoloration and biomodification of wood; taxonomy, physiology, growth and ultrastructure of fungi; heritability of wood properties and disease resistance of trees; biochemistry and physiology of plant growth regulators; photosynthesis; mineral nutrition; mycorrhizae; morphogenesis in shoot and root systems; and plant tissue culture.

Soil Ecology

DINDAL (Invertebrates), HARTENSTEIN (Invertebrates, Physiology), MITCHELL (Invertebrates, Energetics), NAKAS (Microbiology), NORTON (Invertebrates, Taxonomy), WANG (Mycology), WILCOX (Mycorrhizae).

Soil ecology includes the study of interrelationships of soil-inhabiting organisms (as individuals, populations and communities) with their biotic, chemical, and physical environments. This field is a frontier of science because of the myriad of undescribed species of soil-dwelling arthropods, nematodes and annelids, and the wealth of incompletely understood symbiotic relationships. Soil ecology deals with fundamental aspects of biodegradation and nutrient cycling, important for improvements in crop culture and enlightened waste disposal.

The soil ecology concentration is supported by courses in physical aspects of soils, plant and animal taxonomy and general ecology.

INTERDEPARTMENTAL AREA OF STUDY

The concentration in chemical ecology is offered by collaboration between Environmental and Forest Biology and Chemistry. Interested students should apply to the department of major interest, which will have prime responsibility for setting requirements. Faculty from both departments can aid in 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 to grapple with problems requiring an understanding of both.

Chemical Ecology

LANIER (Insect Pheromones), MÜLLER-SCHWARZE (Vertebrate Pheromones), SILVERSTEIN (Pheromone Chemistry), SIMEONE (Insect Pheromones), TANENBAUM (Microbial Chemistry).

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 occur at all taxonomic levels: between uni- and multicellular organisms, microbes and plants, plants and plants, plants and animals, microbes and animals, animals and animals. Study of such interactions has been accelerated in recent years through joint efforts of biologists and chemists in meaningful research accompanied by a growing body of literature.

THE FACULTY OF CHEMISTRY

ANATOLE SARKO, *Acting Chairman*

ANATOLE SARKO, *Acting Chairman* (Physical and Polymer Chemistry), BOYER (Biochemistry), CABASSO (Polymer Chemistry), CALUWE (Organic and Polymer Chemistry), HASSETT (Environmental Chemistry), JOHNSON (Environmental Chemistry), LALONDE (Organic and Natural Products Chemistry), SILVERSTEIN (Ecological Chemistry), SMID (Physical and Polymer Chemistry), SMITH (Physical and Polymer Chemistry), TIMELL (Wood Chemistry).

The academic program in forest chemistry enables the student to develop not only an understanding of chemical phenomena, but also an appreciation for chemistry that can link it to the biological and applied sciences. Programs include courses in traditional areas of chemistry, with additional study in those fields pertaining to environmental science and forestry. This broad spectrum of academic offerings is possible through close cooperation with Syracuse University, where a wealth of accessory courses at both the undergraduate and graduate levels are available emphasis on the investigative function of chemical science is manifest in the wide array of ongoing research projects within the department.

The Faculty of Chemistry offers the following areas of concentration leading to the Bachelor of Science degree:

Biochemistry and Natural Products Chemistry

Environmental Chemistry

Natural and Synthetic Polymer Chemistry

Students in all options, by selecting proper electives, may be certified on graduation as having completed an American Chemical Society approved curriculum. All options are excellent grounding for professional work at the B.S. level or for advanced graduate study.

Undergraduate Program

Lower Division Courses

For students transferring into the College as juniors, recommended courses consist of 68 credits or an associate degree and include:

Course Area	*Credit Hours*
Biology with Laboratory	8
General Chemistry with Laboratory	8
Organic Chemistry with Laboratory	8
Physics with Laboratory	8
Economics	3
English	6
Language, Literature or Communication	6
Electives	12-15
*Mathematics	6-9
TOTAL MINIMUM LOWER DIVISION CREDITS	68

*Mathematics through integral calculus. An additional mathematics course beyond integral calculus is required for the B.S. degree.

Upper Division Courses

Junior Year		*Credit Hours*
First Semester	FCH 325 Organic Chemistry III	4
	[3]CHE 332 Quantitative Analysis	2
	CHE 333 Quantitative Analysis Laboratory	1
	FCH 360 Physical Chemistry	3
	[1]Professional Elective	2-4
	Elective	3
	FCH 496 Safety and Orientation	1
		16-18
Second Semester	[2]Math or Elective	3
	FCH 380 Instrumental Methods	3
	FCH 361 Physical Chemistry	3
	CHE 357 Physical Chemistry Laboratory	2
	FCH 384 Spectrometric Identification of Organic Compounds	2
	[1]Professional Elective	2-3
	Elective	3
		18-19

[1]A sequence of professional electives should be chosen in the junior year. In addition to the freshman biology courses, a student whose emphasis is in biochemistry must take 3 semester hours of genetics and at least one other 3-semester-hour biology course. A student whose emphasis is in natural products must take 3 semester hours of biology in addition to the freshman biology courses and an additional hour or organic chemistry laboratory. Courses leading to a minor in management may be substituted for the professional electives.

[2]One course of mathematics or applied mathematics beyond MAT 397, or equivalent, is required.

[3]CHE designations refer to courses offered at Syracuse University.

Biochemistry and Natural Products Chemistry Option

This option is designed for students who wish to approach problems in the life sciences with the tools and point of view of the chemist. In addition to a major concentration in the several branches of chemistry, the student obtains a solid grounding in the fundamentals of physics, mathematics, and biology. Professional electives can provide a minor concentration in botany, ecology, entomology, zoology, or physiology. Collaborative efforts of chemists and biologists are providing new solutions to problems of environment, natural resources, and health.

Senior Year

			Credit Hours
First Semester	LIB 300	Library Research	1
	FCH 495	Introduction to Professional Chemistry	1
	FCH 571	Wood Chemistry I	2
	FCH 574	Wood Chemistry Laboratory	1
	FCH 530	Biochemistry I	3
	FCH 531	Biochemistry Laboratory	2
	[1]Elective		3
	Elective		3
			16
Second Semester	[2]FCH 498	Introduction to Research	5
	FCH 497	Undergraduate Seminar	1
	FCH 532	Biochemistry II	3
	FCH 573	Wood Chemistry III	2
	Elective		3
	[3]Elective		3
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

[1]Introduction to Polymer Science, FCH 550 (3 credit hours) is suggested.
[2]Petition by student to Department for replacement of this requirement will be considered to allow time for special interest.
[3]Topics in Natural Products Chemistry, FCH 524 (3 credit hours) is suggested.

A total of 134 credit hours is required to complete the B.S. degree in Chemistry with the Biochemistry and Natural Products option.

Environmental Chemistry Option

The environmental chemistry option is designed for those students who wish to obtain a solid fundamental background in chemistry which will enable them to make a strong contribution towards the identification and solution of problems in the areas of pollution, air and water quality, analysis and basic research in environmental chemistry. A large number of professional electives, available through course offerings of other departments such as biology and engineering, provide the important interface with other disciplines necessary for a working understanding of the complex problems inherent in environmental studies.

Senior Year

			Credit Hours
First Semester	LIB 300	Library Research	1
	FCH 495	Introduction to Professional Chemistry	1
	FCH 510	Environmental Chemistry I	3
	FCH 515	Methods of Environmental Chemical Analysis	3
	Chemistry Elective		3
	[1]Elective		3
	Elective		3
			17
Second Semester	[2]FCH 498	Introduction to Research	5
	FCH 511	Environmental Chemistry II	3
	FCH 497	Undergraduate Seminar	1
	FCH 519	Environmental Chemistry Seminar	1
	Electives		6
			16
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

[1]Biochemistry I. FCH 530. (3 credit hours) is suggested.
[2]Petition by student to Department for replacement of this requirement will be considered to allow time for special interest.

A total of 134 credit hours is required to complete the B.S. degree in Chemistry with the Environmental Chemistry option.

Natural and Synthetic Polymer Chemistry Option

This option is designed for students interested in the structure and physical properties of man-made and natural materials, the giant molecules of wood, plastics, polysaccharides, proteins, rubbers, and fibers. The recently discovered chemistry of these materials constitutes one-half the concern of the chemical industry and is the origin of a major revolution in our way of life and our understanding of nature. This special subject area is an advanced core of studies beyond the basic courses of the classical undergraduate chemistry curriculum.

Senior Year			*Credit Hours*
First Semester	LIB 300	Library Research	1
	FCH 495	Introduction to Professional Chemistry	1
	FCH 550	Introduction to Polymer Science I	3
	FCH 551	Polymer Techniques	2
	FCH 571	Wood Chemistry I	2
	FCH 574	Wood Chemistry Laboratory	1
	[1]Elective		3
	Elective		3
			16
Second Semester	[2]FCH 498	Introduction to Research	5
	FCH 552	Introduction to Polymer Science II	3
	FCH 497	Undergraduate Seminar	1
	FCH 573	Wood Chemistry III	2
	Electives		6
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

[1]Biochemistry I, FCH 530 (3 credit hours) is suggested.
[2]Petition by the student to Department for replacement of this requirement will be considered to allow time for special interest.

A total of 134 credit hours is required to complete the B.S. degree in Chemistry with the Natural and Synthetic Polymer option.

Graduate Program

Recent years have seen profound advances in the fundamental knowledge of chemical areas which have special significance for forestry and the environment. The following research areas have received active attention by both faculty and graduate students in the programs: polymer chemistry and physics; wood chemistry; environmental chemistry; biochemistry; chemistry of natural products, including ecological chemistry; and materials sciences.

Requirements for a master of science or doctor of philosophy degree in chemistry include a research project and thesis, along with an appropriate program of courses at the College and at Syracuse University.

Specific projects may vary from year to year, since they reflect the current interests of the faculty. Current research projects with *physiochemical* emphasis are: the chemistry, physics, solid-state and solution properties of natural and synthetic polymers, including studies in thermodynamics, statistical mechanics, crystallization, morphology, elasticity, conformation of macromolecules, optical properties, polymer catalysis, mechanism of polymerizations, polyelectrolytes, ion binding to macromolecules and ion pairing; chemistry of free radicals, radical ions and charge transfer processes; structure and properties of ionic solutions in nonaqueous media; crystal structure and morphology of cell wall constituents; membrane properties and technology; and heavy metal speciation. Current *organic* chemistry programs deal with synthesis of special polymers such as high temperature aromatic block, stereoregular vinyl polymers, and polysaccharides, various aspects of natural products isolation and synthesis including the characterization of insect and mammalian attractants. In *biochemistry*, department members are studying mechanisms of action of plant growth hormones and other biologically active natural products, biochemical regulation of growth and development, and plant enzymology.

Graduate research laboratories in the Hugh P. Baker Laboratory are well equipped for polymer studies, chemical, and biochemical research. Instrumentation includes analytical and preparative ultracentrifuges, Warburg respirometer, recording infrared and ultraviolet spectrophotometers, mass spectrometer, differential refractometer, electron spin resonance spectrometer, nuclear magnetic resonance spectrometers, automatic membrane osmometers, solid- and solution-state light scattering photometers, recording polarimeter an optical dispersion spectrometer, analytical and preparative high performance liquid chromatographs, combined gas chromatographs—mass spectrometry center, spectrofluorimeter, several ultramicrotomes, electron microscopes, X-ray diffraction, instrumentation chromatography and cold laboratories, and radiochemical laboratories with counters for solids, liquids, and gases.

THE FACULTY OF ENVIRONMENTAL STUDIES

RALPH A. SANDERS, *Chairman*

The Faculty of Environmental Studies hosts two interdisciplinary instructional programs, the Bachelor of Science in Environmental Studies (BSES) and the Graduate Program in Environmental Science (GPES), which awards both M.S. and Ph.D. degrees. Together, these programs constitute the formal interdisciplinary offerings of the College.

GPES and the BSES program address environmental issues of high public concern and rest upon the scientific and professional expertise of the College faculty. These programs provide for the study of environmental systems and the interrelationships of human and natural systems. Both are guided by a concern for finding and promoting wise public policies for natural resource and environmental issues. Each program provides a set of core courses dealing with understanding and analyzing complex environmental systems in their human context, and a wide range of student choice in choosing interdisciplinary subjects for concentration. Faculty offering instruction and advisement for these programs are drawn from the academic units of the College, and work intensively with students to shape their programs of study to blend student interests with program goals.

Lower Division Coursework

Course Area	*Credit Hours* Required	Suggested
A. Written Communications ..... Required credit hours should be taken in courses dealing with English comprehension and basis skills of grammar and composition.	3	3
B. Humanities ..... Required credit hours should be taken in philosophy, literature, art, music, drama, or language.	9	12
C. Social Sciences ..... Required credit hours should be taken in history (preferably U.S.), human geography, sociology, psychology, political science (preferably U.S. institutions), social or cultural anthropology, or economics.	9	15
D. Natural Sciences ..... Required credit hours specifically includes a course in general biology. Additional hours should be taken in ecology, physical geography, earth science, geology, biology, chemistry, physics, or other laboratory science.	6	21
E. Mathematics ..... Required credit hours should be taken in statistics, computer programming, or mathematics at the level of college algebra or calculus. At least one statistics course is preferred.	3	9
F. Electives	32	2
TOTAL MINIMUM LOWER DIVISION CREDITS	62	62

BACHELOR OF SCIENCE IN ENVIRONMENTAL STUDIES

The Bachelor of Science in Environmental Studies (BSES) program is concerned primarily with interrelationships among the natural environment, people, and the human environment, including society's institutions. Its focus is on the relationship of people to the condition and form of the natural and manmade environment. The goal of the program is to educate students to be sensitive, articulate, and knowledgeable about complex environmental issues facing contemporary society.

The B.S.E.S. degree is granted at the end of four years and requires the successful completion of 125 credit hours. Students enter the program with up to 62 lower division credits. During their junior and senior years, students are required to complete a group of core courses in the humanities, natural, and social sciences. These include five courses required of all BSES majors to provide a common understanding of human-environment interactions from social, institutional, historical, natural science, and systems analytic perspectives. The particular emphasis of an individual student's program is determined by the development of two concentration areas investigating specific environmental concerns directly related to the student's career goals. Students are recommended to engage some integrative academic experience during their senior year that provides an opportunity to synthesize their environmental studies education.

The scope and complexity of coursework within the BSES program demands both discipline and commitment from students seeking this degree. A clear sense of purpose and objectives is necessary to engage the curriculum beneficially. To meet each student's objectives fully, a close working relationship between faculty and student is also necessary. The program's flexibility makes it especially suited for advanced undergraduates desiring a general environmental background in preparation for either graduate studies or environmental careers that may be entered with a baccalaureate degree.

Students receiving the B.S.E.S. degree have pursued graduate study in the disciplines of planning, landscape architecture, natural resource management, and other environmentally related areas such as business, education, and law. Students with academic standing in the top one-third of their class may apply at the end of their junior year for advanced standing admission to the College's graduate programs.

Prerequisites for Entry into the BSES Program

Because of the wide range of opportunities available to students who enter the BSES program, it is important that they prepare themselves with a broad range of lower division coursework. Understanding the issues involved in the condition and form of the environment requires a background in the humanities, natural, and social sciences. The accompanying table of required and recommended lower division coursework summarizes preparation for entering the BSES program.

Each applicant is required to submit a statement of program interest. This statement should describe how study in the BSES program will contribute to the student's educational and career goals. It should reflect an understanding of the curriculum and represent the student's preparedness to take advantage of the program's broad and flexible nature.

Bachelor of Science in Environmental Studies Curriculum

I. CORE REQUIREMENTS

	Credit Hours
A. *WRITTEN COMMUNICATIONS* ..... Coursework intended to develop a professional-level skill in written communication. Required are three credit hours in report writing or equivalent and LIB 300, a one-credit-hour course in library research.	4
B. *METHODS AND TECHNIQUES* ..... Coursework intended to develop methods and techniques useful for analyzing environmental information. Required are six credit hours, with courses in quantitative methods, statistics or computer applications preferred.	6
C. *ENVIRONMENTAL CONCEPTS AND SYSTEMS THINKING* ..... Coursework intended to develop critical facilities and systems thinking useful for an appreciation of the holistic nature of environmental issues. Required are six credit hours, including EIN 300 Introduction to Environmental Studies.	6
D. *NATURAL SCIENCES* ..... Coursework intended to provide a natural science foundation useful for understanding natural phenomena and processes. Required are nine credit hours, including EIN 311 Natural Processes in Planning and Design.It is recommended that the remaining courses have a laboratory or fieldwork component.	9
E. *HUMAN-ENVIRONMENT INTERACTIONS* ..... Coursework intended to provide a foundation for understanding the interaction of humans and the environment from social, institutional, and historical perspectives. Required are nine credits, including EIN 390 Social/Cultural Influences and Environmental Form, EIN 451 Introduction to City and Regional Planning, and either EIN 371 History of American Landscape Attitudes, or EIN 471 History of Landscape Architecture.	9
II. CONCENTRATION REQUIREMENTS ..... This coursework provides an opportunity to develop proficiency in two particular aspects of the interrelationship of the natural environment, people, society's institutions, and their influence on the condition and form of the physical environment. Two concentration areas of nine credit hours each are required. A maximum of three credit hours of independent study may be counted toward each concentration. Internship-type experience may not be counted toward a concentration. Concentrations are proposed by students after consultation with faculty and must be approved by the faculty advisor. Accepted coursework must be of grade C or better.	18
III. DIRECTED ELECTIVES ..... Eleven credit hours of coursework selected with the approval of the faculty advisor to complement core requirements or concentration areas. It may include a senior-year integrative academic experience. It is recommended that some integrative academic experience providing an opportunity to synthesize their environmental studies education be engaged by each student during their senior year. Possible alternatives include independent readings, a research project, an internship, a senior seminar, or an off-campus study. Each option has its own prerequisites and some have limited enrollments.	11
TOTAL MINIMUM UPPER DIVISION CREDITS	63

A total of 125 credit hours is required to complete the B.S. degree in Environmental Studies.

GRADUATE PROGRAM IN ENVIRONMENTAL SCIENCE

The collegewide Graduate Program in Environmental Science (GPES) offers M.S. and Ph.D. degrees in environmental science through a transdisciplinary program which draws upon faculty from across the College as well as selected faculty participants from Syracuse University.

The central mission of GPES is transdisciplinary education and research for effective resource use, resource conservation, and environmental enhancement and protection. Future environmental scientists and professionals will require sound knowledge of the traditional disciplines, as well as the understanding of a number of ancillary subject areas. Their effectiveness will be demonstrated through technology transfer that brings the science from the experimental to real world situations. The challenge lies in the translation of environmental awareness and concerns into well informed, scientifically-based action. It is here that the central role of a program like GPES resides: *Transdisciplinary education and research to foster the effective use of natural resources while protecting the environmental base from which all resources flow.*

Therefore, the Graduate Program in Environmental Science offers the following approaches to prepare the student to scientifically deal with environmental problems, and to perform as an effective environmental professional:

(a) *multidisciplinary approach*—recognition of the necessity to approach environmental problems with input from several disciplines and professions:
(b) *holistic philosophy*—awareness of and deference to the interdependence of elements (including physical, biological, and social systems, human behavior, and cultural values) within ecosystems;
(c) *sound grounding in at least one concentration*—competency to understand and apply the principles of an environmental area of study, and with that strength interact with other disciplines;
(d) *realistic experience*—through internships or other focused projects which provide direct interaction in social, economic, political, and social institutions which underlie decisionmaking; and
(e) nontraditional *problem solving* tools to permit a student to go beyond traditional disciplinary paths.

PROGRAM OF STUDY

Within the framework of POLICY, PLANNING, and REGULATION, there are six areas of concentration: ENERGY, LAND USE, WATER RESOURCES, URBAN ECOSYSTEMS, WASTE MANAGEMENT and ENVIRONMENTAL COMMUNICATION. These concentrations are designed to be broad-based; are not mutually exclusive and intergrade into each other to form a continuum; and some areas of pursuit belong to several concentrations, e.g., environmental assessment and impact analysis. Similarly, faculty interests are diverse and encompass more than one area of concentration.

Policy, Planning, and Regulation

Policy study, defined as the study of the nature, causes, and effects of alternative public policies, is the integrating force bringing all concentration study areas

together in pursuit of the common goal of meaningful and effective research and education in environmental science.

Hence, the examination of policy by decomposition into its components and the design and synthesis of new alternatives, or *policy analysis*, forms a central core of the program. Policies formulated on the basis of contemporary scientific knowledge together with the societal, economic, and cultural values, pave the way for planning and regulation for environmental issues.

Through the study of public policy, students gain an understanding of the causes and consequences of policy decisions which will help integrate environmental knowledge with the scholarship of public administration and political science. This integration is necessary because the careers of graduates will either be directly in the public sector, or closely linked with government agencies. Second, an understanding of the causes and consequences of public policy assists students to solve practical problems. Such understanding is valuable in developing strategies and tactics to accomplish desired objectives. Third, the knowledge of public policy causes and consequences creates political awareness, a virtual necessity for any professional irrespective of the sector of employment.

An excellent example wherein policy and scientific knowledge are intended to be brought together for decisionmaking is the National Endowment Policy Act of 1969. By this Act, environmental impact statements which consider alternative courses for every stipulated development that has the potential for adverse environmental impact have become institutionalized. The Act provided for active citizen participation; any decisions that invoked the spirit of the Act could be challenged.

Students can opt to specialize in environmental assessment analyses through studies in any one of the GPES concentrations. In practice, such analyses are team efforts, and the program is intended to ensure that potential team members are conversant with, and operationally adapted to, the language and procedures of the disciplines involved. Starting with students who have an undergraduate background in an established discipline or profession (e.g., chemistry, biology, engineering, ecology, forestry), the program seeks to build upon existing strengths while broadening the student's ability to deal effectively with the complex, interdisciplinary problems which arise in studies of environmental impact.

Areas of Concentration

LAND USE

The Land Use Concentration develops an understanding of present and future trends and issues patterns of land use and studies future availability of land for multiple uses. It provides opportunity for economic, sociological, political, policy, planning, and ecological foci. It brings together an interdisciplinary mix of coursework, internship experience or research to address land use value conflict situations, ecologically-based land use considerations of carrying capacity, and appropriate means to anticipate and plan for existing and new land development technologies and processes. The following objectives are important: (a) to foster appropriate use of policy, planning, economic and legal devices for encouraging socially responsible use of the land; (b) to clarify the behavioral and perceptual sources of environmental problems and land use decisions; and (c) to develop, test, and refine methods for evaluating land use proposals with important environmental consequences.

Recommended areas of study include, from (1) physical sciences: energy exchange, soils, remote sensing, visual landscape analysis, meteorology, and soil and water conservation; (2) biological sciences: terrestrial community ecology, wildlife management, and silviculture; (3) social sciences: land use economics, environmental impact, transportation systems, environmental law, and environmental communications.

WATER RESOURCES

The Water Resources Concentration develops an understanding of both the technical information and transdisciplinary relationships of various *water-related* issues. Individual programs may emphasize scientific or social subject areas but all students acquire preparation in both areas. Scientific aspects include the basic physical, chemical, and biological interactions occurring in aquatic ecosystems under natural conditions, as well as under modified conditions that result from changes in water quality or quantity. The social aspects are concerned with planning, regulation, law and institutions, and management of water resources. Both as a resource for many human benefits and uses, and as a critical environmental element, water serves as a focus for graduate study in pollution and water quality control, and water and related land resources management.

Recommended areas of study include, from (1) physical sciences: civil engineering, geology, geomorphology, hydrology, meteorology, sanitary engineering, soils, and water chemistry; (2) biological sciences: ecology, entomology, fishery biology, forestry, microbiology, water quality, wildlife management, and zoology; (3) social sciences: administration, economics, government, history, law, and policy.

URBAN ECOSYSTEMS

The Urban Ecosystems Concentration focuses on urban system structure and function using both analytic and synthetic techniques. Faculty expertise in soils, meteorology and hydrology, wildlife, energy and reclamation, forestry, design, and human attitudes and behavior combine to facilitate the systemic approach to the study of Urban Ecosystems. Three types of systems are available to the students for field work: (a) the nonmetropolitan community typical of Upstate New York rural areas, (b) the metropolitan central city surrounded by suburbs and agricultural lands, and (c) the megalopolitan seaboard extending from Boston to Washington, D.C.

Recommended areas of study include from (1) physical and engineering sciences: microclimate, water management, soils, remote sensing; (2) biological sciences: urban forestry, wildlife, greenspace silviculture, and botany; (3) social sciences: land economics, geography, human and cultural geography, and ecology.

WASTE MANAGEMENT

The Waste Management Concentration encompasses three subject areas: (1) *Toxic Waste Disposal*—Research into natural detoxification is an active and valuable component of waste management studies, and the nature, amounts and disposal/destruction in land fills, or by incineration, chemical neutralization, deep well injection, and ocean dumping are considered. (2) *Biomass Utilization*—Includes the use of forest and agricultural wastes and other forms of biomass that have a vast potential for energy production and as biochemical feedstock. (3) *Biogeochemical Management of Wastes*—Waste materials may have unique features due to their specific chemical and physical composition, their temporal and spatial location, and their possible contamination by toxic substances. These waste materials may have

useful nutrient and energy attributes which make them amenable for use through biogeochemical processes associated both with natural and manmade systems. They include wood product residuals, wastepaper, wastewater effluents, and sewage sludge.

Depending on subject areas chosen, students obtain an understanding of processes that generate waste; of community, chemical and microbial ecology; environmental chemistry including toxicology; wood chemistry; and implementation considerations including engineering and management components.

ENERGY

The Energy Concentration provides for study of fuel energy-environment-economy relationships with a focus in three areas: (1) *Conventional and Alternate Energy Sources*—the distribution, politics, and development of conventionally known sources (gas, oil, hydropower, coal, etc.) together with a search for strategies of exploring alternate sources; (2) *Conservation*—efficient use in industry, public and private sectors; and (3) *Reclamation of Disturbed Lands*—the rehabilitation of land mined for coal, tar sands, oil shales, and other materials and minerals. As an example, surface mining for coal is directly related to the overall energy scenario, and the use of coal will be intensified worldwide. This aspect of study is directly related to land use, water resources, air pollution, and waste management.

Recommended areas of study include, from (1) physical and engineering sciences: geology, chemistry, hydrology, engineering systems; (2) biological sciences: ecology, range management, forestry, agriculture; (3) social sciences: environmental law, sociology, and economics.

ENVIRONMENTAL COMMUNICATION

The Environmental Communication Concentration recognizes three general paths; (1) *Environmental Education and Interpretation*—Effective communication is a necessary element for fulfilling the social contact in democratic societies. A growing concern in the U.S. public for environmental quality reveals a new interest in the historic, cultural, and natural values associated with our environment. Education and interpretation provides a continuum of environmental knowledge from awareness and appreciation to scientific concept understanding. (2) *Environmental Journalism and Media*—Students who choose this path share the same general objective as in (1) above; however, they specialize in presentation through mass media. (3) *Public Participation*—More interactive roles in decisionmaking must emphasize the skills and techniques of public participation. Tasks usually start with soliciting public comprehensions and opinions concerning specific environmental issues, and then employing information dissemination and public interaction. Skills and knowledge in social psychology, public relations, message design and presentation, law and government must be applied.

Recommended areas of study include, from (1) physical sciences: environmental and organic chemistry, environmental geology, mineral resources, energy systems, and soil and water management and conservation; (2) biological sciences: ecology, entomology, and taxonomy; and (3) social sciences: planning, policy, information systems, and instructional technology, journalism, and law.

REQUIREMENTS

The academic requirements of the Graduate Program in Environmental Science are designed to provide graduates with a sound preparation to meet the challenges of the field as leading scientists and professionals. General programmatic requirements constitute a framework to ensure that the individual study program will meet the need for depth of knowledge in one chosen area of concentration, breadth across at least two areas, and training in the analysis and synthesis of attributes of environmental issues.

Each student must be adequately prepared for advanced work in the program. To demonstrate this, each student is required to have satisfactory coverage of basic sciences, professional training, and experience. Student must also have basic training in quantitative methods and demonstrate competence in them. Where preparation in these areas is found deficient at the time of entrance admission may be made on a provisional basis pending the successful completion of deficiencies.

Master of Science

1. Core: A minimum of 9 credit hours is required in general courses designed interactively with the chosen areas of concentration. The distribution of these credits is as follows:
   (i) Three credit hours in environmental policy to prepare the student's background in environmental science institutions and public decision-making as they pertain to natural resources of air, land and water, to resource economics, to waste management, and related topics.
   (ii) Three credit hours each in two areas of concentration supporting the chosen area of concentration in order to gain appreciation and knowledge of the interdependence of the processes and components of ecosystems.
2. Area of concentration: A minimum of 15 credit hours (excluding 898, 899, and 999 numbered courses) to ensure the depth of study in one chosen area supplemented by:

   (a) Thesis: Six credit hours of research resulting in a document which clearly demonstrates the graduate level accomplishments of the student, and is of a quality and scope suitable for publication in a scholarly journal; or

   (b) Internship: Six credit hours with a public, private or industrial organization, a graduating essay on the internship; and the successful completion of a comprehensive examination (credit hours determined by major professor and the student's advisory committee). Study projects in the past have included paid internships with such organizations as the National Wildlife Federation, New York State (NYS) Legislature, NYS Department of Environmental Conservation, NYS Energy Research and Development Authority, Agway, Inc., and Cablesystems of Syracuse.

   (c) Additional coursework: Eighteen credit hours followed by the successful completion of a comprehensive examination may be substituted for the thesis and internship options.

Doctor of Philosophy

Requirements for the doctorate are as follows:

1. Core requirements—coverage as stipulated for the Master of Science degree.
2. Credits—completion of at least three full-time academic years of graduate study beyond the baccalaureate degree or an equivalent that can be shown to accomplish the same goals.

3. Language and tools—as required by advisory committee.

4. Preliminary exam—an examination may be required of those admitted into a doctoral program to ascertain their level of understanding of the basic principles and techniques necessary to function effectively in that program. The results of the preliminary examination will be used to guide the major professor and student in determining the appropriate coursework necessary to complete that requirement for the doctorate.

5. Candidacy exam—must satisfactorily complete a candidacy examination covering the major field and, in a broader manner, allied fields in order to be advanced into the status of doctoral candidate.

6. Doctoral dissertation—a thesis must be completed and successfully defended in order for the doctoral degree to be awarded.

CONCURRENT DEGREES:

Concurrent degree programs are also offered between GPES and Syracuse University's Maxwell School of Citizenship and Public Affairs, S.I. Newhouse School of Public Communications, School of Management, and College of Law. Students seeking concurrent degrees with Syracuse University are advised to state that desire clearly in their applications; in such cases, students must also meet the entrance and degree requirements of the appropriate Syracuse University Colleges and Schools. However, students may not apply for the concurrent degree option until they have completed at least one semester of graduate level coursework and earned grades at a superior level.

THE FACULTY OF FOREST ENGINEERING

ROBERT H. BROCK, *Chairman*

ROBERT H. BROCK, *Chairman* (Photogrammetric and Geodetic Engineering, Mapping Systems)
DUGGIN (Agricultural Assessment, Remote Sensing, Physics), HASSETT (Environmental Engineering, Water Resources), HENNIGAN (Water Resources, Environmental and Water Quality Management and Policy), HOPKINS (Surveying, Site Assessment, Remote Sensing), LEE (Computers and Systems Engineering, Transportation and Equipment, Soil Mechanics), MCCLIMANS (Soils, Hydrology, Site Engineering), PALMER (Engineering Economics, Energy, Production and Harvesting Systems), TULLY (Structures, Engineering Hydrology, Water Resources).

A large portion of our nation's resources exists on forested and rural lands. These include: the increasingly valued renewable resources of timber, biomass and wildlife; the sustaining resources of water, soil and nutrients; and the derivative resources of paper, wood, and fibrous products and recreation and amenity values. Forest engineering is a unique field of engineering which is concerned with the design of systems and facilities to improve the sustained high quality yield of resources and multiple use benefits of goods and services from forested and rural lands.

The undergraduate curriculum in Forest Engineering provides a broad base of study and specialized education in engineering with an emphasis on site development for improved resource use and conservation. Instruction focuses on: locating and quantifying resources; designing harvesting, conveyance and transportation systems and networks for water and timber; designing structures, facilities and pollution abatement systems; and engineering planning for the development of sites and regions for multiple use.

Programs of advanced studies toward an M.S. or Ph.D. degree in environmental and resource engineering are offered. Individually designed programs provide graduates with sufficient understanding of the methodologies of scientific research and of the principles of engineering analysis or design to work with competence in resource related research, engineering design and management. There are opportunities for individuals who seek advanced education in such areas as water resources engineering, photogrammetry and remote sensing, transportation and soils, energy, environmental quality and environmental management, as well as forest engineering.

Because of the special importance of continual measurement and evaluation of the broad scaled parameters which affect the resource base, unique opportunities for study are available for students aiming toward professional careers involving the conceptualization, design, and maintenance of geographically referenced resource information systems. This includes elements of surveying, photogrammetry, remote sensing, and resource information systems design.

Undergraduate Program

The primary objective of this curriculum is to prepare qualified engineering graduates to operate with professional competence within the context of forest and natural resources development. The curriculum includes basic, forest, and engineering sciences. It utilizes elements of traditional engineering disciplines and develops its unique aspects from interweaving engineering design with an understanding of the natural environment and its renewable resource base including water, soil, timber, wildlife, and amenity values. Studies in the humanities and social and economic sciences are integrated throughout the curriculum to help achieve a broad and balanced perspective of professional practice in forest engineering.

Qualified graduates in search of advanced degree education enjoy ready acceptance to engineering graduate schools throughout the country. Graduates of the Forest Engineering curriculum may enter an established five-year program in either civil, industrial, or mechanical engineering at Syracuse University. A bachelor of science degree in engineering will be awarded by Syracuse University upon completion of the requirements of the fifth year.

To enter the Forest Engineering curriculum at the junior level, a transferring student must have acceptable college credit in the following coursework areas or be able to have suitable coursework substitutions for courses listed in the junior and senior years.

The curriculum in Forest Engineering is accredited by the Accreditation Board for Engineering and Technology (ABET).

TOTAL UPPER AND
LOWER DIVISION
ELECTIVE REQUIREMENTS

Humanities or Social Sciences: At least 9 credit hours must be elected in social sciences or humanities, at least 6 of which are recommended to be upper division. (If

Lower Division Courses

Course Area	*Credit Hours*
Biology (Botany preferred)	3
General Chemistry with Laboratory	8
Engineering Physics with Laboratory	8
Calculus through Differential Equations	15
English	6
Economics (Macro- and Microeconomics)	6
Engineering Drawing (Graphics)	1
Computer Programming	3
Engineering Mechanics (Statics and Dynamics)	4
Electrical Science	3
Humanities or Social Science Electives	3
TOTAL MINIMUM LOWER DIVISION CREDITS	60

Upper Division Courses

Junior Year			*Credit Hours*
First Semester	ERE 362	Mechanics of Materials	3
	ERE 371	Surveying for Engineers	3
	FOR 321	General Silviculture	3
	CIE 327	Principles of Fluid Mechanics	4
	EFB 335	Dendrology	2
	Elective		3
			18
Second Semester	FEG 340	Engineering Hydrology and Flow Controls	4
	FEG 350	Introduction to Remote Sensing	2
	FEG 363	Photogrammetry I	3
	MEE 285	Design of Mechanical Equipment	3
	APM 391	Engineering Statistics	3
	ERE 351	Basic Engineering Thermodynamics	2
			17

Senior Year			*Credit Hours*
First Semester	FEG 410	Structure I	4
	FEG 420	Harvest Systems Analysis	1
	FEG 430	Engineering Decision Analysis	3
	CIE 437	Soil Mechanics and Foundations I	4
	FOR 477	Resource Policy and Management	3
	Elective		3
			18
Second Semester	FEG 454	Tractive Power Systems	2
	FEG 437	Transportation Systems	3
	ERE 440	Water Pollution Engineering	3
	FEG 489	Forest Engineering Planning and Design	3
	Elective in Engineering Design Sequence		3
	Elective		3
			17
		TOTAL MINIMUM UPPER DIVISION CREDITS	70

lower division English coursework does not include at least 3 credit hours of humanities coverage, then an additional 3 credit hours of humanities are required.) Humanities coursework deals with branches of knowledge concerned with man and his culture, while social sciences coursework concerns individual relationships in and to society. Traditional subjects in these areas are philosophy, religion, history, literature, fine arts, sociology, psychology, anthropology, economics, and modern languages beyond the introductory skills courses, while modern nontraditional subjects are exemplified by courses such as accounting, industrial management, finance, personnel administration, ROTC studies, and skills courses, such as public speaking and technical report writing, do not fulfill the humanities and social science content.

Engineering Sciences: Electrical Science and coverage of Dynamics (separately or in combination with Statics) are required.

Engineering Design: At least 3 credit hours are required in upper division engineering coursework as part of an advisor approved sequence which complements other forest engineering coursework and provides the equivalent of at least 1 credit hour of depth in the design and synthesis component of the program, such as:

Design of Wood Structural Elements
Structures II
Soil Mechanics II
Air Pollution Engineering
Introduction to Design
Synthesis of Mechanical Systems

A total of 130 credit hours is required to complete the B.S. degree in Forest Engineering.

Graduate Program

Through the program in environmental and resource engineering, the Faculty participates in graduate education leading to the Master of Science and Doctor of Philosophy degrees.

Graduate studies and research are primarily concerned with environmental and resource related programs. Individual study programs leading to the master of science and doctor of philosophy degrees are available to meet the students' needs and interests in graduate study. Successful programs of graduate study may be efficiently designed by students with bachelor of science degrees or in engineering or in forestry, natural sciences, physics, or mathematics.

Study programs with emphasis on environmental and resource engineering measurements may be designed in remote sensing, photo interpretation, geodetic engineering, analytical photogrammetry and photogrammetric systems. Programs emphasizing engineering analysis and design are available in water resources, environmental engineering, water quality management engineering, energy, transportation, harvesting and site engineering systems. Included are the monitoring, measurement and evaluation of physical parameters affecting water, soil, timber, vegetation, and wildlife.

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 in the Engineering School at Syracuse University. Exceptional support exists for programs in environmental engineering measurements in the form of remote sensing and photogrammetric laboratories and the extensive forest properties owned by the College at which research may be conducted.

External support comes from several active sources, including industrial, commercial and governmental. Over the past two decades, close cooperation has developed special study and research opportunities with these sources.

THE FACULTY OF FORESTRY

JOHN V. BERGLUND, *Chairman*

JOHN V. BERGLUND, *Chairman*
(Silvics, Silviculture)

Syracuse Campus

ABRAHAMSON (Entomology, Pathology, Pesticides), BENNETT (Economic Theory, Economic Thought in Forestry), BICKELHAUPT (Nursery Soils, Forest Soils), BLACK (Water and Related Land Resources), BRIGGS (Forest Soils), BURRY (Forestry Extension, Wood Utilization), CANHAM (Forestry Economics, Regional Economics, Natural Resource Economics), COUFAL (Silviculture, Forest Education), CRAUL (Forest and Urban Soils), CUNIA (Operations Research, Biometry), DALL (Environmental Law and Policy), DREW (Tree Physiology, Forest Autecology), ESCHNER (Forest Influences, Forest Hydrology), GRATZER (Forest Recreation, Forest Management), GRAVES (Forest Resource Policy, Planning and Management), HALLIGAN (Silviculture), HERRINGTON (Forest Management-Computers, Micrometeorology), HORN (Forest Management, Law), HOWARD (Silvics, Forest Management), KOTEN (Forest Management, Management Science and Planning), MAYNARD (Tree Improvement), MONTEITH (Forestry Economics, Land Use), MORRISON (Forestry Extension and Continuing Education, Forest Recreation), NYLAND (Silviculture, Forestry Practice), PETRICEKS (Resource Economics, International Forestry Economics), RICHARDS (Silviculture, Urban Forestry), STITELER (Statistics), WHITE (Forest Soils, Silviculture).

Forest Technology Program—Wanakena Campus

MARTIN (Mensuration, Tree Physiology and Morphology, Wildlife Ecology), MILLER (Forest Roads, Installations, Aerial Photogrammetry, Graphics, Recreation), REMELE (Ecology, Silviculture, Surveying), SUHR (Dendrology, Soil and Water Measurements, Forest Protection).

Adjunct Faculty

CZAPOWSKYJ (Forest Soil Science), HEISLER (Meterology), HORSLEY (Silvics), MARQUIS (Silviculture), ROWNTREE (Urban Forestry), SLOAN (Policy), TABER (Renewable Resources, Extension Program), YAWNEY (Silviculture).

Undergraduate Program in Resources Management (Forestry)

Forestry is a field-oriented profession, but increasingly, the forester must learn to manipulate the forest to produce goods and services in the context of societal needs and constraints. Further, the forester must be able to articulate his or her position or viewpoint to the public. It is these attributes that the curriculum in forestry attempts to instill in its students.

The successful management of forests and related resources involves many different people working together as teams to bring their special expertise to bear on problems created by society's demands upon forest resources, including timber, forage, water, wildlife, and recreation values. The Faculty of Forestry presently offers three undergraduate degree programs designed to allow students choice to fit into different parts of the interdisciplinary multi-level teams mentioned:

1. A professional forestry and resource management degree program, at the bachelor's level, offered at the Syracuse Campus.
2. A dual major program that meets the bachelor's degree requirements of both the forestry and the environmental and forest biology curricula. For details of this program see p. 56.
3. A forest technology degree program at the associate's level, offered at the Wanakena Campus, with transfer to the B.S. program possible. For details of this program see p. 53.

Since the dual biology/forestry program and the forest technology program are covered in separate sections, the following discussion pertains to the professional forestry and resource management program.

The forestry program prepares students to manage forests and related resources and their environments for human benefit, with the goal of sustained production integrated with protection and enhancement of the environment. Through a carefully designed sequence of required and elec-

Lower Division Courses

Course Area	*Credit Hours*
Biology (Botany and Zoology preferred) with Laboratory	8
General Chemistry with Laboratory	8
Physics I with Laboratory	4
Calculus I	3
Economics (Microeconomics required)	3
Political Science (U.S. Institutions)	3
Introductory Sociology **OR** Introductory Psychology	3
Computer Programming (Language)	3
*English	6
**Social Science/Business Electives	9
***Mathematics/Physical Science Electives	6
****Free Electives	8
TOTAL MINIMUM LOWER DIVISION CREDITS	64

*Standard freshman English sequences are acceptable, but where possible the student is strongly urged to take technical report writing.

**Courses in sociology, psychology, U.S. history, macroeconomics, political science, anthropology, U.S. geography, business, finance, or accounting.

Note: Students may be admitted with only 9 credit hours of the required or elective courses in economics, political science, psychology/sociology and social science/business areas. The remaining 9 credit hours of deficiencies must be made up as early as possible in the student's ESF program, including the use of summer sessions.

***Courses in mathematics, physics, chemistry, ecology, computer science, meteorology, logic. Math courses must be of a level equivalent to Calculus II or be in some way complementary to Calculus I.

****Free electives and electives in the specified categories should be chosen with the clear idea that they are in preparation for an upper-division, professional program. Courses in the free elective category that have been found to be helpful include personnel management, group dynamics, technical report writing, speech, foreign language, logic, pre-calculus math, first aid and CPR, graphics/drafting, surveying, real estate, marketing, conservation law, ecology, dendrology, plant pathology, philosophy, religion, fine arts or other arts, sciences, or business courses. Free electives can also include further courses from the directed elective categories. All electives should be chosen with the particular career goals of a student in mind.

tive courses, students gain knowledge of the principles of forest ecology, quantitative measurements, economic and managerial policy and administration. The elective program allows students to develop areas of concentration in forestry that meet his or her particular interests.

Field exercises and "hand-on" experience are features of the program. The sequence begins in a summer field program of seven weeks at ESF's Warrensburg Campus, required prior to registration for the junior year. This session emphasizes field skills and techniques, and briefly introduces ecological concepts. It serves as the major avenue of entrance into the professional forestry curriculum.

The field orientation is continued in the junior year by a highly integrated, blocked, team-taught program comprised of an introduction to the physical environment (soil, meteorology, hydrology) and a study of its influence on tree growth and development, and how the forest may be manipulated to take advantage of these responses (silvics-silviculture). The summer program and fall semester total 24 credit hours of field-oriented core courses, and as part of the conditions for admission to this curriculum, applicants must be willing and able to work effectively in the field under a wide range of terrain and weather conditions. Any questions or concerns about this requirement should be discussed with the Director of Admissions.

The remaining core curriculum develops management principles and models of decisionmaking processes applied to forest resources, together with further study of quantitative measurements. These courses, along with the field-oriented ones, form a core of required upper division work, totaling 42 semester hours, which present basic principles and practices underlying the purposeful management of forest and related resources for optimum production and use of any one, or combination, of their potential products and services.

Extensive elective opportunities, totaling about one-fourth of the curriculum, allow students to shape their programs to meet individual needs and interests. In a broad sense, electives may be chosen to provide extensive coverage of either forest resource science or management, and they may be oriented toward immediate employment or as a base for graduate study. For example, one student might distribute electives to cover all areas of forestry's multiple-use, while another might concentrate electives in areas such as timber, watersheds, forest wildlife, recreation, entomology, pathology, soils, international forestry, or urban forestry.

Electives may also be taken at Syracuse University, usually to add to a student's general education or to gain knowledge of an area of business management, communications, geography or other similar topics not offered at ESF. Judicious use of electives, and in some instances meeting certain standards, allows students to (1) develop capabilities for service in a variety of fields pertinent to renewable natural resources and the environment, but not specifically forestry oriented, such as working to obtain provisional certification for teaching secondary science with some additional coursework, or (2) to prepare for selected career options within the resource and forestry area, as by obtaining a minor in management through Syracuse University's School of Management. Elective course selections must be approved by a student's faculty advisor, and it is very important that they be planned early in the student's program.

A significant feature of the elective component of the professional forestry and resource management curriculum is that the spring semester of the senior year consists wholly of electives and thus is available for a variety of independent or group study activities. These may be conducted in whole or in part of any one of the College's several campuses, or off campus at another

Upper Division Courses

Course Area			*Credit Hours*
Summer:	[1]Summer Program in Field Forestry		
	FOR 301	Field Dendrology	1
	FOR 302	Forest Surveying and Cartography	2½
	FOR 303	Introduction to Forest Mensuration	3½
	FOR 304	Introduction to Forestry	1
			8

[1]SUMMER PROGRAM IN FIELD FORESTRY—7 weeks, 8 credit hours: Required of all students (except Forest Technology Program and Paul Smith's Forest Technician Program graduates) prior to registration for junior year.

Junior Year			
First Semester	FOR 305	Forestry Concepts and Applications	1
	FOR 322	Forest Mensuration	1
	FOR 331	Introduction to the Physical Environment	6
	FOR 332	Silvics-Silviculture	8
			16
Second Semester	FOR 360	Principles of Management	3
	FOR 370	Management of the Forest Enterprise	3
	APM 391	Introduction to Probability and Statistics	3
	[2]Electives		6
			15
Senior Year			
First Semester	APM 492	Forest Biometrics	3
	FOR 400	The Social Environment of Resource Management	3
	FOR 461	Management Models	3
	[2]Electives		6
			15
Second Semester	[2]Electives		17
		TOTAL MINIMUM UPPER DIVISION CREDITS	71

[2]In the undergraduate curriculum in Forestry, one-half of the elective credits must be taken in programs of ESF on the Syracuse Campus. More specifically, this means that at least one 3-credit-hour elective course must be taken in each of the following 6 categories: (1) Division of Engineering; (2) Chemistry; (3) Landscape Architecture; (4) Environmental Studies; (5) Environmental and Forest Biology; and (6) Forestry.

A total of 135 credit hours is required to complete the B.S. degree in the Professional Forestry and Resource Management Curriculum.

institution, in cooperation with some resource management agency or firm, or in conjunction with an overseas academic program operated by the College. Proposals for off-campus study must be well planned. They are subject to faculty review and approval and are carried out with varying degrees of faculty guidance to ensure adherence to academic standards. Utilization of the spring senior semester in such a fashion may result in the need for a fifth semester to meet graduation requirements.

A total of 135 credit hours is required to complete the B.S. degree curriculum. For students contemplating entrance to the program, it is required that they have completed at least 64 semester credit hours or have earned an associate degree, and further, that a minimum of 56 of these credits be distributed among specific course areas as outlined below. The maximum number of freshman-sophomore semester credit hours which may be transferred is 64. Students who have completed more than 64 lower division credits may transfer up to 12 additional hours of junior-senior level courses and should seek advice on upper division credits at the time of matriculation. The professional forester must understand both the biological and social influences that affect the use of forest resources. Prospective students should choose lower division elective courses that will serve to broaden and enhance their understanding in the social and political sciences, humanities, and communication skills.

Graduate Education

FOREST RESOURCES MANAGEMENT

Graduate education in forestry builds upon the basic foundations of knowledge and skill acquired by students in professional undergraduate curricula, or in other fields important to Forest Resources Management. Graduate study programs are created to suit the needs of each individual student and are designed to prepare the student for careers in resource administration, management, scientific research, professional education, and a variety of other specialized positions in public and private employment related to forest resources management. Students with nonforestry bachelor's or master's degrees with strong interest in Forest Resources Management are encouraged to apply.

The practice of forestry is based on a number of fields of science ranging from applied physics to sociology. Graduate study in forestry focuses on one or more of these fields in the context of resources management. Understanding the ecosystem as a provider of goods and services and as a modifier of the physical environment is the thrust of silviculture-culture of the forest. The fields of meteorology, soils, hydrology, and silvics (forest ecology) support study and research in silviculture. Tree improvement is the science and practice of improving the forest through genetics. The societal environment in which forests are managed is founded in the study of public and private policy and forestry economics. Forest management provides the bridge between the biological and societal components of forestry and focuses on timber and multiple use management. Recreation management and watershed management are additional areas of focus within the general area of forest management. Quantitative methods, urban forestry, and international forestry encompass the wide range of forestry activity but focus on specific aspects of Forest Resources Management.

AREAS OF SPECIAL INTEREST

Twelve areas of *Special Interest* in the Forest Resources Management program are listed below with examples of current faculty and student interest and activity. These examples are meant only as highlights. Highlighting these areas of special interest should not imply compartmentalization of study; most students have programs of study which encompass two or more areas, and students are encouraged to develop integrative programs.

(The subheadings indicate the current activities and interests of the faculty and their graduate students and do not indicate the full range of faculty interests.)

POLICY AND ADMINISTRATION
- Administrative organization and management
- Policy issues and analysis
- Program implementation

FORESTRY ECONOMICS
- Regional economic impacts
- Economics of nonmarket goods
- Timber and wood using industry economics

FOREST MANAGEMENT
- Resource information systems
- Resource planning and scheduling
- Forest operations
- Timber and multiple-use management

RECREATION MANAGEMENT
- Regional development and tourism
- Recreation resource planning
- Wilderness and river recreation

SILVICULTURE
- Hardwood silviculture (N. Hardwoods, Oaks)
- Conifer plantations
- Biomass production
- Greenspace silviculture

SILVICS
- Tree physiology
- Forest ecology
- Stand dynamics

FOREST SOIL SCIENCE
- Acidic deposition
- Soil physical properties
- Morphology and classification
- Soil chemistry/fertility

TREE IMPROVEMENT
- Clonal propagation/Tissue culture
- Genetic selection and testing
- Seed orchard management

WATERSHED MANAGEMENT
- Hydrology
- Snow hydrology
- Soil and water conservation
- Meteorology/micrometeorology

QUANTITATIVE METHODS
- Statistics
- Forest inventory/mensuration
- Computer applications/modeling
- Operations research/systems analysis

URBAN FORESTRY
- Urban soils
- Urban climate
- Urban forest management/planning
- Urban tree management

INTERNATIONAL FORESTRY
- All phases of forest resources management

The areas of special interest and associated faculty are more fully described below.

STUDY PROGRAM FORMULATION

Each graduate student has selected or is assigned a Faculty Advisor to act as the director of his or her program of study. The student and Faculty Advisor are assisted in planning the student's program and in determining successful completion of the program by at least two other faculty members. These faculty members serve as the student's Steering Committee.

Master's Degree Program

All three of the College's master of science options (thesis, professional experience, or coursework) are available to students in the Forest Resources Management Program. The appropriate option is selected by the student in consultation with

the student's Committee. The master's degree usually takes 2 years of study to achieve.

Doctoral Degree Program

Although doctoral study is usually built upon a master's degree, it can be undertaken directly after a baccalaureate degree. There is no minimum credit requirement for the doctoral program, but usually 30 hours of formal coursework beyond that required for the master's degree is taken. Written and oral candidacy examinations, intended to test the student's mastery of subject matter essential to the student's dissertation topic, and an oral defense of dissertation examination are required. A preliminary examination may be required prior to the candidacy examination. The student's Committee may require languages or other tools be included in the student's program.

Joint Study with Other Faculties of the College

In a number of areas, particularly forest biology, joint programs of study can be established which formally include faculty from other Faculties of the College.

Joint Degree Programs with Syracuse University

Joint degree programs which provide the student with two master's degrees, one from the College and another from Syracuse University, are available with the following Syracuse University Schools:

School of Management
Maxwell School of Public Administration
College of Law
Newhouse School of Communication
School of Education

The joint degree programs usually add an additional year to a normal master's program of study. To be eligible a student must have been matriculated at the College at least one semester and have a grade point average of 3.500 or above.

AREAS OF SPECIAL INTEREST DESCRIPTIONS

POLICY AND ADMINISTRATION

Participating Faculty: DALL, GRAVES, HORN

Graduate study in the area of resources policy and administration is designed to prepare students for leadership positions in the broad range of responsibilities at the planning, budgeting, programming, and operating levels of public agencies and businesses. The expanded role of federal and state government oversight over resource use and land management has brought substantially increased need for thorough understanding of policy matters, legal requirements, and governmental and political interactions with resource owners and users. Programs of study include advanced courses, seminars and special problems structured around these needs and the complex interrelationships of society and resources. Students are encouraged to round out their academic programs through courses offered by other units of the College as well as Syracuse University's Graduate School of Citizenship and Public Affairs, School of Management, or other graduate units. Students with undergraduate preparation in forestry, liberal arts, engineering, or other areas who have strong interest in resource administration and policy can be served through the creation of a study program that complements work already taken. The broad array of courses and the diverse points of view available allow the student to build a program to meet specific career objectives.

FORESTRY ECONOMICS

Participating Faculty: BENNETT, CANHAM, MONTEITH, PETRICEKS

Graduate study in forestry economics can be undertaken by the student with an undergraduate degree in forestry or forest products. By adding courses in forestry, the program can also serve the graduate in liberal arts, engineering, or business. The goals of study in this area are depth of understanding and familiarity with economic tools contributing to making competent decisions in resource economics, management, and policy. The core of the student's program consists of courses in forestry and resource economics. In addition, the student must be aware of the social and biological environment in which forestry economics is applied. Thus the core program is supplemented by courses in general economics, statistics and operations research, resource policy, business administration, and related managerial and biological fields. The course offerings and facilities of the College, and Syracuse University are actively drawn upon.

Individual programs are tailored to fit the student's particular interest. Some examples are: the economics of timber management, land use economics, economics of natural environments, economic development, and forestry. Graduates with the master's degree find employment typically as forest economists or resource analysts with federal and state agencies, and with private industry. Graduates with the Ph.D. usually find careers in teaching or research.

FOREST MANAGEMENT

Participating Faculty: BURRY, GRATZER, GRAVES, HERRINGTON, HORN, KOTEN

Forest management focuses on the planning and implementation processes necessary to achieve integrated use of forests and associated natural resources. The educational objective is to develop expertise sufficient for capable, professional resource management under a variety of natural and societal environments.

The study of forest management requires a broad knowledge of both the natural and social environments as the basis for an understanding of the way in which these environments affect or are affected by the development and utilization of forests and associated wildlands. Implementation of plans also requires an understanding of the social environment as well as the managerial process to facilitate working with people both inside and outside of the organization.

Study programs are flexible, and a student may pursue a special interest in a single product, several products or services, tools and processes of planning for integrated forest use, or in developing managerial skills. The emphasis of the program, however, is in the application of the skills and knowledge to the management of forest lands. Where appropriate, courses may be taken at Syracuse University's School of Management and the Maxwell School of Public Administration to complement the course offerings of the College. Recent graduates have found employment with private and public organizations that own, manage, use, or relate in more indirect ways to forest resources. Students with the doctorate have pursued employment in research and teaching.

RECREATION MANAGEMENT

Participating Faculty: GRATZER, GRAVES, MORRISON

Graduate study in this area equips students with a broad understanding of the nature and purposes of outdoor recreation and how they relate to natural resources,

and builds the skills necessary for capable recreation management.

Individual programs combine study in resources management with relevant studies in the social and political sciences and the development of analytical capabilities needed to implement plans and programs. Other schools of the College and of Syracuse University, treating such areas as planning, engineering, design, and education, provide a wide range of supporting courses and facilities.

WATERSHED MANAGEMENT/ HYDROLOGY

Participating Faculty: BLACK, ESCHNER, HERRINGTON

Forest influences include all the effects resulting from the presence of forest trees and associated vegetation on climate, the hydrologic cycle, erosion, floods, and soil productivity. Health considerations and human comfort have often been included in older definitions of forest influences, and are assuming greater importance today with our growing concern for the environment.

Included among the principal studies in this area are energy exchange between forest and atmospheres; moderation of urban environments by vegetation; soil and slope stability; and watershed hydrology, including snow.

Graduates fill a variety of positions in research, teaching, and public and private management as watershed management specialists, hydrologists, environmental officers, meteorologists, and ecologists.

SILVICULTURE

Participating Faculty: ABRAHAMSON, BERGLUND, COUFAL, HALLIGAN, HOWARD, RICHARDS, WHITE

Classical silviculture is the theory and practice of the manipulation of forest ecosystems, including the control of vegetation establishment, composition, growth, and quality. The nature of cultural treatments, the theories upon which they are based, and the biological, physical, and social constraints to their implementation are stressed in this area of specialization. Forest vegetation is considered from the dual standpoints of fulfilling goals for the production of goods and services and maintaining or enhancing productivity for the future.

The student specializing in silviculture progresses through formal coursework and research toward an understanding of the effect of various cultural treatments on the balanced, sustained supply of wood, water, wildlife, recreation opportunities, and amenity values. One major area of emphasis within this specialization relates to treatment of tree stands for their continued production of wood products and other commodities. Another emphasis centers on the treatment of stands that are managed for several values simultaneously, where the harmonious integration of uses is of concern. A third emphasis focuses on evaluation and manipulation of vegetation systems primarily for their on-site values, such as in wilderness and recreation areas, highway and utility rights-of-way, mining and other wasteland reclamation, and urban greenspace. This involves a broad interpretation of forest ecosystems that includes herbaceous and shrub systems as well as silvics.

SILVICS

Participating Faculty: BERGLUND, DREW, HOWARD

Silvics is the branch of forestry which provides the scientific basis for the cultural treatment of forest vegetation by (1) studying and defining interrelationships within forest ecosystems and (2) cataloging intraspecific characteristics of tree species. In a sense, silvics is the ecology of managed forest ecosystems, although unmanaged and natural forests are often studied intensively to provide the benchmark conditions from which the silviculturist begins.

The specialist in silvics must maintain channels of communication with colleagues in the basic disciplines, including those in soil physics, soil chemistry, micrometeorology and climatology, genetics and tree breeding, plant ecology and physiology, wildlife biology, entomology, and pathology. In addition, certain tools, including a comprehensive knowledge of probability and statistics, the ability to use modern computers effectively, and a familiarity with measurement and sampling theory, are required by specialists in silvics.

The specialist in silvics is essentially at one focal point of much of what has been called fundamental forest research. The most useful function and worthwhile contribution to the field of forestry may very well depend on the ability to synthesize relevant material and, through experimentation, provide the silviculturist with information and possible techniques for use in the cultural treatment of forest vegetation.

FOREST SOIL SCIENCE

Participating Faculty: CRAUL, WHITE

Graduate studies in this area of specialization may be directed toward aspects of soil science related to the quantity and/or quality of goods and services produced in the management of resources of nonagricultural lands, and the impact of management practices on environmental quality. These include soil moisture, soil temperature, and nutrient element status interrelationships in the evaluation of soil productivity; evaluation of ecosystems to quantify nutrient element balances and cycling; amelioration of soils for increased productivity; and impact of various land-use practices on soil productivity.

Modern well-equipped laboratories are available for graduate student use in plant, soil, and water chemical analyses; soil water-holding capacity and compaction; infiltration and runoff; and other chemical and physical property investigations. The extensive College properties noted previously permit forest soil research to be conducted under a wide variety of environments and ecological conditions.

TREE IMPROVEMENT

Participating Faculty: MAYNARD

The objective of a tree improvement program is to develop populations of trees that are well-adapted, rapid growing, and disease-free. Other possible objectives may be to increase the aesthetic or recreational value of forest trees through selection for other traits.

Modern, well-equipped laboratories and greenhouses are available for graduate student use. Many established test plantations are available for collection of materials and field evaluations. Graduate students will take formal coursework in plant biochemistry and physiology, statistical genetics, and plant breeding. This specialization prepares graduates for positions in seed orchard management, tree improvement, and forest genetics with private, state, and federal organizations.

INTERNATIONAL FORESTRY

Participating Faculty: DREW, PETRICEKS

Graduate education in international forestry is designed for individuals who want to pursue internationally-oriented careers in forestry and related fields.

Instruction is aimed at supplementing and enriching the student's technical for-

estry knowledge and providing the broad background deemed necessary for effective service in a variety of professional circumstances. These include forestry advisor, teacher, or research specialist with national and international agencies, private business and industrial firms, philanthropic foundations, and voluntary service organizations whose activities include the development and use of forest resources in other lands.

At the master's level, program emphasis is on the attainment of general competence in research methods, foreign languages, cultural anthropology, world geography, and international affairs, plus a solid understanding of the world forestry situation. At the doctoral level, the program focuses on a specialized discipline area such as forestry economics, forest policy and administration, forest management, or silviculture, and others. Orientation to the world forestry field is achieved in part through the selection of formal coursework, and in part through providing an opportunity for the student to conduct thesis research in residence abroad.

A wide variety of course offerings are available to support the nonforestry elements of this area of study through Syracuse University. Opportunity for field training and research in tropical forestry and related fields is available to qualified candidates.

URBAN FORESTRY

Participating Faculty: CRAUL, HERRINGTON, RICHARDS, ROWNTREE

Graduate study in urban forestry allows the student to pursue either of two broad objectives. Professional Urban Forestry skills may be broadened in the many areas of information important to the practice of forestry in urban and urbanizing areas through advanced coursework and applied research. More specialized study may be pursued in research and study in soils, greenspace ecology, atmospheric science, forest science, tree improvement, forest resource inventory and evaluation, resource economics, and planning. There is strong interaction with other urban-related areas of study within the College, including remote sensing, botany, pathology, entomology, wildlife ecology, and landscape architecture. Academic departments in the Maxwell School of Public Affairs at Syracuse University such as Geography, Economics, Political Science, and Sociology, cooperate with teaching and research programs in urban forestry. The U.S. Forest Service Northeastern Forest Experiment Station maintains a permanent staff of scientists in their Urban Forest Research Project on campus who are engaged in studies dealing with the planning and management of urban forest ecosystems.

QUANTITATIVE METHODS

Participating Faculty: CANHAM, CUNIA, HERRINGTON, HORN, KOTEN, STITELER

Study in the area of quantitative methods is designed to develop professionals skilled in the application of mathematical, statistical, and computer-based problem analysis and solution. Study in this area is designed primarily for students with undergraduate degrees in areas such as biological sciences, forestry, wildlife, or agriculture who wish to strengthen their quantitative skills or with degrees in mathematics, statistics, and computer science who wish to focus on resources management. Students may concentrate in statistics, operations research, biometry, or forest mensuration, econometrics, and computer applications development. Syracuse University's computer facilities, the Center for Advanced Technology in Computer Application and Software Engineering, and a wide range of courses in mathematics, statistics, and quantitative methods provide strong support for activities in this area.

RANGER SCHOOL—FOREST TECHNOLOGY PROGRAM

History and Description

In 1912, some 1,800 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 over 3,000 graduates, most of whom are now working in a variety of forest activities, and it has earned the Wanakena Campus a national reputation for excellence. The Program is administered by and is an integral part of the Faculty of Forestry. This relatively unique model of a single professional Faculty offering all levels of work from the technician through post-doctoral emphasizes the teamwork approach to forest resource science and management espoused by the Faculty.

The two-year curriculum trains students in forest technology. The degree of Associate in Applied Science in Forest Technology (A.A.S.) is awarded. The objectives of the curriculum are to provide students with a knowledge of the field practice of forestry as related to forestry managerial needs; the ability to work and communicate effectively with professional and paraprofessional forestry personnel; and an understanding of the sciences and practices of forestry with some emphasis on ecological applications.

Graduates are generally classified as forest technicians, forestry aides (or surveying technicians) 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. (Surveying firms employ 25 percent or more of the graduates each year to work with crews on road, boundary, right-of-way, mapping, construction, and exploration applications of plane surveying.)

The curriculum is designed to allow graduates immediate job entry at the technician level. Students interested in a baccalaureate degree in forestry and resource management should investigate the Faculty of Forestry's bachelor's degree curriculum described on page 48. It should be understood that transfer into the Faculty of Forestry's professional forestry curriculum, and other ESF bachelor's degree programs, is possible upon completion of the A.A.S. degree at Wanakena.

If a student feels transfer to a baccalaureate program is a possibility after graduation from the Forest Technology Program, he or she should pay close attention to the footnotes under "Freshman Year" on page 54.

The freshman year forest technology curriculum consists of general studies' courses which may be taken at any accredited four-year college, or agricultural and technical institute except Farmingdale or Alfred (although transfer credits from these schools are acceptable otherwise).

The second year of the curriculum is offered at the Faculty of Forestry's Forest Technology Program on 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 relationships between forest technology and managerial needs. About fifty percent of the studies are devoted to field exercises, most of which are held on the School's forest. This managed forest, containing both hardwood and coniferous species, covers an

area some 3½ miles long with widths varying up to 2¼ miles. On two sides, the forest is bounded by State Forest Preserve lands. The forest is also adjacent to several square miles of virgin timber within the Adirondack Forest Preserve. This excellent forest backdrop for the technology program provides a diverse laboratory for instructional purposes.

Since the Program is situated within a forest environment, some applicants may mistakenly believe that the forest technology program is one of forest lore and wilderness survival. It is, therefore, strongly emphasized that the forest technology curriculum demands high quality academic achievement. Students cannot complete the program without 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, at no additional expense to the student, are made during the year in connection with courses in dendrology, silviculture, forest management, forest recreation, wildlife ecology, and surveying.

LIFE AT WANAKENA

The Wanakena Campus 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.

The main building consists of a central service unit with dormitory wings on either side. The central unit contains classrooms, laboratories, a student lounge, faculty offices, the library, a kitchen, dining room and 47 student rooms, each housing two students.

Faculty houses are nearby on the campus. Other buildings include a maintenance shop, garages, a sugar house, and storage buildings.

The close proximity of faculty offices and student quarters and the intensive fieldwork 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 forest technology curriculum at the Wanakena Campus are required to live in the campus's dormitories. An exception may be made for married students who bring their families and rent their own 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 Wanakena Campus does not maintain an infirmary, nor does it employ a physician or nurse. There are two physicians and a dentist as well as an excellent Community Hospital in nearby Star Lake, New York. 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 through ESF's Office of Student Affairs and Educational Services.

Because of the comparatively isolated location of the Wanakena Campus, a stock of books and supplies used in connection with the second year of the program is

FOREST TECHNOLOGY CURRICULUM
(Associate of Applied Science Degree)

Freshman Year — *Credit Hours*

(Completed at a college of the student's choice)

	Credit Hours
[1]General Biology	6-8
English (a technical report writing course is highly recommended)	6
[2]Math	4-6
Economics	3
[3]Electives	7
	30

[1]Courses selected may be in general biology, but at least one course in introductory botany is preferred.

[2]Competency in plane trigonometry and college algebra is required. If demonstrated, credits become electives. If students feel transfer to a baccalaureate program is a possibility, they would be well advised to take calculus.

[3]If a student feels transfer to a baccalaureate program is a possibility, general chemistry and physics should be taken as electives. Otherwise, courses in sociology, psychology, political science, geology, soils, accounting, business, computer science, etc. are desirable electives.

Senior Year — *Credit Hours*
(Wanakena Campus)

First Semester	FTC 200	Dendrology I	2
	FTC 202	Plane Surveying I	4
	FTC 204	Forest Mensuration and Statistics I	3½
	FTC 206	Forest Ecology	3
	FTC 207	Aerial Photogrammetry	2
	FTC 208	Forest Installations	3
	FTC 213	Forest Protection I	2
	FTC 223	Graphics	1
			20½
Second Semester	FTC 203	Plane Surveying II	1
	FTC 205	Forest Mensuration and Statistics II	2
	FTC 209	Forest Roads	2
	FTC 211	Silviculture	2½
	FTC 214	Personnel Management	1½
	FTC 215	Timber Harvesting	2
	FTC 217	Forest Management	3½
	FTC 218	Forest Recreation	1½
	FTC 219	Elements of Wildlife Ecology	1½
	FTC 221	Soil and Water Measurements	1½
	FTC 227	Forest Protection II	2
	FTC 228	Structure and Growth of Trees	1½
	FTC 229	Silviculture II **or**	2
	FTC 230	Plane Surveying III	
			24½

A total of 75 credit hours is required. Upon satisfactory completion, an Associate of Applied Science (A.A.S.) degree of Forest Technology will be awarded.

maintained on campus for sale to students.

During the first year of the program, College-enrolled students will be guided by the rules and regulations that govern attendance at their local campus. During the second year of the program, students will be guided by the general rules and regulations for College of Environmental Science and Forestry students and an additional set of Wanakena Campus "house rules."

ADMISSION

Admission Requirements

Requirements for entrance into the forest technology curriculum require a minimum of high school units consisting of: English; history (social science); science (including biology); mathematics (including trigonometry or Math 11); and electives. Mechanical drawing, technical report writing, and computer science are suggested electives.

In addition to the academic requirements, the following must also be met by all applicants:

1. The applicant must be strongly motivated toward a career in field forestry.
2. The applicant must be willing and able to meet the physical requirements of the program which include pole and tree climbing, walking 2 to 6 miles through forest areas, often carrying 15-20 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 full medical examination report must be submitted.

Questions concerning any of these requirements should be referred to the Director of Admissions who may, under special circumstances, waive some of them.

Admission Procedures

The decision to admit any student to the Forest Technology Program rests solely with the College of Environmental Science and Forestry. Most openings in the program are filled by students who received conditional acceptances while still seniors in high school, contingent on successful completion of the first year of college. Remaining openings are filled by transfer students who have already attended college. Therefore, it is suggested that the potential forest technology student apply while still a high school senior.

Here is the procedure:

1. Seniors in high school must submit a regular SUNY freshman application for the College of Environmental Science and Forestry, using a Curriculum Code 620 (Forest Technology). These applicants should indicate entry date to be one year in advance of the current year.
2. Submit a regular application to that school selected for the first year of study, using Curriculum Code 620. It is important that students gain entry on their own for the first year of studies. The College will request information at a later date concerning what institution the student will be attending.

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 studies, and they must be appropriate to those courses and comparable in subject matter, content, and level. All second year courses must be taken at the Wanakena Campus 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

Cost of the first year will vary with the specific institution attended.

Estimated costs of the second year program on the Wanakena Campus are as follows:

N.Y. Resident

Tuition	*Board, Room*	*Books, Supplies*
$1,350	Approx. $3,100	Approx. $800

Nonresident

Tuition	*Board, Room*	*Books, Supplies*
$3,200	Approx. $3,100	Approx. $800

An additional estimated expense of $200 will likely be incurred to cover the cost of laundry and clothing. There is also a $20 graduation fee and a $13 student activity fee, plus a $25 resident deposit and a $25 equipment deposit. The latter two fees are fully or partially refundable, depending on breakage charged to a student during the year.

FINANCIAL ASSISTANCE

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 on pages 20-25 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 School assists in placement of graduates. The excellent reputation which 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.

DUAL UNDERGRADUATE PROGRAM IN ENVIRONMENTAL AND FOREST BIOLOGY AND RESOURCES MANAGEMENT

This dual curriculum is designed to provide students with a strong background in basic biology and forestry. In doing so it meets the core course requirements in two undergraduate curricula: Environmental and Forest Biology, and Resources Management (Forestry). The Dual Program is one level in a continuum of Biology and Forestry study opportunities at the College:

Environmental and Forest Biology
Environmental and Forest Biology
with Forestry Electives

Resources Management
Resources Management
with Biology Electives

DUAL PROGRAM

Upon completion of the Dual Program, graduates will be highly qualified to work professionally in forested ecosystems. The breadth of training received by students who elect this option will prepare them for a career in forestry and other aspects of environmental science in the federal, state, and private sectors. Exposure to diverse courses and extensive field experience enhances their employment opportunities in multidisciplinary programs that are characteristic of contemporary approaches to forestry management and other environmental problems.

The Dual Program requires a *minimum* of five semesters at the upper division level. Six semesters may be necessary for those students who lack appropriate lower division courses, or who wish to develop specific professional interests in forest biology or forestry. Students need to be aware of the financial aid implications of taking one or two additional semesters, especially in regards to the New York State Tuition Assistance Program (TAP), and plan accordingly, starting with the Pre-ESF (lower division) semesters.

A total of 147 credit hours, 62 of them prior to matriculation, is required for this Bachelor of Science degree. In addition to the 58 credit hours of upper division core courses listed below, six of the elective credit hours must be in Plant Science, six in Animal Science, six in FOR (Forestry) and three in WPE (Wood Products Engineering) or FEG (Forest Engineering), exclusive of the eight-hour summer camp experience.

There is less opportunity to take free electives in the Dual Program than in the two curricula which it combines. It is recommended that elective requirements in plant science and animal science address critical support areas such as forest pathology, plant ecology, fish and wildlife management, and forest entomology. Similarly, forestry electives in silviculture, hydrology, or tree improvement are examples of elective opportunities in important forestry support areas. In all cases, choice of electives depends on the student's professional goals. Students with specific career and professional goals should make them known to their advisor as early as possible so that proper course selections can be made. Course selection is made after consultation with each of two advisors; one from the Faculty of Environmental and Forest Biology and one from the Faculty of Forestry.

There is flexibility in the structure of the curriculum that students might wish to investigate and take advantage of. For example, it is possible to take the required Summer Program in Field Forestry, at Warrensburg, prior to the junior year instead of after it. This will make it possible, and it may be highly advantageous, to take courses at the Cranberry Lake Biological Station (see p. 35) in other summers. If you wish to investigate such opportunities, talk with Admissions Office staff during your admissions processing, and they will direct you to the proper Academic Advisors.

To facilitate transfer at the junior level, it is important that students satisfy the lower division course requirements prior to matriculation at the College of Environmental Science and Forestry.

Students entering at the junior level should have successfully completed a minimum of 62 credits which include:

Lower Division Courses

Course Area	*Credit Hours*
General Chemistry with Laboratory	8
Organic Chemistry with Laboratory	8
General Physics with Laboratory	8
Mathematics, through Integral Calculus	6-8
English	6
General Botany and Zoology **OR** General Biology with Laboratory	8
*Social Sciences/Humanities (Sociology **or** Psychology preferred)	6
*Political Science (U.S. Institutions)	3
*Microeconomics	3
Computer Science	3
Biology Elective	3
	62

Upper Division Courses

Junior Level			*Credit Hours*
Fall Semester	EFB 320	General Ecology	3
	EFB 336	Dendrology I	3
	**EFB 352	Elements of Forest Entomology	3
	****Elective		6
			15
Spring Semester	APM 391	Statistics	3
	EFB 325	Cell Physiology	3
	FOR 360	Principles of Management	3
	****Elective		3
	***Social Science/Humanities		3
			15

Summer:	FOR 301, 302, 303, 304 Field Forestry Program at Warrensburg		8

Fall Semester	FOR 305	Forestry Concepts and Applications	1
	FOR 331	Introduction to Physical Environment	6
	FOR 332	Silvics/Silviculture	8
	FOR 322	Mensuration	1
			16

Senior Level			*Credit Hours*
Spring Semester	FOR 370	Management of Forest Enterprise	3
	EFB 407	Genetics	3
	EFB 408	Genetics Laboratory	1
	****Electives		9
			16
Fall Semester	APM 492	Biometrics	3
	FOR 400	Social Environment of Resource Management	3
	FOR 461	Management Models	3
	****Electives		6
			15

*Students may be admitted with 3 credit hours in each of these subject areas. Deficiencies must be removed as early as possible in the student's program.

**A spring course, EFB 351, may be substituted if scheduling problems conflict with EFB 352. This will open up 3 hours of electives during the fall semester rather than in the spring.

***If this requirement is satisfied in the freshman and sophomore years, biology or forestry electives may be substituted.

****These electives should include at least 3 credits in WPE or FEB, 6 credits in FOR, 6 credits in plant sciences, and 6 credits in animal science.

THE FACULTY OF LANDSCAPE ARCHITECTURE

GEORGE W. CURRY, *Interim Chairman*

FACULTY

EMANUEL CARTER. *Professional Experience:* Project Planner, Ithaca, New York Department of Planning and Development; Recreation and Park Advisor, Pennsylvania Bureau of Recreation and Conservation; Associate Director-Planning, Chase Architectural Associates, Syracuse, New York; Principal Planner, Syracuse Department of Community Development; Adjunct Professor, Landscape Architecture Program, Cornell University; Adjunct Professor, Department of Geography, Syracuse University. *Fields of Specialization:* Urban Design, City and Regional Planning, Development Process, Planning and Design Theory.

GEORGE W. CURRY. *Professional Experience:* The Reimann-Buechner Partnership, Landscape Architects, Syracuse; The Curry-Paulo Partnership; Member, Syracuse Conservation Advisory Council, Syracuse Urban Cultural Parks Advisory Committee, and Syracuse Landmark Preservation Board. Licensed Landscape Architect, New York State. *Fields of Specialization:* Site Planning, Urban Analysis and Design, Historic Preservation.

JOHN P. FELLEMAN. *Professional Experience:* Planning Engineer, Monroe County, N.Y.; Urban Planner, NYS Hudson River Valley Commission; Chief Planner, Bruce Howlett, Inc.; Partner, Impact Consultants; Licensed Professional Engineer, New York State; Designated Planner-in-Charge, New York State. *Field of Specialization:* Site Systems Engineering; Route Location; Environmental Simulation.

CLAUDE C. FREEMAN. *Professional Experience:* Russell Bailey and Associates, Landscape Architects and Planners; Alfred Obrist, Landscape Architect and Civil Engineer. *Fields of Specialization:* Site Design, Plant Materials, Graphics.

DAVID L. HANSELMAN. *Professional Experience:* Ohio Department of Education, Ohio Department of Natural Resources, Ohio State University. *Fields of Specialization:* Communications Strategies and Message Design, Non-Print Communications.

RICHARD S. HAWKS. *Professional Experience:* EDAW, Inc., Cambridge Research Institute. *Fields of Specialization:* Regional Planning and Design, Facility Siting and Routing, Geographic Information Systems, University Campus Design and Planning.

ALLEN R. LEWIS. *Professional Experience:* Chief Community Planner, Bucks County Planning Commission, Doylestown, Pennsylvania. Member, American Institute of Certified Planners. *Fields of Specialization:* Community Land Use Planning; Planning Theory; System Dynamics; Modeling and Simulation.

FRANK L. MARAVIGLIA. *Professional Experience:* Senior High School Teacher; Business and Management Consultant; President, Centre of Applied Creativity, Baltimore, Maryland; Faculty, Annual Creative Problem Solving Institute, SUNY Buffalo, Organizational and Interpersonal Communication. *Fields of Specialization:* Technical Graphics, Creative Problem Solving, Education, Communication, Video, Management.

ROBERT R. MARSHALL. *Professional Experience:* Professional Consultant, Licensed Landscape Architect and Architect, New York State; Department of Architecture, Idaho State University; Project Architect/Landscape Architect for Vern G. Hancock and Associates, and for Paul W. Jensen and Associates, Pocatello, Idaho; R. Fred von Niederhausern and Associates, Logan, Utah. *Field Specialization:* Site Planning and Design, Planning and Design for Low-Income Housing, Third World Housing Issues.

ANTHONY J. MILLER. *Professional Experience:* Clarke and Rapuano Inc., Consulting Landscape Architects and Engineers; Land Use Consultants, United Kingdom, Landscape Architects, Maurice Pickering Associates, United Kingdom, Jacques Miller Partnership, United Kingdom; Thames Landscape Group, United Kingdom; Brian Clouston and Partners, United Kingdom, Architects and Landscape Architects; Sir Denys

Lasdun, Redhouse and Softley, United Kingdom, Architects; Thames Polytechnic, Dartford Kent, United Kingdom; Member Landscape Institute, United Kingdom; Examiner, Landscape Institute. *Fields of Specialization:* Site Design, Graphics, Plant Materials, Provision for Play, Video Simulation.

JAMES F. PALMER. *Professional Experience:* Research Associate, The Environmental Institute, University of Massachusetts; Associate Social Scientist and Resource Planner, Carlozzi, Sinto & Vilkilis, Inc.; College Planner, Kresge College, University of California at Santa Cruz. *Fields of Specialization:* Landscape Perception, Design Evaluation, Social Impact Assessment, Environment and Behavior Research Methods.

MATTHEW R. POTTEIGER. *Professional Experience:* Department of Landscape Architecture, Ball State University. *Fields of Specialization:* Cultural Landscape History, History of Landscape Architecture, Design Theory and Methodology.

ROBERT G. REIMANN. *Professional Experience:* City of Montreal, Department of Public Works, Parks and Playgrounds; Sargent, Webster, Crenshaw and Folly, Architects; James E. Glavin and Associates; Principal, Reimann-Buechner Partnership; Director, Professional Practice Institute (ASLA); President, Landscape Architecture Foundation; Fellow, American Society of Landscape Architects; Member, ASLA Council on Education. *Fields of Specialization:* Environmental Design, Passive Energy Conservation, Site Planning and Design.

RICHARD C. SMARDON. *Professional Experience:* Wallace, Floyd, Ellenzweig, Inc., Cambridge, Mass.; Executive Office of Environmental Affairs, Commonwealth of Massachusetts; Oregon State University Extension Service; Institute for Urban and Regional Development, University of California; USDA Forest Service. *Fields of Specialization:* Landscape and Environmental Planning, Visual Resource Analysis, Environmental Assessment/Administration, Wetland Assessment.

KATHLEEN A. STRIBLEY. *Professional Experience:* Department of Landscape Architecture, The Ohio State University; Anderson-Lesniak and Associates, Inc.; Johnson, Johnson and Roy, Inc.; Dalton-Dalton-Little-Newport, Inc.; Member, Onondaga County Environmental Management Commission; Licensed Landscape Architect, Michigan and New York. *Fields of Specialization:* Design and Behavior; Public Participation; Urban Design, Parks and Recreation; Site Planning and Design.

Landscape Architecture

The alteration of the physical environment has been a product of human activity since the earliest times of human settlement. 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 that requiring skilled individual effort and often demanding multidisciplinary attention.

The Faculty of Landscape Architecture offers two programs designed to educate students to contribute in varied ways to the wise use of land and landscape. Each degree program provides a basis for students to establish career directions in the profession landscape architecture. Both the Bachelor and Master of Landscape Architecture are offered.

Bachelor of Landscape Architecture
Required Lower Division Courses

Course Area	*Credit Hours*
Written and Oral Communication Required credit hours in this area must be taken in courses dealing with English comprehension, the basic skills of grammar and composition, and public speaking.	6
Graphics A minimum of one course in engineering drawing, mechanical drawing, or architectural drafting is required.	3
Natural Sciences Required credit hours in this area must include a course in botany or plant biology. Additional hours should be taken from coursework in ecology*, physical geography, earth science, geology, or environmental geology.	6
Social Sciences Required credit hours in this area are to be taken from coursework in U.S. history, sociology, social psychology, social or cultural anthropology, political science, or economics.	3
Mathematics Required coverage of college trigonometry. Students with prior coverage in math who can demonstrate proficiency at time of admission may substitute elective hours for this prerequisite. More advanced math is desirable.	3
Computer Science Introduction to computers with basic application programs including word processing, spread sheets, and data base. Familiarity with micro computers and programming preferred.	3
Electives	38
TOTAL MINIMUM LOWER DIVISION CREDITS	62

*Can be waived at ESF if completed prior to transfer.

BACHELOR OF LANDSCAPE ARCHITECTURE

The B.L.A. degree is designed for those students desiring to enter the profession of landscape architecture either directly after completing the degree or after completing a graduate degree. The degree 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) as a first professional degree. The B.L.A. degree is granted at the end of five years of study and requires the successful completion of 160 credit hours. Students enter into the third year of the program with a minimum of 62 lower division credit hours and follow the prescribed curriculum.

The B.L.A. degree program consists of a core of courses involving the basic principles and skills of landscape architecture design, land manipulation and engineering, applied ecology, and communications. Additionally, students are required to participate in an intependent study semester of the Off-Campus Program during the fall semester of the fifth year. The major objective of the B.L.A. program is the development of 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 obtain a license to practice landscape architecture. At present, the State of New York requires those holding a 5th-year B.L.A. degree to complete a three-year period of internship

Bachelor of Landscape Architecture Curriculum

Third Year

			Credit Hours
First Semester	LSA 320	Introduction to Landscape Architecture and Planning	3
	LSA 326	Landscape Architectural Design Studio I	3
	CMN 382	Graphic Communication	3
	EIN 311	Natural Processes in Planning and Design	3
	EFB 320	General Ecology or Elective*	3
			15
Second Semester	LSA 327	Landscape Architecture Design Studio II	3
	LSA 330	Site Research and Analysis	2
	EIN 371	History of American Landscape Attitudes	3
	EIN 390	Social/Cultural Influences and Environmental Form	3
	ERE 306	Elements of Map and Air Photo Interpretation or Elective*	1
	ERE 308	Elements of Plane Surveying or Elective*	1
	ENG 404	Technical Writing	3
			16

Fourth Year

			Credit Hours
First Semester	LSA 422	Landscape Design Studio III	4
	LSA 433	Plant Materials	2
	LSA 434	Design Materials	1
	LSA 442	Site Grading	2
	LSA 443	Site Drainage Systems	1
	EIN 471	History of Landscape Architecture	3
	Elective		3
			16
Second Semester	LSA 423	Landscape Design Studio IV	4
	LSA 425	Orientation for Experiential Studio	2
	LSA 444	Vehicular Circulation Design	1
	LSA 445	Introduction to Structures	1
	EIN 451	Fundamentals of City and Regional Planning	3
	EIN 470	Art History or Elective*	3
	LIB 300	Library Research	1
	Elective		2
			17

Fifth Year

			Credit Hours
Summer	LSA 533	Plant Materials	2
First Semester	LSA 524	Experiential Landscape Design Studio V (Off-Campus Program)	16
Second Semester	LSA 522	Landscape Design Studio VI—Urban Design	4
	or		
	LSA 525	Landscape Design Studio VI—Site Design	4
	or		
	LSA 527	Landscape Design Studio VI—Regional Design	4
	LSA 545	Professional Practice Studio	3
	LSA 455	Professional Practice in Landscape Architecture	2
	Architecture Elective		3
	Elective		4
			16

*Elective only with prior coverage in required area.

A total of 160 credit hours is required to complete the B.L.A. degree.

NOTE: A number of the courses listed in the B.L.A. curriculum are in the process of being revised. Upon revision, new course descriptions will be available after approval by the College of Environmental Science and Forestry Faculty.

in the field prior to applying for the licensing examination. Other states have varying requirements for obtaining a license.

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 in designing the form of the environment.

Students receiving a B.L.A. degree have entered the profession as employees in public agencies 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, management, and research.

Prerequisites for Entry into the B.L.A. Degree Program

Because of the breadth of concern of the B.L.A. degree, it is imperative that entering students prepare themselves with a broad range of lower division coursework. The environmental efforts with which the students will be involved require a strong background in both the natural and social sciences. In addition, prior skill development in graphics, mathematics, and computer science is required. The following required prerequisite coursework must be met to prepare the entering student to engage the B.L.A. curriculum.

ELECTIVE GUIDELINES

Students planning to transfer to the Bachelor of Landscape Architecture Program should consider the following as guidelines in selecting their 35 credit hours of electives. The subject areas are considered *highly desirable*. Course areas marked (*) are required following transfer to the Program, but can be waived if completed prior to transferring. This will allow a student to take additional electives at ESF.

1. In addition to the required prerequisite credit hours listed, further subject coverage in Written and Oral Communications, Natural Sciences, and Social Sciences as listed is recommended.
2. Art and Design
   Courses in this category should include Art History* and Studio Art. Studio courses in Drawing or Three-Dimensional Design, Sculpture, Ceramics, and Photography, are recommended.
3. Analytical Tools
   Courses in this category should include Elementary Plane Surveying*, Air Photo Interpretation*, or Elementary Physics. Additional work in computing technology is highly recommended, particularly in the realm

of computer graphics and computer-assisted design (CAD).

Demonstration of academic excellence in environmental design and design graphics through submission of a portfolio is highly recommended as part of the admission's process to the B.L.A. program.

MASTER OF LANDSCAPE ARCHITECTURE

The master's degree is open to those students who hold an undergraduate degree and meet the prerequisites for admission. The program is accredited by the American Society of Landscape Architects and focuses on community design and planning. The three-year course of study provides a strong foundation of design theory and process while emphasizing mastery of the skills associated with the practice of landscape architecture. The core curricula focus on processes of community design and planning. Students are required to integrate the core coursework with an elected area of concentration. The program requires cross-disciplinary study to prepare students to enter a variety of emerging positions in the public and private sectors. Illustration of these positions may be found in design research, community development, impact analysis, urban design, and environmental management. Although these positions require working knowledge of design, they transcend the traditional skills normally associated with project design. Processes related to management, analysis techniques, technological application, and the social and natural sciences are considered necessary to undertake these and other similar positions. Graduates of the program are currently employed by government, educational institutions and private offices practicing environmental design and analysis. The M.L.A. degree is granted upon the completion of 72 credit hours (42 graduate) in a prescribed curriculum.

A variety of joint degree program opportunities exists for applicants wishing to develop a unique career track. Concurrent professional degrees in Public Administration, Public Communication, or Business Management may simultaneously be pursued at Syracuse University. Ph.D. programs for careers in teaching and research are available within the College's Graduate Program in Environmental Science, and with a variety of programs at Syracuse University, such as geography. Applicants interested in concurrent degree programs are encouraged to contact the College's Graduate Admissions Office at an early date.

M.L.A. Program Sequence

The M.L.A. program is established as a three-year sequence of courses. The following sequence illustrates a typical three-year program.

First Year

		Credit Hours
LSA 553	Design Studio I	4
CMN 552	Graphic Communication	3
LSA 671	History of Landscape Architecture	3
[1]LSA 697	Topics and Issues of CDP	2
LSA 554	Design Analysis Studio II	4
LSA 550	Site Research and Analysis	2
LSA 551	Design Implementation	3
[2]Directed Electives		3
		24

Second Year

		Credit Hours
LSA 620	Community Design and Planning Studio I	3
LSA 652	Community Development Process	3
LSA 656	Environmental Factors, Community Response, and Form	3
[3]LSA 433	Plant Materials	2
[3]LSA 434	Design Materials	1
LSA 621	Community Design and Planning Studio II	3
LSA 650	Behavioral Factors of Community Design	3
Directed Electives		6
		24

Third Year

[4]*Typical Options for Integrative Experience:*

		Thesis/Project		Academic/ Professional Experience		Coursework	
		Fall	*Spring*	*Fall*	*Spring*	*Fall*	*Spring*
LSA 898	Academic/Professional			12			
LSA 899	Thesis/Project	3	6				
LSA 643	Ethical Issues in Community Design and Planning		1		1		1
Directed Electives		9	5		11	12	11
		12	12	12	12	12	12

[1]Also required for students who enter with advanced standing.
[2]Directed electives are selected in consultation with the student's advisor. They are designed to augment the student's undergraduate preparation.
[3]Usually not required for students who enter with advanced standing.
[4]The precise number of credit hours taken by a student during a given semester in LSA 899, LSA 898, or in directed electives is determined in consultation with the student's major professor.

NOTE: A number of the courses listed in the M.L.A. curriculum are in the process of being revised. Upon revision, new course descriptions will be available after approval by the College of Environmental Science and Forestry Faculty.

M.L.A. DEGREE PROGRAM

The M.L.A. curriculum has four components: a foundation year, a sequence of required core courses, a series of directed electives, and a terminal experience. The foundation coursework provides the skill and knowledge basis for engaging landscape architecture. The required core courses have as their focus the development, enhancement, and refinement of understanding of landscape architectural philosophy, theory, skills, and techniques, as focused on community design and planning. Emphasis is placed on the refinement of proficiency in design analysis skills, concepts, and objectives.

Three terminal experience options are available: thesis or project, coursework, academic or professional experience. A project consists of the critical application of professional knowledge and skills to a landscape architectural problem. A thesis consists of research which expands or clarifies basic knowledge related to community environmental design. The coursework option involves selected electives.

The academic/professional experience is typically a semester-long internship with a public agency, private firm, or non-profit institution.

The following describes the broad sequential linkages of the six-semester program:

First Year: Foundation courses in design analysis, physical factors, graphics, history, and theory, and start of graduate elective sequence. The scale focus is human, site, and neighborhood.

Second Year, Fall Semester: The third semester of study is intended to provide an introduction to decision-making processes, including computer applications in community design and planning. An examination of the impact of physical factors on the environment is provided. Scale focus includes municipal and site in rural/suburban scenarios.

Second Year, Spring Semester: The fourth semester of study is intended to investigate community design and planning through a variety of projects focusing on the form and condition of environments supporting human behavior. Methods of research and analysis relevant to social determinants at the scale of a urban district are introduced.

The Third Year: This year is individually designed, with the assistance of a major professor, to meet the student's career objectives while satisfying the degree requirements. Study and research opportunities exist both at the Syracuse Campus and throughout the world. Often, all or a portion of the fall semester involves off-campus pursuits, while the spring semester entails final coursework and project documentation.

Research and community service play a significant role in the graduate program, primarily through funded projects and projects/thesis. Not only does research provide new knowledge and applications for the profession, but it enriches the curriculum, enhances faculty expertise and develops student skills in rigorous observation, clear thinking, and lucid writing.

By the nature of a profession which exists on evolving frontiers of human interaction with natural and built environments, much of the research in landscape architecture deals with issues in an exploratory way. Faculty members and graduate students usually work together on research projects in an atmosphere of mutual learning. Approaches may vary from rigorously quantitative analysis of data, to highly qualitative evaluation of broad problems, to application of design and planning methods to specific cases.

The College library and the several libraries on the Syracuse University campus offer reference material to support study programs. Landscape architecture facilities include adequate studio and office space as well as three research laboratories. In addition, there is reproduction, model making, photographic, audio-visual, micro-computer, computer-aided design, video, noise, solar, and visual simulation equipment available. The College's Computer Center is fully interfaced with Syracuse University to provide a complete range of academic and research capabilities. The College also has a fully-equipped video tape recording (VTR) studio, photogrammetric labs and micro-computer based image processing capability for LANDSAT tape interpretation.

Landscape Architecture is unique in its location within the College of Environmental Science and Forestry. This situation provides the M.L.A. candidate with the opportunity to draw upon information and knowledge in ecology, natural sciences, resource management, forestry and many other related environmental disciplines. The U.S. Forest Service Urban Forestry unit located at the College provides a unique opportunity to promote interdisciplinary environmental design research. In addition, the relationship with Syracuse University provides an extensive intellectual as well as physical resource basis.

The Syracuse area has the largest concentration of landscape architectural firms in the state, outside New York City. With a metropolitan population of nearly 500,000, the city has many opportunities for urban-oriented study. Also, the city's central location in Upstate New York provides easy access to a rich variety of community design and planning contexts throughout the northeastern U.S. and the major metropolises of Canada.

Students seeking admission to the M.L.A. program may apply to enter in either the first or second year based on education and experience. Admission requires:

1. An undergraduate degree.
2. Graduate Record Examination scores.
3. Undergraduate transcript.
4. Three letters of recommendation.
5. A completed course in each of four areas:
   a. botany, biology, or ecology;
   b. geology, geomorphology, or earth science;
   c. anthropology, psychology, or sociology;
   d. computer application or programming course.

Students seeking admission to the second year must additionally have:

6. Accredited design degree or equivalent;
7. Design and engineering portfolio;

TOEFL scores required for all applicants whose native language is not English.

Applications should be made prior to March 1 for the following fall.

THE FACULTY OF PAPER SCIENCE AND ENGINEERING

LELAND R. SCHROEDER, *Chairman*

LELAND R. SCHROEDER, *Chairman* (Organic and Carbohydrate Chemistry) BAMBACHT (Pulping, Papermaking, Paper Machine Operation), BRITT (Chemistry of Paper Formation), DENCE (Organic Chemistry, Pulping, Bleaching), HOLM (Water and Air Pollution Abatement, Computer Simulation), JELINEK (Computer Applications, Process Engineering, Thermodynamics), LAI (Organic Chemistry, Pulping), LUNER (Surface and Colloid Chemistry of Papermaking Systems), MARK (Mechanical Properties of Fibers and Paper), MARTON (Mechanical and High-Yield Pulping), STENUF (Chemical Engineering, Instrumentation, Thermodynamics, Flow Phenomena, Process Control, Corrosion), THORPE (Fiber Physics, Paper Physics and Mechanics). UNBEHEND (Wet End Chemistry).

Outstanding for its vigorous growth and diversity of products, the pulp and paper industry is the fifth largest in the nation and exceptionally strong worldwide. Its need for professional men and women with training in science, engineering and technology is increasing even more rapidly than the industry itself. The College pioneered instruction in this area in 1920 with the organization of the paper science and engineering department, which has maintained a singularly high position in professional education for the continuing development of the pulp, paper and allied industries. Its graduates, who are in constant demand, occupy positions of leadership throughout the world.

The curriculum in Paper Science and Engineering is designed to provide a broad base of study and to prepare students for a variety of careers in the paper and related industries. Excellent opportunities are provided for men and women qualified to fill positions as research chemists, process engineers, technical service representatives, line management personnel, and many others.

The program provides education in the physical sciences and chemical engineering, with specific emphasis on those aspects of these disciplines which relate to the manufacture of pulp and paper. This includes the chemistry and anatomy of wood, the conversion of wood to pulp and paper, and the chemistry and physics of paper and paper formation. Instruction in chemical engineering includes a foundation of unit operations basic to the pulp and paper industry, as well as specialized courses, such as water and air pollution engineering.

Paper Science and Engineering is located in Walters Hall, opened in 1969. This facility is devoted to education and research in the field of pulp and paper. In addition to a large number of special purpose laboratories and highly sophisticated scientific equipment, there is an experimental pulp and paper mill equipped

Lower Division Courses

Course Area	*Credit Hours*
Botany or Biology with Laboratory	4
General Chemistry with Laboratory	8
Organic Chemistry with Laboratory	8
Quantitative Analysis	3
Physics with Laboratory	8
Mathematics—Analytic Geometry and Calculus, Differential Equations	12
Computer Science	3
Economics	3
English	6
Engineering Drawing	1
Humanities or Social Science Electives	8
TOTAL MINIMUM LOWER DIVISION CREDITS	64

Upper Division Courses

Junior Year			*Credit Hours*
First Semester	FCH 572	Wood Chemistry II	3
	FCH 360	Physical Chemistry	3
	PSE 300	Introduction to Papermaking	3
	WPE 387	Wood Structure and Properties	3
	PSE 370	Principles of Mass and Energy Balance	3
	PSE 371	Fluid Mechanics	3
			18
Second Semester	PSE 372	Heat Transfer	2
	FCH 361	Physical Chemistry	3
	WPE 390	Wood and Fiber Identification Laboratory	1
	PSE 301	Pulp and Paper Processes	3
	PSE 302	Pulp and Paper Processes Laboratory	1
	ERE 377	Process Control	3
	LIB 300	Library Research Methods	1
	*Elective		3
			17

SUMMER MILL EXPERIENCE: PSE 304 Mill Experience 2
(Twelve weeks of full-time pulp and/or paper mill employment approved by the faculty between the junior and senior years.)

with machinery and instrumentation for studies of pulping, pulp purification, reuse of secondary fibers, refining, paper additives, and papermaking. This facility includes one 12-inch and one 48-inch fourdrinier paper machine, one pressurized grinder for mechanical pulping, and auxiliary equipment. An environmental engineering laboratory is able to demonstrate various methods used for the recycling of waste paper and the treatment of waste water. Also included is a modern chemical engineering laboratory, used for studies in all phases of unit operations and processes, process control, and simulation.

Undergraduate Program

The curriculum is entered at the junior level. Students with an associate degree in engineering science, science and mathematics, or chemical technology usually qualify for admission if their studies have included 8 credit hours of organic chemistry with laboratory. Other applicants with two years of college study may also gain admission if their curriculum includes the appropriate courses. Minor deficiencies can usually be made up during the junior year.

The Paper Science and Engineering curriculum consists primarily of chemistry and chemical engineering courses and specialized courses relating to the manufacture of pulp and paper products.

Graduate Program

Through the program in environmental and resource engineering, the Faculty participates in graduate education leading to the Master of Science and Doctor of Philosophy degrees.

Graduate studies reflect the strong trend toward diversification in the industry and offer opportunities for obtaining master of science and doctor of philosophy degrees in a variety of subjects related to the manufacture of pulp and paper. Individual study programs are designed to meet specific personal needs. Typical areas of study range from new pulping processes, chemical interactions on the paper machine and the disposal of pulping and papermaking effluents, to the fluid dynamics of fiber suspensions, the colloid chemistry of papermaking constituents, and the physical properties of fiber networks.

An important component of the graduate program is thesis research under direction of a graduate advisor. 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), an integral part of the department. Its research activities aim to generate new information regarding the fundamentals, the science, the engineering and the technology of the papermaking process, utilizing advanced techniques such as computer simulation, electron microscopy, specialized spectrophotometry, nuclear magnetic and electron spin resonance and nuclear tracer methods. Recent work has been directed to fundamental investigations of pulping, bleaching, additives, paper recycling, effluent disposal, the papermaking process, the properties of paper, reactions of wood components during mechanical and chemical treatments, the structure of wood and wood fibers, evaporation, fluid dynamics, heat transfer, and chemical recovery.

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 Faculty of Wood Products Engineering, as well as the Department of Aerospace and Mechanical Engineering at Syracuse University.

The faculty enjoys excellent external support in the form of graduate fellowships and grants from ESPRI, the Syracuse Pulp and Paper Foundation, and other industry sources, as well as a number of government granting agencies.

Senior Year

			Credit Hours
First Semester	PSE 461	Pulping Technology	3
	PSE 465	Paper Properties	4
	PSE 473	Mass Transfer	3
	PSE 491	Paper Science and Engineering Project	1
	*Electives		6
			17
Second Semester	PSE 466	Paper Coating and Converting	2
	PSE 468	Papermaking Processes	3
	ERE 440	Water Pollution Engineering	3
	*Electives		6
			14
		TOTAL MINIMUM UPPER DIVISION CREDITS	68

*At least 9 hours of electives must be selected from an advisor-approved sequence of technical courses. Examples of suggested areas are shown below.

TECHNICAL ELECTIVES

Colloid and Surface Chemistry	Applied Mathematics
Instrumental Analysis	Computer Modeling
Polymer Chemistry	Principles of Management
Pollution Abatement	Mechanics
Independent Research Project	Engineering Design
Thermodynamics	Materials Science

A total of 132 credit hours is required to complete the B.S. degree in Paper Science and Engineering.

THE FACULTY OF WOOD PRODUCTS ENGINEERING

LEONARD A. SMITH, *Chairman*

LEONARD A. SMITH, *Chairman* (Adhesives, Coatings, Wood-based Composites) CÔTÉ (Cellular Ultrastructure, Light and Electron Microscopy), DAVIDSON (Physical Properties of Wood), HANNA (Ultrastructure and Microscopy), KYANKA (Construction, Applied Mechanics, Engineering Design), R. MEYER (Wood Properties and Anatomy), SACZYNSKI (Construction), W. SMITH (Wood Preservation and Seasoning).

Undergraduate Program

The Wood Products Engineering Program prepares students for a wide variety of professional occupations in heavy construction or in the use of wood as a material. These interests are presented in two curriculum options: Construction and Wood Science and Technology. Both options have elective courses taken at Syracuse University and ESF which permit tailoring the program to complement the education from a wide variety of two-year preparatory programs. A description of each option follows:

To enter either option at the junior level, a transferring student must have acceptable college credit in the following coursework areas. Individuals not meeting the basic outline shown are encouraged to contact the Admissions Office to work out special arrangements and/or additional study requirements.

Construction Option

The construction industry represents a very large segment of this nation's GNP. A consequence of this enormous economic consideration is that the industry is very competitive. With more construction firms bidding on fewer jobs, it is the contracting organization that knows and uses the latest developments that becomes the successful bidder. The economic considerations apply not only to contractors, but to other entities that are involved in construction operations; e.g., owners, engineers, the work force, and material and equipment suppliers. People engaged in the industry must possess current knowledge in the state-of-the-art to be effective.

The basic objective of the construction option is twofold: First, to provide a fundamental understanding of the engineering considerations that comprise the design concept; secondly, to demonstrate the various methods used to take the design into the field and produce a quality product in the most economic manner. The state-of-the-art is followed in striving to reach these objectives.

Particular attention is first given to the study of engineering practices. Students learn the behavior of such construction materials as timber, steel, concrete, soil and rock. Analysis and design of various structural functions are studied that include buildings, excavations, foundations, and waterfront structures. Investigation of construction equipment and operations methods are combined with project control practices to achieve a well-grounded understanding of field construction, planning, and management of the execution. Quality, economy, and behavior of the materials is stressed throughout. Legal and social aspects are integrated into the program in the later stages.

Graduates of the Construction Option are well prepared for careers in a very challenging and dynamic field. Positions held by alumni include:

- Construction Manager
- Project Manager
- Project Engineer
- Cost Engineer
- Construction Engineer
- Field Engineer
- Planning/scheduling Engineer
- Timber Engineer
- Truss Design Engineer
- Technical Sales Representative

Wood Science and Technology Option

Students electing this option have a choice of emphasizing business administration or emphasizing science. Both build upon a core set of courses designed to develop a comprehensive knowledge and understanding of wood and wood products. Each semester the student uses "emphasis courses" to specialize in business administration or to specialize in science. Students meet individually with their faculty advisors to discuss their career goals and choose the appropriate emphasis courses. Regardless of their choice, students have the privilege of taking courses at Syracuse University as a registered ESF student.

Students choosing *business administration* will select courses from Syracuse University's School of Management and from ESF. Some emphasis courses are:

- Accounting
- Economics
- Finance
- Management
- Law and Public Policy
- Marketing
- Real Estate

Lower Division Courses

Required Courses	*Credit Hours*
General Chemistry with Laboratory	4
General Physics with Laboratory	8*
Mathematics through Integral Calculus	8-9
English	6
Computer Programming	3
Electives	33-32
TOTAL MINIMUM LOWER DIVISION CREDITS	62

Some Recommend Additional Courses for Wood Science and Technology Option:
Accounting, biology or botany, economics (Micro and Macro), engineering drawing, organic chemistry, statistics, and electives in the humanities and social sciences.

Some Recommended Additional Courses for Construction Option:
Accounting, economics (Micro and Macro), engineering drawing, soil mechanics, statistics, surveying, and electives in the humanities and social sciences.

*Four credits of physics are required, although 8 hours are recommended. However, students who emphasize science in the Wood Science and Technology Option must have: general chemistry with laboratory (8); general physics with laboratory (8); and general botany with laboratory (4); organic chemistry (3).

Students are encouraged to consult the Admissions Office (315/470-6600) and Wood Products Engineering (315/470-6880) for answers to questions regarding program requirements.

CONSTRUCTION

Upper Division Courses

Junior Year			Credit Hours
First Semester	WPE 387	Wood Structure & Properties	3
	WPE 361	Engineering Mechanics-Statics	3
	ERE 371	Surveying for Engineers	3
	ACC 204	Financial Accounting Systems	3
	Elective		3
			15
Second Semester	ERE 362	Mechanics of Materials	3
	ERE 364	Engineering Materials	3
	ACC 252	Introduction to Managerial Accounting	3
	WPE 450	Construction Equipment	3
	Statistical Analysis		3
	Elective		3
			18

INDUSTRIAL FIELD TRIP (a two-week field trip immediately following final exam period): WPE 399 Field Trip 2

Senior Year			Credit Hours
First Semester	WPE 420	Adhesives, Sealants, and Coatings	3
	WPE 454	Construction Management	3
	FEG 410	Structures	4
	CIE 437	Soil Mechanics & Foundations I	4
	WPE 497	Senior Seminar	2
			16
Second Semester	WPE 326	Fluid Treatments	2
	WPE 327	Fluid Treatments Laboratory	1
	Management Elective		3
	WPE 422	Composite Materials	3
	WPE 404	Design of Wood Structural Elements or technical elective	3
	Elective		3
			15
		TOTAL MINIMUM UPPER DIVISION CREDITS	66

A total of 128 credit hours is required to complete the B.S. degree in Wood Products Engineering with the Construction option.

Personnel Relations
Operations Management
Transportation

Students may elect to gain a broad knowledge or focus on one or two areas. For students who qualify, minors in Management are available. Each minor in Management has a specific required set of business courses. Students will use emphasis courses and electives shown in the program to obtain these business courses.

Those students who choose *science* will select courses in the biological, chemical, and/or physical science courses offered at ESF and Syracuse University. Advanced courses in wood science and wood technology are also available. Some emphasis courses are:

Tropical Timbers
Wood Chemistry
Physiology and Pathology
Computer Applications
Independent Research

Graduates have used their educational background in business, science, and technology to obtain positions in the wood industry, industries serving the wood industry (adhesvie, coating manufacturers), or industries not associated with the wood industry. Knowing the principles of business and technology, graduates are effective communicators with people having financial responsibilities of the corporation and with people having design and production responsibilities.

Some areas of employment are: marketing, manufacturing, technical service, and product development. A special knowledge of the material properties of wood and the suitability of specific wood species for use in various products enable a graduate with marketing emphasis to assist a customer in selection of the right wood product for the intended end use or makes possible the procurement of the best wood raw material for some manufacturing operation. These situations include considering the correct species of wood, treatments to prolong the useful life of a wood product, or selection of the most suitable manufactured product, such as medium density fiberboard or plywood, for a specific application. Complete understanding of the employer's products, the material properties of wood, and the customer's special needs and problems are necessary for the marketing specialist to function efficiently.

Numerous manufacturing methods are used to produce the over 5,000 products that use wood in one form or another. By studying various production systems and ways to modify wood properties, a production-oriented wood technologist is prepared for a career in the manufacture of forest products (veneer, plywood, particleboard, etc.). These careers deal with product and process development, quality control, production control, design engineering, personnel relations, and management.

Wood science deals with materials science and engineering. Graduates that have stressed science and technology of wood are prepared to utilize their knowledge of wood in numerous ways: to increase the efficiency of wood use, apply existing or new knowledge to wood product manufacture or utilization, or to do the research and development required for the new products, processes, and treatments.

Job titles of recent graduates include.

Wholesale Sales
Technical Sales Representative
Applications Engineer
Sales Manager
Export Trade Analyst
Product Development Engineer
Marketing Research Analyst
Quality Control Engineer
Plant Engineer
Production Supervisor
Forest Products Specialist
Materials Research Associate
Wood Products Technologist
Research Associate in Wood Science

Some students desire to continue their formal education by pursuing Master's degrees. Students who have achieved a good grade point average are well prepared to pursue Master of Business Administration or Master of Science degree programs.

WOOD SCIENCE AND TECHNOLOGY

Upper Division Courses

Junior Year			Credit Hours
First Semester	FBO 305	Dendrology	2
	WPE 361	Engineering Mechanics-Statics	3
	WPE 387	Wood Structure & Properties	3
	WPE 388	Wood & Fiber Identification Laboratory	2
	Electives		6
			16
Second Semester	WPE 326	Fluid Treatments	2
	WPE 327	Fluid Treatments Laboratory	1
	ERE 362	Mechanics of Materials	3
	Emphasis Courses		6
	Statistical Analysis		3
			15

INDUSTRIAL FIELD TRIP (a two-week field trip immediately following final exam period): WPE 399 Field Trip 2

Senior Year			Credit Hours
First Semester	WPE 420	Adhesives, Sealants, and Coatings	3
	WPE 497	Senior Seminar	2
	Emphasis Courses		6
	Electives		3
			14
Second Semester	WPE 422	Composite Materials	3
	FOR 404	Economics of Wood-Using Industries	3
	WPE 404	Design of Wood Structural Elements	3
	Emphasis Courses		6
	Electives		3
			18
		TOTAL MINIMUM UPPER DIVISION CREDITS	65

A total of 127 credit hours is required to complete the B.S. degree in Wood Products Engineering with the Wood Science and Technology option.

Graduate Program

Through the program in environmental and resource engineering, the Faculty participates in graduate education leading to the Master of Science and Doctor of Philosophy degrees.

The philosophy of the graduate program is to instill in the students an understanding of the behavior of wood and composite materials made from wood. Areas of research include processing and properties of wood plus design and construction. Persons with varied backgrounds such as wood technology, engineering, or biology can pursue a course of study either for breadth or for depth, as the professional goals of the student dictate.

Recent research projects in wood ultrastructure have dealt with the interaction of coatings and adhesives with the wood substrate, with cell wall development, with the effectiveness of wood preservatives. Projects in tropical wood identification and structure-property relations in foreign and domestic timbers are examples of work in the field of systematic wood anatomy. The field of wood physics has had active projects in the permeability of wood and the mechanics of fluid transport. Current projects in the field of mechanics are focused on the elastic behavior of wood and wood-base composites, fracture mechanics of wood, including examination of the behavior using scanning electron microscopy, the behavior of new structural designs such as truss systems, and the mechanical properties of laminated-veneer-lumber. Other active research areas include biodegradation, properties of juvenile wood, and the growth-wood quality relationships.

In the construction area, current projects involve an examination of the alternatives in choosing a bridge superstructure system for use in remote areas; estimating the engineering properties of subgrades and the risks when a complete soil investigation is impractical; low-cost and medium technology methods for construction and maintenance of limited-use roads in remote areas.

Laboratory facilities include a mechanical testing laboratory with a wide range of testing machines, a physics laboratory with electronic instrumentation, and complete wood processing facilities including a sawmill, plywood mill, dry kilns, and wood preservation equipment. One of the United States' largest foreign wood collections is used for graduate research and to support the program of the Tropical Timber Information Center (TTIC).

A complete microscopy laboratory, containing transmission electron microscopes, scanning electron microscope with energy dispersive x-ray analysis and particulate analysis accessories, a wide variety of light microscopes, and related equipment give the student the ability to relate macroscopic behavior to anatomical characteristics of the products being investigated. Extensive equipment for chemical analysis and nuclear chemical techniques also serve the research program.

Course Offerings

Students at the College of Environmental Science and Forestry have not only the academic and research resources of their own institution, but also the resources of nearby Syracuse University and SUNY Health Science Center at Syracuse.

COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY 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 cognizant Faculties or programs, approved by the appropriate academic dean, faculty committee, and the college faculty.

Course Numbering System

Code Levels:

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 or in the professional program leading to the Bachelor of Landscape Architecture. Undergraduate students with superior academic records may register for these courses.

600-699 Graduate courses which permit undergraduate students to enroll only by petition with a well-documented justification approved by the undergraduate advisor, curriculum director, and course instructor.

700-999 Graduate courses for which no undergraduate may enroll.

General Subject Areas

APM—Applied Mathematics 67
CMN—Communications (Landscape Architecture) 68
EFB—Environmental and Forest Biology 68
EIN—Environmental Influences (Landscape Architecture) 73
ENS—Environmental Science 74
ERE—Engineering (Environmental and Resource Engineering) . . 75
ESF—Nondepartmental 77
FCH—Chemistry 77
FEG—Forest Engineering 80
FOR—Forestry (Resources Management) 81
FTC—Forest Technology 85
LIB—Library (College of Environmental Science and Forestry Course) 86
LSA—Landscape Architecture 86
PSE—Paper Science and Engineering 89
WPE—Wood Products Engineering 90

APM—APPLIED MATHEMATICS

205. Topics in Integral Calculus (3)
Three hours of lecture and recitation covering the fundamentals of integral calculus and associated topics of analytic geometry. Fall.
Prerequisite: Calculus I.

360. Introduction to Computer Programming (3)
The basic course in computer use offered by the College. It is intended to provide the student with the skill and understanding needed to utilize digital computer languages for problem solving. The course will cover instruction in APL, FORTRAN IV, use of operating systems, and some background material in general hardware/software designs. Fall and Spring.

391. Introduction to Probability and Statistics (3)
Two hours of lecture, three hours of laboratory. Elementary probability, theoretical and sampling distributions, hypothesis testing, statistical estimation, analysis of variance, regression and correlation, nonparametrics and sampling concepts. Spring.
Prerequisite: Two semesters of calculus.

492. Forest Biometrics (3)
Two hours of lecture, three hours of laboratory. Analysis of variance including nested and cross-classification. Matrix approach to multiple linear regression and weighted least squares. Nonlinear regression. Sampling methods and design. Applications to forestry problems. Fall.
Prerequisite: APM 391 or equivalent.

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 IV and APL with a discussion of an Assembly Language. Other topics include representation of information, management of files, error control, operational systems and job control. Fall and Spring.

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.

620. Analysis of Variance (3)
Three hours of lecture and recitation and three hours of laboratory. Multiway 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. Fall.
Prerequisites: Graduate standing and an introductory course in statistics covering material through the one-way analysis of variance.

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 or equivalent.

630. Regression Techniques with Applications to Forestry (3)

Two one and one-half hours of lecture. Review of matrix algebra, probability theory and statistical methods. Basic concepts in regression analysis. Classical linear regression model. Least and weighted least squares method. Dummy variables and their uses in regression and covariance analysis. Applications to problems of statistical prediction and estimation from the field of forestry in general and forest mensuration and inventory in particular. Fall.

Prerequisite: APM 391 or equivalent.

635. Multivariate Statistical Methods (3)

Estimation and inference for the multivariate normal distribution. Multivariate analysis of variances, factor analysis, principal components analysis, canonical correlation, discriminate analysis, cluster analysis. Spring.

Prerequisite: One semester of statistics.

650. Operations Research (3)

Two one and one-half hours of lectures. Deterministic and Stochastic Operations Research models applicable to managerial problems. Linear programming, transportation and allocation models, goal programming, dynamic programming, network analysis, and simulation techniques. Spring.

Prerequisites: APM 391 and MAT 227 or equivalent, or permission of the instructor.

CMN—COMMUNICATIONS (LANDSCAPE ARCHITECTURE)

(See also courses listed below under EIN and LSA.)

380. Technical Drawing I (1)

One three-hour drafting room period. Elements of perspective, isometric, oblique, and orthographic projection. Practice in freehand and instrument drawing. Fall.

381. Technical Drawing II (2)

Two three-hour drafting room periods. Elements of perspective, isometric, oblique, and orthographic projection. Practical applications of these principles in machine and architectural drawing, including piping and electrical drawings. Spring.

382. Graphic Communication (3)

Two three-hour studios and one one-hour lecture per week. Studio time devoted to demonstrations, exercises, and projects. Focusing on sketching, drafting, drawing construction and rendering techniques used in the landscape architecture field. Emphasis on skill development, and use of graphics in the design process. Drawings, examinations, and actual project constitute basis for grades. Fall.

530. Environmental Communications Studio (2)

Three-hour studio and one-hour discussion. For seniors and graduate students, this course offers the opportunity for students to apply communications theory and strategies through the planning, production, and display of media projects developed around the student's area of professional interest. Enrollment limited to 20 students. Fall.

Prerequisite: CMN 531 or permission of the instructor.

531. Environmental Communications (3)

Three hours of lecture/discussion. An introductory course for seniors and graduate students which presents techniques and processes in education and communications applicable in environmental science, management, planning, and design. Topics incude basic teaching, learning and communications theory and strategy, working with the press, electronic media, gaming and simulation, public address techniques, slide/tape production and use, film production and use. Spring.

552. Graphic Communication (3)

Two three-hour studios and one one-hour lecture per week. Studio time devoted to demonstrations, exercises and projects focusing on sketching, drafting, drawing construction and rendering techniques used in the landscape architecture field. Introduction to drawing reproduction and technologies. Emphasis on skill development, use of graphics in the design process. Drawings, examinations, and a final project constitute basis for grades. Fall.

Prerequisites: M.L.A. status or permission of the instructor.

637. Environmental Communications Project (1-3)

This course is designed to give graduate students an opportunity to work as a team in identifying, developing, administering, and evaluating a communications project related to an environmental issue. Typically, a workshop or shortcourse will be developed and offered for some targeted public through the School of Continuing Education. The nature of the topic and format of the project will be determined according to experience background of students enrolled. Task responsibilities and time commitments are correlated with number of hours for which student has registered. Spring.

682. Video Communications (3)

Three hours of studio plus lecture. This course will provide students with instruction and experience in the skills necessary to provide video tape programs. Each student will prepare and develop a video script for production of a program on an assigned topic. Completed programs will be tested and evaluated. Class size is limited. Fall and Spring.

Prerequisite: Permission of the instructor.

738. Environmental Education Programs of Agencies and Institutions (1-3)

One three-hour seminar session. An analysis of contemporary environmental education objectives, methodologies, and philosophies employed by various public and private institutions. Attendance, readings, and short paper required for one-hour credit. For two or three hours credit, an individual investigation of the environmental education and communications activity of an agency or organization is also required. Fall.

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. In the following list, courses numbered from ( )00 - ( )25 (at each level) are General Biology offerings; those from ( )26 - ( )50 are Plant Sciences, those from ( )51 - ( )75 are Entomology; and those from ( )76 - ( )95 are Animal Science courses.

NOTE: All EFB courses require a minimum prerequisite of one year of college biology or equivalent. A course at an appropriate level may be taken with permission of the instructor.

226. General Botany (3)

An introduction to plant biology with special emphasis on the classification, structure, and function of the green plant.

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.

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.

310. Evolutionary and Systematic Biology (3)

Three hours of lecture. Exploration of the core concepts of evolutionary and systematic biology to better understand organic diversity. Includes study of evolution's causal factors (mutation, migration, drift, and natural selection) and results (microevolution, differentiation, speciation and macroevolution) as well as the principles that allow classification of living organisms and reconstruction of evolutionary histories. Examples are drawn from plants, animals, and microorganisms. Spring.

Prerequisities: Courses in general biology, zoology, botany, ecology.

320. General Ecology (3)

Two hours of lecture, three hours of field trips during the first half of the semester. Introduction to ecosystem ecology stressing the dynamic interrelationships of plant and animal communities with their environments.

ecological factors, energy flow and trophic levels in natural communities, plant responses and animal behavior, population dynamics, biogeography, and representative ecosystems. The ecological impact of man is reviewed. Fall.

325. Cell Physiology (3)
Three hours of lecture. Introduction to the dynamics of living systems with emphasis on the universality of the biological world. Spring.
Prerequisite: One semester of organic chemistry.

326. Plant Structure, Function and Morphology (4)
Three hours of lecture and three hours of laboratory. An exposition of plant biology with emphasis on the structure and function of the life forms, reproduction, and adaptations of major groups of plants. Fall and Spring.

330. Plant Nutrition (3)
Three hours of lecture. Descriptive aspects of the fundamental activities of plants. Subjects covered include cell structure, water and mineral metabolism, organic nutrition, and a brief introduction to biological control mechanisms. Spring.
Prerequisite: EFB 326 or equivalent.

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. Open only to students in the Forest Engineering curriculum. Fall.

336. Dendrology I (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.

340. Forest and Shade Tree Pathology (3)
Two hours of lecture and three hours of autotutorial 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.

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 Resources Management. Spring.

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.

382. Wildlife Conservation (3)
Two hours of lecture, one hour of recitation. Introduction to the biological principles of conservation including the relationship of natural resources to modern society. The wildlife resource and its conservation will be emphasized. It is not designed for students concentrating in the area of Forest Wildlife Management. Fall.

385. Comparative Vertebrate Anatomy (4)
Three hours of lecture and three hours of laboratory per week. Analysis of vertebrate structure, with emphasis on comparative study of organ systems. Includes evolution of form and function, major adaptive patterns, and phylogenetic relationships in vertebrates. Spring.

386. Vertebrate Histology (3)
Two hours of lecture and three hours of laboratory. A study of tissues from protochordates, fishes, amphibians, reptiles, birds, and mammals, with emphasis on evolution, environment, and function, and with introduction to histopathologies. Spring.

387. Vertebrate Physiology (3)
Three hours of lecture. A study of functional responses of vertebrates to internal and external environmental conditions. Fall.

405. History of Natural Science (1)
One hour of lecture. A review of the history of western science from pre-Ionian times to Darwin, with evaluation of the impact of culture and religion on scientific progress. Spring.

407. Principles of Genetics (3)
Three hours of lecture and discussion. A general course covering concepts of genetics and evolution base 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, the genetic structure of populations and their evolution. Numerical methods for characterizing and analyzing genetic data are introduced. Spring.

408. Principles of Genetics Laboratory (1)
Three hours of autotutorial laboratory. Experiments with plants and animals and computer simulation exercises demonstrate the basic principles of inheritance of Mendelian and quantitative 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. Spring.
Corequisite: EFB 407.

409. Introduction to Quantitative and Population Genetics (1)
Ten lecture-discussions and four autotutorial laboratories the second half of the semester (incl. Lecture-Lab Modules 5 and 6 of EFB 407 and 408). Basic genetic concepts of quantitative inheritance, the structure of populations and evolution. Laboratory experiments and computer simulations are used to demonstrate these concepts. Numerical methods for characterizing and analyzing genetic data are introduced. Spring.
Prerequisite: An introductory genetic lecture-laboratory course deficient in these areas of genetics and permission of the instructor.
Note: Not open to students taking EFB 407 and 408.

420. Field Experience—Internship (5)
Full-time for at least five weeks, or equivalent, of employment with an agency or professional involved in field activity. A resident faculty member is required to serve as course evaluator. Approval of curriculum director is necessary. See advisor for detailed procedural information. Summer.

421. Ecology of Freshwaters (2)
Half-time for four weeks. Cranberry Lake Biological Station. Experimental and observational studies of environmental and biotic interactions influencing productivity of freshwaters. Basic concepts at the organismic, population, and community level. Summer.

426. Plant Propagation (1)
One combined lecture-demonstration laboratory plus supervised greenhouse assignments. Instruction in principles and practices of plant propagation and in related greenhouse operations. Fall and Spring.
Prerequisite: Senior status in Environmental and Forest Biology curriculum.
Note: Cannot be used to satisfy the 6-hour biology curriculum requirement in the plant sciences.

430. Fungal Physiology (3)
Three hours of lecture and discussion. Principles of growth, morphogenesis, and reproduction of the fungi emphasizing the role of the environment in controlling fungal processes. Spring.
Prerequisite: EFB 325 or equivalent.

431. Fungal Physiology Laboratory (1)
Three hours of laboratory. Selected experiments in the quantitative study of fungal growth, nutrition, sporulation, and spore germination. Spring.
Corequisite: EFB 430.

435. Adirondack Flora (2)
Half-time for four weeks. Cranberry Lake Biological Station. Field study of the summer flora of the Adirondack Mountains. Summer.

436. Dendrology II (1)
One three-hour field trip/laboratory. A continuation of Dendrology I emphasizing trees and shrubs ecologically important in the Central New York region and economically important in North America. Fall.

440. Principles of Forest Pathology (3)
Three hours of lecture, discussion or laboratory. Concepts and principles of tree diseases in relation to forest practices and practical experience in disease diagnosis and impact evaluation. Fall.
Prerequisite: EFB 340.

441. Field Problems in Forest Pathology (1)
Full-time for one week. Cranberry Lake Biological Station. Field study of important tree diseases in the Adirondacks, including heartrots, rootrots, cankers, rusts, foliage diseases, mistletoe, and physiological diseases. Also field study of mycorrhizae and other tree-root mutualisms. Summer.

442. Field Mycology (2)
Half-time for four weeks. Cranberry Lake Biological Station. An introduction to the collection and identification of the Adirondack fungal flora. Field techniques and laboratory identification of the major fungi found in selected ecosystems. Summer.

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.

446. Bryoecology (3)
Two hours of lecture and one three-hour laboratory or field trip. A study of the taxonomic diversity and ecological adaptations of Bryophytes in regional ecosystems. Spring.

448. Physiological Ecology of Plants (3)
Three hours of lecture. Examination of the interactions between plants and their environment. Emphasis will be given to the physiology of plants as it is modified by fluctuating external conditions and the mechanisms of plant adaptation. Students completing EFB 448 should not enroll in EFB 330. Fall.
Prerequisites: An introductory course in physics, EFB 320 and EFB 326.

451. Pest Management—Theory and Practice (2)
Two hours of lecture for nine weeks; then one lecture hour and one three-hour laboratory for four weeks. A review of history and governmental policy for four weeks. A review of history and governmental policy of pest management, as well as basic instruction in theory and practicum. Spring.
Prerequisite: EFB 352 or equivalent.

452. Principles of Chemical Control (3)
Two hours of lecture; one three-hour laboratory. A study of the chemistry, toxicology, handling and application of chemicals used to manage pest populations. A primer for the State Pesticide Application examinations. Fall.
Prerequisite: EFB 451.

453. Forest and Aquatic Insects (2)
Half-time for four weeks. Cranberry Lake Biological Station. The forest and aquatic insects of Cranberry Lake Region and their role in these environments and habitats. Insect collection required. Summer.

454. Wood Deterioration by Insects (3)
Three hours of lecture, discussion, and demonstration. Biology, identification, ecology of insect and wood interrelations; prevention of injury and control of insects injurious to forest products and wood in use. Spring.
Prerequisite: EFB 352 or equivalent.

476. Vertebrate Ecology (2)
Half-time for four week. Cranberry Lake Biological Station. Utilization of unique Adirondack forms and communities to study population dynamics behavior, systematics, and ecological role of vertebrates; standard field and laboratory techniques. Summer.

478. Microcommunity Ecology (2)
Half-time for four weeks. Cranberry Lake Biological Station. Study of terrestrial invertebrate microcommunities; descriptive and comparative assay of microhabitats incorporating experimental and field techniques. Summer.

479. Field Ornithology (2)
Half-time for four weeks. Cranberry Lake Biological Station. Field study of the ecology, distribution and behavior of birds of the Adirondack region. Techniques used in conducting field studies in avian biology will be emphasized. Summer.

480. Principles of Animal Behavior (4)
Three hours of lecture, one hour of recitation per week. A study of the basic principles of animal behavior, stressing exogenous and endogenous mechanisms of control, with emphasis on the evolution of behavior. Spring.

481. Behavioral Ecology (2)
Half-time for four weeks. Cranberry Lake Biological Station. Study of the behavioral adaptations of animals to their environment. Emphasis will be placed on animal orientation and social behavior. Habitat selection and interspecific interactions will also be considered. Summer
Prerequisite: EFB 480.

482. Invertebrate Zoology (4)
Three hours of lecture, three hours of laboratory. Structure, function, classification, and evolution of invertebrates. Emphasis on ecological role of invertebrates in specific habitats. Fall.

483. Biology of Birds and Mammals (4)
A course surveying the taxonomy, anatomical-behavioral-physiological adaptations and natural history of birds and mammals. Techniques for the field study of a vertebrate species will be discussed. Fall.

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. Spring.

486. Ichthyology (3)
Two hours of lecture, three hours of laboratory. An introduction to the anatomy, physiology, ecology, behavior, and taxonomy of fishes. Spring.

487. Fishery Biology (4)
Three hours of lecture and three hours of laboratory. Introduction to models of growth, mortality, production, and exploitation; aspects of fish ecology and behavior related to the dynamics and management of fish populations. Fall.
Prerequisite: EFB 486 or equivalent.

488. Ecology of Adirondack Fishes (2)
Half-time for four weeks. Cranberry Lake Biological Station. Study of the ecology of fishes, with detailed individual investigation of the ecology of Adirondack fishes. Summer.

490. Wildlife Ecology and Management (3)
Three hours of lecture. A study of the ecological principles governing wild animal populations and their habitats and the relationship of these principles to management programs and decisions. Spring.
Prerequisites: EFB 320 or equivalent.

491. Wildlife Ecology and Management Practicum (2)
One hour discussion, 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.
Corequisite: EFB 490; *Pre- or corequisite:* LIB 300.

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.

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.

500. Forest Biology Field Trip (1-3)
A five- to ten-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. Estimated student expense, $75. Fall or Spring.

501. Introduction to Genetic Engineering (3)
Three hours of lectures. The concepts and processes of recombinant DNA technology for the manipulation of genomes of plants, animals, fungi, and bacteria to produce new organisms of practical value. Spring.

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.

512. Chemical Ecology (3)
Two hours of lecture and one hour of discussion. A treatment of biological phenomena incorporating elements of ecology, physiology, and chemistry as a basis for development, behavior, and survival. Emphasis is on the intra- and inter-specific relationships involving chemical messengers at the organismal, population, and community levels. Spring.
Prerequisites: Organic chemistry, EFB 320, EFB 325.
Note: Also listed as FCH 540.

515. Population Ecology (3)
Two hours of lecture and three hours of laboratory. Description, analysis, evolution, interactions and stability of natural and experimental populations. Spring.
Prerequisite: EFB 320 or equivalent.

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.

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.
Co- or Prerequisite: EFB 524.

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.
Prerequisite: A semester of General Botany or equivalent.

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.

531. Plant Physiology Laboratory (1)
One laboratory session. Introduction to methods and procedures of physiological research. Spring.
Corequisite: EFB 530.

532. Plant Anatomy (3)
Two hours of lecture and three hours of laboratory. An introductory course in plant anatomy designed to familiarize the student with the organization and development of the primary and secondary plant body of higher plants. Spring.
Prerequisite: EFB 326.

533. Chemical Defenses of Plants (3)
Three hours of lecture/discussion about the ways in which plants defend themselves chemically against microorganisms, insects, herbivores, and other plants. Fall.
Prerequisite: A course in physiology or biochemistry.

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.
Prerequisites: EFB 326, EFB 327.

540. Mycology (3)
Two hours of lecture and three hours of laboratory. Fundamentals of the morphology, taxonomy, cytology, life histories, and ecology of fungi. Fall.

541. Wood Microbiology (3)
Two hours of lecture and three hours of laboratory/field trip. Major types of fungus defects of wood and its products and principles of control. Special emphasis on chemistry of wood decay, wood durability, toxicants, lumber discolorations, heart-rots and decay in forest products. Fall.
Prerequisites: Organic chemistry, EFB 340.

551. Forest and Shade Tree Entomology (2)
Two hours of lecture. Important forest and shade tree insects, detection, evaluation, prevention, and control of their damage; their relation to silviculture and management of forests and shade trees. Spring.
Prerequisite: EFB 352 or equivalent.

552. Forest and Shade Tree Entomology Laboratory (1)
Three hours of laboratory/field trip. Identification of important forest and shade tree insects and their damage. Spring.
Pre- or Corequisite: EFB 551.

553. Biological Control (2)
Two hours of lecture. Theory and practice of biological control of insect pests and weeds. Emphasis on the ecology and utilization of major groups of predators, parasitoids, and pathogens used in pest management and interpretation of mortality. Fall.
Prerequisite: EFB 352 or equivalent.

554. Aquatic Entomology (2)
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.
Prerequisite: One course in entomology or permission of the instructor.

560. Environmental Toxicology of Insecticides (3)
Two hours of lecture. Basis of action of insecticides in living systems, behavior of insecticides and microtoxicants in environment, interaction of insecticides and biological systems. Fall.
Prerequisite: EFB 325 or equivalent course in physiology or biochemistry.

561. Medical Entomology (3)
Three hours of lecture and recitation. Study of arthropods affecting man, domestic animals, and wildlife with emphasis on their biology, control, and relationships to vertebrate disease. Spring (even years).
Prerequisite: EFB 352 or equivalent.

565. Insect Morphology (3)
Two hours of lecture and three hours of laboratory. A comparative study of the external morphology of insects emphasizing evolutionary trends, especially modifications of homologous structures. Topics of special importance include intersegmental relationships, feeding, sensory mechanisms, locomotion, and reproduction. Spring.
Prerequisite: EFB 352.

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.

578. Terrestrial Community Ecology (3)
Three hours of lecture. Relation of terrestrial vertebrates and invertebrates to their physical, chemical, and biological environment. Emphasis on community principles, structural quantification, and evolutionary processes of terrestrial animals. Fall.
Prerequisite: EFB 320 or equivalent.

590. Wilderness Wildlife Management (2)
Two hours of lecture followed by one hour of group discussion. Students will participate in a two-day field trip at Huntington Forest. Completion of a term paper will be required for graduate credit. Fall.

607. Breeding Plants for Resistance to Disease and Pests (2)
Two hours of lecture and discussion. Principles, methods, and strategies in breeding for resistance to diseases and pests. The effectiveness, durability, and limitations of resistance breeding in pest management and control are considered.
Prerequisites: Introductory courses in genetics or forest tree improvement and in forest pathology or entomology, or permission of the instructor.

610. Ecological Energetics and Nutrient Cycling (3)
Three hours of lecture and discussion. Investigation of the principles of energy flow and nutrient cycling in ecological systems. The linkage of energy and nutrient fluxes in organisms, populations, communities, and ecosystems is emphasized. Fall.
Prerequisite: A course in general ecology.

625. Membranes and Biological Transport (3)
Two hours of lecture and one hour of discussion. Composition, structure, and physical properties of membranes. Membrane functions including transport, bioelectricity, and cell compartmentalization. Specific transport processes in biological systems. Fall (even years).
Prerequisites: One semester of biochemistry and an advanced physiology course.

630. Fungus Physiology (3)
Two hours of lecture and one hour of discussion. Principles of growth, reproduction, and differentiation of the fungi emphasizing the role of the environment in controlling fungal processes. Spring (even years).
Prerequisite: Two semesters of physiology or biochemistry.

632. Plant Growth Regulation (3)
Three hours of lecture/discussion on topics concerned with the biochemistry and physiology of plant hormones and synthetic growth regulators. Fall.
Prerequisite: A course in plant physology or biochemistry.

635. Topics in Plant Nutrition (2)
Two hours of lecture, discussion, and seminars. Advanced course dealing with selected topics of mineral and organic nutrition of plants. Fall (odd years).
Prerequisites: Completion of one or more physiologically-oriented plant science courses.

640. Principles of Forest Pathology (3)
Four hours of lecture, discussion, and laboratory. Concepts and principles of tree diseases in relation to forest practices and practical experience in disease diagnosis and impact evaluation. Fall.
Prerequisites: EFB 340, EFB 641.

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.

642. Principles and Practices of Tree Disease Control (3)
Two hours of lecture and three hours of laboratory or discussion. An advanced course considering the major chemical, cultural, and biological practices and integrated disease management strategies for tree disease control. Spring.
Prerequisites: EFB 440, EFB 540.

643. Plant Virology (3)
Three hours of lecture. The structure function, and replication of virus particles. Transmission mechanisms, vector relationships, symptomatology, and disease control strategies are covered in detail. Spring.
Prerequisite: Organic chemistry.

644. Plant Virology Laboratory (2)
Four hours of laboratory. Methodologies necessary to manipulate viruses and to identify and fully characterize virus unknowns will be presented. Spring (even years).
Prerequisite: EFB 643.

645. Plant Ecology (3)
Two hours of lecture and discussion and one laboratory/discussion. 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: EFB 320 or equivalent.

651. General Insect Taxonomy (3)
Two hours of lecture and three hours of laboratory. Identification and classification of the important orders and families of insects; acquaintance with pertinent taxonomic literature and use of keys; and understanding of evolutionary principles and concepts and a knowledge of systematic theory and practice. Insect collection required. Fall.
Prerequisite: EFB 565.

660. Insecticide Toxicology Laboratory (2)
One hour of discussion and three hours of laboratory. Laboratory experiments in mode of action and behavior of insecticides, biological and instrumental analysis of insecticides including tracer analyses. Spring (odd years).
Prerequisites: EFB 560 or equivalent and permission of the instructor.

678. Practicum in Terrestrial Community Ecology (3)
One hour of lecture, one hour TBS, and three hours of laboratory. Intensive practical application of ecological principles to the study of terrestrial animal communities. Includes experimental and field collection of data, quantifications, synthesis, and final reporting. Fall.
Pre- or Corequisite: EFB 578 or equivalent.

680. Behavioral and Physiological Ecology (3)
Two hours of lecture and one hour of discussion. An examination of the concepts of animal adaptations to ecological change from a behavioral point of view. Particular emphasis will be placed on the role the environment plays in shaping the behavior of a given species. Behavioral and physiological responses to environmental conditions will be treated as a continuum. Spring (odd years).
Prerequisites: One course in ecology, behavior, and physiology.

682. Invertebrate Symbiosis (3)
Two hours of lecture and one three-hour laboratory. An introduction to the ecology and evolution of interspecific relationships of invertebrates. Spring (even years).
Prerequisites: EFB 320, EFB 482.

690. Management of Wildlife Habitats and Populations (4)
Three hours of lecture and three hours of laboratory; some weekend field trips. For graduate students intending to enter professions in natural resource management, especially fish and wildlife and forestry. Focus is on the application of ecological principles and management techniques in the planning of habitat and harvest management programs for wildlife. Extensive independent work required. Fall.
Prerequisite: EFB 491.

691. Habitat Inventory and Evaluation (3)
Four hours of lecture and discussion. For students intent on careers in natural resource management, environmental planning or environmental

impact analysis. Focus is on methods for investigation of species-habitat relationships, and construction of models for the inventory and evaluation of habitat. State-of-the-art habitat evaluation procedures are explored. Spring.
Pre- or Corequisite: Multivariate Statistics.

692. Biology and Management of Waterfowl (2)
A consideration of the identification, life history, ecology, and economic importance of waterfowl of the Atlantic Flyway. The management of local, flyway, and continental waterfowl populations, including the establishment of hunting seasons, will be discussed. One Saturday field trip. Fall (odd years).

695. Urban Wildlife (2)
Three hours of lecture and discussion with field trips. A study of the occurrence, adaptations, and values of wildlife in urbanized areas, with emphasis on current research and agency programs. Spring (even years).

720. Topics in Soil Invertebrate Ecology (3)
Two one-hour lecture and discussion periods and a three-hour laboratory. Study of literature relating to soil invertebrate microcommunities; taxonomy, culturing, and collection methods of soil fauna; student will conduct an individual research problem. Spring (odd years).

724. Seminar in Aquatic Ecology (1)
Two hours of lecture and discussion. A seminar to explore in some depth areas of current research in aquatic ecology. Fall (even years).
Prerequisite: Six credits in aquatic ecology.

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 and Spring.
Prerequisites: EFB 531 or equivalent, biochemistry with laboratory.

740. Mycorrhizae (3)
Two hours of lecture and three hours of laboratory/discussion. A basic background course covering structural, functional, and ecological aspects of mycorrhizae; their methods of field and laboratory study; and applications in forestry practice. Fall (odd years).

741. Topics in Phytopathology (3)
Two two-hour lectures and discussions. Discussions of specific subjects in phytopathology and wood microbiology. Topic selection is based on availability of expertise and will be announced in advance. This course may be repeated for credit in different specialties. Fall or Spring.

745. Topics in Plant Ecology (2)
Two hours of seminar and discussion. An advanced course dealing with current research in plant community dynamics. May be repeated for additional credit. Fall.
Prerequisite: EFB 445 or EFB 645.

790. Topics in Wildlife Biology (1-3)
Hours to be arranged. Group study of a wildlife management topic. Fall or Spring.
Prerequisite: Six credits of wildlife management courses.

796. Topics in Environmental and Forest Biology (1-3)
Special instruction, conference, advanced study, and research in selected subject areas. Typewritten report required. Check *Schedule of Courses* for details. Fall and Spring.

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.

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. Typewritten report required. Fall and Spring.

830. Physiology of Growth and Development (2)
Lecture. A study of the growth and development of plants and the physiological and biochemical processes that influence the development of form and structure in higher plants. Fall (even years).
Prerequisites: EFB 530, EFB 532, and organic chemistry.

840. Advanced Mycology, Homobasidiomycetes (3)
Review of selected literature as well as laboratory training in identification and research techniques. Fall.
Prerequisite: EFB 540.

841. Advanced Mycology, Heterobasidiomycetes (3)
Review of selected literature as well as laboratory training in identification and research techniques. Spring (even years).
Prerequisite: EFB 540.

842. Advanced Mycology, Ascomycetes (3)
Review of selected literature as well as laboratory training in identification and research techniques. Spring (odd years).
Prerequisite: EFB 540.

843. Advanced Mycology, Deuteromycetes (3)
Review of selected literature as well as laboratory training in identification and research techniques. Fall (even years).
Prerequisite: EFB 540.

851. Advanced Insect Taxonomy (3)
Two hours of lecture and three hours of laboratory. Methods, procedures, and concepts of systematics. Examples and material will be drawn from among important groups of forest insects. Fall.
Prerequisite: EFB 651.

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.

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.

980. Topics in Animal Behavior (2)
Two hours of lecture and discussion. A seminar-type course designed to explore in depth selected and controversial subject areas in animal behavior. Fall or Spring.

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.

EIN—ENVIRONMENTAL INFLUENCES (LANDSCAPE ARCHITECTURE)

(See also courses listed under CMN and LSA.)

300. Introduction to Environmental Studies (3)
Three hours of lecture and discussion per week on the interrelationships among the natural environment, people, and the human environment. Emphasis is placed on developing critical facilities and systems thinking useful for assessing environmental issues. Fall.
Prerequisite: Permission of the instructor.

311. Natural Processes in Planning and Design (3)
Section 1: Landform and Soils
Section 2: Hydrology, Climate and Energy
Section 3: Plant, Animal, and Human Ecology
Three hours of lecture. This course presents an overview of the basic principles governing the dynamics of natural resources and processes which should be understood in planning and designing the human landscape. In each section, sources of reference data application to planning and project scale design will be discussed. Occasional local field trips will be utilized. Fall.
Prerequisite: Permission of the instructor.

371. History of American Landscape Attitudes (3)
Three hours of lecture-discussion. This course presents, through lectures, readings, and slides, uniquely American historical attitudes toward land and nature as shown through various cultural activities and disciplines, such as painting, architecture, landscape architecture, religion, philosophy, utopianism, exploration and recreation, land development and economics, and certain technological developments. Cultural expressions of the 19th century will be of primary interest, but formative attitudes from the Colonial period and certain 20th century results will be included. One-third to one-half of lecture periods are given over to student reports, criticism, and discussion. Spring.
Prerequisite: Permission of the instructor.

390. Social/Cultural Influences and Environmental Form (3)
Three hours of lecture. This course provides an introduction to an interdisciplinary social science analysis of human settlements. The course introduces the basic concepts, vocabulary, theories, and units of analysis for an interdisciplinary social perspective of the environmental form of human settlements. As such, it 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.

451. Fundamentals of City and Regional Planning (3)
Three hours of lecture per week. Lectures, assigned readings, written reports. Discussion of the meaning and purposes of city and regional planning. Examination of the historical development of urban places. Explanation of the principal elements of the comprehensive planning process, including goal formulation and decisionmaking, social and advocacy planning, planning for community facilities, and planning administration. Discussion of the methods and objectives of city and regional planning. Spring.
Prerequisite: Permission of the instructor.

452. Simulated Planning in Metropolitan Systems: Theory and Practice (3)
Three hours of laboratory, two hours of lecture/discussion. A computerized simulation designed to provide an understanding of the decision-making environment of metropolitan planning. Each participant is assigned a role consistent with his/her background. Lectures provide a theoretical framework for the activities in the simulation; a discussion section provides for evaluation. Computer experience is not necessary. Spring.

470. Art History (3)
Three hours of lecture. Informal lectures will emphasize and review assigned text and other readings and handout notes. Slides will be shown regularly; reports, quizzes and examinations. Evolutionary nature of the main cultural periods of Western man and fine art as man's selected environment will be the course emphasis. Spring.
Prerequisite: Permission of the instructor.

471. History of Landscape Architecture (3)
Three hours of lecture. Informal lectures and class participation, reports, assigned text and assigned reserve shelf reading, optional text and handout notes, quizzes and exams. Slides. Historical study and style analysis of Western man's efforts to design his environment and his changing attitudes and relationships to environment. Also, non-Western coverage where significant or influential on Western Man. Study of historical personalities as well as periods that are of environmental concern up into the modern period. Fall.
Prerequisite: Permission of the instructor.

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 the instructor.

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 the instructor.

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 the instructor.

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.
Prerequisite: Environmental Studies senior standing and written approval of an internship contract by faculty sponsor, curriculum director, and field supervisor.

510. Creative Problem Solving Seminar (3)
Three hours of lecture and discussion. A course designed to extend the student's understanding and application of creative problem solving processes. One requirement will be to select and carry out an application of the techniques to a particular problem, with consultation and guidance from the instructor. Critique and survey of the literature on creativity, in-depth analysis of the synectics process, and various procedures which have been developed for nurturing creative behavior comprise the essence of the program. Spring.
Prerequisite: Undergraduate degree or permission of the instructor.

ENS—ENVIRONMENTAL SCIENCE

505. Waste Management (3)
A multidisciplinary course. Course begins with foundation materials and progresses through a series of field trips and guest lectures aimed at preparing students to develop and communicate details of feasible alternative designs for waste management facilities/programs for specific case studies. Enrollment limited. Fall.
Prerequisite: Permission of the instructor.

600. Environmental Policy (3)
Three hours of lecture and discussion. This course develops the components of the interdisciplinary framework necessary for the study of Environmental Policy through systematic survey of theoretical approaches, analytical methods, and the literature of related disciplines. It emphasizes policymaking, analysis, implementation, and evaluation. This course is required for all GPES students. Fall.

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.

602. Land Use (3)
Three hours of lecture and discussion. Introduction to the basic concepts and methods of land use planning and policy analysis, and comprehensive examination of land use dimensions: ecological, economic, social, political, and institutional dimensions. Spring.

603. Urban Ecosystems: Science and Policy (3)
Three hours of lecture and discussion per week. An introduction to the ecosystem approach of describing and assessing urban areas. The study of the integration of natural, cultural, policy, and management systems.

796. Special Topics in Environmental Science and Policy (1-3)
Lectures and discussion, seminars, conferences and group research on topics of special or current interest, in fields related to environmental science and policy. See schedule of classes for current offerings. Fall and Spring.

797. Environmental Science Seminar (1-2)
Discussion of current topics and research related to environmental science. Fall and Spring.

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.

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.

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.

999. Doctoral Thesis Research (Credit hours to be arranged)
Research and independent study for the doctoral degree and dissertation. Fall, Spring, and Summer.

When choosing courses, students must consult their advisors/major professors.

ERE—ENGINEERING (ENVIRONMENTAL AND RESOURCE ENGINEERING)

306. Elements of Map and Air Photo Interpretation (1)
Two hours of lecture and three hours of laboratory per week for five weeks of a semester. Introduction to map and photograph interpretation to extract information useful to site inventory, analysis, planning, and design activities. The physical and geometric properties of maps and photographs, the characteristics of information contained in them, and the principles and procedures of interpretation are discussed. Spring.
Prerequisite: Junior standing in Landscape Architecture.

308. Elements of Plane Surveying (1)
Two hours of lecture and three hours of laboratory per week for the last five weeks of the semester. Introduction to the principles and procedures of plane surveying for mapping and construction layout purposes. Topics briefly discussed include the basic mathematical principles of surveying, the types and uses of surveying, horizontal and vertical distance measurement, angle measurement, traversing and computations, construction layout, tacheometry, and surveying errors (and their treatment). Spring.
Prerequisites: Junior standing in Landscape Architecture and college level plane trigonometry.

320. APL for Engineers and Scientists (2 or 3)
Programming and operation of time-sharing digital computer systems via the APL language. Analysis, modeling, and solution of basic problems in environmental science and engineering. Students desiring three credits will complete an original, substantial term project. Spring.
Prerequisites: Calculus and physics or permission of the instructor.

350. Wood Preservation (2)
Two hours of lecture with some demonstrations. A survey of basic wood-water relationships, shrinking and swelling, elementary wood structure, wood permeability, capillary forces, heat transmission, agencies of wood deterioration, wood preservation processes, wood fire performance, fire tests, and fire retardant treatments. Not open to WPE students. Fall.

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 open for credit to students who have completed successfully FCH 360 or equivalent.

352. Applied Engineering Thermodynamics (2)
Classical principles applied to devices and systems. Emphasis on efficient design of manufacturing equipment and processes. Power and refrigeration cycles; energy conservation; materials recovery. Environmental case studies and design project. Computer-aided data correlation and system simulation. Spring.
Prerequisites: ERE 351, FCH 360, or equivalent.

362. Mechanics of Materials (3)
Three hours of lecture. Theories of stress, deformation, and stability of common structural materials subjected to various force systems. Fall.
Prerequisites: Integral calculus and statics.

364. Engineering Materials (3)
Two hours of lecture and one three-hour laboratory per week. An introduction to the study of materials used in the construction industry in general. Lab work includes fabrication, testing, and evaluation of actual systems. Spring.
Prerequisites: Junior standing, physics, chemistry, and engineering mechanics.

371. Surveying for Engineers (3)
Two hours of lecture and recitation and three hours of laboratory. The principles of plane surveying for engineers. Subject matter areas include introduction to the theory of measurement and errors. Linear and angular measurements in both the horizontal and vertical planes, traversing and computations, horizontal and vertical control and associated computations, areal and volumetric computation, circular and parabolic curves, state plane coordinates, public land surveys, and the analysis and treatment of systematic and random errors. Laboratory field work and computations culminate in a topographic map. Fall.
Prerequisites: Differential and integral calculus.

375. Elementary Corrosion (1)
One hour of lecture. Basic electro-chemistry, film formation and passivation, galvanic corrosion and pitting, cathodic and anodic protection, protective coatings and inhibitors. Application of the above in the home, car, field, at sea, and in industrial plants. Spring.

377. Process Control (3)
Three hours of lecture. The study of the principles of process control both with and without electronic computers. The emphasis is on sensing and control elements, signal transmission, non-computerized controllers, conversion of signals to digital input for computer programs, control problems such as lag and errors, and applications with emphasis on the paper industry. Spring.
Prerequisites: College level physics.

420. Computer Applications in Science and Engineering (3)
Principles and methods of mathematical modeling for analog and digital computer solution. Applications to data reduction and correlation, statistical analysis, process and equipment simulation, optimization and control, and computer-assisted instruction. Typical examples, class problems and student projects. Current status and future projection of computational equipment, software and operating techniques. Fall.
Prerequisites: Calculus and computer programming, or permission of the instructor.

422. Process Design and Simulation (3)
Two hours of lecture/discussion and three hours of design laboratory per week. Mathematical modeling of process units and systems. Consideration of energy requirements, operating costs, and optimization techniques. Steady-state and dynamic simulation via computer programs. Use of data sources and software, applied to design exercises and case studies. Spring.
Prerequisites: Unit operations and computer programming, or permission of the instructor.

440. Water Pollution Engineering (3)
Two hours of lecture and three hours of laboratory. Introduction to the physical, chemical, and biological parameters of waste water treatment processes and to the principles of the unit operations involved. Study of the design parameters and design procedures of waste water treatment systems. Spring.
Prerequisites: Physics and CHE 356 or equivalent.

441. Air Pollution Engineering (3)
Three hours of lecture and discussions. 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 equivalent.

496. Special Topics (1-3)
Lectures, readings, problems, and discussions. Topics as announced in the areas of environmental or resource engineering. Fall and/or Spring.

500. Engineering Fundamentals (3)
This course provides a foundation and frame-of-reference for non-engineers entering graduate study. Completion enables nonengineering students to solve simple, applied problems in engineering science fundamentals. The course also helps the student recognize good and poor approaches to problem formulation and analysis, and to be better prepared to deal with technical, social, and economic constraints on environmental problem solving. Enrollment limited. Fall.
Prerequisite: Permission of the instructor.

505. Waste Management (3)
A multidisciplinary course. Course begins with foundation materials and progresses through a series of field trips and guest lectures aimed at preparing students to develop and communicate details of feasible alternative designs for waste management facilities/programs for specific case studies. Enrollment limited. Fall.
Prerequisite: Permission of the instructor.

510. Energy: Alternate Systems (3)
Three hours of lecture. An introduction to alternate energy resources and conversion processes. Focus is on relatively small-capacity, decentralized systems and means for judging appropriateness, costs, and impacts of application under varying conditions and needs. Instruction modules on passive and active solar heating, wind energy system, biomass resources and conversion, including ethanol production, methane recovery and wood gasification, and internal combustion cogeneration.

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. Fall and Spring.
Prerequisite: ERE 371 or equivalent.

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. Introduction to scanning and transmission electron microscopy. Fall.
Prerequisite: Permission of the instructor.

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.

611. Energy: Production and Conservation (3)
Three hours of lecture. An introduction to the technology, impacts, hazards, and costs of large-scale, centralized power generation, with emphasis on opportunities for resource conservation. Spring.

642. Water Quality Modeling (3)
Two hours of lecture and three hours of laboratory per week. An analysis of the biological, chemical, and physical factors of receiving waters governing the action of wastes and their reactions in receiving waters. Introduction to modeling techniques applicable to water quality management issues. Fall.
Prerequisite: ERE 440 or equivalent as evaluated by the instructor.

643. Water Pollution Engineering (3)
Two hours of lecture and three hours of laboratory. Introduction to the physical, chemical, and biological parameters of waste water treatment processes and to the principles of the unit operations involved. Study of the design parameters and design procedures of waste water treatment systems. Spring.
Prerequisites: Physics and CHE 356 or permission of the instructor.
Note: A student may not enroll in or receive credit for both ERE 440 and ERE 643.

655. Remote Sensing Measurements (3)
Two hours of lecture comprising an in-depth coverage of the theory, design, and application of remote sensing systems and techniques employed to obtain precise spectroradiometric measurements to map and monitor natural resources. Photographic and non-photographic systems are considered. Laboratory experiments in the form of an assignment using remote sensing data. Fall or Spring.
Prerequisites: ERE 572 and FEG 363 or ERE 563 or consent of the instructor.

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 or equivalent.

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. Fall.
Prerequisites: Organic, physical, and analytic chemistry.
Note: A student may not enroll in or receive credit for both PSE 461 and ERE 670.

671. Chemistry of Pulping and Bleaching (3)
Three hours of lecture. Discussion of the chemistry underlying the commercial pulping and bleaching processes, designed to assist in interpreting the phenomena observed in these operations. Emphasis is placed on those reactions which contribute to delignification and the removal of chromophormic groups in lignin and extractives. Spring.
Prerequisite: FCH 572 or permission of the instructor.

675. Principles of Unit Operations (4)
Three hours of lecture and discussion and one two-hour computation period. Fundamentals of fluid dynamics, heat and mass transfer, appropriate analogies and process applications. Stage operations and computation methods. Application to distillation, extraction, gas absorption, evaporation, crystallization and drying. Design, operation, and computer simulation of equipment. Fall.
Prerequisites: Calculus and physical chemistry or permission of the instructor.

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 between paper manufacturing methods, papermaking additives, test results and the ultimate properties desired in the finished paper. Fall.
Prerequisite: Permission of the instructor.
Note: A student may enroll in or receive credit for both PSE 465 and ERE 677.

678. Paper Coating and Converting (2)
Two hours of lecture plus evaluation of literature, independent project planning, and/or laboratory study. 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: PSE 465 or permission of the instructor.
Note: A student may enroll in or receive credit for both PSE 466 and ERE 678.

680. The Anatomy and Ultrastructure of Wood (2)
Two hours of lecture and/or demonstration and discussion. The gross, microscopic and submicroscopic structure of wood including organization of the cell wall, distribution of chemical constituents and abnormalities in wood. Fall.

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: Permission of the instructor.

Note: A student may enroll in or receive credit for WPE 326 or WPE 327 and ERE 682.

684. Mechanical Properties of Wood (3)

Two hours of lecture and three hours of laboratory. The effect of the anatomical and chemical nature of wood on its response to static and dynamic force systems. The theory of elasticity as applied to wood and wood-based composites. Spring.

Prerequisite: Permission of the instructor.

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. Fall.

Prerequisite: Consultation with the instructor.

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 the instructor.

688. Tropical Timbers in Commerce (2)

Two hours of lecture. Introduction to the commercial use of tropical timbers; the factors of forest conditions, stand types and wood qualities influencing their utilization and the development of trade. Sources of information. Spring.

Prerequisite: Permission of the instructor.

689. Tropical Wood Anatomy (1)

Anatomical characters, identification and taxonomy of tropical woods important in commerce. Spring.

Prerequisite: WPE 387 or ERE 360. Recommended that ERE 688 be taken concurrently or previously.

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 the instructor.

Note: A student may enroll in or receive credit for both ERE 441 and ERE 691.

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 or equivalent.

762. Instrumental Photogrammetry I (3)

Two hours of lecture and three hours of laboratory. The theory and practice of extracting information from photographs with the aid of photogrammetric plotters. Fall or Spring.

Prerequisite: FEG 363 or equivalent.

775. Applied Thermodynamics (3)

The study and application of thermodynamics, including the first and second law, phase relationships, thermochemistry, the production of work and equilibrium relationships. Spring.

Prerequisites: FCH 360, FCH 361 or equivalent.

785. Scanning Electron Microscopy (5)

Two hours of lecture, demonstration and laboratory. Six hours of independent laboratory experience. The theory and operation of the scanning electron microscope including specimen preparation, photographic technique, and interpretation of micrographs. Spring.

Prerequisite: Permission of the instructor.

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 the instructor.

797. Seminar (1-3)

I. Forest Engineering topics. II. Paper Science and Engineering topics. III. Wood Products Engineering topics. Fall and Spring.

798. Research in Environmental and Resource Engineering (Credit hours to be arranged)

I. Independent research topics in Forest Engineering. II. Independent research topics in Paper Science and Engineering. III. Independent research topics in Wood Products Engineering. Fall, Spring, and Summer.

880. Interpretation of Cellular Ultrastructure (2)

One hour of lecture and two hours of demonstration and discussion. The organization and sculpturing of the walls and plant cells; the cellulose microfibril, matrix and incrusting substances, and the warty layer. The ultrastructure and function of cytoplastic organelles in cells. The nucleus, the mitochondrion, the chloroplast, the endoplasmic reticulum, microtubules, the gap junction and the tight junction. The tools and techniques used for light end electron microscopic study of cells, and the interpretation of structural evidence. Directed study and discussion of the latest (current) literature on pertinent topics. Spring.

Prerequisite: Permission of the instructor.

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.

999. Doctoral Thesis Research (Credit hours to be arranged)

Research and independent study for the doctoral degree and dissertation. Fall, Spring, and Summer.

ESF—NONDEPARTMENTAL

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.

FCH—FOREST CHEMISTRY

221. Organic Chemistry I (3)

Two hours of lecture, one hour of recitation. A survey of representative classes of carbon compounds with emphasis on structure, fundamental reactivity, and other important properties and characteristics relevant to biological systems. Fall.

222. Organic Chemistry Laboratory I (2)

One hour of pre-laboratory instruction. Three hours of laboratory. Laboratory safety. Melting and boiling points, distillation, recrystallization, thin-layer and column chromatography, and isolation of natural products. Qualitative functional group analysis. Fall.

223. Organic Chemistry II (3)

Three hours of lecture and discussion. The structure and reactivity of organic compounds, utilizing natural products as examples, will be studied in order to develop an organic chemical background for further study of biological chemistry. Spring.

Prerequisite: FCH 225 or equivalent.

224. Organic Chemistry Laboratory II (2)

Four hours of laboratory including pre-laboratory instruction. Continuation of FCH 222. Simple physical and instrumental techniques applied

to organic chemistry. Gas chromatography, polarimetry, kinetics. Introduction to classical literature syntheses. Spring.

Prerequisite: FCH 222 or equivalent.

Corequisite: FCH 223 or equivalent.

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.

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.

361. Physical Chemistry II (3)

Three hours of lecture. Includes discussion on the structure of matter, principles of quantum mechanics, spectroscopy, and chemical kinetics. Spring.

Prerequisite: Physical Chemistry FCH 360 or the equivalent.

380. Instrumental Methods of Analysis (3)

Two hours of lecture and one three-hour laboratory. Lecture includes theory, applicability, and limitations of a number of current methods of instrumental analysis. Laboratory sessions provide practice with several of these techniques. Spring.

Prerequisites: General chemistry and quantitative analysis.

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.

390. Drugs from the Wild (3)

Three hours of lecture and discussion each week. This course is designed to give students a comprehensive understanding of the variety of medicinal agents available from natural sources. Economic and societal aspects will be explored as well as scientific ones. In addition to curative agents, discussion will include toxic substances, folk medicine (including herbal) preparations, and the so-called "recreational drugs." Fall.

495. Introduction to Professional Chemistry (1)

The professional chemist and his 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.

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 advsior and objectives of the study. Evidence of competence and appropriate effort is required for credit. A written report will be expected. Fall and Spring.

Prerequisite: Upper division status.

497. Undergraduate Seminar (1)

One hour per week. Literature surveys and seminars on topics of current research interest and recent advances in chemistry. Spring.

498. Introduction to Research (5)

Eighteen hours of laboratory, library search and report writing. Solution of a selected research problem using special laboratory techniques. Typewritten report on data, procedures, results, and conclusions. Spring.

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. Fall.

Prerequisites: An introductory course in physical chemistry is required and a shortcourse in computer programming is recommended.

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. Spring.

Prerequisite: Chemistry through physical chemistry, or consent of the instructor.

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.

519. Environmental Chemistry Seminar (1)

One hour of lecture. Seminars on current research and issues in environmental chemistry and related areas. Spring.

520. Nuclear and Radiation Chemistry (2)

The two one-hour lectures will cover the information required for the basic understanding of nuclear reactions, the types of radiation emitted, the instrumentation necessary to detect and measure this radiation, the principles of radioisotope tracer techniques, and radiation chemistry which is the effect of radiation on organic systems. Visits to the Cornell Reactor and the Nuclear Medicine Department of the Upstate Medical Center will be arranged. Spring.

Prerequisites: Physical, organic and inorganic chemistry or by permission of the instructor.

Note: This course can be taken independently of FCH 521.

521. Nuclear Chemical Techniques (1)

The laboratory will consist of one four-hour laboratory class every two weeks, with one hour to be made up at the student's discretion to accommodate counting periods which extend over several weeks. A short movie by the AEC each week will be required for the sixth hour. The laboratory will give each student the opportunity to use the individual counting instruments, gain experience in the handling and preparation of radioactive samples and the use of the 1000-curie-cobalt source in radiation chemistry. Spring.

Prerequisite: Physical, organic, and inorganic chemistry or permission of the instructor. Advanced tentative registration is required.

Corequisite: FCH 520.

524. Topics in Natural Product Chemistry (3)

Three hours of lecture and discussion each week. A course intended to introduce the student to various types of secondary metabolites including several of past and current interest because of their pronounced biological activities. Modes of chemical reactivity and means of structure determination and syntheses are covered. Spring.

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.

Prerequisites: One year of organic chemistry and one year of physical chemistry.

531. Biochemistry Laboratory (2)

Six hours of laboratory. This course will stress techniques used in biochemical research. Techniques used include various types of chromatography, electrophoresis, and spectrophotometry and methods

involved in the isolation, purification, and assay of enzymes. Fall.
Prerequisite: One semester of quantitative analysis with laboratory.

532. Biochemistry II (3)
Three hours of lecture. Topics discussed are: application of tracer techniques to biochemistry, the chemical and biochemical properties of lipids, theories on the origin of life, photosynthesis and the biosynthesis of steroids and terpenes, plant aromatics, amino acids, porphyrins and other aspects of nitrogen metabolism. Spring.
Prerequisites: FCH 530 and its prerequisites.

539. Principles of Biological Chemistry (3)
Three hours of lecture. Principles of biochemistry with emphasis on their relationship to biology. Topics include basic metabolic pathways, structure, and function of proteins, enzymes, and nucleic acids, energy relationships and biochemical control mechanisms. Nonchemistry majors. Fall.
Prerequisite: A two-semester course in organic chemistry is desirable, but a one-semester course is acceptable.

540. Chemical Ecology
This course is the same as EFB 512. Refer to description on page 71.
Note: Credit cannot be received for both FCH 540 and EFB 512.

550. Introduction to Polymer Science I: Polymer Synthesis and Mechanisms (3)
Three hours of lecture. 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, reaction on polymers, polyelectrolytes. Fall.
Prerequisites: One year of organic chemistry and one year of physical chemistry.

551. Polymer Techniques (2)
One hour of lecture and discussion and three hours of laboratory; lab reports. Techniques of polymer preparation: free radical solution and emulsion polymerization, gel permeation. Molecular weight determination by light scattering, osmometry, viscosity, gel chromatography. Structure characterization by X-ray diffraction, electron microscopy, nuclear magnetic polarized microscopy, stress-strain and swelling equilibrium and thermal analysis. Fall.
Prerequisites: One year of organic and one year of physical chemistry.

552. Introduction to Polymer Science II: Polymer Properties and Technology (3)
Three hours of lecture. Introduction to the 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. Spring.
Prerequisites: One year of organic chemistry and one year of physical chemistry.

555. Natural and Synthetic Polymers: An Overview (2)
Two hours of lecture. A series of 24 introductory lectures on all aspects of polymer science. The material covered will include: types of natural and synthetic polymers; molecular size and shape; molecular weight determinations; chemical synthesis and reactions; polymer type vs. properties; properties in the liquid state; properties in the solid state; rubber and elastomers; crystallinity and morphology; mechanical and thermal characteristics; manufacturing and polymer technology. Fall.
Prerequisites: Organic chemistry. Some knowledge of physical chemistry is helpful, although not required.

560. Chromatography and Related Separation Sciences (3)
Three hours of lecture and discussion each week. A course designed to give the student a thorough understanding of analytical and isolation chemistry by modern chromatographic, distributive and molecular sieving techniques. The chemistry of the systems discussed will be stressed as well as the important physical aspects. Spring.
Prerequisite: Two semesters each of organic and general chemistry.

571. Wood Chemistry I: General Wood Chemistry (2)
Two hours of lectures. 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.

572. Wood Chemistry II: Wood and Pulping Chemistry (3)
Three hours of lectures. 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. Chemistry of the industrial pulping processes with emphasis on sulfite and kraft pulping of wood. Chemistry of the major bleaching agents. Chemical byproducts in the pulping industry. Complete tree utilization in the manufacture of pulp and paper. Fall.
Prerequisite: One or two semesters of a three-credit undergraduate course in organic chemistry.

573. Wood Chemistry III: Biosynthesis of Wood (2)
Two hours of lecture. Chemistry of pectin and starch. Photosynthesis with emphasis on the chemical phase. Chemistry of the primary cell wall in plants. Biosynthesis of cellulose, hemicelluloses, pectin, and starch. Biosynthesis of aromatics, including lignin. Biodegradation of wood. Fall.
Prerequisite: FCH 571 or an equivalent course in general wood chemistry.

574. Wood Chemistry IV: Wood Chemistry Laboratory (1)
Three hours of laboratory. Reports. Gravimetric and spectrophotometric determinations of lignin. Determination of the number-average molecular weight of ethylcellulose by osmometry. Estimation of the weight-average molecular weight of ethylcellulose by viscometry. Calibration of a gel permeation chromatography (GPC) column. Separation and characterization of larch arabinogalactans A and B by GPC. Fall.
Prerequisite: FCH 571 Wood Chemistry I or an equivalent course in general wood chemistry.

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 530-532 or FCH 539 or equivalent.

650. Physical Chemistry of Polymers I (3)
Three hours of lecture. Includes: thermodynamics of polymer solutions, phase equilibria, fractionation, structure-property relationships, elementary chain statistics, molecular geometry, network elasticity, polyelectrolyte theory, and viscosity. Fall.
Prerequisites: One year of organic chemistry and one year of physical chemistry.

651. Physical Chemistry of Polymers II (3)
Three hours of lecture. Viscoelasticity. The glassy state and glass transition temperature. The crystalline state and crystallization kinetics. Characterization of structure and morphology of polymer solid states. Survey of structure and properties of native polymers. Spring.
Prerequisites: One year of organic and one year of physical chemistry.

652. Organic Chemistry of Polymers I (3)
Three hours of lecture. A broad survey of the chemistry of polyfunctional molecules and methods for their conversion to high molecular weight materials. Synthesis of a variety of specialty polymers and chemical reactions on natural and synthetic polymers. Some relations between molecular structure and useful properties. Spring.
Prerequisite: One year of organic chemistry.

653. Organic Chemistry of Polymers II (3)
Three hours of lecture. Kinetics and mechanism of polymerization processes, with emphasis on addition polymerization reactions initiated by radical, cationic and anionic initiators. Mechanism of stereospecific polymerization. Structure of polymers. Reactions on polymers and their

modification for specific end uses. Block and graft polymers. Spring.
Prerequisites: One year of organic chemistry and one year of physical chemistry.

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.

798. Research in Chemistry
(Credit hours arranged according to nature of problem)
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 typewritten report required. Fall, Spring, and Summer.

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.

997. Seminar (1)
Seminars scheduled weekly; an average of twenty to thirty seminars are given annually. Discussion of recent advances in chemistry. Credit is given only once to a student. Fall and Spring.

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

340. Engineering Hydrology, and Flow Controls (4)
Three hours of lecture and three hours of laboratory and discussion. Analysis of the waters of the earth, their occurrence, circulation, and distribution; physical properties and their interaction with their environment. Principles of hydrologic budgeting and routing; and basic hydraulics of open channel, conduit, groundwater and overland flow. Applications of probability as a basis for the design of solutions to groundwater, surface runoff, flooding and water supply problems. Spring.
Prerequisites: CIE 327, IOR 326, and APM 360.

350. Introduction to Remote Sensing for Engineers (2)
Two hours of lecture. 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 standing and FEG 363 (which may be taken concurrently with FEG 350).

352. Introduction to Remote Sensing (3)
Two hours of lecture. 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.
Prerequisites: Physics and calculus or permission of the instructor.

363. Photogrammetry (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 or equivalent.

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 concrete 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, APL Computing.

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. A context is developed for the application of other Forest Engineering courses.
Prerequisites: EFB 315, FOR 321.

430. Engineering Decision Analysis (3)
An introduction to the design process as a decision model, with emphasis on techniques for determining economic attractiveness of engineering alternatives, and analyzing construction and production operations. Includes a survey of mathematical models useful for operations planning and analysis. Fall.
Prerequisite: IOR 326.

437. Transportation Systems (3)
Three hours of lecture and three hours of laboratory. Interrelationships among natural features, transportation types, design, and management objectives to provide the most effective system within the 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.
Prerequisite: CIE 437, FEB 422.

448. Advanced Topics in Hydraulics (3)
Three hours of lecture per week. Classroom instruction and exercises introduce advanced concepts in hydraulics. Topics include 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 as determined by the instructor.

454. Tractive Power Systems (2)
Two hours of lecture per week. An introduction to analysis and design of tractive power systems used in timber extraction and other forestry, agriculture, and construction applications. Spring.
Prerequisites: MEE 285, ERE 351, FEG 420.

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.

477. Survey Systems Design (3)
Three hours of lecture and discussion. Land survey systems including the U.S. Public Land System, plane coordinate systems, and land use and resource systems—Specifications for Surveying and Mapping Projects. The design of future systems. Spring.
Prerequisites: FEG 371 and FEG 363.

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 standing in forest engineering.

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 the instructor.

FOR—FORESTRY (RESOURCES MANAGEMENT)

205. Introduction to Macroeconomics (3)
Three hours of lecture per week. The role of macroeconomic theory in public policy will be emphasized. Basic macroeconomic models of the banking system and of the interplay of consumer, business firms and government purchases of goods and services will be used in the analysis of public policy with respect to stability of consumer prices and the level of employment in the economy, the role of foreign trade in the performance of the national economy.

206. Introduction to Microeconomics (3)
Three hours of lecture per week. Consumer behavior, pricing and resource allocation, and the theory of the firm and industry will be emphasized. The role of microeconomic theory in public policy analysis.

301. Field Dendrology (1)
Approximately one half-day lecture, five eight-hour field study, presented as the first portion of the Summer Program in Field Forestry held at Pack Demonstration Forest, Warrensburg, N.Y. Field identification and ecology of common woody species of the southeastern Adirondack area. Natural and cultural history of the area as it affects the growth and development of these species. Summer.

302. Forest Surveying and Cartography (2½)
Course consists of approximately thirteen, eight-hour class days, combining lectures and practical field applications. The course stresses development of functional ability in the areas of cartography, overland navigation, and land measurement. It is part of the Summer Program in Field Forestry held at Pack Demonstration Forest, Warrensburg, N.Y. Summer prerequisite for FOR 303, 322, 332.
Prerequisite: FOR 301.

303. Introduction to Forest Mensuration (3½)
Lecture and field practice on methods and procedures for measuring trees, forest stands, and forest products. Descriptive statistics and sampling are introduced as they relate to the measuring process. Emphasis is placed upon field procedures and performance. The course is part of the Summer Program in Field Forestry held at Pack Demonstration Forest, Warrensburg, N.Y. Summer.
Prerequisites: FOR 301 and FOR 302.

304. Introduction to Forestry (1)
Approximately one day of lecture and at least four all day field trips, presented as an integral part of the Summer Program in Field Forestry. Students will be introduced to the diversity of forestry and the activities of a professional forester, and will visit forestry field operations and wood-using industries. Summer.

305. Forestry Concepts and Applications (1)
Lectures and some labs will help students explore basic concepts of forestry, the breadth of and scope of forestry-related activity, and the diversity of forest values and uses. Topics include an introduction to many disciplines related to forest management and use, and study of how basic concepts from physical, biological, and social sciences are applied in forestry. Required of all forestry juniors.

321. General Silviculture (3)
Two hours of lecture and one three-hour laboratory first half of semester, three hours of lecture last half of semester. Survey of silvical principles and concepts and practice of silviculture for the production of goods and services from the forest. Designed for students in curricula other than resources management. Not available for resources management majors. Fall.

322. Forest Mensuration (1)
Lecture, field, and laboratory work blocked in time and subject matter with FOR 331 and 332. Principles and methods used in the measurement of the trees and forest stands, the use of aerial photos for mapping and inventory, and the theory and application of compound interest to forestry decisions. Fall.

331. Introduction to the Physical Environment (6)
Lectures, discussions, field, and laboratory work blocked in time and subject matter with FOR 332 and 322. Study of the environmental media: air, soil, and water, through examination of the flow of energy and matter within and between these components of the environment. Drawing together information from geology, physical geology, soil science, water science, and meteorology, this course provides understanding of these areas, their interactions, and the interface with the biological system. Fall.
Prerequisite: Junior year standing in FOR curriculum or equivalent. Course should be taken concurrently with FOR 332 Silvics-Silviculture, because of the blocking of these two courses.

332. Silvics-Silviculture (8)
Lectures, field and indoor laboratory work, and field trips blocked in time and subject matter with FOR 331, 322, and 305. Emphasis is placed on the biological interrelationships within the forest community, including site factors and forest stand dynamics, and the consideration of these in silvicultural operations. Fall.
Prerequisites: Summer Program in Field Forestry, and FOR 331 (taken concurrently) or permission of the instructor.

335. Regional Silviculture (3)
Three hours of classroom study. Topics cover regional factors that influence silvicultural methods commonly used in different forest types. Provides study of various silvicultural systems used in operating forest properties in various regions, with attention to geographical differences in land use, market opportunities, species characteristics, and economic conditions. Spring.
Prerequisite: FOR 332 or FOR 321.

345. Soils (3)
Two hours of lecture and three hours of laboratory. Introduction to the fundamentals of soil science with particular reference to forestry, but including other land uses. Spring.

360. Principles of Management (3)
Three hours of lecture and recitation. Basic principles and concepts of management which are universally applicable to any organization, business enterprise, or public agency. The various approaches to management including the classical, behavioral and quantitative concepts with emphasis upon the integrative approach, now required to meet modern society's changing life styles and values and the new awareness of the public regarding environmental matters and natural resources management. Spring.

361. Computing in Forestry (3)
Introduction to the use of the computer in forestry and to the BASIC programming language. Commonly used forestry techniques are implemented by the student on the computer and the student has the opportunity to use other professionally prepared programs. The student also uses the computer as a communication device. The course is designed for students in the forestry curriculum. Open to other students by permission of the instructor.
Prerequisite: An introductory course in computers.

364. Soil and Water Conservation Policy (3)
Three hours of lecture. An integrated, historical survey of water and related land resource conservation in the United States. Interrelationships of governments and private organizations in their functions of policy-setting and planning, administration of programs, and evaluation of projects. Three lectures per week. Spring.

370. Management of the Forest Enterprise (3)
Two hours of lecture and one hour of discussion and laboratory. This course is concerned with the management alternatives, both of a technical and social nature, that are available in the planning for and the production of timber, recreation, wildlife, forage, and water from the forest and with the criteria for choice to meet management objectives. Spring.

371. Range Management (3)
Three hours of lecture and discussion covering range ecology, inventory and evaluation; animal husbandry and grazing management; multiple-use of rangelands; range improvement practices; and range policy and administration. Spring.
Prerequisite: Upper division status in Resource Management or Biology, or by permission of the instructor.

373. Timber Harvesting (3)
Two hours of lecture and one three-hour laboratory and discussion. Harvesting as a production system including equipment, equipment mixes, costs and manpower in serving and logmaking and primary and secondary transportation. Evaluation of various systems as to environmental impacts. Wood as a raw material to the primary processing system and trees as inputs to the harvesting system. Spring.

378. New York Forestry (3)
Lecture, discussion, and field trip. Historical development of forests and forest uses in New York, analysis of current issues in New York forestry, and consideration of possible future developments for New York forests. Provides information useful to geographers, foresters, planners, and others interested in the social environment of New York's natural resources. Meets one evening a week plus one all day Saturday field trip.

400. The Social Environment of Resource Management (3)
Three hours of lecture and discussion. This course describes the institutional framework within which the resource manager practices his profession. It intends to show how economics, law, public policy, pressure groups and financial considerations constrain the professional judgment of the resource manager and the goals and objectives of the institution employing him. Fall.
Prerequisites: Senior standing in forest resources management or permission of the instructor.

404. Economics of Wood-Using Industries (3)
Three hours of lecture and discussion. Structure and organization of selected wood-using industries. Analysis of decisionmaking by the firm. Principles of production and marketing including demand and cost analysis and pricing. Special issues and current problems of the industries, and introduction to the newer mathematical and statistical tools for meeting them. Spring.
Prerequisite: Microeconomics.

405. World Forestry Resources: Problems and Prospects (3)
Three hours of lecture and discussion plus guided readings, pertaining to world forest resources and the problems and opportunities associated with their use and development. Major topics include: world forest resources; production and trade; principal wood-producing countries; forestry and the problems of underdevelopment; and special areas and topics of interest to world forestry. Spring.
Prerequisite: Senior status preferred.

433. Commodity Production Silviculture (3)
Six hours of lecture and study, or field work classroom instruction and exercises will introduce topics, followed by field exercises stressing application of silvicultural methods for growing wood products, mostly in hardwood stands. Topics will cover concepts, techniques, diagnostic methods, and field application of silvicultural prescriptions in both even- and uneven-aged management. Offered one day per week as a block of instruction and exercise. Spring.
Prerequisites: FOR 331-332, and one mensuration course beyond Summer Program in Field Forestry; Senior standing.

434. Greenspace Silviculture (3)
Two hours of lecture, one to three hours seminar or field trip. Concepts, techniques, and field practice of evaluating and manipulating vegetation systems, including site conditions, woody and herbaceous vegetation, and use impacts, primarily for on-site values in park, recreation, wildlife and multiple-use lands, roadsides, utility rights-of-way, protection areas, etc. Fall.
Prerequisites: At least one silviculture course and senior status or permission of the instructor.

446. Forest Soil Classification, Survey, and Interpretation (3)
Three hours of lecture and discussion, one three-hour laboratory. Detailed examination of soil genesis and classification, and the survey and description of the soilscape. Interpretations are made for various land uses, especially forestry. Fall.
Prerequisites: FOR 331 or 345 or an introductory soils course.

455. Forest Tree Improvement (3)
Two hours of lecture, three hours of laboratory or field work. General principles and methods of tree improvement as practiced in this country and abroad. Tree selection techniques of vegetative propagation, hybridization, polyploidy, establishment and management of seed orchards, clonal and progency testing and other problems. Spring.
Prerequisites: FBL 470, or Introduction to Mendelian Genetics or Population Genetics.

461. Management Models (3)
Three hours of lecture. Introduction to the various models used in managerial decisionmaking. Emphasis is on the characteristics of the various models: their formulation, assumptions, uses, and limitations. The major topics covered will include: the role of models in management; simple optimization; constrained optimization; multi-valued choices; time adjustment of value; simulation; and models in nondeliberated decisions. Integration of the deliberative and intuitive models is stressed. Fall.

472. Fundamentals of Outdoor Recreation (3)
Three hours of lecture. 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 on major recreational issues and conflicts faced by area managers, and how they integrate solutions into their plans. Spring.

473. Planning and Development of Forest Recreation Areas (3)
Three hours of lectures or equivalent laboratory and assignments. Planning and designing forest recreation areas, structures, and facilities. Development of construction plans for camp and picnic sites, for waterfront areas and for trails. Emphasis is on the functional relationship between planning and design, management, and maintenance. Field trips required. Fall.
Prerequisite: FOR 472.

475. Sociology and Psychology of Leisure Behavior (3)
Three hours of lecture and discussion. Introduction to theory and research findings dealing with the sociological and psychological aspects of leisure behavior; field work and lectures demonstrate applications, particularly with regard to leisure behavior. Spring.
Prerequisites: FOR 472, and an introductory course in sociology or psychology, or permission of the instructor.

477. Resource Policy and Management (3)
Three hours of lecture supplemented by one hour of discussion and/or lecture. Public and private forest policy formation; principles of modern management; overall management and operation of a productive forest property. Primarily for forest engineers. Not available to Resource Management undergraduates. Fall.
Prerequisites: Mensuration and silviculture, senior standing in Forest Engineering, or by permission of the instructor.

480. Urban Forestry (3)
Two hours lecture and three hours of laboratory or field trip. Introduction to urban forestry: its professional status and potentials. Elements of urban physical geography. Nature and functions of various kinds of urban greenspace: their physical and social interactions as an integrated system, and management within the broader context of urban processes. Field practice in evaluating urban greenspace resources. Spring.
Prerequisites: Senior status. FOR core courses or permission of the instructor. For students in other schools FOR 434 is desirable.

496. Special Topics in Environmental and Resource Management (1-3)
Guided readings, lectures, discussions, tutorial conferences, or special coursework designed to help the undergraduate student apply scientific analysis of a social, biological, or physical nature to questions within his area of interest. Questions and analyses would include those dealing with forest resources management and administration; forest cultural practices; land use and land use planning; hydrology and watershed management; outdoor recreation; resource economics; world forestry; and others. Fall and Spring.
Prerequisite: Permission of the instructor.

498. Special Studies in Environmental and Resource Management (1-6)
Independent research in environmental and resource management for selected undergraduate students. Selection of subject areas determined by the student in conference with appropriate faculty member. Final written report is required for departmental record. Fall, Spring, and Summer.
Prerequisite: Cumulative G.P.A. of at least 2.50 and approval of the instructor and advisor.

499. Independent Study in Resources Management (7-12)
Independent study of some significant aspect of environmental and resources management. The selection of the topics will be determined by the student in consultation with his advisor. Guidance will be provided by a faculty committee. Limited to seniors in Resources Management. Fall or Spring.
Prerequisite: Must have cumulative G.P.A. of at least 3.00.

520. Application of Ecology (3)
Two hours of lecture and discussion and one to three hours seminar, workshop, or field trip. Exploration of use and implications of ecological concepts for practices modifying terrestrial ecosystems for human benefit. Discussion of ecological writings in relation to applied problems; workshops, field trips, and student presentations exploring ecological implications of specific situations. Course designed for interdisciplinary participation. Spring (even years).

535. Advanced Forest Soils (3)
Three hours of lecture-discussions 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 331, 332 or beginning courses in soils and silviculture.

540. Forest Hydrology (3)
Two hours of lecture and three hours of laboratory. The relation of forest and range vegetation to its environment, and its effect upon soil and water. Measurement of precipitation, runoff, erosion, and other variables. Spring.

542. Practice of Watershed Management (3)
Two hours of lecture and three hours of laboratory. The impact of the multiple use of forest and range lands on water yield and soil stability. Regional problems and potential solutions. Fall.
Prerequisite: FOR 540.

543. Energy Exchange at the Earth's Surface (3)
Two hours of lecture and three hours of laboratory. A comprehensive study of the physical processes taking place in the lowest layer of the atmosphere. Primary emphasis on the turbulent transfer of heat, momentum, and water vapor and the expression of these fluxes in the microclimate. Spring.
Prerequisites: FOR 452, physics, and calculus.

550. Environmental Impact: Principles and Strategies (3)
Three hours of lecture and discussion. Principles and theory of environmental impact and statements of impact as required by federal law. Administrative procedures for review and evaluation. Procedural strategy and effective constitution of statements for various governmental levels. Means of obtaining sources of authoritative information. Fall.
Prerequisite: Senior standing.

560. Nonindustrial Private Forest Management (3)
Three hours of lecture and discussion. Resource conditions and management issues associated with private nonindustrial private forest lands. Special attention is given to owner characteristics and objectives, public and private programs which directly or indirectly influence management decisions and the role of foresters in relation to the above. Spring.
Prerequisite: Senior or graduate student standing in forestry.

561. Land Use Economics (3)
Three hours of lecture-discussion. Study of the theory and methods of land use economics and the application of economic analysis to open space and regional planning. Emphasis is on understanding basic concepts; development of operational methods and data sources. Case studies, outside readings, and guest speakers are utilized. Spring.
Prerequisites: One course in microeconomics and permission of the instructor.

562. International Timber Trade (3)
Three hours of lecture. Basic principles of international trade. Structure and procedures of international timber trade. Major trade regions and their relationships. Economic context of timber trade. Emphasis is placed upon methods of analyses for understanding both opportunities and limitations of timber products exports and imports. Fall.
Prerequisites: Two semesters of undergraduate economics, and senior standing in forestry or wood products engineering.

565. Environmental and Forestry Issues (3)
Three hours per week of lecture, study, and field work. Classroom instruction and exercises introduce environmental and forestry concepts, history, and current environmental issues/problems. Excellent material to incorporate into all disciplines of middle school or high school curricula. Students explore content in depth through assigned readings, practical exercises, and field studies. One or two Saturday field trips. Evening course. Not available for Graduate credit for Forestry majors. Fall.

572. Outdoor Recreation Management (3)
Three hours of lectures per week. Description of specific methods and techniques used in outdoor recreation management. Discussion of practices applicable to resource, visitor, and service management. Spring.
Prerequisite: FOR 472, or equivalent, and FOR 360, or equivalent.

587. Environmental Law (3)
Three hours of lecture and discussion. Studies in Environmental Law designed for resource managers. Review of structure and processes of American legal system, constitutional framework of environmental law, The National Environmental Policy Act, legal framework for management of federal lands, focus on legal aspects of common property resource management, land, water, and air. Fall.

588. The Law of Natural Resource Administration (3)
Three hours of lecture and discussion. An introduction to the law concerning the procedures, powers, and judicial review of public agencies responsible for the management of natural resources. Topics will include the extent of an agency's rule-making power and the rights of aggrieved parties to appeal from agency decisions. Spring.
Prerequisite: FOR 360 or equivalent course in public administration.

600. Field Applications in Forest Management and Operations (3)
Equivalent of three weeks of lectures, seminars, and field trips related to the management and utilization of the high value forest resources of the Allegheny Basin region. This course is the required entry point to the M.F. program and is taught during summer at the Allegany State Park near Salamanca, NY.
Prerequisite: Matriculation in the M.F. program—open to others by permission of the instructor.

601. Resource Information for Forest Management (3)
Three hours of lecture, discussion, or laboratory work per week. Introduces the student to the characterization of biophysical and socioeconomic resources, their inventory and compilation into a geographic information system as an application of database management, and their evaluation and analysis for incorporation into the forest management decisionmaking process.
Prerequisite: Matriculation in the M.F. program—open to others by permission of the instructor.

602. Forest Resource Economics (3)
Three hours of lecture, discussion, or laboratory work per week. Provides students with analytical tools in forestry economics for analyzing and evaluating forest management operations. Provides an understanding of the operation of the economic system within which forest resources are found.
Prerequisite: Matriculation in the M.F. program—open to others by permission of the instructor.

603. Advanced Silviculture (3)
Applications of basic principles and practices of silviculture within forest stands in accordance with and dictated by varying forest resource values and ownership objectives. Four hours of lecture and discussion per week for the first portion of semester, followed by six weekly hours of laboratory/field practicum thereafter. Field trips and lectures by guest experts. Several written and oral presentations required. Fall.
Prerequisite: Matriculation in the M.F. program—open to others by permission of the instructor.

604. Forest Policy (3)
Three hours per week of lecture, discussion, and recitation. Course content brings students to an advanced level of understanding of policies, the nature of issues, the institutional framework for policy evaluation. Emphasizes policy roles and functions in management, interrelationships, information resources, public input, and policy analysis for effective professional contributions in forest policy matters.
Prerequisite: Matriculation in the M.F. program—open to others by permission of the instructor.

605. Advanced Forest Management (3)
Equivalent of three credit hours per week of lecture and recitation. Provides students with the foundation necessary for the management and administration of a complex enterprise involving the use of forestland. Emphasizes the inherent multiresource nature of forest management; the diverse activities involved in producing outputs and services from forestland; and the managerial and technical skills required in planning, directing, and controlling those activities.
Prerequisite: Matriculation in the M.F. program—open to others by permission of the instructor.

606. Human and Organizational Behavior (3)
Three hours per week of lecture and recitation. Provides advanced students with knowledge of the interactions of individuals within organizational settings. Emphasizes the interdependency of people and organizational structures and requirements, and the role of management in facilitating harmonious mutual goal achievement. Deals with the nature and meaning of work, motivation, individual performance, job satisfaction, informal organizations, work environment, reward systems, controls, work stress.
Prerequisite: Matriculation in the M.F. program—open to others by permission of the instructor. Prior basic course in management principles highly desired.

610. Field Applications in Integrated Forest Management (3)
Two weeks of field trips, discussions, and problem analyses of operating forest systems in the Northeastern United States. Provides an intregation and field application of material in the courses in the M.F. program.
Prerequisite: Matriculation in the M.F. program—open to others by permission of the instructor.

620. Silvicultural Concepts and Applications (3)
Six hours of lecture, study, or field work. Classroom instruction and exercises introduce topics important to silvicultural practice. Students explore these in depth through independent study and the solving of assigned problems. Field exercises will serve as a means to apply concepts, primarily in hardwood stands. Topics include concepts, techniques, diagnostic methods, and formulation and application of silvicultural prescriptions. Offered one day per week as a block of instruction. Spring.
Prerequisite: Previous undergraduate study of silviculture.

625. Productivity of Forest Stands (3)
In two hours of lecture and three hours of laboratory, whole tree, stand, and forest community productivity are studied from an ecophysiological viewpoint. Quantitative techniques and methods used to evaluate biological as well as economic forest production are learned and utilized. From the perspective established, new trends and developments in silvicultural practice are critically examined. Spring.
Prerequisite: Permission of the instructor.

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).
Prerequisites: FOR 446; background in physical and biological recommended.

640. Advanced Wildland Hydrology (3)
Lecture, discussion, and laboratory sessions in advanced problems of forest and range hydrology, watershed management methods, and techniques and evaluation of new methods of hydrologic data collection and analysis. Fall.
Prerequisite: SIL 540 or FEG 340.

642. Snow Hydrology (3)
Three one-hour lectures and two three-day field trips. Physical characteristics of snow and the energy relations important in its accumulation and dissipation. Problems of measurement and prediction of runoff and melt. Potentials for management. Spring.
Prerequisite: SIL 540 or FEG 340.

655. Advanced Forest Tree Improvement (3)
Two hours of lecture and discussion and three hours of laboratory. A study of advanced principles and techniques for genetic improvement of forest trees. Special emphasis is placed on selection and breeding for growth rates, wood quality, and insect and disease resistance. Problems of tree hybridization, racial variations, sexual reproduction, and quantitative genetics in forest trees. Laboratory training in pollen germination, vegetative propagation and other problems. Independent research problems will be undertaken by the student. Fall.
Prerequisites: FBL 470 and 471, FOR 455.

664. Soil and Water Conservation Policy (3)
One three-hour meeting per week. An integrated, historical survey of water and related land resource conservation in the United States. Interrelationships of governments and private organizations in their functions of policy-setting and planning, administration of programs, and evaluation of projects. Fall

671. Economics of Nonmarket Goods (3)
Group discussion, lectures, guided readings, case studies, and student projects on the economic aspects of watershed management, fish and wildlife management, and outdoor recreation. Major topics include theories of valuation and application to nonmarket goods, cost analysis for nonmarket goods, and techniques for valuing nonmarket goods and services.
Prerequisites: Microeconomics, knowledge of basic statistical analysis, and six hours or more of resource management coursework.

672. Open Space Planning (3)
Three hours of lecture and discussion; one overnight field trip required. Study of methods and techniques applicable to open space planning in nonurban areas. Survey of literature and current research. Open space standards, classification systems, and inventory methods. Development of plans for large scale recreational areas, and inclusion of recreation into regional plans. The interrelationship and conflicts between resource utilization/development and recreation/aesthetics reviewed through case studies. Fall (odd years).

675. Psychology of Leisure Behavior (3)
Three hours of lecture and discussion. Introduction to theory and research findings dealing with the sociological and psychological of leisure behavior: field work and lectures demonstrate applications, particularly in outdoor recreation. Fall.

676. Regional Development and Tourism (3)
Three hours of lecture/discussion per week. Study of the basic concepts of tourism as an important economic and social activity, and its place in regional resource development plans. Overnight field trip required. Spring (odd years).
Prerequisite: Permission of the instructor.

697. Seminar (1)
Group discussion and individual conference concerning current topics, trends, and research in management. Fall and Spring.

735. Forest Soil Fertility (Applied Studies) (2-4)
Two hours of lecture and one hour of discussion. Up to six hours of laboratory depending on number of credit hours. Influence of soil fertility on development and growth of seedlings and trees, and techniques involved to determine this influence. Chemical and biological analysis to determine levels of soil fertility. Nutrient element deficiencies and their correction by soil amendments and fertilizers. Term projects by the student will be undertaken. Spring (even years).
Prerequisites: CHE 332 and 333, FBO 530, FOR 446 and FOR 635, or equivalent.

737. Forest Soil Physics (4)
Three hours of lecture and discussion and three hours of laboratory. Presentation of principles of soil physics including water flow, strorage

and availability, soil permeability, heat transfer, and their consideration as root environmental factors. Analytical procedures are introduced and evaluated. Applications of soil physics to silvics, soil fertility, watershed management and hydrology, soil biology, and land-use. Spring (odd years).

Prerequisites: FOR 345, 446, or their equivalents. Physical chemistry and integral calculus strongly recommended.

751. World Forestry (3)

Three hours of lecture and discussion. World forest distribution and types; regional production and consumption of forest products; international trade in timber and related products; the role of forest resources in development; and special topics: tropical forestry, comparative forest policies and programs, forestry education, the problems of developing countries, international cooperation in forestry development, the role of the United States in world forestry, etc. Spring.

753. Resources Policy (3)

Three hours of lecture and seminar. Evaluation of basic environmental and resource issues and their evolvement in public and institutional policies. Exploration of alternative resource goals, policies, and program approaches and their implications. Analysis of processes for policy delineation and modification. Fall.

754. Advanced Forest Administration (3)

Critical appraisal of existing public, semipublic and private forest agencies in the United States, and the comparative study of major administrative organizations and practices. Occasional inspection trips to forestry headquarters and field units and discussion of internal administrative problems with forest officers. Fall or Spring.

Prerequisite: FOR 360 or equivalent.

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.

797. Seminar (1)

Group discussion and individual conference concerning current topics, trends, and research in management. Fall and Spring.

798. Research Problems in Resources Management and Policy (1-12)
(Credit hours arranged according to nature of problem)

Special investigation and analysis of resources management problems where integrative relationships of several subject aspects of forestry are a major consideration. Fall, Spring, and Summer

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.

899. Master's Thesis or Project (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.

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

200. Dendrology I (2)

Twenty-five hours of lecture and 34 hours of field time. A study of the distinguishing characteristics, growth features, distribution, associates and importance of the major tree species of North America. Seasonal field identification and on-the-spot discussion of habitats, associates, and the place in succession of the predominant forest trees and shrubs as found in the Adirondack area of the Northeast, plus a limited number of introduced species. Fall.

202. Plane Surveying I (4)

Fifty-four hours of lecture and 100 hours of field and laboratory time. An introduction to the theory and practice of plane surveying. Emphasis is on individual skill development through small crew projects, 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 and introduction to map use and preparation. Field projects include traversing, methods, and proficiency projects in handling typical surveying instruments. Fall.

203. Plane Surveying II (1)

Twelve hours of lecture and 32 hours of field time. A continuation of FTC 202 with emphasis on small crew field projects introducing the use of the engineer's level and the theodolite. Classroom work is directed at explaining the United States Public Land Survey system and introducing the concepts of modern deed descriptions and recordkeeping procedures. A trip to the County Court House is scheduled for a first hand look at a modern deed and recordkeeping operation. Spring.

Prerequisite: FTC 202.

204. Forest Mensuration and Statistics I (3½)

Sixty-seven hours of lecture and 36 hours of field time. A classroom and field study of the basic principles and skills required for timber measurements. Volume tables, their use and construction are studied. Cruise reports are required in which the student presents cruise results. Various methods of forest sampling are studied including methods of calculating necessary sampling intensities and sampling errors. Fall.

205. Forest Mensuration and Statistics II (2)

Four hours of lecture and 44 hours of field and laboratory time. A field problem of practical nature utilizing methods for collecting, analyzing, and presenting data dealing with timber volumes. Spring.

Prerequisite: FTC 204.

206. Forest Ecology (3)

Forty-one hours of lecture and 52 hours of field time. Study of weather and weather data collection; students manning a forest weather station. Study of climate and soil factors, how they affect trees and forests and the interactions both within the forest community and within the forest ecosystem. Introduction to cover type mapping. Final field problem and written and oral report on the detailed analysis of a forest transect. Fall.

207. Aerial Photogrammetry (2)

Fourteen hours of lecture and 48 hours of laboratory. Development of the ability to interpret important ground features by viewing aerial photos singly and in pairs, using stereoscopic techniques and equipment. Work scale problems and make reliable horizontal and vertical measurements. Use radial line plotter and zoom transfer scope for transfer of detail to base map. Forest type mapping and forest inventory using photos. Fall.

208. Forest Installations (3)

Thirty-six hours of lecture and 60 hours of field time. This course provides the student with the technical competence necessary to use, plan, construct, and maintain such typical forest improvements as telephone lines, radio systems, trails, and light frame structures. Fall.

209. Forest Roads (2)

Twenty-two hours of lecture and 32 hours of laboratory time. This course provides the student with the technical competence necessary to administer, locate, and design the construction and maintenance of a typical forest gravel road. Spring.

Prerequisite: FTC 202.

211. Silviculture (2½)

Thirty hours of lecture and 40 hours of laboratory and field work blocked with forest management. Lectures based on text study cover orientation, terminology and present a framework of the various treatments used in many common stand conditions to bring the forest into a more productive state in accord with the objectives of management. Emphasis on thinning in computer simulation and field practice. Exercises in planting and pruning. Demonstrations in chemical silviculture. Spring.

Prerequisite: FTC 206.

213. Forest Protection I (2)

Thirty-eight hours of lecture and 36 hours of laboratory/field time. A study of the insect and disease agents that damage trees and their role in the total forest community. The course covers identification of local forest insects and disease-causing organisms, study of the major pest

groups of other forest regions, and control measures including the effects of pesticides on the environment. Field trips cover local pests and the damage caused, while laboratory work covers major groups of pests likely to be encounted elsewhere. Fall.

214. Personnel Management (1½)
Fourteen hours of lecture and 12 hours of laboratory. A study of company and agency organization functions, including selection of and placement of personnel, training of personnel and performance evaluations, planning for and administering crew responsibilities, human relations in the working situation and special personnel problems of the forest are covered. Techniques of foremanship are applied in various field exercises in other courses, along with the duty of safety hazards, accident prevention, accident classification and accident reporting. Spring.

215. Timber Harvesting (2)
Sixteen hours of lecture and 36 hours of field time. This course acquaints the student with the basic harvesting methods and techniques, with emphasis on the Northeast, along with the knowledge of how and where harvesting fits in with other forest uses. Students gain technical competence in timber sale contract administration and basic timber appraising. Spring.

217. Forest Management (3½)
Thirty-seven hours of lecture and 68 hours of lab and field work blocked with silviculture. Coverage of the common problems met in organizing a forest property to approach the goals of ownership. Study and practice in techniques of growth measurement and the gathering and use of forest records in general. Review actual examples and case studies of forest management and production activities. Summary application of pertinent information from many other courses in a work plan involving management decisions for an assigned forest property. Spring.
Prerequisite: FTC 206.

218. Forest Recreation (1½)
Fifteen hours of lecture and 32 hours of laboratory or field time. This course acquaints the student with the forest recreational resources—its present and future needs. Principles of recreation development and management are discussed with special emphasis placed on the technical aspects. Spring.

219. Elements of Wildlife Ecology (1½)
Twenty-four hours of lecture and four hours of field time. A study of the principles of wildlife ecology with fundamentals related to the actions of the preservationist, conservationist, and particularly those of the forest manager. Spring.

221. Soil/Water Measurements and Control (1½)
Sixteen hours of lecture and 32 hours of laboratory and field time. A basic introduction to precipitation and streamflow measurements taken at weather stations, snow courses, streamgaging stations, and other sample points. Includes introduction to physical properties of soils related to land management. Discusses forest management practices commonly used to control erosion and water quality. Spring.
Prerequisite: FTC 206.

223. Graphics (1)
Sixteen hours of lecture. An introduction to lettering and drafting with emphasis on the skills needed by the forest or surveying technician. Individual skill development is achieved through several projects. The concept behind each project is explained in handout material and lecture, and each student is then expected to complete the project on his/her own time. Freehand and mechanical lettering plates are produced in addition to precision and map drawings. Fall.

227. Forest Protection II (2)
Twenty-three hours of lecture and 24 hours of field and laboratory time. The basic principles of fire ecology, forest fire behavior, fire danger and fire danger rating, forest fire prevention and control, and prescribed burning are covered. Handtool fire suppression techniques are demonstrated and practiced. Spring.
Prerequisite: FTC 213.

228. Structure and Growth of Trees (1½)
Nineteen hours of lecture and twelve hours of laboratory. A study of the various tissues of forest trees and how their growth and development are affected by internal and external factors. Differences in stem structures of some of the more important commercial tree species of the United States are studied in the laboratory, and these differences are related to the commercial uses of these species. Spring.
Prerequisite: An introductory course in general botany or biology.

229. Silviculture II (2)
Twenty-six hours of lecture and 28 hours of field and laboratory. Continuation of FTC 211 dealing mainly with the handling of the more complex hardwood and mixed stands common to the Northeast. Special coverages will be offered on current practices of regional importance beyond the Northeast where graduates are likely to be employed. Spring.

230. Plane Surveying III (2)
Twenty-six hours of lecture and 28 hours of field time. A continuation of FTC 202 and FTC 203 with emphasis on small crew projects using the theodolite. Advanced field techniques are discussed and practiced, such as the determination of the true-meridian by the method of direct solar observation, layout of highway curves and simple triangulation procedures. Each topic is developed in detail in the classroom before each field project is completed. Spring.
Prerequisites: FTC 202 and FTC 203.

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 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.

LIB—LIBRARY (COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY COURSE)

300. Library Research (1)
Fifteen hours of class time per semester (usually the first five weeks). Introduction for students at all levels to basic library material and the research process leading to preparation of a bibliography. Fall and Spring.

LSA—LANDSCAPE ARCHITECTURE
(See also courses listed under EIN and CMN.)

320. Introduction to Landscape Architecture and Planning (3)
Three hours of lecture. The course presents an overview of the professions of landscape architecture and planning. It surveys the historic and contemporary situations of environmental design and planning. The course introduces the socio-cultural and natural factors which influence the form and condition of the physical environment. It will introduce issues, personality, and projects. Fall.

326. Landscape Architecture Design Studio I (3)
Six hours of studio and one hour of lecture. The first in a sequence of studios focusing on the concepts, skills, and methods of design. This course introduces students to the basic vocabulary, concepts, and principles of design; the application and operation of these in the physical environment, development of three-dimensional spatial concepts. The requirements for this course include readings, examinations, field trips, design exercises, and projects. (Student field trip expense $125-$150.) Fall.
Prerequisite: Permission of the instructor.

327. Landscape Design Studio II (3)
One hour of lecture and six hours of studio. The second in a sequence of studios focusing on the concepts, skills, and methods of design. This course continues the development of design abilities through study of the interrelationship between the requirements of a design established in a program, the visual character of the site and the development of a designed result. The development of spatial concepts which meet principles of composition organization and a given set of requirements. The requirements for this course include readings, examinations, field trips, design exercises, and projects. (Student field trip expense $125-$150.) Spring.
Prerequisites: LSA 326, with a minimum grade of C, and CMN 382.

330. Site Research and Analysis (2)
One hour of lecture and three hours of studio. This course will require those enrolled to apply principles of natural resources and processes to assess the land use and development potentials and limitation of a site. The principles will include landforms, soils, hydrology, climate, energy, and plant, animal, and human ecology. A variety of manual and computer techniques for data collection, analysis and synthesis of natural systems information will be explored. The course will concentrate on the comparison of synthesis techniques and their implications for land use and design decisionmaking. Occasional local field trips will be utilized. Spring.
Prerequisite: EIN 311 or permission of the instructor.

422. Landscape Design Studio III (4)
Twelve hours of studio. This course is a continuation of skill development, theory, and strategies as they relate to design issues and process. Emphasis is placed on in-depth investigation on projects of a direct scale illustrating form derivation and the man-made and natural form. Occasional field trips to illustrate various design solution. Fall.
Prerequisites: LSA 327, with a minimum grade of C, and LSA 330.

423. Landscape Design Studio IV (4)
Twelve hours of studio. This course emphasizes skill development, theory, and strategy as they relate to large-scale site design situations. Continues prior courses' emphasis on design process and form manipulation. Occasional field trips to illustrate and inspect design form. Spring.
Prerequisite: LSA 422, with a minimum grade of C.

425. Orientation for Experiential Studio (2)
Three hours of lecture and recitation. Investigation and documentation of an area of specialty, discussion, readings, and research. Fall and Spring.
Prerequisite: Permission of the instructor.

433. Plant Materials (2)
Three hours of lecture and field work for first one-third of semester. Two hours of lecture for second one-third of semester. This course concentrates on woody plant materials used in landscape architecture, the ecological relationships of plants, ornamental plant materials use and identification, plant culture propagation, transplanting, planting plans and specifications. Fall.
Prerequisite: Permission of the instructor.

434. Design Materials (1)
Three hours of lecture for last one-third of a semester. An introduction to wood, concrete, masonry, asphalt, stone, and synthetic materials intended to provide students with an understanding of the basic visual, structural, and maintenance principles of each, in order to both use the materials in design and prepare written specifications. Fall.

442. Site Grading (2)
Two hours of lecture and three hours of studio during first two-thirds of semester. Lectures, projects, and assigned readings. The study of grading as the primary means of landform modification in landscape architectural design. Primary emphasis will be given to principles of grading, including contour manipulation, sections, profiles, and computations. Concepts of establishing acceptable slopes and positive surface drainage will be introduced. Enrollment limited to BLA or MLA students. Fall.
Prerequisite: LSA 330, Site Research and Analysis.

443. Site Drainage Systems (1)
Three hours of lecture for last one-third of semester. Lectures, projects, and assigned readings. Provides a basis for the design of drainage systems. Coverage includes concepts relevant to understanding precipitation, methods of run-off quantification, open channel flow, systematic pipe network analysis. Enrollment limited to BLA or MLA students. Fall.
Prerequisite: LSA 330, Site Research and Analysis.

444. Vehicular Circulation Design (1)
Three hours of lecture for first one-third of semester. Lectures, projects, and assigned readings. Must be taken concurrently with LSA 423. Introduces the circular geometry of horizontal curves and the parabolic geometry of vertical curves, curve coordination based on safety and aesthetic relationships, road grading. Enrollment limited to BLA or MLA students. Spring.
Prerequisites: Computer Programming and Surveying.

445. Elements of Structures (1)
Three hours of lecture during the second one-third of the semester. Lectures, projects, and examinations. An introduction to the concepts of assembling engineering materials into structure. All common building systems will be surveyed and emphasis will be placed on fundamentals rather than on detailed mathematical design procedures.
Prerequisite: Non-Faculty of Landscape Architecture students by permission of the instructor. Not open to engineering majors. Spring.

455. Professional Practice in Landscape Architecture (2)
Two 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. Occasional field trips will be utilized. Spring.
Prerequisites: Senior status in landscape architecture or permission of the instructor.

495. Selected Readings in Environmental Studies (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 the instructor.

496. Special Topics in Landscape Architecture (1-3)
One to three hours of class meetings. 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 areas is identified and developed. Fall and Spring.
Prerequisite: Permission of the instructor.

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 the instructor.

522. Landscape Design Studio VI (4)
Twelve hours of studio. Studio problems, research, drafting and field trips. Concentration on complex urban problems. Concern for social and psychological considerations of the individual and large groups of people, their interaction and resultant forms of the environment. Spring.
Prerequisite: Permission of the instructor.

524. Experiential Landscape Studio Design (16)
Forty-eight hours per week. The articulation of the study proposal established in LSA 425, as approved by faculty, through research, readings, field study with graphic and written documentation, and group discussion. Academic study in an off-campus location in an area of landscape architectural significance, as described and delineated in a student-prepared proposal approved by the faculty. Fall or Spring.
Prerequisites: LSA 425 and LSA 423, with a minimum grade of C.

525. Landscape Design Studio VI (4)
Twelve hours of studio. Investigation of a problem in landscape architecture as proposed by the student and conducted in conjunction with faculty advisor. Spring.
Prerequisite: Permission of the instructor.

527. Landscape Design Studio VI (4)
Twelve hours of studio. Studio problems, research, reports, and field trips. Concentration on regional landscape problems, the techniques of their analysis and derivation of their significance to the practice of landscape design. Spring.
Prerequisite: Permission of the instructor.

533. Plant Materials (2)
Field trips and discussion. Ornamental woody plant identification. Observation and sketches of outstanding examples of planting design. Two weeks. Summer.
Prerequisite: Permission of the instructor.

545. Professional Practice Studio (3)
Six hours of studio, one hour of recitation per week. Studio problems, research, discussion and recitation sessions on the processes and methods of office practice. Emphasis on all aspects of site development. Spring.
Prerequisite: Permission of the instructor.

550. Land Research and Analysis (2)
One hour of lecture and three hours of studio per week. This course requires the application of natural resources principles and processes to assess the land use and development potentials and limitation of a site. The principles will include landforms, soils, hydrology, climate, energy, and plant, animal, and human ecology. A variety of manual and computer techniques for data collection, analysis and synthesis of natural systems information will be explored. The course will concentrate on the comparison of synthesis techniques and their implications for land use and design decisionmaking. Occasional local field trips will be utilized. Spring.
Prerequisite: MLA status or permission of the instructor.

551. Design Implementation (3)
One hour of lecture and six hours of studio per week. Introduction to the production of construction documents, including: scheduling, drawing, grading, layout, planting, details, structures, specifications and estimating. Spring.
Prerequisite: MLA status and concurrent enrollment in LSA 554 and permission of the instructor.

553. Design Studio I (4)
Nine hours of studio and one hour of lecture/discussion per week. The first in a sequence of studios focusing on the concepts, skills, and methods of design. This course introduces students to the basic vocabulary of theoretical design principles, to the application and operation of these in the physical environment, and to the development of three-dimensional spatial concepts in community scale patterns. The requirements for the course include readings, examinations, field trips, design exercises, and projects. Fall.
Prerequisites: MLA status or permission of the instructor.

554. Design Studio II (4)
Nine hours of studio and one hour of lecture per week. The second in a sequence of studios applying the concepts, skills, and methods of design in a critical analysis of various natural and human systems in community scale environments. Concentration is on the evaluation of options in the ordering of a variety of land use activities, with special emphasis on the functional and spatial quality of built environments. The requirements for this course include readings, examinations, field trips, design exercises, and projects. Spring.
Prerequisites: MLA status and LSA 553, CMN 552, or permission of the instructor.

595. 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 or Spring.
Prerequisite: Fifth-year status or permission of the instructor.

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 the instructor.

598. Research Problem (1-3)
Independent study of selected areas of environmental interest. Emphasis on a self-disciplined study, development of procedures and techniques to be employed in environmental design and planning. Engagement with specific sites and problems as proposed for study by individual communities. Enrollment at periodic intervals throughout the semester. Fall, Spring, and Summer.
Prerequisite: Permission of the instructor.

620. Community Design Studio I (3)
Six hours of studio and one lecture-seminar hour. An examination and evaluation of the landscape architectural design process with an emphasis on the methodological variations which occur in its definition and application. A variety of projects, scales, and programs are employed as a vehicle for study of the design process. Fall or Spring.
Prerequisite: Permission of the instructor.

621. Community Design Studio II (3)
Six hours of studio and one lecture-seminar hour. An examination and evaluation of the landscape architectural design process with an emphasis on the methodological variations which occur in its definition and application. A variety of projects, scales, and programs are employed as a vehicle for study of the design process. Fall or Spring.
Prerequisite: Permission of the instructor.

643. Ethical Issues in Community Design and Planning (1)
Three hours of lecture-discussion for one-third of a semester. Status and role of the profession in society, standards of professional conduct and responsibility, ethical responses to a variety of professional situations is the focus of the course. Fall or Spring.
Prerequisites: MLA status or permission of the instructor.

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 to 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.
Prerequisites: MLA status or permission of the instructor.

651. Process of City/Regional Planning (3)
Three hours of seminar. The purpose of this course is the introduction of planning as a process of decisionmaking and to familiarize graduate students with its scope and content. The course relies upon lectures and readings to develop introductory knowledge as well as seminars and discussions to cover the constitutional basis, tools, and techniques and the current directions of planning. Fall or Spring.
Prerequisite: Permission of the instructor.

652. Community Development Process (3)
Discussion and analysis of the elements of community development process: private sector development, public sector initiatives and programs aimed at community development; and role of planning design in coordinating public and private sector initiatives.

653. Visual Landscape Analysis (2-3)
Three hours of lecture and discussion weekly during the first three quarters of the semester will cover aspects of landscape perception; introduction to methods of visual landscape inventory and evaluation, visibility determination, psychometric assessment, and visual impact assessment; and visual resource management strategies. Problems and exams will be required. Optional third credit entails four hours weekly of laboratory or field projects applying analysis methods and techniques during last quarter of semester.

656. Environmental Factors, Community Response, and Form (3)
Two and one-half hours of lecture and six studios per semester. The course presents an introduction to a comprehensive process for the integration of environmental phenomena, such as solar access, visual access, noise, and wind into community design. The process includes data gathering and analysis, prediction methods, objective criteria, and implementation. Fall.
Prerequisites: Second year MLA status, or permission of the instructor.

671. History of Landscape Architecture (3)
Three hours of lecture-seminar. Regular use of slides and other projected lecture material; assigned texts as a basis for lecture; supplemental readings, assigned and individually researched; class discussion from

readings and lecture; and student presentations and term paper. Historical study and style analysis of Western man's efforts to design his environment and his changing attitudes and relationships to environment. Also, non-Western coverage where significant or influential on Western man. Study of historical personalities as well as periods that are of environmental concern up into the modern periods. Fall.

Prerequisites: MLA standing or permission of the instructor.

696. 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 the instructor.

697. Topics and Issues of Community Design and Planning (2)

Two hours of lecture and discussion. Topics for discussion are selected to acquaint the entering graduate student with a generalized view of current issues facing landscape architects in community design and planning. Readings and papers are regularly assigned. Fall.

Prerequisites: MLA students or permission of the instructor.

699. Landscape Architecture Internship (1-12)

Internships provide students with a supervised field experience to apply and extend their academic abilities in a professional working environment. Enrollment is possible at various times during the semester. Fall, Spring, and Summer.

Prerequisite: Fast Track BLA/MLA status and written approval of an internship contract by major professor, curriculum director, and field supervisor.

752. Urban and Regional System Dynamics (3)

Lectures and workshop. The major concerns of this course are application of system dynamics; basic principles of system dynamics; and system dynamics modeling. This method is investigated as a useful tool in modeling many landscape architectural and planning problems. No prior computer experience is necessary. Spring.

Prerequisite: Permission of the instructor.

796. Special Topics in Landscape Architecture (1-3)

One to three hours of class meetings. 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. Fall and Spring.

Prerequisite: Permission of the instructor.

798. Research Problem (Credit hours to be arranged according to nature of problem)

Special study of assigned problems relating to landscape architecture or planning, with emphasis on critical thinking. Fall, Spring, and Summer.

Prerequisite: Permission of the instructor.

799. Thesis Project Proposal Development (1)

One hour of lecture and workshop. During this course, a student will prepare a proposal for a thesis/project in the MLA program. Fall.

Prerequisites: LSA 699 and permission of the instructor.

898. Professional Experience (1-12)

A supervised external professional work experience which satisfies Option 2 of the master's study integration requirement. Graded on an "P/F" basis. Fall, Spring, and Summer.

Prerequisite: Formation of committee, approval of proposed experience by committee, and the sponsor of the professional experience.

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.

PSE—PAPER SCIENCE AND ENGINEERING

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.

301. Pulp and Paper Processes (3)

Three hours of lecture. Technological consideration of pulping and bleaching of woody raw material. Includes consideration of wood procurement and preparation, pulping and bleaching processes, recovery of secondary fibers, pollution abatement and other ancillary operations. Spring.

Prerequisites: FCH 572, PSE 300 (or concurrent).

302. Pulp and Paper Processes Laboratory (1)

One three-hour laboratory. Study and practice in the techniques of laboratory procedures normally encountered in the pulp and paper industry. Laboratory exercises selecting and using standard testing methods. Field trips to observe commercial equipment of the pulp and paper industry. Spring.

Prerequisite: PSE 301 (or concurrent).

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. Summer.

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.

Prerequisites: Calculus, physics, and FCH 360 (or concurrent).

371. Fluid Mechanics (3)

Three hours of lecture and/or demonstrations. The study of momentum transfer. Steady and unsteady flow of liquids and gases in pipelines, ducts, open channels, and porous media. Movement of particles in fluid media. Newtonian and non-Newtonian flow and flow of suspensions. Filtration, sedimentation, centrifugation, agitation and mixing. Characteristics and selection of pumps, blowers, agitators and other equipment. Flow measurement and flow system design with economic considerations. Fall.

Prerequisites: College level physics and chemistry, calculus.

372. Heat Transfer (2)

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 and 371 or equivalent.

461. Pulping Technology (3)

One hour of lecture and six hours of laboratory. Discussion of pulping and bleaching processes: effect of chemical and physical variables on the wood components and pulp properties; chemistry involved. Experiments in pulping and bleaching, and pulp evaluation. Fall.

Prerequisites: PSE 301, CHE 346 and CHE 356.

Note: A student may not enroll in or receive credit for both PSE 461 and ERE 671.

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 between paper manufacturing methods, papermaking additives, test results and the ultimate properties desired in the finished paper. Fall.

Prerequisites: PSE 301 and PSE 302.

Note: A student may not enroll in or receive credit for both PSE 465 and ERE 677.

466. Paper Coating and Converting (2)
Two hours of lecture. 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: A student may not enroll in or receive credit for both PSE 466 and ERE 678.

468. Papermaking Processes (3)
Two hours of lecture and three hours of laboratory. Study of the papermaking process, featuring operation of the pilot 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 balance. Results of each paper machine run are evaluated in seminar-type discussions. Spring.
Prerequisites: PSE 461 and PSE 465.

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, 371, and 372 or equivalent.

491. Paper Science and Engineering Project I (1)
Student makes a systematic survey of all available literature on the problem assigned him and incorporates it in a formal, typewritten report. An essential part of this report is a detailed outline of a research project which the student may undertake during the next semester (PSE 492). Fall.
Prerequisites: PSE 300 and PSE 301.

492. Paper Science and Engineering Project II (3)
The analysis of a problem, the synthesis of a solution and the basic design of the facilities needed to solve a problem. Laboratory research, field work, and consulting as needed in addition to the literature survey completed in PSE 491. Progress reports and a final report and seminar-style presentation. Spring.
Prerequisite: PSE 491.

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.

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.
Prerequisite: PSE 461 and PSE 465.

WPE—WOOD PRODUCTS ENGINEERING

300. Properties of Wood for Designers (2)
Two hours of lecture. An introduction to the basic structure and properties of wood for the designer. Discussion of the effects of wood structure and properties on practical woodworking techniques. Fall.

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. Spring.

326. Fluid Treatments (2)
Two hours of lecture. An introduction to wood-moisture relationships, wood permeability and pressure treatments, thermal conductivity, water-vapor movement, and drying and fire retardancy. The flow of fluids, heat and water vapor are treated as analogous phenomena and are related to the cellular structure of wood. Unsteady-state flow of gases, heat and water vapor are introduced. Spring.

327. Fluid Treatments Laboratory (1)
Three hours of laboratory. Laboratory studies in relative humidity measurement, wood-moisture relationships, the relationship between permeability and treatability, wood-preservative treatments, wood drying and flame testing. Spring.
Prerequisite: WPE 326 (or concurrent).

361. 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.

386. Structure and Properties of Wood (3)
Two hours of lecture and three hours of laboratory. Structure of wood in relation to defects, properties and uses. The variability of wood. Identification of major U.S. timber by gross features. Spring.

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.
Prerequisite: FBO 300 or equivalent is recommended.

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.

389. Wood Identification Laboratory (1)
Three hours of laboratory. Identification of principal commercial timbers of United States on gross characteristics. Spring.
Prerequisite: WPE 387.

390. Fiber Identification Laboratory (1)
Three hours of laboratory. Identification of woody and nonwoody papermaking fibers. Spring.
Prerequisite: WPE 387.

399. Field Trip (2)
Two weeks supervised study and reporting of representative wood products industries. Required of all students in WPE. Estimated individual expenses are $200-$250 while on the trip. Spring.

400. Introduction to Forest Products (2)
Two hours of lecture. Characteristics of the products of the forest tree and manufacture of wood products. Spring.

401. Creative Approaches to Management (3)
Three hours of lecture and recitation with a workshop/seminar emphasis. Provides practical guidelines for dealing effectively with modern managerial problems that require new thinking. This course uses relevant, real-life examples, practical applications, and develops creative approaches. It is designed for individuals who intend to or are engaged in managing people and activities in achieving both organizational and personal goals.

404. Design of Wood Structural Elements (3)
Lectures. A development of the principles involved in designing structural elements in wood and practice in their application. Fall or Spring.

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 when used with wood systems. Emphasis will be placed on knowing how to apply this knowledge to understand current practice and to solve problems that may occur. Laboratory demonstrations to identify materials, methods of application, and methods of evaluating these materials. Fall.
Prerequisite: Junior standing.

422. Composite Materials (3)

Two hours of lecture and three hours of laboratory. Manufacturing methods, physical and mechanical properties, and major uses of each of the following products will be examined—decorative plywood, construction and industrial plywood, particleboards, waferboards, fiberboards, laminated beams, laminated-vener lumber, wood polymer composites, and paper overlays. 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.

Prerequisites: WPE 320. Concurrent or prior registration in ERE 362.

442. Light Construction (3)

Two hours of lecture and two hours of discussion. Elements of light frame construction, blueprint reading, and estimating. Fall.

450. Construction Equipment (3)

Three hours of lecture. Principles of selection, operation, and maintenance of construction equipment. Primary types of site preparation, handling and assembly devices and their efficient utilization will be examined. Spring.

Prerequisite: Senior standing.

454. Construction Management (3)

Three hours of lecture. Fundamental concepts of construction management activities. Topics include construction contracts, sheduling, project planning, estimating and bidding. Fall.

Prerequisite: OPM 365 or permission of the instructor.

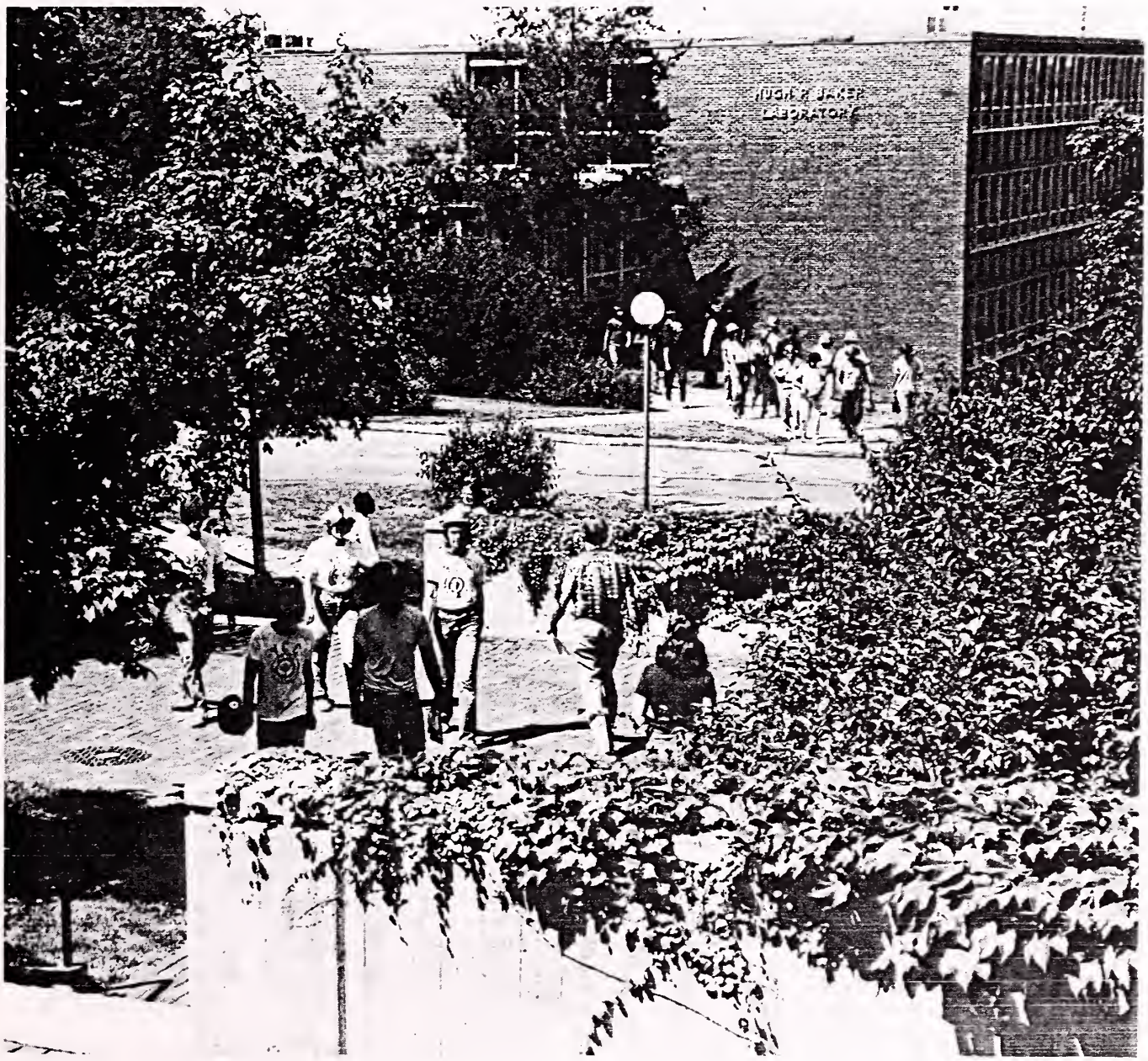
497. Senior Seminar for Wood Products Engineering Majors (2)

Discussion and assigned reports in current problems and new developments in Wood Products Engineering. Spring.

498. Research or Design Problem (1-3)

Conferences, library, laboratory and/or field research on a specific problem in Wood Products Engineering. Typewritten report (original and one copy) required. Fall, Spring, and Summer.

Prerequisite: Permission of the instructor and advisor.



State University of New York

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

When founded in 1948, the University consolidated 29 State-operated, but unaffiliated, institutions. In response to need, the University has grown to a point where its impact is felt educationally, culturally, and economically the length and breadth of the state.

Nearly 370,000 students are pursuing traditional study in classrooms or are working at home, at their own pace, through such innovative institutions as Empire State College, whose students follow individualized and often nontraditional paths to a degree. Of the total enrollment, more than 100,000 students are 24 years or older, reflecting State University's services to specific constituencies, such as refresher courses for the professional community, continuing education opportunities for returning service personnel, and personal enrichment for more mature persons.

State University's research contributions are helping to solve some of modern society's most urgent problems. It was a State University scientist who first warned the world of potentially harmful mercury deposits in canned fish, and another who made the connection between automobile and industrial exhaust combining to cause changes in weather patterns. Other University researchers continue important studies in such wide-ranging areas as immunology, marine biology, sickle-cell anemia, and organ transplantation.

More than 1,000 Public Service activities are currently being pursued on State University campuses. Examples of these efforts include special training courses for local government personnel, State civil service personnel, and the unemployed; participation by campus personnel in joint community planning or project work, and campus-community arrangements for community use of campus facilities.

A distinguished faculty includes nationally and internationally recognized figures in all the major disciplines. Their efforts are recognized each year in the form of such prestigious awards as Fulbright-Hays, Guggenheim, and Danforth Fellowships.

The University offers a wide diversity of what are considered the more conventional career fields, such as business, engineering, medicine, teaching, literature, dairy, farming, medical technology, accounting, social work, forestry, and automotive technology. Additionally, its responsiveness to progress in all areas of learning and to tomorrow's developing societal needs has resulted in concentrations which include pollution, urban studies, computer science, immunology, preservation of national resources, and microbiology.

SUNY programs for the educationally and economically disadvantaged have become models for delivering better learning opportunities to a once-forgotten segment of society. Educational Opportunity Centers offer high school equivalency and college preparatory courses to provide young people and adults with the opportunity to being college or to learn marketable skills. In addition, campus based Educational Opportunity Programs provide counseling, developmental education and financial aid to disadvantage students in traditional degree programs.

Overall, at its EOC's, two-year college, four-year campuses and university and medical centers, the University offers 3,600 academic programs. Degree opportunities range from two-year associate programs to doctoral studies offered at 12 senior campuses.

The 30 two-year community colleges operating under the program of State University play a unique role in the expansion of educational opportunity. They provide local industry with trained technicians in a wide variety of occupational curriculums, and offer transfer options to students who wish to go on and earn advanced degrees.

The University passed a major milestone in 1985 when it graduated its one-millionth alumnus. The majority of SUNY graduates pursue careers in communities across the State.

State University is governed by a Board of Trustees, appointed by the Governor, which directly determines the policies to be followed by the 34 State-supported campuses. Community colleges have their own local boards of trustees whose relationship to the SUNY board is defined by law. The State contributes one-third to 40 percent of their operating cost and one-half of their capital costs.

The State University motto is: "To Learn—To Search—To Serve."

STATE UNIVERSITY OF NEW YORK

UNIVERSITY CENTERS

State University of New York at Albany
State University of New York at Binghamton
State University of New York at Buffalo
State University of New York at Stony Brook

COLLEGES OF ARTS AND SCIENCE

Empire State College
State University College at Brockport
State University College at Buffalo
State University College at Cortland
State University College at Fredonia
State University College at Geneseo
State University College at New Paltz
State University College at Old Westbury
State University College at Oneonta
State University College at Oswego
State University College at Plattsburgh
State University College at Potsdam
State University College at Purchase

COLLEGES AND CENTERS FOR THE HEALTH SCIENCES

Health Science Center at Brooklyn
Health Science Center at Syracuse
College of Optometry at New York City
Health Sciences Center at Buffalo University Center*
Health Sciences Center at Stony Brook University Center*

AGRICULTURAL AND TECHNICAL COLLEGES

Agricultural and Technical College at Alfred
Agricultural and Technical College at Canton
Agricultural and Technical College at Cobleskill
Agricultural and Technical College at Delhi
Agricultural and Technical College at Farmingdale
Agricultural and Technical College at Morrisville

SPECIALIZED COLLEGES

College of Environmental Science and Forestry at Syracuse
Maritime College at Fort Schuyler
College of Technology at Utica/Rome
Fashion Institute of Technology at New York City**

STATUTORY COLLEGES***

College of Agriculture and Life Sciences at Cornell University
College of Ceramics at Alfred University
College of Human Ecology at Cornell University
School of Industrial and Labor Relations at Cornell University
College of Veterinary Medicine at Cornell University

COMMUNITY COLLEGES

(Locally-sponsored, two-year colleges under the program of State University)

Adirondack Community College at Glens Falls
Broome Community College at Binghamton
Cayuga County Community College at Auburn
Clinton Community College at Plattsburgh
Columbia-Greene Community College at Hudson
Community College of the Finger Lakes at Canandaigua
Corning Community College at Corning
Dutchess Community College at Poughkeepsie
Erie Community College at Williamsville, Buffalo and Orchard Park
Fashion Institute of Technology at New York City**
Fulton-Montgomery Community College at Johnstown
Genesee Community College at Batavia
Herkimer County Community College at Herkimer
Hudson Valley Community College at Troy
Jamestown Community College at Jamestown
Jefferson Community College at Watertown
Mohawk Valley Community College at Utica
Monroe Community College at Rochester
Nassau Community College at Garden City
Niagara County Community College at Sanborn
North Country Community College at Saranac Lake
Onondaga Community College at Syracuse
Orange County Community College at Middletown
Rockland Community College at Suffern
Schenectady County Community College at Schenectady
Suffolk County Community College at Selden, Riverhead and Brentwood
Sullivan County Community College at Loch Sheldrake
Tompkins Cortland Community College at Dryden
Ulster County Community College at Stone Ridge
Westchester Community College at Valhalla

*The Health Sciences Centers at Buffalo and Stony Brook are operated under the administration of their respective University Centers.

**While authorized to offer such baccalaureate and master's degree programs as may be approved pursuant to the provisions of the Master Plan, in addition to the associate degree, the Fashion Institute of Technology is financed and administered in the manner provided for community colleges.

***These operate as "contract colleges" on the campuses of independent universities.

College of Environmental Science and Forestry

ESF BOARD OF TRUSTEES

Appointed by Governor

ARTHUR V. SAVAGE, *Chairman* ..... Pelham
CURTIS H. BAUER ..... Jamestown
HOWARD GARTNER ..... Syracuse
PATRICIA W. GONZALEZ ..... Syracuse
JAMES M. HANLEY ..... Washington, D.C.
M. PETER LANAHAN, JR. ..... Albany
JOSEPH N. WALSH ..... New York
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MARGARET S. J. WILLIAMSON ..... Central Square

Ex Officio

CLIFTON R. WHARTON, JR., *Chancellor, State University of New York* ..... Albany
MELVIN A. EGGERS, *Chancellor, Syracuse University* ..... Syracuse
GORDON M. AMBACH, *Commissioner, Department of Education* ..... Albany
HENRY G. WILLIAMS, *Commissioner, Department of Environmental Conservation* ..... Albany
GEORGE M. GRIFFITH *Student Representative* ..... Syracuse

COLLEGE ADMINISTRATION

President ..... ROSS S. WHALEY
Assistant to the President for Public Relations ..... ROLLA W. COCHRAN
Director of Development ..... ARTHUR J. FRITZ, JR.

Vice President for Academic Affairs/Provost ..... WILLIAM P. TULLY
Dean of Instruction and Graduate Studies ..... ROBERT H. FREY
College Librarian ..... DONALD F. WEBSTER
Dean of Nonresident Programs and Continuing Education ..... Vacant
Acting Dean of Research ..... WILLIAM P. TULLY
Coordinator of Sponsored Programs ..... J. DONALD MABIE
Acting Director of Institute of Environmental Program Affairs ..... WILLIAM P. TULLY
Coordinator of Demonstration and Information, IEPA ..... ROLLA W. COCHRAN
Director of Academic Computing ..... Vacant
Director of Analytical and Technical Services ..... Vacant
Acting Chair, Chemistry Faculty ..... ANATOLE SARKO
Acting Director, Polymer Research Institute ..... ISRAEL CABASSO
Director, Cellulose Research Institute ..... TORE E. TIMELL
Chair, Environmental and Forest Biology Faculty ..... ROBERT L. BURGESS
Chair, Environmental Studies Faculty ..... RALPH A. SANDERS
Chair, Forest Engineering Faculty ..... ROBERT H. BROCK, JR.
Chair, Forestry Faculty ..... JOHN V. BERGLUND
Director, Forest Technician Program of the Forestry Faculty ..... RICHARD W. MILLER
Interim Chair, Landscape Architecture Faculty ..... GEORGE W. CURRY
Chair, Paper Science and Engineering Faculty ..... LELAND R. SCHROEDER
Director, Empire State Paper Research Institute ..... LELAND R. SCHROEDER
Chair, Wood Products Engineering Faculty ..... LEONARD A. SMITH
Director, N. C. Brown Center for Ultrastructure Studies ..... WILFRED A. CÔTÉ, JR.
Director, Tropical Timber Information Center ..... ROBERT W. MEYER
Director, Adirondack Ecological Center ..... WILLIAM F. PORTER

Vice President for Administration and Planning ..... DAVID G. ANDERSON
Director of Administrative Computing ..... DAVID J. SODERBERG
Director of Business Affairs ..... HARRY J. CORR
Director of Forest Properties ..... RICHARD A. SCHWAB
Acting Director of Institutional Research ..... DAVID J. SODERBERG
Director of Personnel and Affirmative Action ..... MARCIA JAMES
Acting Director of Physical Plant ..... JOHN C. COFFEY
Acting Director of Public Safety ..... CARL F. BRAENDLE

Vice President for Student Affairs and Educational Services ..... JAMES M. HEFFERNAN
Director of Admissions ..... DENNIS O. STRATTON
Director of Alumni Affairs ..... JUSTIN F. CULKOWSKI
Director of Counseling ..... THOMAS O. SLOCUM
Director of Financial Aid ..... JOHN E. VIEW
Registrar ..... ROBERT S. NORTH
Project Leader, U.S. Forest Service Cooperative Research Unit ..... ROWAN A. ROWNTREE

COLLEGE FACULTY AND PROFESSIONAL STAFF

DISTINGUISHED TEACHING PROFESSOR

GEORGE W. CURRY, *Distinguished Teaching Professor*, Landscape Architecture Faculty

THEODORE J. STENUF, *Distinguished Teaching Professor*, Paper Science and Engineering Faculty

DISTINGUISHED ADJUNCT PROFESSOR

HARRY L. FRISCH, *Distinguished Adjunct Professor*, Chemistry Faculty

DISTINGUISHED TEACHING PROFESSOR EMERITUS

EDWIN H. KETCHLEDGE, *Distinguished Teaching Professor Emeritus*, Environmental and Forest Biology Faculty

DISTINGUISHED PROFESSOR EMERITUS

CONRAD SCHUERCH, *Distinguished Professor Emeritus*, Chemistry Faculty

MICHAEL M. SZWARC, *Distinguished Professor Emeritus*, Polymer Research Institute.

This listing represents an official record of the State University of New York College of Environmental Science and Forestry faculty and professional staff for 1986. It is designed for use in 1986-87.

The date in parentheses after each name denotes the first year of service, two or more dates, the term of service.

LAWRENCE P. ABRAHAMSON (1977), *Senior Research Associate*, Forestry Faculty and Environmental and Forest Biology Faculty; B.S., Michigan Technological University, 1964; M.S., University of Wisconsin, 1967; Ph.D., 1969

JUDD H. ALEXANDER (1979), *Adjunct Professor*, Environmental Studies Faculty; B.A., Carleton College, 1949; P.M.D., Harvard Business School, 1967

DOUGLAS C. ALLEN (1968), *Professor*, Environmental and Forest Biology Faculty; B.S., University of Maine, 1962; M.S., 1965; Ph.D., University of Michigan, 1968

WAYNE ALLEN (1979), *Technical Assistant*, Forest Technician Program of the Forestry Faculty

DAVID A. ANDERSON (1985), *Facilities Planning Intern*, Physical Plant; B.S., Syracuse University, 1985

DAVID G. ANDERSON (1959), *Vice President for Administration and Planning; Professor;* A.A.S., State University of New York College of Forestry (Ranger School), 1950; B.S., State University of New York College of Forestry, 1953; M.S., University of Utah, 1958; M.P.A., Syracuse University, 1974

ROBERT E. ANTHONY (1953), *Technical Specialist*, Environmental and Forest Biology Faculty; A.A.S., State University of New York Agricultural and Technical College at Morrisville, 1952

RAYMOND J. APPLEBY (1982), *Technical Assistant*, Paper Science and Engineering Faculty; A.S., State University of New York Columbia-Greene, 1980

ROBERT W. ARSENEAU (1972), *Programmer/Analyst*, Administrative Computing, Office of the Vice President for Administration and Planning; A.A.S., Mohawk Valley Community College, 1967; B.S., Syracuse University, 1978

CAROLINE B. BAILEY (1978), *Technical Assistant*, Landscape Architecture Faculty

JAMES P. BAMBACHT (1967), *Acting Chair and Professor*, Paper Science and Engineering Faculty; A.B., Kalamazoo College, 1954; M.S., The Institute of Paper Chemistry, 1956; Ph.D., State University of New York College of Environmental Science and Forestry, 1973

JOHN D. BENNETT (1960), *Associate Professor*, Forestry Faculty; B.A.. Ohio Wesleyan University, 1954; Ph.D., Syracuse University, 1968; *Chancellor's Award for Excellence in Teaching* (1973)

JOHN V. BERGLUND (1965), *Chair and Professor*, Forestry Faculty; *Director*, Division of Forest Resources; B.S., Pennsylvania State University, 1962; M.S., 1964; Ph.D., State University of New York College of Forestry, 1968

DONALD H. BICKELHAUPT (1969), *Research Assistant*, Forestry Faculty; B.S., State University of New York College of Forestry, 1970; M.S., State University of New York College of Environmental Science and Forestry, 1980

ARTHUR J. BILCO (1983), *Assistant Director of Physical Plant*, Office of the Vice President for Administration and Planning

PETER E. BLACK (1965), *Professor*, Forestry Faculty; B.S., University of Michigan, 1956; M.F., 1958; Ph.D., Colorado State University, 1961; *Executive Chairman of the Faculty* (1974-78)

RAYMOND W. BLASKIEWICZ (1982), *Assistant Registrar*, Office of Student Affairs and Educational Services, Registrar's Office; B.S., State University of New York College of Environmental Science and Forestry, 1979

CONSTANCE H. BOBBIE (1982), *Associate Librarian*, F. Franklin Moon Library; B.S., Bemidji State College, 1956; M.A., University of Minnesota, 1962

WILLIAM R. BORGSTEDE (1971), *Technical Assistant*, Environmental and Forest Biology Faculty; A.A.S., Miner Institute, 1966; A.A.S., State University of New York College at Delhi, 1970; B.S., State University of New York College of Environmental Science and Forestry, 1975; M.S., Syracuse University; 1978

GREGORY L. BOYER (1985), *Assistant Professor*, Chemistry Faculty; A.S., Reedley College, 1973; A.B., University of California, 1975; Ph.D., University of Wisconsin, 1980

CARL F. BRAENDLE (1976), *Acting Director of Campus Public Safety*, Office of the Vice President for Administration and Planning

STEPHEN B. BRANDT (1983), *Research Associate Professor*, Environmental and Forest Biology Faculty; B.A., University of Wisconsin, 1972; M.S., 1975; Ph.D., 1978

DUDLEY C. BREED, JR. (1985), *Visiting Assistant Professor*, Landscape Architecture Faculty

BRUCE W. BREITMEYER (1983), *Forest Property Manager*, Warrensburg and Newcomb Campuses, B.S.F., University of Michigan, 1975; M.S., 1982

JEROME BREZNER (1961), *Professor, Curriculum Director*, Environmental and Forest Biology Faculty; A.B., University of Rochester, 1952; A.M., University of Missouri, 1956; Ph.D., 1959; Postdoctoral, Dartmouth Medical School, 1960; *Executive Chairman of the Faculty*, (1974-76); SUNY Senator, (1984-87)

KENNETH W. BRITT (1971), *Senior Research Associate*, Paper Science and Engineering Faculty; B. Chem., Cornell University, 1929

ROBERT H. BROCK, JR. (1967), *Chair and Professor*, Forest Engineering Faculty; *Director*, Division of Engineering; B.S., State University of New York College of Forestry, 1958; M.S., 1959; Ph.D., Cornell University, 1971

RAINER H. BROCKE (1969), *Associate Professor*, Environmental and Forest Biology Faculty; *Director*, Cranberry Lake Biological Station; B.S., Michigan State University, 1955; M.S., 1957; Ph.D., 1970

DAVID F. BRODOWSKI (1977), *Programmer/Analyst*, Administrative Computing; Environmental and Forest Biology Faculty; B.S., Cornell University, 1975

ALTON F. BROWN (1963), *Technical Specialist*, Empire State Paper Research Institute

THOMAS E. BROWN (1977), *Adjunct Assistant Professor*, Environmental and Forest Biology Faculty; B.S., Niagara University, 1957; M.S., State University of New York College of Forestry, 1968

PATRICIA BURAK (1983), *Adjunct Associate Foreign Student Counselor*, Office of Student Affairs; B.A., State University of New York College at Oswego, 1973; M.A., State University of New York College at Albany, 1974

ROBERT L. BURGESS (1981), *Chairman and Professor*, Environmental and Forest Biology Faculty; B.S., University of Wisconsin (Milwaukee), 1957; M.S., University of Wisconsin (Madison), 1959; Ph.D., 1961

KENNETH F. BURNS (1970), *Technical Assistant*, Forestry Faculty; A.A.S., Paul Smith's College, 1969

HARRY W. BURRY (1962), *Senior Research Associate and Extension Coordinator; Associate Professor*, Forestry Faculty; B.S., New York State College of Forestry, 1941; M.F., State University of New York College of Forestry, 1964

ISRAEL CABASSO (1981), *Professor*, Chemistry Faculty; *Acting Director*, Polymer Research Institute; B.S., Hebrew University, 1966; M.S., 1968; Ph.D. Weizmann Institute of Science, 1973

PAUL M. CALUWE (1969), *Associate Professor*, Chemistry Faculty; *Associate Member*, Polymer Research Institute; Ph.D., University of Leuven, Belgium, 1967

ROBERT W. CAMPBELL (1984), *Adjunct Professor*, Environmental and Forest Biology Faculty; B.S., New York State College of Forestry, 1953; M.S., University of Michigan, 1959; Ph.D., 1961

HUGH O. CANHAM (1966), *Associate Professor*, Forestry Faculty; B.S., State University of New York College of Forestry, 1960; M.S., 1962; Ph.D., 1971

EMANUEL J. CARTER, JR. (1985), *Assistant Professor*, Landscape Architecture Faculty; B.A., Cornell University, 1969; Master of Regional Planning, 1978

COSTAS A. CASSIOS (1978), *Adjunct Professor*, Landscape Architecture Faculty; B.S., University of Thessaloniki, 1965; M.S., Graduate Industrial School, 1969; M.S., University of Wisconsin, 1972; Ph.D., 1976

JOHN D. CASTELLO (1978), *Associate Professor*, Environmental and Forest Biology Faculty; B.A., Montclair State College, 1973; M.S., Washington State University, 1976; Ph.D., University of Wisconsin, 1978

THOMAS M. CATTERSON (1982), *Senior Research Associate*, Office of Research Programs; B.S., State University of New York College of Environmental Science and Forestry, 1967; M.S., 1973

ROBERT E. CHAMBERS (1967), *Professor*, Environmental and Forest Biology Faculty; B.S., Pennsylvania State University, 1954; M.S., 1956; Ph.D., Ohio State University, 1972

ROLLA W. COCHRAN (1964), *Assistant to the President for Public Relations*, Office of the President; *Associate Professor, Coordinator of Demonstration and Information*, Institute of Environmental Affairs; B.A., Denison University, 1949; M.S., Ohio State University, 1951

JOHN C. COFFEY (1982), *Acting Director of Physical Plant*; Office of the Vice President for Administration and Planning; B.S., Rensselaer Polytechnic Institute, 1971; B. Architecture, 1972; Master Regional Planning, Syracuse University, 1977; Registered Architect, New York State

ETHEL M. COMP (1978), *Personnel Associate*, Office of the Vice President for Administration and Planning

HARRY J. CORR (1967), *Director of Business and Fiscal Affairs*, Office of the Vice President for Administration and Planning; B.S., Siena College, 1957

WILFRED A. CÔTÉ, JR. (1950), *Professor of Wood Technology*, Wood Products Engineering Faculty; *Director*, N.C. Brown Center for Ultrastructure Studies; B.S., University of Maine, 1949; M.F., Duke University, 1950; Ph.D., State University of New York College of Forestry, 1958; *Executive Chairman of the Faculty* (1970-72)

JAMES E. COUFAL (1965), *Professor and Curriculum Coordinator*, Forestry Faculty; Certificate, State University of New York College of Forestry (Ranger School), 1957; B.S., State University of New York College of Forestry, 1960; M.S., 1962; Ed.S., State University of New York at Albany, 1976

PHILLIP J. CRAUL (1968), *Professor*, Forestry Faculty; B.S.F., Pennsylvania State University, 1954; M.S., 1960; Ph.D., 1964

THIERRY M. CRESSON (1981), *Technical Assistant*, Empire State Paper Research Institute; M.S., Ecole Francaise de Papeterie, 1981

JAMES O. CREVELLING (1970), *Forest Property Manager*, Southern Properties, Wanakena and Cranberry Campuses; A.A.S., Paul Smith's College, 1965, B.S., University of Massachusetts, 1967

CLAY M. CROSBY (1964), *Research Assistant*, Empire State Paper Research Institute; B.S., State University of New York College of Forestry, 1964; M.S., 1970

JUSTIN F. CULKOWSKI (1978), *Director of Alumni Affairs*, B.S., State University of New York College of Environmental Science and Forestry, 1973; M.B.A., Syracuse University, 1983

TIBERIUS CUNIA (1968), *Professor*, Forestry Faculty; Forest Engineer, Ecole Nat. des Eaux et Forets, Nancy-France, 1951; M.S., McGill University, Montreal, Canada, 1957

GEORGE W. CURRY (1966), *Interim Chair and Distinguished Teaching Professor*, Landscape Architecture Faculty; B.A., Michigan State University, 1962; B.S., 1965; M.L.A., University of Illinois, 1969

MIROSLAW M. CZAPOWSKYJ (1979), *Adjunct Professor*, Forestry Faculty; Diplomforstwirt, Ludwig-Maximiliams University, Munich, 1949; M.S., University of Maine, 1958; Ph.D., Rutgers University, 1962

BENJAMIN V. DALL (1975), *Professor*, Forestry Faculty; B.S., Yale University, 1955; M.F., 1956; J.D., University of Virginia, 1959; Ph.D., Pennsylvania State University, 1972

ROBERT W. DAVIDSON (1957), *Professor*, Wood Products Engineering Faculty; B.S., Montana State University, 1948; M.S., State University of New York College of Forestry, 1956; Ph.D., 1960

ARNOLD C. DAY (1947), *Technical Specialist*, N.C. Brown Center for Ultrastructure Studies

SALVACION DE LA PAZ (1973), *Associate Librarian*, F. Franklin Moon Library; B.S.L.S., University of the Philippines, 1956; M.S.L.S., Simmons College, 1962

CARLTON W. DENCE (1951), *Professor*, Empire State Paper Research Institute; B.S., Syracuse University, 1947; M.S., State University of New York College of Forestry, 1949; Ph.D., 1959

DANIEL L. DINDAL (1966), *Professor*, Environmental and Forest Biology Faculty; B.S. Ed. and B.S. Agri., Ohio State University, 1958; M.A., 1961; Ph.D., 1967; *Chancellor's Award for Excellence in Teaching* (1974)

BARBARA DI PIAZZA (1983), *Counselor*, Office of Student Affairs and Educational Services; B.A., Hamilton and Kirkland Colleges, 1976; M.S., Syracuse University, 1981

ALLAN P. DREW (1980), *Associate Professor*, Forestry Faculty; B.S., University of Illinois, 1965; M.S., University of Arizona, 1967; Ph.D., Oregon State University, 1974

MICHAEL J. DUGGIN (1979), *Professor*, Forest Engineering Faculty; B.Sc., Melbourne University, 1959; Ph.D., Monash University, 1965

PATRICK R. DURKIN (1980), *Adjunct Assistant Professor*, Environmental Studies Faculty; B.S., State University of New York College at Fredonia, 1968; M.S., Fordham University, 1972; Ph.D., State University of New York College of Environmental Science and Forestry, 1979

ANDREW L. EGGERS (1967), *Technical Specialist*, F. Franklin Moon Library/Learning Resources-Educational Communications

WILLIAM P. EHLING (1983), *Adjunct Professor*, Environmental Studies Faculty; B.A., Syracuse University, 1943; M.A., 1952; Ph.D., 1954

ELIZABETH A. ELKINS (1973), *Associate Librarian*, F. Franklin Moon Library; B.A., Hartwick College, 1968; M.L.S., State University of New York at Geneseo, 1970; *Chancellor's Award for Excellence in Librarianship* (1980)

DONALD P. ELY (1980), *Adjunct Professor*, Environmental Studies Faculty; B.A., State University College for Teachers, Albany, 1951; M.A., Syracuse University, 1953; Ph.D., 1961

ARTHUR R. ESCHNER (1961), *Professor*, Forestry Faculty; B.S., State University of New York College of Forestry, 1950; M.S., Iowa State College, 1952; Ph.D., State University of New York College of Forestry, 1965

AMINUR EUSUFZAI (1977), *Research Assistant*, Empire State Paper Research Institute; B.Sc. (Hons.), Dacca University, 1957; M.Sc., 1960; B.Sc. (Hons.) Forestry, Peshawar University, 1962; M.S., West Virginia University, 1969; M.S., State University of New York College of Environmental Science and Forestry, 1982

MILDRED FAUST (1976), *Adjunct Professor*, Environmental and Forest Biology Faculty; A.B., Penn College, 1921; M.S., University of Chicago, 1923; Ph.D., 1933

JOHN P. FELLEMAN (1973), *Professor*, Landscape Architecture; Faculty; B.C.E., Cornell University, 1966; M.E.C., 1966; N.D.E.A. Fellow, University of North Carolina, 1967; D.P.A., New York University, 1973

DAVID L. FINCH (1985), *Instrument Maintenance Specialist*, Analytical and Technical Services, Office of the Dean for Research Programs; A.A.S., Florida Keys Community College, 1980; A.A.S., Onondaga Community College, 1985

JOHN S. FISHLOCK (1965), *Technical Assistant*, Environmental and Forest Biology Faculty; A.A.S., State University of New York College of Forestry, 1975

R. WARREN FLINT (1984), *Adjunct Assistant Professor*, Environmental and Forest Biology Faculty; B.S., Canisius College, 1968; M.S., Long Island University, 1971; Ph.D., University of California, 1975

CLAUDE C. FREEMAN (1959), *Associate Professor*, Landscape Architecture Faculty; B.S. in Landscape Architecture, State University of New York College of Forestry, 1959

ROBERT H. FREY (1977), *Dean of Instruction and Graduate Studies/Associate Professor*; B.A., Valparaiso University, 1965; M.Ed., Springfield College, 1966; Ed.D., Indiana University, 1973

HARRY L. FRISCH (1980), Associate Member, Polymer Research Institute; A.B., Williams College, 1947; Ph.D., Polytechnic Institute of Brooklyn, 1952

ARTHUR J. FRITZ, JR. (1985), *Director of Development*, President's Office; A.B., Syracuse University, 1962

DOUGLAS H. FROST (1982), *Assistant Director of Business Affairs*, Office of the Vice President for Administration and Planning; A.A., College of San Mateo, 1962; B.S., Wagner College, 1967

RONALD J. GIEGERICH (1977), *Technical Assistant*, Environmental and Forest Biology Faculty; A.A.S., State University of New York Agricultural and Technical College at Cobleskill, 1975; B.S., State University of New York College of Environmental Science and Forestry, 1978

MICHAEL GOODEN (1982), *Technical Assistant*, Newcomb Campus; A.A.S., State University of New York Agricultural and Technical College at Morrisville, 1976; B.S., State University of New York College of Environmental Science and Forestry, 1978

SERGE N. GORBATSEVICH (1956), *Associate Professor*, Paper Science and Engineering Faculty; B.S., State University of New York College of Forestry, 1954; M.S., 1955

W. DOUGLAS GOULD (1983), *Adjunct Assistant Professor*, Environmental and Forest Biology Faculty; B.S., University of Manitoba, 1965; M.S., University of Alberta, 1970; Ph.D., 1976

STEPHEN GRANZOW (1969), *Technical Specialist*, Empire State Paper Research Institute

MIKLOS A. J. GRATZER (1973), *Professor*, Forestry Faculty; Forest Engineer, Sopron University, 1956; B.Sc., University of British Columbia, 1959; M.S. (R.C.), University of Montana, 1965; Ph.D., 1971

PAUL F. GRAVES (1947), *Professor*, Forestry Faculty; B.S., New York State College of Forestry, 1939; M.F., 1941; Ph.D., Syracuse University, 1949

CHARLES GREEN, JR. (1979), *Adjunct Professor*, Paper Science and Engineering Faculty; B.S., University of Iowa, 1956

DAVID H. GRIFFIN (1968), *Professor*, Environmental and Forest Biology Faculty; B.S., State University of New York College of Forestry, 1959; M.A., University of California, 1960; Ph.D., 1963

JAMES P. HALLIGAN (1979), *Technical Assistant*, Forestry Faculty; B.S., State University of New York College of Environmental Science and Forestry, 1974

JUDITH C. HAMILTON (1979), *Financial Aid Advisor*, Office of Student Affairs and Educational Services-Financial Aid Office; B.S., State University College at Brockport, 1967; M.S., State University of New York at Albany, 1968

KENNETH E. HAMMEL (1986), *Assistant Professor*, Chemistry Faculty; A.B., University of California, 1974; Ph.D., University of California Berkeley, 1982.

ROBERT B. HANNA (1977), *Assistant Director*, N.C. Brown Center for Ultrastructure Studies; *Associate Professor*, Wood Products Engineering Faculty; B.S., University of Michigan, 1967; M.S., State University of New York College of Forestry, 1971; Ph.D., State University of New York College of Environmental Science and Forestry, 1973

DAVID L. HANSELMAN (1963), *Professor*, Landscape Architecture Faculty; B.S., Cornell University, 1957; M.S., 1958; Ph.D., The Ohio State University, 1963

ROY C. HARTENSTEIN (1959-65) (1967), *Professor*, Environmental and Forest Biology Faculty; B.S., State Teachers College at Buffalo, 1953; M.S., Syracuse University, 1957; Ph.D., State University of New York College of Forestry, 1959

JAMES M. HASSETT (1981), *Assistant Professor*, Forest Engineering Faculty; Graduate Program in Environmental Science; A.B., Cornell University, 1970; M.S., Syracuse University, 1979

JOHN P. HASSETT (1980), *Research Associate*, Chemistry Faculty; B.S., University of Maryland, 1971; M.S., University of Wisconsin, 1973; Ph.D., 1978

RICHARD S. HAWKS (1979), *Associate Professor*, Landscape Architecture Faculty; B.L.A., State University of New York College of Environmental Science and Forestry, 1972; M.L.A., Harvard University, 1978

JAMES M. HEFFERNAN (1985), *Vice President of Student Affairs*, Office of Student Affairs and Educational Services; A.B., Lafayette College, 1965; M.A., Columbia University Teachers College, 1967; M.A., University of Michigan, 1970; Ph.D., 1971

GORDON M. HEISLER (1973), *Adjunct Associate Professor*, Forestry Faculty; B.S., Pennsylvania State University, 1961; M.F., Yale University, 1962; Ph.D., State University of New York College of Forestry, 1970

ROBERT D. HENNIGAN (1967), *Professor*, Forest Engineering Faculty; B.C.E., Manhattan College, 1949; M.A., Syracuse University, 1964, P.E., New York State

LEE P. HERRINGTON (1965), *Professor and Coordinator*, Research and Graduate Studies, Forestry Faculty; B.S., University of Maine, 1959; M.F., Yale School of Forestry, 1960; Ph.D., Yale University, 1964

ROBERT A. HOLM (1982), *Associate Professor*, Paper Science and Engineering Faculty; B.S., University of Illinois, 1958; M.S., University of Delaware, 1961; Ph.D., 1962

MARY O'BRIEN HOOVEN (1980), *Food Service Supervisor*, Wanakena and Cranberry Lake Campuses, B.A., State University of New York at Buffalo, 1972

PAUL F. HOPKINS (1979), *Assistant Professor*, Forest Engineering Faculty; B.S., University of Maine, 1977; M.S., State University of New York College of Environmental Science and Forestry, 1979

ALLEN F. HORN, JR. (1957), *Professor*, Forestry Faculty; B.S., Michigan State University, 1950; M.S., 1951; Ph.D., State University of New York College of Forestry, 1957; L.L.B., Syracuse University, 1967

STEPHEN B. HORSLEY (1979), *Adjunct Associate Professor*, Forestry Faculty, B.S., Pennsylvania State University, 1965; M.S., University of Massachusetts, 1968; Ph.D., 1970

JOEL R. HOWARD (1974), *Instructor*, Forestry Faculty; B.S., State University of New York College of Environmental Science and Forestry, 1973; M.S., 1978; Ph.D., North Carolina State University, 1984

JOHN J. HOWARD (1978), *Adjunct Associate Professor*, Environmental and Forest Biology Faculty; B.A., University of New Hampshire, 1966; M.P.H., Yale University, 1970, Dr. P.H., 1973

DARLENE M. HUNTLEY (1984), *Technical Assistant*, Newcomb Campus

MARCIA JAMES (1985), *Director of Personnel and Affirmative Action*, Office of the Vice President for Administration and Planning; B.A., Grove City College, 1960; M.A., Cornell University, 1962; M.A., 1965; J.D., Syracuse University, 1978

ROBERT V. JELINEK (1972), *Professor*, Paper Science and Engineering Faculty; B.S., Columbia University, 1945; M.S., 1947; Ph.D., 1953

DAVID L. JOHNSON (1975), *Associate Professor*, Chemistry Faculty; B.S., Antioch College, 1965; Ph.D., University of Rhode Island, 1973

DIANNE M. JUCHIMEK (1967), *Associate Librarian*, F. Franklin Moon Library/Learning Resources; B.S., University of Illinois, 1965; M.S.L.S., Syracuse University, 1967

RONALD R. KARNS (1965), *Editorial Associate*, Office of Publications; B.S., Ohio State University, 1954

JAMES P. KARP (1983), *Adjunct Professor*, Environmental Studies Faculty; B.S., Penn State University, 1960; J.D., Villanova University, 1964

ROWENA V. KATHER (1974), *Coordinator of Academic Support Stores*; Analytical and Technical Services, Office of the Dean for Research Programs, B.A., Syracuse University, 1979; M.P.A., 1981

THERESE M. KENNETT (1984), *Assistant for Sponsored Programs*, Office of Research Programs; B.S., State University of New York, Geneseo, 1983

JUDITH J. KIMBERLIN (1981), *Assistant Director of Personnel and Affirmative Action*, Office of the Vice President for Administration and Planning; A.A.S., Pennsylvania State University, 1964; B.A., State University of New York College at Cortland, 1975

GERALD J. KINN (1984), *Visiting Assistant Professor*, Forest Engineering Faculty; B.S., State University of New York College of Environmental Science and Forestry, 1977; M.S., 1981

DONALD E. KOTEN (1961), *Professor*, Forestry Faculty; B.A., North Central College, 1951; B.S., Oregon State College, 1957; Ph.D., State University of New York College of Forestry, 1966

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