NEW YORK STATE COLLEGE OF AGRICULTURE AND LIFE SCIENCES

ADMINISTRATION

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Kenneth E. Wing, associate dean

George J. Conneman, director of academic programs

Elizabeth A. Oltenacu, associate director of academic programs

Brian F. Chabot, acting director of research

David L. Brown, associate director of research

Lucinda A. Noble, director of cooperative extension

R. David Smith, associate director of cooperative extension

E. Walter Coward, Jr., director of international agriculture

Office of Academic Programs Staff

Student services: Donald Burgett, Patricia Long, Catherine Thompson

Records: Tom Wakula

Registrar: Ruth Stanton

Scheduling: Cathy Place

Admissions: Richard Church, Susan Miller, Nancy Rehkugler, Randy Stewart

Career development: William Alberta, Catherine McCormick-Loerch

Department Chairs

Agricultural and biological engineering: G. E. Rehkugler, Riley-Robb Hall

Agricultural economics: W. G. Tomek, Warren Hall

Agronomy: R. J. Wagenet, Emerson Hall

Animal science: J. M. Elliot, Morrison Hall

Communication: R. D. Colle, Roberts Hall

Education: R. E. Ripple, Roberts Hall

Entomology: R. A. Morse, Comstock Hall

Floriculture and ornamental horticulture: G. L. Good, Plant Science Building

Food science: R. A. Ledford, Stocking Hall

Microbiology: W. C. Ghiorse, Stocking Hall

Natural resources: J. P. Lassoie, Fernow Hall

Plant breeding and biometry: W. R. Coffman, Emerson Hall

Plant pathology: W. E. Fry, Plant Science Building

Pomology: G. H. Oberly, Plant Science Building

Poultry and avian sciences: R. E. Austic, Rice Hall

Rural sociology: E. C. Erickson. Warren Hall

Vegetable crops: E. E. Ewing, Plant Science Building

Facilities

The College of Agriculture and Life Sciences is located on the upper campus, up the hill from the central area of Cornell University, on land that was once part of the Ezra Cornell family farm.

Buildings around the area commonly known as the Ag Quad house classrooms, offices, and laboratories. Flanking them are the greenhouses, gardens, and research facilities. Nearby orchards, barns, field plots, forests, and streams extend as far as the Animal Science Teaching Research Center at Harford and the Agricultural Experiment Station at Geneva.

Roberts Hall serves as headquarters for the administrative units, including offices of the deans and directors of academic programs, research, and cooperative extension. Included in the Office of Academic Programs are the director and associate director, the Admissions Office, the Career Development Office, and the Office of Student Services.

Mann Library, with its extensive collections of materials in the agricultural and biological sciences, is at the east end of the Ag Quad. The student lounge and service center, known as the Alfalfa Room, and many of the college classrooms are in Warren Hall. Public computer facilities are available in Warren Hall, in Riley-Robb Hall, and in Mann Library.

DEGREE PROGRAMS

The College of Agriculture and Life Sciences offers programs leading to the degrees of Bachelor of Science, Master of Science, and Doctor of Philosophy. Professional degrees include the Master of Professional Studies and the Master of Arts in Teaching. Some registered professional licensing and certification programs are also available.

Each curriculum in the college creditable toward a degree is registered with the New York State Education Board and is linked with the national Higher Education General Information Survey (HEGIS) codes for federal and state reporting.

Graduate Degrees

Graduate study is organized by fields that generally coincide with the academic departments but may draw faculty from several disciplines in the various colleges of the university. The following graduate fields have primary affiliation in Agriculture and Life Sciences. Current graduate field representatives are also listed.

Agriculture [M. P.S. (Agr.)], G. Conneman, Roberts Hall

Agricultural and Biological Engineering, W. Gunkel, Riley-Robb Hall

Agricultural Economics, W. Lesser, Warren Hall

Agronomy, J. Peverly, Bradfield Hall

Animal Breeding, J. Pollak, Morrison Hall

Animal Science, R. Quaas, Morrison Hall

*Biochemistry, Molecular and Cell Biology; A. Bretscher, Biotechnology Building

Biometry, S. Schwager, Warren Hall

*Botany, K. Niklas, Plant Science Building

Communication [M.P.S. (C.A.)], R. Ostman, Roberts Hall

Development Sociology, F. Young, Warren Hall

*Ecology and Evolutionary Biology, P. Marks, Corson Hall

Education [also M.A.T.], H. Wardeberg, Roberts Hall

Entomology, G. Eickwort, Comstock Hall

Environmental Toxicology, J. Fessenden MacDonald, Clark Hall

Floriculture and Ornamental Horticulture, K. Mudge, Plant Science Building

Food Science and Technology, D. Miller, Stocking Hall

*Genetics, C. Aquadro, Biotechnology Building

International Agricultural and Rural Development

[M.P.S. (Agr.)], E. W. Coward, Jr., Caldwell Hall

Landscape Architecture [M.L.A.], L. Mirin, W. Sibley Hall

Microbiology, W. Ghiorse, Stocking Hall

Natural Resources, R. Oglesby, Fernow Hall

*Neurobiology and Behavior, R. Harris-Warrick, Seeley Mudd Hall

Nutrition, B. Lewis, Martha Van Rensselaer Hall

*Physiology, H. Howland, Seeley Mudd Hall

Plant Breeding, E. Earle, Bradfield Hall

Plant Pathology, S. Beer, Plant Science Building

Plant Protection [M.P.S. (Agr.)], G. Bergstrom, Plant Science Building

Pomology, L. Powell, Plant Science Building

Statistics, G. Casella, Warren Hall

Vegetable Crops, P. Ludford, Plant Science Building

*Division of Biological Sciences

Bachelor of Science Degree

Departments in the College of Agriculture and Life Sciences sponsor study for the B.S. degree in seventeen major fields. To qualify for the degree, students must fulfill requirements established by the faculty of the college and administered through the Office of Academic Programs. The following units offer major fields of study for undergraduates. A faculty advising coordinator is listed for each unit. Students should consult with the faculty coordinator regarding requirements and opportunities for concentrations within the major field.

Agricultural and Biological Engineering: G. Rehkugler, 104 Riley-Robb Hall

Agronomy and Meteorology: T. Scott, 1001 Bradfield Hall

Animal Sciences: D. Hogue, 255 Morrison Hall

Applied Economics and Business Management: O. Forker, 254 Warren Hall

Biological Sciences, Division of: H. Stinson, 118 Stimson Hall

Communication: B. Earle, 307 Roberts Hall

Education: H. Wardeberg, 408 Roberts Hall

Entomology: B. Peckarsky, 3134 Comstock Hall

Food Science: J. Sherbon, 207 Stocking Hall

Landscape Architecture: D. Krall, 230 E. Roberts Hall

Microbiology: V. Stewart, 412a Stocking Hall

Natural Resources: H. Brumsted, 122e Fernow Hall

Plant Science Units (Plant Biology, Breeding, Pathology/Protection, Floriculture, Pomology, Vegetable Crops): J. Lorbeer, 424 Plant Science Building

Rural Sociology: E. Erickson, 133 Warren Hall

Statistics and Biometry: C. McCulloch, 338 Warren Hall

Special Agricultural Studies (ALS): D. Burgett, 17 Roberts Hall

Summary of Basic College Requirements for Graduation

1. Credit Hours

a. Minimum: 120
b. Minimum with letter grade: 100
c. Maximum independent study, internships: 15
d. Minimum College of Agriculture and Life Sciences: 55
e. Maximum from endowed colleges without additional charge: 55
f. Maximum transferred in: 60; minimum at Cornell: 60

Note: Credits received for physical education and for certain other courses, such as Mathematics 109 and Education 005, do not count toward the 120 hours but are included on the transcript and in the grade-point average.

2. Residence

a. Normally, eight full-time semesters
b. Seven semesters, if all other degree requirements are met, with a grade-point average of 2.0
c. Minimum of 12 credits per semester
d. Minimum of two semesters in the College of Agriculture and Life Sciences (residency in the Division of Unclassified Students [DUS] does not count toward residency in the college)
e. Students who have 8 semesters in residence at Cornell, including two in the college, and who have 8 or fewer credits remaining for graduation may petition for approval to complete this work elsewhere.

3. Physical Education

a. Completion of university requirement for two terms of work
b. Transfer students may be exempt from part or all of the requirement.

Note: Requests for postponement or exemption should be made in writing to the University Faculty Committee on Physical Education. Questions should be referred to Alan Gantert, Teagle Hall (255-4286).

4. Grade-Point Average (GPA)

a. Cumulative GPA: 1.7 or above must be maintained
b. Final GPA: 1.7 for a minimum of 12 credits in last term.

Note: Only grades earned at Cornell and while registered in the college are included.

5. Distribution

The purpose of the distribution requirement is to acquaint students with a broad range of subject matter. Through study of the physical sciences, students develop quantitative and analytic skills based on an understanding of the physical laws governing the universe; through study of the biological sciences, they gain an appreciation of the variability of living organisms. The social sciences and humanities give students perspective on the structure and values of the society in which we live. Through development of written and oral expression skills, students master the essentials of effective communication.

Credits received for independent study, field, teaching, or work experience, and internships cannot be used to fulfill the distribution requirement. Courses judged to be remedial in the discipline such as Education 005, will not be counted.

Group A: Physical Sciences. 9 credits of 100- or 200- level courses, in at least two disciplines, including at least one course in chemistry or physics.

Agronomy 131
Astronomy
Chemistry
Geology
*Mathematics (excluding Education 005 and Mathematics 109)
Education 115
Physics

*The college mathematics requirement is described below.

Group B: Biological Sciences. 9 credits, including 6 of introductory biological science.

Biological Sciences (except 202, 205, 206, 301)
Animal Sciences 220, 221
Entomology 212
Microbiology
Plant Breeding 225
Plant Pathology 301, 309

Group C: Social Sciences and Humanities. 12 credits (6 in each of the following two categories):

Social Sciences. 100- or 200-level courses in the following departments (excluding Freshman Seminars):

Archaeology
Anthropology
CEH 110/CEH 111 (cannot receive credit for these courses and Econ 101/Econ 102)
Economics
Government (including Africana Studies 190)
HDFS 150 (cannot receive credit for this course and Soc 243)
Psychology
Sociology (including Rural Sociology)

Humanities. 100-, 200-, or 300-level courses in the following departments (excluding Freshman Seminars and language courses):

Africana Studies (humanities and history)
ALS 100 or ALS 318
Asian and Near Eastern Studies
Classics
Comparative Literature
English (literature only)
French, German, Italian, Russian, and Spanish (literature only)
History and History of Art/Architecture
Music and Theatre Arts (theory, literature, and history only)
Philosophy (also Natural Resources 407)

Group D: Written and Oral Expression. 9 credits, of which at least 6 must be in written expression, selected from the following:

Freshman Seminars
Communication 161, 201, 350, 352, 360, 363, 365
English 280–281, 288–289, 382–385, 388–389
Hotel Administration 365

6. Mathematics

The faculty requires minimum competency in mathematics as a requisite to satisfactory pursuit of a degree. All students must complete, with a passing grade, one course in mathematics as part of the physical sciences requirement. Advanced placement credit in mathematics or transfer credit in a college calculus course may be presented to meet this requirement.

a. The ALS Mathematics Placement test: All entering undergraduates, except those presenting advanced placement or transfer credit in college calculus, must take the test, which is administered free of charge just prior to registration each semester. No student may repeat the placement test. It consists of fifty sample questions from arithmetic, algebra, geometry, trigonometry, and basic calculus. The index score is determined by the number of correct answers minus one quarter of the number of incorrect answers.

b. The index score is used to help students select appropriate courses. If a high index score (currently defined as equal to or greater than 30) is attained, the mathematics requirement in physical sciences is waived. If a low index score (of 12 or less) is attained, the student is to enroll in Education 005 before selecting a mathematics course to fulfill the requirement.

c. When presenting mathematics transfer credit, a student may

1. include precalculus credits along with the calculus credits
2. transfer up to 6 credits to the physical sciences requirement, if the index score is 30 or above
3. *not* transfer any credit to the physical sciences requirement if the index score is from 13 to 20 (credit may, however, be counted toward graduation)
4. *not* transfer any credit in mathematics if the index score is below 13.

7. Faculty Adviser

a. Each student is assigned to a faculty adviser soon after being admitted to the college. The faculty adviser will help the student plan a program of study and enroll in courses appropriate to the degree programs offered by the college.

b. Course enrollment each semester should be planned in consultation with the faculty adviser. The signature of the faculty adviser indicates approval of, or at least consent to, the choice of courses made and is required before the course enrollment can be processed.

c. All academic plans, such as acceleration and graduate study, should be made in consultation with the student's faculty adviser. Support of the adviser is essential if a student petitions for an exception to any of the requirements of the college.

8. Progress toward the Degree

a. The progress of each student toward meeting the degree requirements is recorded each term in the college registrar's office on a summary of record form.

b. Students who have been in residence for eight semesters and who have met the graduation requirements will be graduated. Students are entitled to attend for the full eight semesters even if they have completed the graduation requirements in fewer semesters. A student who wishes to continue study after graduation must apply for admission as a special student.

c. *Graduation with distinction:* Students who rank in the top 10 percent of the college's graduates on the basis of the GPA for the last 60 credits completed at Cornell will be graduated with distinction.

STUDENTS

Undergraduate enrollment is approximately 3,000, with about 56 percent in the upper division. Each year about 850 students are graduated, while 650 freshmen and 250 transfer students are enrolled. Members of the faculty of the college serve as chairs of the Special Committees of about 1,000 graduate students.

Admission

The College Admissions Committee selects applicants who are academically well prepared and appear most likely to profit from the college's various curricula.

Most students come from New York State, but around 25 percent come from other parts of the United States or abroad. About half of the undergraduates are women. Approximately 11 percent are identified as members of minority ethnic groups.

Transfer Students

Approximately 18 to 20 percent of the ALS undergraduate students are transfers who have taken part of their collegiate work at community colleges, agricultural and technical colleges, or other four-year institutions. Many of them hold an associate degree.

A Cornell student in good standing may apply for *intra-university transfer* to pursue a course of study unavailable in his or her current college. Guidelines are available in the Admissions Office of the College of Agriculture and Life Sciences, 195 Roberts Hall. The procedure includes filing a transfer request and submitting a letter explaining reasons for making the transfer.

Consideration is given to students who have demonstrated an interest in their intended field of study, by taking appropriate prerequisite courses and courses within this area of study. Academic achievement is also considered. Students are seldom allowed to transfer during their freshman year.

In some cases a student may be referred to the Division of Unclassified Students to study for one semester before entering the college. A second semester is considered under unusual circumstances. During this trial semester the student must achieve a predetermined average (usually 2.7) and take approved courses to assure acceptance.

Special Students

A limited number of non-degree candidates who want to take selected courses in the college are admitted each year. Applicants should submit the standard Cornell application, a resume of their work experience and a list of the courses they want to take. For more information, students should contact the Admissions Office, 195 Roberts Hall.

Part-time Students

All students in the College of Agriculture and Life Sciences are expected to be enrolled as full-time students in a registered program of study. Part-time students must register in the Division of Summer Session, Extramural Courses, and Related Programs. The Continuing Education Information Service, B-12 Ives Hall, provides information, counseling, and special programs for mature students throughout the university.

Off-Campus Students

Programs in which students study off campus but enroll for Cornell credit include SEA semester, field study in human ecology or industrial and labor relations, Albany programs, Cornell-in-Washington, student teaching, IPM internship, and clinical microbiology internship. Students intending to receive Cornell credit for work done off campus should inform the college registrar at the time of enrolling for courses to ensure that proper registration will occur.

Leave of Absence

A student considering taking a leave of absence from the university should contact the Office of Student Services. A petition must be filed when requesting a leave of a semester or more. Students returning from a leave of absence do not need to reapply for admission; they should contact Student Services.

Withdrawal

A student who finds it necessary to leave the university permanently should file a petition for withdrawal. Such petitions are approved if the student is in good standing. Students who have withdrawn and who later decide to return must apply to the Admissions Office.

Graduation

Diplomas are prepared by the Office of the University Registrar and distributed to those who have completed the degree requirements and have been approved by the college faculty.

ADVISING AND COUNSELING SERVICES

Faculty members in the College of Agriculture and Life Sciences recognize that students need information and advice to make intelligent decisions while they are in college. They believe that personal contact on a one-to-one basis is an important way to identify individual differences and needs of students. Faculty members believe that they can and should be an important source of information and advice on both academic and personal matters. Thus they consider advising to be an important and integral part of the undergraduate program.

The Office of Student Services has overall responsibility for coordinating the college advising and academic counseling program. Each student enrolled in the college is assigned to a faculty adviser in the major field of study for aid in developing a program of study and to a peer adviser who has volunteered to help with problems of a general nature relating to personal matters and campus life.

Student Services provides a variety of services for undergraduates in the College of Agriculture and Life Sciences. The staff is available to help students with academic, social, and personal concerns. In addition, learning skills information and tutoring is offered, at no charge, by the college's honor society, Ho-Nun-De-Kah. Assistance is also available for students considering submitting petitions for waiver of college regulations.

The office is located on the basement floor of Roberts Hall, Room 17. Appointments are not necessary and questions regarding services and procedures should be directed to Donald Burgett and the Student Services staff.

Minority students in the College of Agriculture and Life Sciences receive counseling, tutoring, advising, and referral to agencies that will meet their special needs. The Educational Opportunity Program (EOP) is a state-supported program intended to assist New York State students who meet specific economic and academic criteria set by the State Programs Office and the NYS Board of Regents. Eligible students are accepted during the admissions process.

For further information, please contact Catherine Thompson in 17 Roberts Hall.

The Office of Career Development offers a variety of services to all students and alumni of the college. Career development includes self-awareness and assessment, career exploration, decision making, and job search. Services are designed to assist students and alumni with those activities and to help them develop the career planning and job search skills they will find useful as their career paths progress and change.

An active on-campus recruitment program is integrated with the other services provided by the office. Extensive job vacancy files are updated daily and a bulletin of select job listings is published each month. The Career Library contains an extensive collection of current and useful material. The Sigi Plus system is a computer-assisted guidance system that can help in career and educational planning, providing useful information and ideas about work-related interests, skills and values, and occupations and careers. Internships, summer jobs, job search presentations, and assistance with resume writing are other activities of interest.

The office, in conjunction with a network of college faculty members, assists students throughout their undergraduate years. For further information students should contact William Alberta and the staff in 16 Roberts Hall.

Financial aid is administered through the university office in Day Hall. Endowment funds and annual donations provide supplemental aid for students in the college who are eligible for aid. Information about these college grants is available from the Office of Academic Programs in Roberts Hall, *after* students have a financial aid package established through the university office in Day Hall. Grants recommended by the college Financial Aid and Scholarship Committee are processed through the university's Office of Financial Aid.

A small loan fund is administered by the college through the Office of Academic Programs to assist students facing short-term emergencies. The loans are interest-free and are usually made for no more than ninety days. For information and an application form students should contact the Office of Academic Programs, 192 Roberts Hall.

Academic Integrity Policy

The College of Agriculture and Life Sciences faculty, students, and administration support and abide by the university Code of Academic Integrity. Its principle is that absolute integrity is expected of every student in all academic undertakings: students must in no way misrepresent their work, fraudulently or unfairly advance their academic status, or be a party to another student's failure to maintain academic integrity.

The maintenance of an atmosphere of academic honor and the fulfillment of the provisions of the code are the responsibility of the students and the faculty. Therefore, all students and faculty members shall refrain from any action that would violate the basic principles of this code.

1) Students assume responsibility for the content and integrity of the work they submit, such as papers, examinations, or reports.

2) Students are guilty of violating the code if they

- knowingly represent the work of others as their own
- use or obtain unauthorized assistance in any academic work
- give fraudulent assistance to another student
- fabricate data in support of laboratory or field work
- forge a signature to certify completion or approval
- knowingly deprive other students of library resources, laboratory equipment, computer programs, and similar aids
- in any other manner violate the principle of absolute integrity

3) Faculty members assume responsibility to make clear to students and teaching assistants specific regulations that apply to scholarly work in a discipline.

4) Faculty members fulfill their responsibility to

- maintain in all class, laboratory, and examination activities an atmosphere conducive to academic integrity and honor
- make clear the conditions under which examinations are to be given
- make clear the consequences of violating any aspects of the code
- provide opportunities for students to discuss the content of courses with each other and help each other to master that content and distinguish those activities from course assignments that are meant to test what students can do on their own without help from others
- state explicitly the procedures for use of materials taken from published sources and the methods appropriate to a discipline by which students must cite the source of such materials
- approve in advance, in consultation with other faculty members, which work submitted by a student and used by a faculty member to determine a grade in a course may be submitted by that student in a different course
- monitor the work and maintain such records as will support the crucial underpinning of all guidelines: the students' submitted work must be their own and no one else's

Cornell's Code of Academic Integrity spells out how individuals who have allegedly violated Cornell standards for academic integrity are to be confronted and, if found to be in violation of those standards, sanctioned. The code provides for informal resolution of most perceived violations through a primary hearing between the faculty member and the student involved. If necessary, a hearing before a hearing board follows.

The Academic Integrity Hearing Board for the College of Agriculture and Life Sciences consists of three elected faculty members, three elected student members, a chair appointed by the dean, and the coordinator of student services, who serves as a nonvoting record keeper. Professor J. Bugliari is the current chair.

Individuals who observe or are aware of an alleged violation of the code should report the incident to the faculty member in charge of a course or to the chair of the hearing board. General information and details on procedures for suspected violations or hearings are available from the Office of Student Services, 17 Roberts Hall.

ACADEMIC POLICIES AND PROCEDURES

Records

The college registrar maintains for each student a complete record of academic achievement. A permanent record card is on file for each matriculated student and is updated whenever new information becomes available. Staff members are available in 192 Roberts Hall to consult with students regarding the assignment of credit toward meeting distribution and elective requirements and to verify the official summary of record.

The Committee on Academic Achievement and Petitions is a standing committee of six college faculty members and two students. On behalf of the faculty and subject to its review, the committee

- reviews, at the end of each semester and at other times as shall seem appropriate to the committee, the progress of all students not meeting academic requirements
- receives and acts upon petitions from individual students asking for exceptions from particular academic regulations or requirements of the college, or for reconsideration of action previously taken by the committee
- acts upon readmission requests from persons whose previous enrollment was terminated by the committee
- notifies the petitioner in writing of the action taken by the committee

Good academic standing means a student is eligible for, or has been allowed to register and enroll in, academic course work for the current semester. Whether an individual student is in good academic standing is determined by the college registrar and the Committee on Academic Achievement and Petitions.

A petition to be exempt from a college academic requirement or regulation may be filed by any student who has grounds for exemption. Forms are available in the Office of Student Services, 17 Roberts Hall.

A petition is usually prepared with the assistance of a student's faculty adviser, whose signature is required; it indicates the adviser's awareness of the petition. The adviser's recommendation is helpful to the committee. The committee determines whether there is evidence of mitigating and unforeseen circumstances *beyond the control of the student* that would warrant an exemption or other action.

Registration Procedures

All students must register with the university and this college at the beginning of each semester. Registration materials are available at a time and place announced each term by the Office of the University Registrar.

Course Enrollment Procedures

To enroll in courses, students pick up materials from the college Scheduling Office, 192 Roberts Hall; plan a schedule in consultation with their adviser; and return the completed forms to the Scheduling Office for verification and processing. Class lists are generated on the basis of the properly filed course enrollment forms.

To enroll in courses that involve independent study, teaching, or research, a student must file an *independent study statement.* Students who will be studying off campus or abroad should file the *intent to study off campus* form to ensure that proper registration will occur. Both forms are available from the college registrar, 192 Roberts Hall.

Students may enroll again for a course in which they received a grade of F in a previous semester. The grade received the second time will be recorded and both grades calculated as part of their GPA.

Students should *not* enroll again for a course in which they received an incomplete. Work for that course should be completed. The instructor will file a change of grade form. An incomplete not made up by the end of two successive semesters of registration reverts to a failure. In the case of a graduating senior, incompletes revert to failures at the time of graduation.

Students enrolled in a two-semester course will receive an R at the end of the first semester and should enroll again for the same course the second semester. The letter grade will be recorded for the second semester when all work for the course is completed. A note on the transcript will explain the two grades for the same course.

A student is held responsible for and receives a grade for those courses in which he or she enrolls unless the *student* officially changes such enrollment. All changes in courses or credit, grading options, or sections must be made by the student at the Scheduling Office, 192 Roberts Hall, on an official form provided for that purpose.

Add/Drop/Changes are made by filing properly signed forms in the Scheduling Office, 192 Roberts Hall. Approval and signature of the faculty adviser and course instructor are required to add or to drop a course.

Students may add courses and change grading options or credit hours where applicable during the first three weeks of the term and may drop courses until the end of the sixth week.

Students wishing to withdraw from a course after the end of the sixth week must petition to the college Committee on Academic Achievement and Petitions. A form is available in 17 Roberts Hall. Requests for course changes are approved only when the members of the committee are convinced that unusual circumstances are clearly *beyond the control of the student.* The committee assumes that students should have been able to make decisions about course content, total work load, and scheduling prior to the end of the sixth week of the semester.

If the petition to drop a course is approved after the end of the eighth week of classes, the course remains on the student's record and a W (for "withdrawal") is recorded on the transcript.

Grade Reports

Grade reports for the fall term are included in spring term registration materials; grade reports for the spring term are mailed to students at their home addresses unless alternative addresses are reported to the college or university registrar by mid-May.

Academic Deficiency Policies

At the end of each semester, the Committee on Academic Achievement and Petitions reviews the records of those students who in any respect are failing to meet the academic requirements of the college or who persistently fail to attend classes. In case of students not making satisfactory progress, the committee takes appropriate action, including, but not limited to, issuing warnings to students, suspending them, decreeing that they may not reregister, granting them leaves of absence, and advising them to withdraw.

Specifically, the committee considers as possible cause for action failure to attend and participate in courses on a regular basis or, at the end of any semester, failure to attain one or more of the following:

- semester GPA of at least 1.7
- cumulative GPA of at least 1.7
- satisfactory work in 12 or more credits per semester
- reasonable progress toward completion of distribution requirements
- appropriate completion of college and university requirements

In general terms, regular participation in course work with academic loads at a level sufficient to assure graduation within eight semesters and grades averaging C– (1.7) or higher are prima facie evidence of satisfactory progress.

HONORS PROGRAM

The Bachelor of Science degree with honors will be conferred upon those students who, in addition to having completed the requirements for the degree of Bachelor of Science, have satisfactorily completed the honors program in their area of major interest and have been recommended for the degree by the honors committee of that area.

An undergraduate wishing to enroll in the honors program must have completed at least 55 credits, at least 30 of the 55 at Cornell. Also, the student must have attained a cumulative grade-point average of at least 3.0 at the time of entry.

Interested students must make written application no later than the end of the third week of the first semester of their senior year, but are encouraged to make arrangements with a faculty member during the second semester of their junior year. An application form is available from the college registrar, 192 Roberts Hall, or from the area committee chair. (Biological sciences students should get applications at 118 Stimson Hall.)

Written approval of the faculty member who will direct the research and of the honors committee in the area is required. After the college registrar verifies the student's grade-point average, the student will be officially enrolled in the honors program.

Academic credit may also be earned by enrolling in an appropriate independent study course. When applying for admission to the program, the student may, if appropriate, submit a budget and a modest request for funds to cover some of the costs the student incurs in doing the research.

The honors committee for each area recommends to the college registrar those students who qualify for honors. Only those who maintain a GPA of at least 3.0 will be graduated with honors.

Students in the College of Agriculture and Life Sciences wishing to participate in the honors program must be accepted in one of the program areas approved by the faculty. Students are not eligible for honors by participating in a program offered by another college or administrative unit.

Animal Sciences

Faculty committee: J. A. Marsh, chair; H. F. Hintz, R. L. Quaas

The objective of the animal sciences honors program is to provide outstanding undergraduates with the opportunity to pursue supervised independent research and to develop an awareness of the scientific process. It is expected that the research will require significant effort and creative input by the student in its design and execution and in the reporting of the results.

Those students with majors in animal sciences who are interested in doing an honors project should consult with their faculty advisers early in their junior year. All students are expected to meet the college requirements in qualifying for the program and to complete the following:

- Identify a potential honors project sponsor (i.e., a faculty member working in the animal sciences) and secure that faculty member's commitment to sponsor the student in the honors project. That should be accomplished early in the second semester of the junior year.
- Preregister during the spring semester for AS 496, Animal Sciences Honors Seminar, which is offered in the fall semester.
- Register for 3 credit hours of AS 499, Undergraduate Research, for the research project during a semester *prior* to that in which the honors thesis will be completed.

Additional AS 499 credit on other topics may be taken in earlier semesters if the student so desires. AS 499 credit *will not* be given during the last semester of the student's honors project.
- Participate in AS 402, Seminar in Animal Sciences, during the spring semester and report on and discuss the project and results.
- Submit a written thesis to the honors committee and to a selected external reviewer by the scheduled deadline. Specific information regarding deadlines, format, and organization for the thesis will be provided.
- Meet with the honors committee for a short oral defense of the thesis following a review of the thesis by the student's sponsor, the external reviewer, and the honors committee.

Details pertaining to the specific requirements of the program can be obtained from the office of the committee chair, 102 Rice Hall.

Biological Sciences

Students interested in the honors program in the biological sciences should consult with their faculty advisers early in their junior year. Applications and details pertaining to program requirements may be obtained from the Division Office for Academic Affairs, 118 Stimson Hall. Also see Biological Sciences section in this catalog. Information on faculty research activities is available in the Behrman Biology Center, G20 Stimson Hall.

Entomology

Faculty committee: W. L. Brown, Jr., chair; D. Pimentel, M. J. Tauber

An honors program in the area of entomology may be pursued by any qualified student in the College of Agriculture and Life Sciences (see the requirements at the beginning of this section). The student need not be specializing in entomology. Insects, because of their variety, small size, and easy availability, are convenient subjects for study in a wide array of problems dealing with living systems. Short life cycles, unique physiologies and developmental patterns, and species with easily managed colony requirements and a wide range of behavioral traits provide the raw material for honors study. Cornell's diverse faculty interests and extensive collections and library in entomology are also major assets if a student selects entomology as the area for honors study.

The honors committee requires that an undergraduate who is interested in embarking upon an honors project proceed with the following steps:

- Discuss the matter with his or her academic adviser, preferably in the junior year, so that a research project can be carefully planned. The possibility of conducting some research during the junior year and/or summer should be discussed.
- Discuss the project with an appropriate faculty member in the Department of Entomology who can serve as a supervisor to oversee the honors research. (The faculty adviser will be of assistance in determining which faculty entomologist might be the best supervisor, the decision being based primarily on available faculty members' areas of expertise.)
- Prepare a brief, tentative plan for the project for discussion and approval of the honors project supervisor. The plan should include a statement of objects or hypotheses, proposed methods for testing hypotheses, needs for laboratory space or shared equipment, and a budget outlining financial support needed for travel and supplies.
- Present a completed application to the chair of the entomology honors committee no later than the end of the third week of the first semester of the senior year. Earlier submission is encouraged.
- Submit a brief progress report, approved by the project supervisor, to the entomology honors committee by midterm of the semester in which the student will complete his or her graduation requirements.
- Present a formal seminar reporting the significant findings of the research to the Department of Entomology (preferably as a Jugatae seminar) in the last semester of the senior year.
- Submit two copies of the final project report (honors thesis) to the chair of the entomology area honors committee no later than two weeks before the last day of classes in the semester in which the student anticipates graduation. The thesis will be reviewed by the faculty honors project supervisor and one other referee from the department honors committee. The committee will return the thesis to the student one week before the last day of classes. If reviewers indicate that changes must be made, the revised thesis should be submitted to the chair no later than the last day of classes.

Natural Resources

Faculty committee: M. E. Richmond, chair; J. W. Kelley, R. J. McNeil

The honors program in natural resources provides an opportunity for undergraduates to participate in independent research in the areas of fisheries and aquatic science, forest science, wildlife science, ecotoxicology, and conservation. The subject matter and nature of the research experience may be quite varied in this program but require the guidance and supervision of a faculty member with substantial interest or expertise in the problem area chosen.

In addition to meeting requirements of the college, the student is expected to do the following:

- Register for the honors program in the junior year or earlier.
- Select a faculty adviser who will help identify and formulate a research problem.
- Carry out an independent research effort that is original and separate from the work of others who may be investigating similar subjects.
- Describe and summarize the work in the format of a conventional master's thesis or in the form of a scientific paper ready for journal submission. About half of the theses have been published.
- Work closely with at least two faculty or staff members who will agree to serve as readers for the thesis. Provide readers with a copy of the guidelines for evaluation of honors theses, available from the department's honors program committee.

Nutritional Sciences

Faculty committee: W. J. Arion, chair; C. Campbell, T. C. Campbell

The honors program in nutritional sciences is designed to provide the academically talented undergraduate with the opportunity to become involved in a faculty research program. This program is available to students majoring in general studies with a concentration in nutritional sciences. Students are selected in the spring semester of the sophomore year on the basis of scholastic achievement, cumulative grade point average, and motivation for independent study. Students interested in participating in the honors program should consult their faculty advisers or contact committee chair Professor William J. Arion, 227 Savage Hall, and submit their application to the honors committee.

In addition to meeting requirements of the college, to qualify for graduation with honors, students must:

- Maintain high scholastic achievement.
- Satisfactorily complete the junior seminars, NS 398 and 498. Students are required to complete biochemistry by the end of the first semester of the junior year, and strongly encouraged to complete NS 332, Laboratory Methods in Nutritional Sciences, by the end of the junior year.
- Satisfactorily complete NS 499, Honors Problem, with a minimum of 6 credits, during the senior year. To do so they must (1) attend a one-hour senior seminar, fall and spring, (2) plan and carry out an independent research problem in consultation with a faculty adviser, (3) submit for approval a written thesis to the division honors committee, (4) present a final seminar on their research, and (5) register for honors with the ALS college registrar by the first two weeks of the senior year.

A copy of the honors program guidelines are available in the division's Undergraduate Office, 335 Martha Van Rensselaer Hall, or from the honors chair.

Physical Sciences

Faculty committee: C. E. McCulloch, chair; G. W. Fick, J.-Y. Parlange, J. W. Sherbon

The honors program in physical sciences provides outstanding students with an opportunity to do independent research under the supervision of a faculty member in the Departments of Agricultural and Biological Engineering, Agronomy, Food Science, or in the Biometrics Unit.

Students must be enrolled in the program for a minimum of two semesters and must also enroll in the appropriate departmental independent study course for a total of at least 6 credits. They must submit a report of their research to the honors committee at least four weeks prior to the end of instruction of the semester in which they expect to graduate.

Details of the program can be obtained from the chair of the physical sciences honors committee.

Plant Sciences

Faculty committee: M. Petrovic, chair; L. Creasy, R. L. Obendorf, C. Wien, R. P. Korf, S. Zinder

Before acceptance into the program, students must submit to the chair of the plant sciences honors committee a completed application and a one-page tentative project outline by the end of the second week of classes in the first semester of their senior year. The project outline must be approved by the faculty supervisor and should include a clear statement of the objective(s) of the research, methodology, and needs for space, equipment, and supplies (attached budget required). Full committee approval is needed for acceptance into the program.

Completion of the honors program in plant sciences requires two copies of a report of independent research in the honors program to be submitted to the chair of the honors committee before the last day of classes of the semester in which the degree is sought. The report should be written in the format for research publication required by that discipline of plant science in which the student is enrolled. The report must be accompanied by a letter of recommendation from the supervisor of the research, that letter reflecting the supervisor's familiarity with the research and providing an evaluation of the performance and a recommendation for graduation with honors.

The honors committee will review the report, and if a majority of the committee votes favorably, the chair will recommend graduation with honors for that student in a letter to the director of academic programs. One copy of the report will be returned to the student. The other will be shelved in Mann Library.

Social Sciences

Faculty committee: N. E. Awa, chair; J. M. Conrad, D. B. Gowin, T. A. Hirschl

Honors degrees are awarded in the behavioral and social sciences upon approval of an honors thesis reporting a piece of original research in an appropriate area.

The research should deal with a substantive issue within one of the fields in the behavioral and social sciences. Both the results of the research and the methodology or the argument by which the results were achieved must be reported. Reviews of literature, practical conclusions or applications, or broad characterizations of an area of inquiry may constitute part of the research report but are not themselves sufficient to count as research. While work may originate in prior class work, it is expected that honors will extend it. Students may, however, register for independent study in conjunction with an honors project.

Reports must be written according to the form of any standard journal within the appropriate fields. Four copies of the report should be submitted to the chair of the committee no later than three weeks prior to the last day of classes of the semester for which the degree is sought. A supporting letter from the faculty member supervising the work must also be submitted. Approval of the thesis requires a majority vote of the honors committee.

INTERCOLLEGE PROGRAMS

The College of Agriculture and Life Sciences *does not* participate in any dual-degree programs. Study for the Bachelor of Science is the only undergraduate degree program offered.

The College of Veterinary Medicine may accept students who are then permitted to double-register in their seventh or eighth semester and complete requirements for the Bachelor of Science degree in the College of Agriculture and Life Sciences. Students should consult with the college registrar, 192 Roberts Hall, to assure that degree requirements have been fulfilled.

Students who have been offered admission to the S. C. Johnson Graduate School of Management upon completion of the B.S degree in Agriculture and Life Sciences may take a program of management courses in their senior year if it is approved by their college faculty adviser as part of their undergraduate program. In certain cases an "upset" tuition charge, equal to the endowed undergraduate tuition rate, will be applied for undergraduate statutory college students taking excess credit hours from endowed colleges and schools. Inquiries should be directed to the university bursar.

Students in the Field Program in Agricultural and Biological Engineering are usually enrolled in the College of Agriculture and Life Sciences during the freshman and sophomore years and jointly enrolled in this college and the College of Engineering in the junior and senior years. Students pay the engineering college tuition in the junior year. The curriculum is accredited by the Accreditation Board for Engineering and Technology. The B.S. degree is awarded in cooperation with the College of Engineering.

The Program in Landscape Architecture is cosponsored by the Department of Floriculture and Ornamental Horticulture in the College of Agriculture and Life Sciences and by the College of Architecture, Art, and Planning. The program offers a first professional degree curriculum in landscape architecture at both undergraduate and graduate levels, as well as a graduate second professional degree program.

The Division of Nutritional Sciences is an intercollege unit affiliated with the College of Human Ecology and the College of Agriculture and Life Sciences. The undergraduate nutrition major is based in the College of Human Ecology. Students in Agriculture and Life Sciences may study nutrition in areas such as animal sciences, poultry and avian sciences, food-industry management, food science, microbiology, pomology, and vegetable crops. Students may also plan a concentration in biological sciences, option 8, or a concentration in general studies in agriculture to include a human nutrition component.

The Program on Science, Technology, and Society is an academic unit that engages in teaching and research involving the interactions of science and technology with social and political institutions. The program draws its students, faculty, and research staff from the various divisions of the university, including the College of Agriculture and Life Sciences. It offers an interdisciplinary undergraduate curriculum in Biology and Society. A concentration in general studies in the agriculture major may be planned in consultation with a faculty adviser to include a biology and society component. Further information, including a list of courses, may be obtained from the program office, 632 Clark Hall.

The American Indian Program (AIP) is a multidisciplinary intercollege program with instructional, research, and extension components. The instructional core consists of courses focusing on American Indian life with emphasis on the Iroquois and other Indians of the Northeast. A description of the program and general information is available from the director of the American Indian Program, Caldwell Hall.

The Comparative and Environmental Toxicology Program is an interdisciplinary intercollege program with research, teaching, and cooperative extension components coordinated by the Institute for Comparative and Environmental Toxicology (ICET). Courses are cosponsored by academic departments in several colleges of the university. A description of the program and general information is available from the director of the program through the ICET office, N202 Martha Van Rensselaer Hall.

The Cornell Laboratory of Environmental Applications of Remote Sensing (CLEARS) is an interdisciplinary intercollege center with teaching, research, and extension components affiliated with the College of Agriculture and Life Sciences and the School of Civil and Environmental Engineering. A description of the program and general information is available from the director through the CLEARS office in Hollister Hall.

OFF-CAMPUS STUDY PROGRAMS

Study off campus is of two types: (1) credit may be earned at another institution and transferred to Cornell, or (2) credit may be earned in Cornell courses that require off-campus activity.

An Intent to Study Off Campus form should be filed with the college registrar before leaving campus. Tuition may be reduced. In some cases stipends or cost of living allowances are provided. Students should consult with the Office of Financial Aid if receiving financial aid and clear all accounts with the bursar prior to departure.

Students who plan to enroll in courses at another institution in the United States must petition to register for *study in absentia*. Courses should be selected in consultation with the faculty adviser. Approval of the petition, including the list of courses to be taken, guarantees acceptance of transfer credit if grades received are equivalent to C– or better. The petition form is available in the Office of Student Services, 17 Roberts Hall, and should be returned there for consideration by the Committee on Academic Achievement and Petitions.

Albany Programs

Study off campus in Albany, the New York State capital, provides a unique opportunity to combine career interests with academic and legislative concerns. Students receive an intensive orientation to state government and attend a lecture-seminar program composed of three two-credit components and offered by professors-in-residence. An internship experience, supervised by an internship committee, provides up to six academic credits. Independent study and research courses offered by the various departments in ALS and/or courses offered by academic institutions in the Albany areas may be elected.

Three opportunities are available. The *Assembly Intern Program* provides a placement with a member of staff of the New York State Assembly. The *Senate Assistants Program* has placements with New York State senators and selected staff. The *Albany Semester Program* provides experience with a state agency such as the Departments of Environmental Conservation, Education, or Labor.

Applicants are screened by the ALS Internship Committee in the term prior to assignments. Those accepted should plan a program of study in consultation with their faculty adviser. At least twelve credits must be carried to meet the residence requirement. Seniors should note that the last term average must be 1.7 or above.

All interns will audit the orientation sessions and meet participation requirements in at least two of the lecture-seminar sections. The paper required in each section constitutes an independent study project to be directed and evaluated by a Cornell faculty member in an appropriate discipline. Normally a faculty member will not sponsor more than one of the independent study courses for any one student. To receive academic credit for the internship, students enroll in ALS 400, for an S-U grade only.

Information and applications are available in the Career Development Office, 16 Roberts Hall.

Cornell-in-Washington

Students in all colleges apply for the Cornell-in-Washington program through the Department of Government, 134 McGraw Hall. ALS students admitted to the program should file the off-campus study form with the college registrar prior to leaving campus. Selection of courses should be made in consultation with an academic faculty adviser to assure that the courses are appropriate for the degree program being pursued. The course enrollment forms should be filed in the office of the college registrar as soon as course selection is completed and approved.

SEA Semester

The Sea Education Association is a nonprofit educational institution offering ocean-focused academic programs and the opportunity to live, work, and study at sea. Science, the humanities, and practical seamanship are integrated in small, personal classes. The 17-credit program is twelve weeks in length. Six weeks are spent in Woods Hole, the following six weeks are spent on either one of SEA's two sailing vessels: the R/V *Westward*, or the R/V *Corwith Cramer*. For more information, students should contact the Cornell Marine Programs office, G14 Stimson Hall. ALS students should file the intent to study off campus form with the college registrar as early as possible to ensure proper registration and enrollment in courses.

Shoals Marine Laboratory

The Shoals Marine Laboratory, run cooperatively by Cornell University and the University of New Hampshire, is a seasonal field station located on 95-acre Appledore Island off the coast of Portsmouth, New Hampshire, in the Gulf of Maine. SML offers undergraduate, beginning graduate students, and other interested adults a unique opportunity to study marine science in a setting noted for its biota, geology, and history. Please refer to "Courses in Marine Science," under the section on the Division of Biological Sciences, for a list of courses offered.

For more information, contact the Shoals Marine Laboratory office, G14 Stimson Hall, 607-255-3717.

Internships

Several departments in the college offer supervised internships for academic credit. Arrangements should be made with the offering department for assignment of a faculty member who will be responsible for placement, for planning the program of work, and for evaluation of student performance.

For internships not governed by an established internship course, the student must enroll in a 497 course for the number of credits to be assigned. If the work is done during the summer, the student must enroll in the Cornell summer session for the agreed-upon credits.

In cases where the work is not done at Cornell, the awarding of credits depends upon a prior contractual arrangement between a Cornell professor and the student. Specific terms for receiving credit and a grade should be recorded, using the Independent Study, Research, Teaching, or Internship form, available in the Scheduling Office, 192 Roberts Hall.

A maximum of 15 of the 120 credits required for the degree may be taken in internships, independent study courses, and undergraduate teaching or research. A maximum of 6 credits per term may be earned in independent study. No more than 6 of the 15 credits allowed for independent study may be awarded for internships consisting of off-campus work experiences that do not have the continued presence of a Cornell faculty member. The 6-credit allotment includes transfer credit and credit for internships in other colleges at Cornell. The 6-credit limit does not apply to secondary, postsecondary, and cooperative extension teaching internships in the Department of Education.

The College of Agriculture and Life Sciences does not offer a field study option. In general, a rather narrow view is taken towards awarding academic credit for work experience, "life" experience, or apprenticeships. Credit will only be assigned or accepted in cases where a professor is directly involved in determining both the course content and in evaluating a student's work. The awarding of credit will not be allowed in cases where a student brings to the college or to a professor a description of a past experience and requests credit.

All students enrolling for an internship must file an independent study, research, teaching, or internship form with the Scheduling Office. If the study is to take place off campus, the Intent to Study Off Campus form should also be filed with the college registrar.

Overseas Academic Programs

The Cornell Abroad program is open to students in all colleges of the university. Students in the College of Agriculture and Life Sciences should consult with their faculty adviser and the college registrar to ensure that credit received for academic work abroad will meet requirements for graduation. The Office of Student Services, 17 Roberts Hall, has information and application forms.

Cooperative arrangements with the University of Reading, in England, and the University of Dublin, in Ireland, enable the college to endorse several students for a year of study under a tutor in those schools. The Swedish exchange program is operated in cooperation with the Agricultural College of Sweden at Uppsala. The ALS student selected to participate in the Swedish exchange spends the junior year at Uppsala. All essential expenses in Sweden, including a living allowance, are provided by a student group there. Round-trip air transportation must be paid by the student. An exchange student from Uppsala spends a year at Cornell, partially supported by the college and student groups here.

MAJOR FIELDS OF STUDY

The college curriculum emphasizes the biological and physical sciences and the technology basic to the study of agriculture and life sciences. The sixteen major program areas reflect the departmental academic effort in the college. Faculty curriculum committees in each area identify a sequence of courses appropriate to all students studying in that field. Courses of study are designed to provide systematic development of basic skills and concepts. Opportunity for concentration in an area of particular interest is usually available.

Programs are planned with considerable flexibility, allowing students to prepare for careers, graduate work, professional opportunities, and the responsibilities of educated citizens. Course requirements in each program area are different, but all students must meet minimum distribution requirements of the college.

Agricultural and Biological Engineering

Agricultural and biological engineering links engineering and technology with the biological, social, environmental, and agricultural sciences. It is the branch of engineering that serves the public sector all the way from the grower to the consumer in addition to contributing to the public interest in other ways. The primary challenge is to apply engineering principles to solve problems in the agricultural and food industries. Applications involve production, processing, distribution, cost, environmental quality, safety, and computer utilization. An increasingly important and emerging aspect of

the field is the engineering activity related to biotechnology. A strong mixture of engineering and biology is the feature that makes this program area unique.

Students in this program area study topics such as biological engineering, food engineering, soil and water conservation, mechanical systems, waste management, small-scale energy production and management, international agriculture, structures and building design, design and construction of secondary roads, and environmental quality engineering.

The program area, which includes two distinct specializations—agricultural engineering and biosystems technology—is offered by the Department of Agricultural and Biological Engineering. The department is located in Riley-Robb Hall, and operates specialized facilities that are among the largest and most complete agricultural engineering facilities in the world.

The **agricultural engineering** specialization is intended for the student who is particularly interested in the theoretical and fundamental aspects of engineering required for design and research. The student must be highly motivated and have a strong aptitude for mathematics and the sciences. Biological, social, and agricultural sciences are integrated into this specialization, but the physical sciences dominate. The specialization is accredited by the Accreditation Board for Engineering and Technology and is jointly sponsored by the New York State College of Agriculture and Life Sciences and the College of Engineering. Students double register in both colleges during their junior and senior years. The specialization provides excellent preparation for a variety of positions in industry, and qualified graduates may also continue study in a Master of Engineering, Master of Science, or doctoral degree program, or in veterinary science or medicine.

For specific course requirements and other information, see the section on the College of Engineering.

The **biosystems technology** specialization emphasizes the applied and technical aspects of agricultural and biological systems. The curriculum incorporates courses in basic biological and physical sciences as well as engineering, agronomy, agricultural economics, natural resources, and animal, plant, and food sciences.

Interest areas include agricultural systems, biological systems, and environmental systems. The student develops his or her own program of advanced and elective courses in consultation with a faculty adviser and may have an informal minor in an area such as communication, business, education, or international agriculture.

Specific course requirements for the specialization in biosystems technology are:

A. Basic Subjects	*Credits*
1. Calculus	8
2. Chemistry	6
3. Physics	8
4. Introductory biological science	6
5. Computer applications	4
6. Statistics or probability	3
7. Economics	3
8. Oral communication	3

B. Advanced and Applied Subjects

1. Five courses in the agricultural, biological, or environmental sciences 15
2. Five engineering courses at the 300 level or above; at least 9 credits in agricultural and biological engineering 15

C. Electives

Additional courses to complete college requirements

D. Total (minimum) 120

For further details on both the agricultural engineering and biosystems technology specializations, see the department's undergraduate program brochure, available at 106 Riley-Robb Hall.

Agronomy: Crops, Soils, and Meteorology

Agronomy, crop science, meteorology, soil science, and **weed science** are offered by the Department of Agronomy, which is located in Bradfield and Emerson halls.

Agronomy is the study of crop production and soil management, and as a specialization it provides a broad education in all the agronomic sciences, including aspects of environmental quality. Students are expected to take at least ten credits of both crops and soils courses. In addition, agricultural meteorology, weed science, entomology, plant pathology, and farm management are recommended. Students interested in careers in agribusiness and with government agencies should also consider additional training in communication, applied economics, and computer science. Careers in research and development require course work in mathematics and chemistry.

Crop science is the application of basic biological and ecological concepts to the production and management of field crops. Examples of field crops are alfalfa, corn, soybeans, and wheat. Courses required include general biology, botany, plant physiology, general chemistry, mathematics, computing, crops, and soils. Students who anticipate a career in agricultural production or service after completion of the B.S. degree should take additional courses in crops, soils, crop physiology, economics, communication, plant pathology, entomology, nutrition, genetics, microbiology, and climatology. Students planning graduate or professional study beyond the bachelor's degree should take advanced course work in biochemistry and botany; qualitative, quantitative, and organic chemistry; and calculus, physics, and statistics.

Meteorology is the study of the atmosphere and the processes that shape our weather. The core curriculum in meteorology is designed to provide students with an understanding of the fundamental physical and dynamic properties and processes of the atmosphere. All students are required to complete a minimum of three semesters of calculus; two semesters of physics; a semester each of chemistry, computer science, and statistics; and a sequence of eight courses covering observational, general, theoretical, and synoptic meteorology. Additional courses are available for students interested in subjects of agricultural meteorology, climatology, physical meteorology, and statistical meteorology. The curriculum satisfies the basic requirements for employment as a professional meteorologist and provides a sound background for graduate study or work in the numerous specialized areas of meteorological science. Students are encouraged to choose additional course work in related or complementary areas of interest, such as agriculture, biology, computer science, mathematics, statistics, physics, chemistry, or engineering.

Soil science is the application of basic physical and biological science to the classification, use, and management of soils on an ecologically sound basis. The curriculum in soil science combines training in the physical and biological sciences with a thorough background in soil science. Students take 16 credits in soil science, including 4 credits in the introductory course and 12 credits chosen from four of the following five areas: soil geography, soil chemistry, soil physics, soil microbiology, and soil fertility. In addition, 10 credits of chemistry, 6 credits of mathematics, and 6 credits of physics, as well as supporting biological sciences courses, are expected to satisfy the major.

Weed science is that branch of pest management which emphasizes the principles and practice of weed control. The scientific basis for mechanical, cultural, chemical, and biological control procedures is considered. Plant physiology, ecology, organic chemistry, and biochemistry are required in addition to fifteen credits in weed science and plant protection. The specialization is offered cooperatively by the departments of Agronomy, Floriculture and Ornamental Horticulture, and Vegetable Crops so that a variety of managed plant systems may be studied.

Animal Sciences

The animal sciences program area involves two departments—the Department of Animal Science (in Morrison Hall) and the Department of Poultry and Avian Sciences (in Rice Hall)—which offer a coordinated group of courses dealing with the principles of animal breeding, nutrition, physiology, management, and meat science. While emphasis in subject matter is directed toward farm-animal species, including dairy and beef cattle, horses, poultry, pigs, and sheep, laboratory and other species are used in research and teaching programs as well. The departments have extensive facilities for raising animals and well-equipped laboratories and classrooms, including a teaching barn, in which students can gain practical experience in the care and management of large animals at a convenient location on campus.

The program focuses on the application of science to the efficient production of animals for food, fiber, and pleasure and easily accommodates a variety of interests and goals. Beyond a core of basic courses (suggested minimum, 12 credits) students select production (minimum, 6 credits) and advanced (minimum, 6 credits) courses to fulfill an individually tailored program worked out in consultation with their advisers. In this way it is possible to concentrate by species as well as by subject matter (nutrition, physiology, breeding, management, meat science). Dairy management, for example, is a popular program among students who may be preparing to manage a dairy farm or enter a related career. Supporting courses in other departments are readily available and strongly encouraged. Thus, some students elect a program emphasizing supportive preparation

in the basic physical and biological sciences appropriate to graduate or professional study following graduation. Others elect a program heavily oriented toward economics and business in preparation for a career in the poultry, dairy, meat-animal, horse, feed, or meats industry. Those are but two examples of the programs that can be developed to meet a student's career interests. It is highly recommended that students obtain appropriate fieldwork experience during summers.

Several special training opportunities exist for highly motivated students. Upperclass students whose academic records warrant it may, by arrangement with individual faculty members, engage in research (either for credit or for honors) or assist with teaching (for credit). The Dairy Management Fellows program offers an equally challenging but different type of experience for a highly select group of students.

Applied Economics and Business Management

The undergraduate program in applied economics and business management is based in the Department of Agricultural Economics. Courses in agricultural economics are supplemented with others in related areas such as computer science, economics, sociology, history, government, industrial and labor relations, hotel administration, consumer economics, animal sciences, plant sciences, natural resources, mathematics, and statistics.

Six areas of specialization are offered:

Agricultural economics provides a general program in the economics of the agricultural sector. It is an appropriate major for those students who want to (1) survey offerings in agricultural economics, such as management, marketing, economic development, and policy and resource economics; and (2) prepare for graduate work in agricultural economics.

Business management and marketing applies the principles of economics and the tools of management to prepare students for careers in business. Special emphasis is given to developing decision-making skills and to the study of the structure and practices of business institutions. Market analysis, sales, banking, merchandising, and production management are fields for which students may prepare.

Farm business management and finance is intended for students with farm experience who are interested in farming or in preparing for work in farm management or farm finance, in cooperative extension, or in farm cooperatives.

Food-industry management is designed for students interested in management or sales positions with the processing, manufacturing, or distribution segments of the food industry.

Public affairs management integrates a wide range of subject areas designed to familiarize students with the nature of public affairs and managerial complexities created by the interaction of economic factors in social and political institutions.

Resource economics is an option for students interested in the application of the principles of economics to problems, both public and private, involving natural and human resources.

In planning a course schedule, students must work closely with their faculty adviser. Each area of specialization has its own unique set of required and recommended courses, yet all the areas have enough flexibility to satisfy the interests and abilities of each individual student.

Biological Sciences

The program of study in biology is offered by the Division of Biological Sciences. Students enroll in either the College of Agriculture and Life Sciences or the College of Arts and Sciences.

Programs of study within the biology major include general biology; animal physiology and anatomy; biochemistry; botany; cell biology; ecology, systematics, and evolution; genetics and development; neurobiology and behavior; and an independent study option. Programs of study are described under the Division of Biological Sciences.

Communication

Everyone relates to others through the process of communication. Whether these human linkages are personal or through the mass media, there is an increasing need for individuals who can help establish communication relationships and make them more efficient and effective. Individuals who are able to do this must have good communication skills themselves and must comprehend the social psychology of human communication. Students in the Department of Communication have the opportunity to learn both the social science underlying human communication and the most effective means of adapting written, interpersonal, audio, and visual communication to audiences. The curriculum emphasizes learning communication theory along with communication skills.

Students elect one of five different sequences by the beginning of their junior year: public communication, electronic media, publication, interpersonal communication, or science communication. Each sequence has a required core of courses that includes Writing for Media, Theories of Human Communication, Introduction to Mass Media, Visual Communication, and Oral Communication.

Public communication prepares students for careers as communication, information, or public relations specialists in a wide variety of organizations. Required courses for this sequence include communication planning and strategy, survey research, communication in organizations, and visual communication. There is heavy emphasis on developing writing skills.

Electronic media is a special track within the public communication sequence emphasizing structure and application of electronic media. The track prepares students for careers in electronic media or information agencies in which they must work with electronic media. Required courses include electronic media production, visual communication, media writing, and mass media industries. There is an emphasis on planning and writing skills, and on development of an in-depth understanding of media industry audiences and economic structure.

Publication provides an excellent background for working as an editor or writer in virtually any organization. Such work might include preparing annual reports, editing an employee newspaper, writing sales or marketing literature, or writing news stories. Required courses for this sequence are taken in writing, media law, publication design, and communication theory. Students serve as staff members for the *Cornell Countryman* for one or two terms. The publication sequence provides students with a good background for science communication.

Interpersonal communication coupled with a carefully designed concentration prepares students for careers in human service professions, such as personnel administration, training, or sales and consulting. The sequence also may be used to prepare for graduate study in communication and other social sciences. Required courses for this sequence are taken in communication theory, survey research, and writing. Electives include such courses as small group communication, listening, persuasion, intercultural communication, and organizational communication.

Science communication combines the superior resources of Cornell's natural and social science courses with a broad range of courses in communication principles and skills to offer students the background needed to succeed in positions that involve the communication of scientific and technical information. The sequence emphasizes courses in writing and those involving production in various media. The sequence is appropriate for those who are interested in communicating with the general public or with scientific and technical constituents.

In addition to the requirements for a sequence, a concentration of at least 12 credits outside the department is required. The concentration helps orient students to a communication career in either a business, government, education, or public service organization or to a very specific profession such as agribusiness public relations or science communication.

Students are strongly encouraged to seek practical communication experience through part-time or summer employment, the department's internship course, or the campus media. Work experience contributes to a portfolio of professional materials that is invaluable in obtaining a position in communication.

Detailed descriptions of the sequences and the guidelines for the selection of elective courses are available from the Department of Communication, 307 Roberts Hall.

Education

The focus in the Department of Education is on organization and management for teaching and learning in both the public and private sectors of society. A major in education provides a student with the opportunity to study educational ideas, practices, and issues from a variety of disciplinary perspectives, not only in public schools, but also in colleges, in business and industry, and in other educational settings.

The core curriculum includes courses in educational psychology, the social/philosophical foundations of education, and field experience. Combined with courses in other social sciences and with appropriate study in a subject area, the program provides a useful

base for careers in a variety of settings. Students work closely with their faculty advisers to plan a systematic sequence of courses relevant to their career goals and interests. Positions as educators are available in such areas as agribusiness and cooperative extension, industrial and military training, and social service sectors such as counseling centers, youth organizations, nature centers and educational publishing, as well as in public or private schools.

Agricultural education. This specialization leads to teaching agriculture in secondary schools and two-year colleges, positions in extension education and international agricultural education, and educator jobs in agricultural industry. It is intended for students who have good academic ability, experience in agriculture, and an interest in youth and young adults. The ability to work with people is essential.

Certification is required to teach in public secondary schools. Provisional certification, good for five years, may be earned by completion of an approved curriculum, including a student teaching experience, leading to the baccalaureate degree. A passing grade on a state teacher's test is also required. Permanent certification requires a master's degree. Plant and animal sciences, mechanization, conservation, and agricultural business are the areas most frequently taught in secondary schools. Directed field experiences and internships are used to prepare students for agricultural educator positions not requiring certification.

Science and Mathematics. A program leading to certification to teach secondary school science began in 1987. Students selected for the program will major in one of the sciences, e.g., biology, and come to the Department of Education to arrange for courses that will lead to provisional or permanent New York State certification. A program leading to certification to teach mathematics is also available.

Students considering education as a major field of study can secure further information about requirements and options from the Education Department Office, 400 Roberts Hall.

Entomology

The intent of this curriculum is to provide students with a basic background in the biological and environmental sciences, with a special emphasis on the study of insects. Many students pursue graduate studies in entomology or related sciences upon completion of the B.S. degree, and the requirements are based on a preprofessional degree. Those who do not anticipate graduate training are urged to select electives of immediate value to the careers they plan. Some suggestions are made in section B below.

A. Specific Requirements

Basic Sciences
- College mathematics, including calculus
- A course in physics
- Chemistry 103–104 or 207–208
- Chemistry 253 (organic)

General Biology
- Introductory biology
- Biological Sciences 330 or 331, Principles of Biochemistry
- Biological Sciences 311, Introductory Animal Physiology
- Biological Sciences 281, Genetics, or Plant Breeding 225, Plant Genetics
- Biological Sciences 221, Neurobiology and Behavior
- Biological Sciences 360, General Ecology

Entomology
- Entomology 212, Insect Biology, or 241, Applied Entomology
- Entomology 322, Insect Morphology
- Entomology 331, Insect Taxonomy

Two courses selected from the groups below. Both may not be from the same group:

Group a
- Entomology 444, Integrated Pest Management
- Entomology 677, Biological Control
- Entomology 690, Insect Toxicology and Insecticidal Chemistry

Group b
- Entomology 455, Insect Ecology
- Entomology 471, Ecology and Systematics of Freshwater Invertebrates

Group c
- Entomology 452, Medical Entomology
- Entomology 453, Insect Pathology
- Entomology 483, Insect Physiology

B. Suggested Electives

The choice of electives should reflect a student's particular interests within entomology. Two broadly distinct areas of interest are the impact of insects on human welfare and the more basic aspects of insect biology. Courses in botany, evolution, invertebrate zoology, microbiology, cell biology and histology, vertebrate biology, statistics, foreign languages, scientific writing, oral communication, plant pathology, and other areas of agriculture are also recommended.

Food Science

The food science program area is designed to provide students with the basic skills and knowledge necessary to ensure an adequate general food supply. Students may choose from two curricula, food science and food technology. Food science is designed for those interested in the more basic aspects, whereas food technology is intended for those interested in the more applied aspects. Students in both curricula take a core of fundamental courses and in consultation with faculty advisers select courses suitable for specific career objectives.

The core is designed to meet minimum guidelines of the Institute of Food Technologists, the professional society of U.S. food scientists. The flexibility of the food science program allows students to prepare for a variety of positions in industry, government, or education. Some of the positions and areas of work require graduate training, and it can be useful in others as well. Opportunities for graduate study exist at a number of universities, including Cornell.

During the first two years, students are required to take the two-semester introductory courses in biology, chemistry, and physics plus introductory courses in microbiology, calculus, food science, and nutrition. During the last two years, students take courses dealing with the application of science and technology to the processing, preservation, distribution, and utilization of foods. This includes the following required courses: Food Analysis, Food Engineering I, Sanitation and Public Health, Food Processing I and II, Food Chemistry, Sensory and Objective Evaluations of Foods, Food Microbiology, Food Chemistry Laboratory, and introductory statistics. Students also take courses in the social sciences and humanities to meet the general college requirements.

Students may choose additional courses in chemistry, microbiology, or nutrition in preparation for careers in research and development; in mathematics and engineering, for careers in processing and engineering; in marketing and business management; or in a variety of production courses related to specific commodities. Emphasis may be placed on the international aspects of food science.

Students are strongly encouraged to obtain further competence in one or more areas of emphasis. Lists of recommended courses are available for many areas, but the student is free to select courses for special objectives. The areas of emphasis include processing technology; food chemistry; nutritional aspects of processing; technology and management; dairy science; meat, poultry, and fish technology; food microbiology; and international food development.

A state-of-the-art food processing and development laboratory, a full-scale dairy plant, and extensive research laboratory facilities are available for training, research, and employment.

Landscape Architecture

Landscape architecture is a licensed profession that deals with design of the environment to fit human needs. It involves the interaction between elements of the built and natural landscape and involves creative thought and technical skill in shaping future outdoor environments. Qualifications for licensing include completion of an accredited degree program in landscape architecture, a specified period of approved professional work experience, and passing a comprehensive uniform national licensing examination.

Bachelor of Science Curriculum

The landscape architecture undergraduate curriculum is a four-year professional program leading to a Bachelor of Science degree. The program is accredited by the American Society of Landscape Architects and is registered with the New York State Education Department State Board for Landscape Architecture.

The undergraduate curriculum in landscape architecture centers around a four-year sequence of design studio courses that begins in the spring semester of the freshman year.

Core courses in design, plant materials, landscape history and theory, landscape planning, landscape materials and construction, graphics, professional practice, and natural sciences are required throughout the four-year curriculum. Studio courses deal with the application of design methods and principles that reflect knowledge and appreciation of land, water, plants, and the built environment in planning and designing land areas for public and private use. Basic to the curriculum is concern for the creation of

environments that meet complex social needs and are ecologically sound and aesthetically pleasing. Requirements for specialization in landscape architecture include satisfactory completion of the core curriculum.

An option for study abroad in Denmark is incorporated into the fall semester of the senior year. Under a special arrangement between Cornell University and the University of Copenhagen, landscape architecture majors who have completed four semesters of design and who have a cumulative average of 3.0 or above have the option of participating in a uniquely developed architecture and design studies curriculum in the Denmark International Study Program in lieu of a semester at Cornell. This program is part of Cornell Abroad and is administered through the Center for International Studies.

First Year

Fall Term	*Credits*
*LA 100, Landscape Architecture Freshman Orientation	1
*FR DR 109, Nature Drawing	3
†Biological sciences elective	3
†Physical sciences elective	3
†Social sciences or humanities elective	3
†Written or oral expression elective	3
	16
Spring Term	
*LA 140, Landscape Design Studio	4
†Biological sciences elective	3
†Social sciences or humanities elective	3
†Written or oral expression elective	3
‡Free elective	3
	16

Second Year

Fall Term	
*LA 220, Principles of Spatial Design and Aesthetics	3
*LA 201, Theory and Application Studio	6
*LA 205, Graphic Communication	3
*HORT 335, Woody Plant Materials for Landscape Use	3
	15
Spring Term	
*LA 202, Project Design and Site-Planning Studio	6
*LA 310, Site Construction	4
†Written or oral expression elective	3
†Physical sciences elective	3
	16

Third Year

Fall Term	
*LA 301, Natural Systems and Planting Design Studio	6
*LA 521, History of European Landscape Architecture	3
†Biological sciences elective	3
‡Free elective	3
	15
Spring Term	
*LA 302, Urban Systems Studio	6
*LA 522, History of American Landscape Architecture	3
†Physical sciences elective	3
*LA 312, Site Engineering for Landscape Architects	4
	16

Fourth Year

Fall Term	
*LA 401, Advanced Project Design and Graphics Studio	6
‡LA 520, Contemporary Issues in Landscape Architecture	2
†Social sciences or humanities elective	3
‡Free elective	3
(Optional landscape architecture study abroad semester in Denmark)	14
Spring Term	
*LA 402, Senior Project Studio	6
†Social sciences or humanities elective	3
*LA 412, Professional Practice	1
‡Free elective	2
	12
Summary of credit requirements	
*Specialization requirements	68
†Distribution electives	38
‡Free electives	14
	120

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

First professional degree curriculum. The three-year M.L.A. curriculum is accredited by the American Society of Landscape Architects and organized to prepare a student for professional practice in landscape architecture. It is structured to provide a first professional degree for students with a bachelor's degree in areas other than landscape architecture or architecture.

Through a course sequence intended to develop basic landscape architectural skills and concepts, the three-year curriculum provides opportunities for students from diverse educational backgrounds to become proficient in landscape design, site construction, graphic communication, plant materials, and other related areas necessary to enter the profession fully qualified at the master's level.

Requirements of the three-year M.L.A. curriculum include 90 credits, satisfactory completion of the core curriculum courses, an approved summer internship, and a thesis.

First Year

Fall Term	*Credits*
*LA 205, Graphic Communication	3
*LA 220, Principles of Spatial Design and Aesthetics	3
*LA 501, Theory & Application Studio	6
*HORT 335, Woody Plant Materials for Landscape Use	3
	15
Spring Term	
*LA 502, Project Design and Site-Planning Studio	6
*LA 310, Site Construction	4
‡Free elective	6
	16

Second Year

Fall Term	
*LA 601, Natural Systems and Planting Design Studio	6
*LA 611, Site Engineering for Landscape Architects	4
*LA 521, History of European Landscape Architecture	3
*LA 531, Regional Landscape Planning I	4
	17
Spring Term	
*LA 602, Urban Systems Studio	6
*LA 634, Landscape Architectural Research	3
*LA 522, History of American Landscape Architecture	3
‡Free elective(s)	5
	17

Third Year

Fall Term	
*LA 701, Advanced Project Design and Graphics Studio	6
*LA 621, Summer Internship Seminar	2
*LA 520, Contemporary Issues in Landscape Architecture	2
‡Free elective	3
	13
Spring Term	
*LA 800, Master's Thesis in Landscape Architecture	9
*LA 412, Professional Practice	1
‡Free elective(s)	2
	12
Summary of credit requirements	
*Specialization requirements	74
‡Free electives	16
	90

Second professional degree curriculum. The two-year Master of Landscape Architecture (M.L.A.) curriculum serves to broaden and enrich undergraduate education in design by providing an expanded educational experience to those who are technically skilled. Applicants are therefore expected to hold a bachelor's degree in landscape architecture or architecture from an accredited program.

The objectives of the two-year M.L.A. curriculum are to permit students to conduct research relating to landscape architecture and to provide advanced education and training to individuals who may wish to teach, practice, or conduct applied research in landscape architecture. Students are permitted considerable flexibility in establishing programs that take full advantage of the teaching and research resources of the university.

Students admitted to the two-year M.L.A. curriculum are required to complete 60 credits of course work as approved by the members of their graduate committee. This must include at least two advanced studios, a graduate seminar, and a thesis or final master's project.

Microbiology

Microbiology is concerned with both basic and applied study of microorganisms such as bacteria, fungi, and viruses. Microorganisms touch many areas of human activity such as food production and nutrient and waste recycling, in addition to causing infectious diseases. Fundamental knowledge of microbiology is crucial for continued advances in basic biological sciences such as biochemistry and genetics as well as in applied areas such as agriculture, agronomy, animal sciences, bioengineering, ecology, food science, medicine, and natural resources. Microbiology also provides the basis for the new and exciting disciplines of genetic engineering and biotechnology.

The undergraduate major in microbiology provides excellent preparation for graduate study in many areas of biological science, as well as for professional study in medical, veterinary, or dental school. Microbiology graduates can pursue careers in biotechnology or industrial microbiology, clinical microbiology, food microbiology, or pharmaceutical microbiology. Microbiologists also work as technicians in university, government, industry, or hospital research laboratories.

Study in microbiology emphasizes laboratory as well as classroom training and requires a rigorous background in basic sciences. Courses in general biology, genetics, general chemistry, organic chemistry, biochemistry, biochemistry laboratory, physics, and calculus are required. The required microbiology courses include introductory microbiology, advanced general microbiology, microbial physiology, microbial genetics, either pathogenic microbiology or immunology (taught in the College of Veterinary Medicine), and at least two microbiology laboratory courses. Electives include courses in procaryotic cytology, bacterial diversity, tissue culture techniques, soil microbiology, food microbiology, and microbial engineering. Students with good academic records are encouraged to conduct independent research during their senior year.

Students interested in clinical microbiology may apply to the Clinical Microbiology Specialization Program. Students selected for the program spend their senior year at Cornell Medical College and the New York Hospital, studying and working in clinical microbiology. Applicants must have completed their departmental course requirements by the end of their junior year.

More information may be obtained from the Department of Microbiology, Stocking Hall. A pamphlet entitled *Microbiology in Your Future* can be obtained without charge by writing to the American Society for Microbiology, 1913 I Street N.W., Washington, D.C. 20006.

Natural Resources

The undergraduate curriculum is designed to provide an enduring and broadly applicable education. The focus of study is on the systems that yield our renewable natural resources (water, forests, fish, and wildlife) and includes emphasis on both natural sciences and human organizations involved with resource management. Students are provided with an opportunity to understand the scientific, ethical, and societal basis for the protection and management of renewable resources through the application of ecological principles and knowledge of social needs.

The program is based in the Department of Natural Resources and is housed in Fernow Hall, named after the father of American forestry. The curriculum helps prepare students for a wide range of careers and can serve as a base for graduate work in numerous fields. Students are prepared to appreciate and understand their natural environment and humanity's interactions with it. A foundation is developed for the many students who continue with graduate professional training in natural resource science and management, including wildlife, fisheries, and forest sciences, aquatic systems, and policy studies.

Students are encouraged to study in each of the seven learning areas listed below:

1) Understanding basic substrates for life: geology, soils, water resources
2) Understanding natural processes: chemistry, physics, ecology, field biology, meteorology
3) Understanding how organisms, populations, and ecosystems function: biology, physiology, anatomy, behavior, ecology, population dynamics
4) Understanding how people and their institutions function: psychology, sociology, political science, government, history, anthropology, law, economics
5) Identifying and measuring the environment: taxonomy, remote sensing, mathematics, statistics
6) Understanding resource management processes: communication, analysis, planning, philosophy, computer science, decision making, law, ethics
7) Learning about the world: Students should recognize that not all learning takes place in the classroom. Exploring different careers, participating in campus and community activities, and conducting independent research all contribute to continuing growth.

Students need not select an area of concentration, but those who wish to do so may specialize further in wildlife science, forest science, aquatic science, fishery science, or natural resource policy and management.

Opportunities for field-oriented studies are available at the Arnot Forest Teaching and Research Center; the Cornell Biological Field Station, on the shore of Oneida Lake; and the Uihlein Maple Syrup Research and Extension Field Station at Lake Placid.

Students should seek relevant work experience to complement their academic studies.

Plant Sciences

Plant sciences students may specialize in general plant science, plant biology, plant breeding, plant pathology, plant protection, field crops, or horticultural sciences, including floriculture and ornamental horticulture, pomology, and vegetable crops. Students with well-defined interests may specialize when they enter college. Others may start in the general plant sciences curriculum and, if they desire, specialize after the second year.

Plant sciences is a multidepartmental program area, sponsored by the Department of Agronomy, in Emerson Hall, and the departments of Floriculture and Ornamental Horticulture, Plant Breeding, Plant Pathology, Pomology, and Vegetable Crops, all located in the Plant Science Building.

General plant science is intended for students whose interest in studying plants has not yet centered on any one of the more specialized groups within the area. Students may continue with this option throughout their undergraduate years, particularly if they are likely to be interested in and qualified for advanced studies beyond the bachelor's degree. Students who plan to seek employment upon graduation may prefer to specialize. There are, however, opportunities for general plant science graduates in the service and supply industries as extension agents, as teachers, and as research technicians.

More than a hundred courses are offered that deal directly with some area of plant science. Other courses relating to plant science are offered in agronomy and biological sciences. In addition, an interest in plant science may be combined with some other area of specialization, such as agricultural and biological engineering, education, extension, statistics, international agriculture, food science, or agricultural economics.

Undergraduates are encouraged to obtain practical experience. It may involve research under the direction of a faculty member or work in a commercial industry or research institute or on a farm. Departments will assist students looking for positions that would provide useful experience.

Floriculture and ornamental horticulture applies principles of plant science and business management to the production and marketing of florist, nursery, and turfgrass crops, as well as to the selection and management of plants for both indoor and outdoor landscapes. Programs prepare students for careers at the professional and managerial levels in horticultural business, research, teaching, communications, and extension and public education.

The core curriculum consists of the following courses:

Hort 101, Introduction to Horticultural Science
Hort 102, General Horticulture
Hort 230, Woody Plant Materials
Hort 300 or 301, Garden and Interior Plants I or II
Hort 400, Principles of Plant Propagation
Bio S 241, Plant Biology (Introductory Botany)
Bio S 242, Plant Physiology (lecture)
Bio S 244, Plant Physiology (laboratory)
Agron 260, Nature and Properties of Soils
Entom 241, Applied Entomology, or Entom 212, Insect Biology
Pl Pa 301, Introductory Plant Pathology

Although mastery of those subject areas is considered essential for students planning to enter a floriculture or landscape horticulture career, justifiable exceptions to the core curriculum may be granted by the student's adviser.

With permission of the adviser, a transfer student may receive core curriculum credit for similar courses taken at other institutions provided that transfer credit is granted by the college. In addition, all transfer students must complete a minimum of 12 credits in floriculture and ornamental horticulture courses at Cornell. No more than two of the following landscape architecture courses may be included in this 12-credit requirement: LA 140, LA 220, LA 310, or LA 312. No other landscape architecture or freehand drawing courses may be applied to the requirement because they do not contain horticultural subject matter.

Students may select an area of emphasis in either floriculture or landscape horticulture. Specialization in floriculture prepares students for careers in management of the production of crops in greenhouses and wholesale- and retail-florist marketing, whereas specialization in landscape horticulture trains students for careers in nursery-crop production, turfgrass management, landscape contracting and service, retail- and wholesale-marketing of nursery products and services, botanical garden and arboretum management, urban horticulture, and related areas. Some students choose to pursue a general program in floriculture and landscape horticulture including courses in both areas. Similarly, programs in horticultural business management, research, teaching, extension and public education, and communications/journalism may be arranged across two specialization areas. Students wishing to prepare for graduate study in horticultural science may develop a program in basic sciences and their application in horticultural science. Lists of recommended courses for the areas of specialization are available from student advisers and from the undergraduate program coordinator.

Working with his or her faculty adviser, each student will tailor a program to achieve individual educational objectives in floriculture, landscape horticulture, or general horticultural science. Students are also encouraged to take courses in these areas: agricultural economics and business management, agricultural and biological engineering, agronomy (soil science), computer science, ecology, entomology, geology, plant pathology, plant physiology, oral and written expression, and plant taxonomy. Use of electives to pursue study in the humanities and in other areas of special interest to the student is encouraged and provides opportunities for broadening and enriching learning experiences. Numerous opportunities to become familiar with the horticultural industries and professions are provided through field trips, guest lectures, undergraduate seminars, independent or small-group study, optional internship, and work experience programs.

Questions concerning the undergraduate curriculum, advising, and related manners should be addressed to Dr. Carl F. Gortzig, Undergraduate Program Coordinator, Department of Floriculture and Ornamental Horticulture, 20 Plant Science Building, Ithaca, New York 14853-5908 (telephone: 607/255-3090).

The department's office is 20 Plant Science Building. Departmental facilities include classrooms and laboratories in the Plant Science Building, greenhouse and laboratory facilities at the Kenneth Post Laboratory, the Test Garden, the Turfgrass Research Field and Laboratory, landscape architecture studios in East Roberts Hall, and freehand drawing studios in Mann Library.

Plant biology provides undergraduates with preparation for graduate study in the plant sciences that stresses basic, rather than applied, research. In cooperation with an adviser, each student plans a curriculum with a concentration in basic sciences supplemented by courses in applied areas that seem appropriate. Options include molecular biology, plant physiology, plant biology, genetics, cytology, organic chemistry, biochemistry, anatomy, taxonomy, ecology and evolution, and statistics. A core of courses, including mathematics, plant biology and physiology, and cytology, is strongly suggested. However, different specialties within plant biology afford a flexible curriculum.

Plant breeding provides undergraduates with (1) preparation for graduate study leading to advanced degrees in plant breeding and plant genetics and (2) preparation for work in producing and marketing plant varieties and making varietal recommendations and for positions in seed analysis, regulation, and quality control.

In cooperation with an adviser, each student plans a curriculum with a concentration in basic sciences supplemented by courses in applied fields best suited to his or her individual goals. Options include plant breeding and plant genetics; genetics, cytology, and cytogenetics; mathematics (calculus) and statistics; organic chemistry and biochemistry; plant anatomy, ecology, and physiology; crop production; and plant pathology and disease control.

Plant pathology requires broad training in the physical and biological sciences and a general background in crop production with emphasis on crop protection. Specific requirements depend upon a student's career interests. Career options include working as a mycological or microbiological technician, biological research technician, technical representative for agricultural industry, cooperative extension agent, plant protection technician, or biology teacher. Students may also be interested in graduate work in plant pathology or some other area of biology.

A core of basic and applied courses is strongly suggested, including chemistry, mathematics, physics and biological sciences, plant breeding, and plant pathology. Courses chosen from agronomy, entomology, floriculture and ornamental horticulture, pomology, or vegetable crops complete the program.

Plant protection is offered for students who are interested in pest management or plant protection. The study of insects, diseases, weeds, vertebrate pests, and other factors that prevent maximum crop production may prepare students for careers in agribusiness, the agrichemical industry, cooperative extension, pest management consulting, state and federal regulatory work, and a variety of other technical positions. Although designed as a terminal program for students desiring a practical preparation in general plant protection, this specialization may also provide an adequate background for graduate work in entomology, plant pathology, or weed science.

The following subjects are considered essential to the plant protection specialization: botany and plant physiology, general ecology, soils, crop science, and microbial ecology. Additional courses in introductory entomology, insect pest management, introductory plant pathology, plant disease control, weed science, and pest management for plant protection are recommended. Students should plan to take a total of 62 to 70 credits in courses required and recommended for the specialization.

In addition, a number of other subjects pertinent to plant protection are recommended, depending upon the student's interests: agricultural economics, agricultural and biological engineering, agronomy, biochemistry, communication, pathology and entomology, general physics, genetics, meteorology, mycology, pesticides in the environment, and plant anatomy. Employment involving practical experience in plant protection between the junior and senior years is encouraged. The job may be on a farm, at an experimental station, with an agrichemical company, or with a regulatory agency.

Pomology (the science of fruit growing) provides students with knowledge of the scientific technology and the influence of environmental factors on the production, handling, and storage of deciduous fruit crops. New York is a national leader in fruit production. An on-farm value of over $155 million generates an estimated $620 million for the state's economy.

Courses are selected by students in consultation with a faculty adviser. Flexibility in programs makes it possible to establish a course of study to fit the desired goals of individual students. The diverse pomology curriculum, complemented by courses in basic sciences and arts and electives in a student's area of interest, prepares pomology majors for a career in fruit production, agricultural business related to the fruit industry, storage and merchandising, or professional pomology. Job opportunities for graduates can be found in fruit production, marketing, sales and service, research, teaching, and extension.

Vegetable crops is one of the most diverse applied and scientific fields in agriculture. In New York more than twenty economically important vegetables are produced and marketed. Vegetable crops have a high value per acre, making it economically feasible to invest relatively large sums in land, equipment, fertilizers, seed, and pesticides. Many vegetables are highly perishable; consequently, considerable expenditure is made for refrigeration and special storage facilities as well as for packaging and handling techniques that have been specifically developed for each particular crop.

The opportunities for trained personnel are numerous in all aspects of vegetable production and the closely related fields of purchasing, processing, merchandising, extension, and banking. Some students may continue their studies in graduate school in preparation for teaching, research, or cooperative extension work in colleges and universities or in private industry. Recently there has been an

increased interest in growing vegetables in tropical countries, and international agriculture, with a specialization in vegetable crops, provides excellent training for this vocation.

The different specialties within vegetable crops afford a very flexible curriculum. Courses are chosen by students in consultation with an adviser and other members of the staff. Students usually take most of the courses offered by the Department of Vegetable Crops and commonly choose other courses from accounting, agricultural geography, and marketing; soils, soil fertility, and regional agriculture; plant biology, physiology, ecology, and anatomy; oral expression; food sciences; nutritional sciences; plant genetics, statistics, and plant breeding; economic entomology, plant diseases and their control, and weed science. Students supplement their course work with study in areas in which they have particular interest.

Rural Sociology

Technological, economic, demographic, and environmental changes are social processes, and each has major impacts on individuals, social groups, societies, and the international order. At Cornell, rural sociology students study these and other facets of social change in both domestic and international settings. Among the topic areas in which faculty members in the Department of Rural Sociology specialize are international agricultural and rural development, community and regional development and changes in the United States, environmental sociology, sociology of agriculture, rural industrialization and labor markets, population and development, political economy, and research methodology. Students acquire background in one or more of these areas by specializing in one of the three concentrations described below. Each of the concentrations, through its required courses, provides background in both domestic and international aspects of the subject matter. Normally, students will develop a specialization with either a domestic or international emphasis by choosing appropriate elective courses for their concentration. Regardless of the area of specialization, however, all students learn the theory and methodology of sociology and how to apply both to research and policy in their subject areas.

Recognizing that students are concerned with future career opportunities, the undergraduate program emphasizes acquisition of skills as well as general knowledge in preparation for jobs or further study upon graduation. Accordingly, students are expected to become involved in the application of theory, methodology, principles, and concepts in the analysis of practical problems. The concentration in social data and policy analysis is particularly well suited to providing skills in research and policy analysis that will be useful for students who wish to obtain employment after completion of the baccalaureate degree.

Rural sociology offers degree programs at both the undergraduate and graduate levels (B.S., M.S., M.P.S., or Ph.D.). These programs are offered through the Department of Rural Sociology and the Graduate Field of Development Sociology, both of which are located in Warren Hall. For many years, the department and graduate field have been recognized as among the top programs in the country, and both are known for innovative program orientations. The department is particularly well known for providing instruction in international as well as domestic aspects of development, environmental sociology, sociology of agriculture, population studies, and other topics. Faculty members in this department are committed to both quality instruction and research programs.

Being located in a college of agriculture, faculty members maintain strong ties with the technical fields in the college as well as with the International Agriculture Program, the Biology and Society Program, the Cornell Institute for Social and Economic Research, the Women in Development Program, the Program on Science, Technology, and Society, and the Center for International Studies. Nearly half of the department faculty are associated with one or more area studies programs (the Southeast Asia Program, South Asia Program, Latin American Studies Program, East Asia Program, or the Institute for African Development). Department members also maintain working relations with faculty in the Department of Sociology and other social science units located in other colleges at Cornell. Students are encouraged to supplement their course work by electing courses in these other departments and programs, thereby rounding out their educations by acquiring different perspectives.

The undergraduate concentrations offered in rural sociology include development sociology; population, environment, and society; and social data and policy analysis. The concentrations vary in terms of course requirements and credits needed for graduation.

All students majoring in rural sociology are expected to take four core courses: an introductory course (R Soc 101, 102, or 103), methods (R Soc 213), theory (R Soc 301), and a course in statistics.

The concentration in development sociology provides an understanding of the processes and policies that influence social and economic development in rural settings in North America and low-income countries in the developing world. The required courses provide background in the sociology of development in both the advanced and developing countries. Students normally select a set of elective courses in which either domestic or international development is emphasized. The required and elective courses provide background in several aspects of development sociology, including (1) an understanding of the processes of socioeconomic development in low-income or Third World countries and training in the formulation of strategies to enhance the socioeconomic well-being of citizens of those countries, (2) analysis of the social structures and processes for development in nonmetropolitan settings in the United States, (3) analysis of the processes of agricultural change and development in industrialized and low-income countries, and (4) an understanding of the processes of technological development and change in agriculture and other rural industries in developed and developing countries.

Students are encouraged to complement courses in the department with course work in the history and economics of development, area studies, and the policy sciences.

Total credits required, including the four core courses: 27

Courses Required	*Credits*
R Soc 205, Rural Sociology and International Development or R Soc 208, Technology and Society	3
R Soc 445, Rural Social Stratification	3
R Soc 370, Social Structure of Industrial Change, or R Soc 436, Small Towns in Metropolitan Society: Changing Structures and Quality of Life	3
	9

Electives for the Concentration

At least six credits must be selected from a list of complementary courses for the concentration in development sociology. The list of courses is available in 133 Warren Hall.

The concentration in population, environment, and society provides an understanding of (1) the causes and consequences of the major components of population change—fertility, mortality, and migration; (2) the major patterns of population distribution and population characteristics in the United States and the developing world, (3) the relationships between social structure and the biophysical environment, and (4) the relationships between population change and natural resource utilization in development. Students normally select the elective courses for the major in such a way as to stress either population studies or sociological aspects of natural resources and the environment.

Students are encouraged to complement courses in the department with course work in demographic methods, household analysis, ecology and evolution, environmental studies, and natural resources.

Total credits required, including the four core courses: 27

Courses Required	*Credits*
R Soc 201, Population Dynamics	3
R Soc 324, Environment and Society	3
R Soc 438, Social Demography, or R Soc 440, Social Impact of Rapid Resource Development	3
	9

Electives for the Concentration

At least six credits must be selected from a list of complementary courses for the concentration in population, environment, and society. The list of courses is available in 133 Warren Hall.

The concentration in social data and policy analysis provides (1) in-depth knowledge of research methodology, statistics, and computer applications, (2) an understanding of social, economic, political, and historical concepts essential for conducting meaningful analyses of practical problems and issues faced by organizations, communities, regions, and states, and (3) knowledge and practice in policy analysis. Students ordinarily select electives for the concentration in order to specialize in either policy analysis or in a particular area of public policy (international development policy, domestic rural development policy, environmental policy, or population policy).

In addition to the required courses listed below, students in the concentration in social data and policy analysis are required to take Soc 301, Evaluating Statistical Evidence, as their statistics course for meeting the core requirements of the major.

Students are encouraged to complement courses in the department with course work in data collection and research design, evaluation research, computing, and advanced statistics.

Total credits required, including the four core courses: 27–29

Courses Required	*Credits*
R Soc 201, Population Dynamics, or R Soc 205, Rural Sociology and International Development, or R Soc 206, Gender and Society, or R Soc 208, Technology and Society	3
Soc 303, Primary Data Collection and Design [4 credits], or HSS 292, Research Design and Analysis, or Comm 382, Survey Research Methods	3–4
Ag Eng 102, Introduction to Microcomputer Applications, or CRP 421, Introduction to Computers in Planning [4 credits]	3–4
	9–11

Electives for the Concentration

At least six credits to be selected from a list of complementary courses for the concentration in social data and policy analysis. The list is available in 133 Warren Hall.

Brochures are available from rural sociology faculty members.

Statistics and Biometry

Statistics is concerned with quantitative aspects of scientific investigation: design, measurement, summarization, and drawing conclusions based on probability statements. Biometry is the application of mathematical and statistical techniques to the life sciences. Students with ability in mathematics and an interest in its applications will find this a chall enging specialization.

The work of a statistician or biometrician can encompass research, teaching, consulting, and computing in almost any mix and in a wide variety of applications. Opportunities for employment are abundant in universities, in government and in businesses and industries ranging from large corporations to small consulting firms, and salaries are usually excellent.

While satisfying course requirements for a specialization in statistics and biometry, students can also take a wide variety of courses in other disciplines. In fact, students are encouraged to take courses in applied disciplines such as agriculture, biology, economics, and the social sciences that involve numerical data and their interpretation.

Students specializing in this area are required to take computer science courses (e.g., Computer Science 100 and 211), mathematics courses (at least three semesters of calculus), and statistics courses (Statistics and Biometry 200, 215, 408–409, 417, 601–602 and 607 and Industrial and Labor Relations 310). Work experience gained through summer employment or undergraduate teaching is highly recommended. Students should contact Charles E. McCulloch for information.

Special Programs in Agriculture and Life Sciences

Some students are interested in pursuing a general education in the agricultural sciences. Others are uncertain about career objectives in agriculture and the life sciences. The opportunity to develop an independent major in general studies in agriculture and the life sciences is available for such students. In consultation with a faculty adviser, they may plan a sequence of courses suited to their individual interests, abilities, and objectives in an area not encompassed by the existing programs. Once the distribution and other college requirements are met, this major may include a concentration of courses in one or several academic units of the university.

Students completing this major are often planning a career in agriculturally related food and service enterprises. Many of the fast-growing occupations require the broad perspective, the scientific and technical skills, the attitudes, and the analytical ability that a general education fosters. A course of study for a special program must be planned with and approved by a college faculty adviser. Information on the options and names of faculty advisers prepared to advise in special programs are available in the Office of Student Services, 17 Roberts Hall.

General studies includes production agriculture as well as technical work in the agricultural and life sciences. Many biotechnology concerns deal with aspects of agriculture, especially plants, crops, and ecosystems in the natural environment. A strong grounding in biological sciences as well as knowledge of the agricultural sciences is essential in this rapidly growing field. Students should plan basic course work in the major areas of study in the college—animal sciences, plant sciences, environment and technology, agronomic sciences, biological sciences, and social sciences. Advanced courses may be selected in those and other areas of individual interest or career aspiration.

International agriculture provides students with an understanding of the special problems of applying basic knowledge to the processes of agricultural modernization in low-income countries. The student typically specializes in a particular subject and works with an adviser to plan a program oriented toward international agriculture. The courses in international agriculture are designed to acquaint students with the socioeconomic factors in agricultural development, with the physical and biological nature of tropical crops and animals, and with various world areas for which study programs exist. The study of a foreign language is required.

In addition to the college distribution requirement, students majoring in international agriculture must take a minimum of 30 credits. A minimum of 7 credits in international agriculture and 8 credits in a modern foreign language are required. The other courses recommended are drawn from a wide range of disciplines. The objective is to acquaint students with the many facets of agricultural development in low-income countries. Students are encouraged to take additional specialized courses in one of the other program areas of the college.

DESCRIPTION OF COURSES

Undergraduate and graduate courses in the college are offered through the seventeen academic departments and also through the Divisions of Biological Sciences and Nutritional Sciences.

Descriptions of courses, both undergraduate and graduate, are given by department, arranged in alphabetical order.

Graduate study is organized under graduate fields, which generally coincide with the departments. Graduate degree requirements are described in the *Announcement of the Graduate School*. Courses for graduate students are described in the section on the academic department that offers them.

NONDEPARTMENTAL COURSES

ALS 100 American Indian Studies: An Introduction
Fall. 3 credits. S-U grades optional.
Lec, W 7–10 p.m. Robert W. Venables.
This course provides a foundation for the study of American Indians. Emphasis will be placed on social, cultural, historical, educational, and human development. Guest lecturers from Cornell's staff and the Indian community will serve to broaden the scope of the course.

ALS 127–128 Introduction to Farm Techniques
127, fall; 128, spring. 1 credit each semester. Prerequisite: permission of instructor. S-U grades only. Contact C. Place, 192 Roberts Hall, for scheduling. Limited to 8 students per section.
T or W, 1:25–4:30. Class assembles in front of 192 Roberts Hall for transport to various facilities. J. G. Whitcomb.
Practical instruction in the basic skills of farming and field research. Includes safe tractor and equipment operation and maintenance; harvesting and planting crops; safe use of pesticides; caring for and handling dairy and beef animals, sheep, and poultry; and milking by machine and by hand. General orientation in the day-to-day procedures of farm operation. Field trips to area farms and agribusinesses will provide knowledge of farmers' skills, problems, and way of life.

ALS 318 Ethnohistory of the Northern Iroquois
Fall. 3 or 4 credits. S-U grades optional.
Lec, T 1:25–4:30. Robert W. Venables.
The development of Iroquois (Houdenosaunee) culture is traced from the Archaic period to the present day. Changes in cultural ecology, social organization, and world view are examined. Supplemental information is drawn from accounts of neighboring groups in southern Canada and western New England. Approximately one-third of the course is devoted to contemporary issues faced by the Iroquois people.

ALS 400 Internship
Fall, spring, or summer. 6 credits maximum. Not open to students who have earned internship credits elsewhere or in previous terms. S-U grades only.
Staff.
Students may register only for internships approved by the College Internship Committee. Currently, the opportunities are available in the New York State Assembly Intern Program, the New York State Senate Session Assistant's Program, and the Albany Semester Program. A learning contract is negotiated between the student and the faculty supervisor, stating conditions of the work assignment, supervision, and reporting. Participation is required in any structured learning activities associated with the internship.

ALS 661 Environmental Policy (also Biological Sciences 661 and Biology and Society 461)
Fall and spring. 2 or 3 credits each term. Limited to 12 students. Prerequisite: permission of instructor.
Sem R 2:30–4:30 p.m. D. Pimentel.
This course uses an interdisciplinary approach to focus on complex environmental and energy problems. Ten to twelve students, representing several disciplines, investigate significant environmental problems. The research team spends two semesters preparing a scientific report for publication in *Science* or *BioScience*.

Related Course in Another Department
History of the Agricultural Sciences (History 443)

AGRICULTURAL AND BIOLOGICAL ENGINEERING

G. E. Rehkugler, chair; L. D. Albright, D. J. Aneshansley, J. A. Bartsch, J. K. Campbell, T. J. Cook, J. R. Cooke, A. K. Datta, R. C. Derksen, R. B. Furry, K. G. Gebremedhin, R. W. Guest, W. W. Gunkel, D. A. Haith, P. E. Hillman, J. B. Hunter, W. W. Irish, L. H. Irwin, W. J. Jewell, H. A. Longhouse, D. C. Ludington, J. Y. Parlange, R. E. Pitt, T. S. Steenhuis, M. B. Timmons, L. P. Walker, M. F. Walter

102 Introduction to Microcomputer Applications (also Computer Science 102)
Fall. 3 credits. Each lab section limited to 16 students. Not open to students enrolled in the College of Engineering or to students who have taken any prior computer courses at Cornell. Students in statutory colleges must enroll in Agricultural and Biological Engineering 102.
Lecs, T R 10:10 or 12:20; lab M 1:25–4:25 or 7:30–10:30 p.m., T 1:25–4:25, W 1:25–4:25 or 7:30–10:30 p.m., or R 1:25–4:25. 1 evening prelim. P. E. Hillman and computer science staff.
An introduction to the use of application packages on microcomputers using the Macintosh. An attempt will be made to assess and demonstrate the capability and limitations of the current generation of personal computers through software for word processing, spreadsheets, database, and other applications. The course will involve very little programming using high-level languages.

110 Farm Metal Work
Spring. 2 credits.
Lec, R 9:05; labs, M T or R 1:25–4:25, M 7–10 p.m. T. J. Cook.
M, T and R labs, each limited to 20 students, include instruction in sheet metal work, pipe fitting, hot and cold metal work, and arc and acetylene welding.

132 Farm Carpentry
Fall. 2 credits. Each lab limited to 15 students.
Lec, T 9:05; labs, T W or R 1:25–4:25, M 7–10 p.m. T. J. Cook.
Instruction in the fundamentals of farm carpentry, including concrete work, and equipment and buildings constructed of wood. Each student is required to plan and construct an approved carpentry project.

151 Introduction to Computing*
Fall. 4 credits.
M W 11:15; labs, W or R or F. 12:20–2:20 or 2:30–4:30. Plus second evening lab to be arranged. L. D. Albright.
An introduction to computer programming and concepts of problem analysis and algorithm development in an engineering context. The structured programming language, Pascal, is used, implemented on interactive personal computers, and applied to problems of interest in agricultural and biological engineering. No previous programming experience is assumed. An introduction to the use of spreadsheet programs for engineering is included.

*Pending approval of the College Curriculum Committee.

153 Engineering Drawing
Fall. 2 credits. Limited to 30 students (15 in each lab).
Lec, M 9:05; lab, T or W 1:25–4:25. H. A. Longhouse.
Designed to promote an understanding of engineering universal graphic language. The lectures and laboratories develop working knowledge of drawing conventions, drafting techniques, and their application to machine and pictorial drawing problems. The course will involve both instrument and Autocad computer drawings.

200 Undergraduate Seminar
Spring. 1 credit. S-U grades optional.
Lec, M 2:30. G. E. Rehkugler.
A forum to discuss the contemporary and future role of agricultural and biological engineering in society. A series of lectures will be given by practicing engineers, Cornell faculty members, and students. Written critiques are required. Students may take the seminar more than once but are limited to 2 credits maximum.

204 Introduction to Computer Uses
Spring. 4 credits. Each lab section limited to 20 students. S-U grades optional.
Lecs, T R 11:15; lab, T, W or R 1:25–2:15. 2 evening prelims. R. B. Furry.
An introductory course in computing for those interested in using microcomputers to handle data. Topics include preparing and processing computer programs in Pascal and FORTRAN. No prior knowledge of computers or computer languages is necessary.

221 Plane Surveying
Fall. 3 credits. S-U grades optional.
Lab, M 1:25–4:25; lecs, M W 12:20. H. A. Longhouse.
Principles and practice of measurement of distance, elevation, and direction. Use and care of equipment is stressed during field problems related to mapping, engineering design, and construction. Other topics include surveying specifications, error analysis, and standards of accuracy.

250 Engineering Applications in Biological Systems
Fall. 3 credits. Prerequisite: enrollment in an engineering curriculum. Recommended for the sophomore year.
Lec, M W F 12:20. R. E. Pitt.
Case studies of engineering problems in agricultural and biological systems, including animal and crop production, environmental control, energy, and food engineering. Emphasis is on the application of mathematics, physics, the engineering sciences, and biology to energy and mass balances in agricultural systems.

301 Introduction to Energy Technology
Spring. 3 credits. Prerequisite: high school or college physics. S-U grades optional. Offered alternate years.
Lec, M W F 10:10. D. C. Ludington.
Basic concepts of energy transfer and traditional and alternate sources of energy. Design of small systems and appropriate technology are emphasized. Topics include heating, cooling, solar energy, electricity, hydropower, wind power, biogas production, and energy economics.

305 Principles of Navigation
Fall. 4 credits.
Lecs, M W F 9:05 or 12:20; rec, R 9:05 or 12:20. W. W. Gunkel.
Coordinated systems, chart projections, navigational aids, instruments, compass observations, tides and currents, soundings. Celestial navigation: time, spherical trigonometry, motion of stars and sun, star identification, position fixing. Nautical Almanac. Electronic navigation.

310 Advanced Farm Metal Work
Spring. 1 credit (2-credit option available). Prerequisite: Agricultural and Biological Engineering 110 or permission of instructor.
Lab F 1:25-4 (second lab must be arranged for 2-credit option). T. J. Cook.
Advanced welding and metal construction project.

311 Farm Machinery
Fall. 3 credits. Each lab limited to 16 students. Prerequisite: high school physics or equivalent.
Lecs, T R 11:15; rec-lab, T or W 1:25–4:25. W. W. Gunkel.
A study of the operating principles, use, selection, and methods of estimating costs of owning and operating farm machines. Lab work includes practice in the calibration of planting, fertilizing, and pesticide application machinery, and study of the functional characteristics of agricultural machines and

312 Engines and Tractors for Agricultural Applications
Spring. 3 credits. Each lab limited to 16 students. Students missing the first week of classes without permission of the instructor are dropped so others may register. Prerequisite: high school physics or equivalent.
Lecs, T R 11:15; lab, M T or W 1:25–4:25. Staff.
A study of the principles of operation, adjustment, and maintenance of internal combustion engines and tractors. Topics include engine cycles, fuels, lubricants, carburetion, fuel injection systems, ignition, charging circuits, valve reconditioning, engine testing, transmissions, traction, and human factors in tractor operation.

315 Electricity: Its Use and Control
Spring. 3 credits. Prerequisite: Physics 102 or equivalent.
Lecs, T R 10:10; lab, T or R 1:25-4:25. D. C. Ludington.
The application and control of electricity for power, lighting, and heat are studied. Principles of operation and selection of single-phase equipment are emphasized. Conventional and solid state controls are included. Laboratories offer hands-on experience.

321 Soil and Water Management
Spring. 2 credits. S-U grades optional. Concurrent registration in Agronomy 321 required. Prerequisite: Agronomy 190 or 260.
Lec, M W 9:05; disc-lab, M 1:25–4:25. M. Walter, R. Oglesby, T. Scott, N. Bills.
An interdisciplinary course intended to introduce students to the general principles of soil and water interaction and to the effects of human intervention in these processes. Aspects of soil and water management, including hydrology, soil erosion, irrigation, drainage, and water quality are examined. Case studies from both the United States and the tropics are used to illustrate basic principles.

331 Environmental Control for Agricultural Production Systems
Fall. 3 credits. S-U grades optional.
M W F 11:15. K. G. Gebremedhin.
A study of analysis and design of agricultural production environments, ventilation design, regulation and control, animal physiology and homeothermy, material handling, waste management, alternate energy sources on the farm, and farmstead layout. Specific farmstead production systems (dairy, swine, poultry, fruit, and vegetable storage facilities) are discussed. A systems approach to agricultural production is emphasized. A project is expected at the end of the semester.

367 Introduction to Biological Engineering
Spring. 3 credits. Prerequisites: one year each calculus and introductory biology; minimum one term each college chemistry and physics. S-U grades optional.
Lecs, T R 10:10; lab, R 1:25–4:25. J. B. Hunter.
An exploration of the use of engineering principles to solve biological problems in the context of laboratory experiments. Topics may include artificial organs, electrical signals of nerves and muscles, mass transfer in fermentation, enzyme use in food processing, mechanics of plant or animal tissue, and physical methods of DNA transfer. Many topics are linked to original research underway on campus. Appropriate for both engineering and life science students. Field trips, demonstrations, and readings in current scientific literature are special features of the course.

[371 Introduction to Hydrology and Ground-Water Pollution
Fall. 3 credits. Prerequisites: knowledge of soils and one year of calculus. Not offered 1989–90.
Lecs, T R 9:05; lab, R 1:25–3:20. T. S. Steenhuis.
Introduction to basic hydrologic processes that focuses on the description of water in the unsaturated and saturated soil. The interaction of hydrologic processes with chemical transport processes is discussed. Emphasizes basic understanding of the processes involved. Case studies are used to illustrate the theory.]

401 Career Development In Agricultural and Biological Engineering
Fall. 1 credit. Limited to seniors. S-U grades only.
Lec, T 12:20. G. E. Rehkugler.
A career development seminar for majors in the field of agricultural and biological engineering. Presentations of career opportunities in corporations, independent businesses, consulting, and public service. Professionalism, ethics, and public policy issues are discussed.

420 Marine Pollution
Summer. 2 credits. Prerequisite: Biological Sciences 364 or permission of instructor. A special 2-week course offered at Cornell's Shoals Marine Laboratory. For more details and application, consult the SML office, G14 Stimson Hall. Estimated cost (includes tuition, room and board, and ferry transportation), $975.
Daily lecs, labs, and fieldwork for 2 weeks. SML faculty.
Dispersion modeling and the effects of pollutants (including oil, outfalls, solid wastes, sludge and dredge spoils, and radioactive wastes) are discussed from the perspectives of elementary physical oceanography and biological processes. Laboratories include basic methods for targeting and tracing waste water; organic carbon determinations; microbial tests for *Salmonella*, *E. coli*, and *Streptococcus*; and practical field projects.

435 Principles of Aquaculture
Spring. 3 credits. Prerequisite: junior and above. S-U grades optional.
Lecs, T R 1:25–3. M. B. Timmons, W. D. Youngs, C. A. Bisogni, G. A. German, G. L. Rumsey, P. R. Bowser, and J. M. Regenstein.
An in-depth treatment of the principles of aquaculuture: fish biology, waste treatment, engineering design, fish health, nutrition, processing, etc. This course is intended to build upon the undergraduate's previous course background and interests. Majority of the grade will be determined from a term project.

450 Instrument Design
Fall. 3 credits. Prerequisites: Math 293 or equivalent, physics or electrical science, computer programming.
Lecs M W 12:20; lab to be arranged. D. J. Aneshansley.
An introduction to static and dynamic characteristics of instruments, electronic instruments, digital and analog signal conditioning circuits and techniques, data acquisition and instrument control with personal computers and micro-controllers, and computer data analysis. Biological and agricultural examples of instrument problems and designs are used. A final design project is required.

451 Biomass Conversion Processes for Energy and Chemicals
Spring. 3 credits. Prerequisites: Agricultural and Biological Engineering 250, Mathematics 294, thermodynamics (co-registration permissible), and Chemistry 207 or equivalent.
Lecs, M W F 12:20. L. P. Walker.
There are a variety of physical and biological processes available for converting plants and other biomass resources into energy, industrial chemicals, and foods. The design of these processes is accomplished through fusing concepts from biochemistry, microbiology, and plant biology with the concepts and methods of engineering. There are four major components to this course: plants as biochemical resources, heat and mass transfer, enzyme catalysis, and fermentation kinetics. Each component is concluded with a case study that demonstrates how the scientific concepts and methods are used to design a biomass conversion process.

461 Agromechanical Engineering: Machine Systems and Design
Fall. 3 credits. Prerequisites: Agricultural and Biological Engineering 250 and mechanical design or equivalent.
Lecs, T R 10:10; lab, R 1:25–4:25. W. W. Gunkel.
Principles of design and analysis of agricultural machines to meet functional requirements. Emphasis is given to computer-aided analysis and design, selection of construction materials, and testing procedures. Engineering creativity, economic considerations, and safety are also stressed.

462 Agromechanical Engineering: Power and Traction
Spring. 3 credits. Prerequisites: engineering dynamics, thermodynamics, and Agricultural and Biological Engineering 250.
Lecs, T R 10:10; lab, R 1:25–4:25. Staff.
Synthesis of engineering sciences in the analysis, design, and testing of internal combustion engines and traction devices. Study areas include vehicle statics and dynamics, soil-machine interaction, electro-hydraulic control systems, human factors in vehicle design, and machine reliability. Computer analysis involves Runge-Kutta simulation, the finite element method, and digital data acquisition and processing. Students gain experience in modern laboratory and field testing.

[465 Agricultural Processing Systems
Fall. 3 credits. Prerequisite: Agricultural and Biological Engineering 250. Not offered 1989–90.
Lecs, T R 11:15; lab, W 2–4:25. R. B. Furry.
Grain drying, flow measurement, and material handling for agricultural engineering applications, with an introduction to system simulation, dimensional analysis, and similitude.]

466 Food Engineering: Design of Equipment and Processes
Spring. 3 credits. Prerequisite: courses in either fluid mechanics and heat transfer or unit operations in food processing.
T R 9:05, F 1:25–3:25. A. K. Datta.
Process equipment design and analysis for various food operations including transportation, heat transfer, concentration, drying, freezing, separation, on-line property sensing, inspection using machine vision computer control, etc. Materials of construction and a review of food properties are included. Emphasis is on uniqueness of food influencing the design. Field trips to food industries.

467 Bioprocessing Applications in Agriculture
Fall. 4 credits. S-U grades optional. Prerequisites: Biochemistry 231, college biology and calculus, one year each; Agricultural and Biological Engineering 250 or Engineering 219, or senior standing in life sciences. May not be taken for credit after Chemical Engineering 643.
T R 10:10–12. J. B. Hunter.
An introduction to microbial and enzymatic process technology for engineers and life scientists. A substantial introduction to process engineering is illustrated by case studies of food and agricultural bioprocesses. Emphasis on engineering analysis and design. Suitable for both engineers and life scientists seeking careers in the biotechnology industry.

471 Geohydrology (also Geology 445 and Civil and Environmental Engineering 431. Students enrolled in the statutory colleges must enroll in Agricultural and Biological Engineering 471.)
Fall. 3 credits. Prerequisites: Mathematics 294 and Engineering 202.
Lecs, M W F 10:10. T. S. Steenhuis, J.-Y. Parlange, A. L. Bloom, W. H. Brutsaert, L. M. Cathles.
An intermediate course in surface and groundwater flow and related design factors. Includes principles of fluid flow, the hydrologic cycle, natural channel dynamics and sediment transport, description and behavior of natural aquifers, ground-water hydraulics, soil water, and solute transport.

475 Environmental Systems Analysis
Fall. 3 credits. Prerequisites: computer programming and one year of calculus.
M W F 11:15. D. A. Haith.
Systems analysis and its use in environmental quality management. Emphasis is on mathematical modeling of environmental problems, translation of models into efficient computational algorithms, and use of computer simulation and optimization procedures (search techniques, linear programming, dynamic programming, and separable programming) to evaluate management alternatives. Applications include pollution control and resource management problems.

481 Design of Wood Structures
Spring. 3 credits. Prerequisite: permission of instructor.
Lecs, M W 11:15; disc-lab. T 1:25–4:25. K. G. Gebremedhin.
Computer-aided and design code manual procedures of timber engineering of agricultural, commercial, and industrial structures. Timber stress properties, design of columns, beams, trusses, rigid and post-frame buildings, shear walls, horizontal diaphragms, connections, and special timber structural systems.

482 Environmental Control for Animals and Plants
Spring. 3 credits. Prerequisite: Agricultural and Biological Engineering 250.
Lecs, T R 11:15; lab, M 1:25–4:25. L. D. Albright.
Analysis and design of the thermal and aerial environment of animal housing and greenhouses. Heat flow, air flow, psychrometrics, energy balances, thermal modeling, mechanical and natural ventilation, solar energy, and weather phenomena.

491 Highway Engineering (also Civil and Environmental Engineering 642)
Spring. 3 credits. Prerequisites: junior standing in engineering, fluid mechanics, and soil mechanics (may be taken concurrently).
Lecs, M F 12:20; lab, M 1:25–4:25. L. H. Irwin.
An introduction to engineering design in professional practice, using the design of highways as the subject of study. Students will use current standards and design criteria in five laboratory design projects. Topics of discussion include planning, economic analysis, human factors and public safety, route location and design, traffic engineering, hydrology and drainage design, soil engineering, highway materials, pavement design, and maintenance.

497 Special Topics in Agricultural and Biological Engineering
Fall or spring. 1–4 credits. S-U option. Prerequisite: written permission of instructor and adequate ability and training for the work proposed. Normally reserved for seniors in upper two-fifths of their class. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade.
Staff.
Special work in any area of agricultural engineering on problems under investigation by the department or of special interest to the student, provided, in the latter case, that adequate facilities can be obtained.

498 Undergraduate Teaching
Fall or spring. 1–3 credits. Prerequisite: written permission of instructor.
Staff.
The student assists in teaching an agricultural and biological engineering course appropriate to his/her previous training. The student meets with a discussion or laboratory section, prepares course materials, grades assignments, and regularly discusses objectives and techniques with the faculty member in charge of the course.

499 Undergraduate Research
Fall or spring. 1–3 credits. Prerequisites: normally reserved for seniors in upper two-fifths of their class. Adequate training for work proposed. Written permission of instructor.
Staff.
Research in any area of agricultural or biological engineering on problems under investigation by the department or of special interest to the student, provided that adequate facilities can be obtained. The student must review pertinent literature, prepare a project outline, carry out an approved plan, and submit a formal final report.

501–502 M.P.S. Project
Fall and spring. 1–6 credits. Required of each M.P.S. candidate in the field.
Hours to be arranged. Staff.
A comprehensive project emphasizing the application of agricultural technology to the solution of a real problem.

551–552 Agricultural and Biological Engineering Design Project
Fall and spring. 6 credits. Prerequisite: admission to the M.Eng.(Agr.) degree program.
Hours to be arranged. D. J. Aneshansley and staff.
Comprehensive design projects dealing with existing engineering problems in the field. Emphasis is on the formulation of alternative design proposals that include consideration of economics, nontechnical factors, engineering analysis, and complete design for the best design solution. Projects are supervised by faculty members on an individual basis. However, there is a formal orientation during the first four weeks of the semester. A formal report and public presentation of the results of the design project are required for completion of the course(s).

652 Instrumentation
Spring. 3 credits. Prerequisites: linear differential equations, Fourier Transforms, experience with computer data-acquisition systems, and introductory biology and electrical science, or permission of the instructor.
Lecs, T R 12:20; lab to be arranged. D. J. Aneshansley.
Application of instrumentation concepts and systems to the measurement of environmental, biological, and agricultural phenomena. Construction and characterization of electronic sensors and transducers will be emphasized. Digital signal conditioning techniques will also be included. A final project is required. Intended for seniors and first-year graduate students.

655 Thermodynamics and Its Applications
Spring. 3 credits. Prerequisite: Mathematics 293 or equivalent.
Lecs, M W F 12:20. J.-Y. Parlange.
Thermodynamics and its applications to problems in engineering and agriculture. Topics include basic concepts (equilibrium, entropy, processes, systems, potentials, stability, phase transitions) and applications (soil and water processes, dilute solutions, electromagnetism, surface phenomena, heat and mass transport, structure of organizations).

665 Engineering Properties of Foods (also Food Science 665)
Fall. 2 credits. Prerequisite: course in transport processes or unit operations as applied to foods; or permission of instructor.
Lecs, T R 12:20. S. S. H. Rizvi, A. K. Datta.
Theories and methods of measurement and prediction of rheological, thermal, and mass transport properties of foods and biomaterial systems. Emphasis is on physical-mathematical basis of the measurement as well as the prediction processes. Examples of appropriate use of these properties in engineering design and analysis of food processes will also be provided.

[671 Analysis of the Flow of Water and Chemicals in Soils
Fall. 3 credits. Prerequisites: two calculus courses and fluid mechanics. Not offered 1989–90.
Lecs T R 3:35–4:50. J.-Y. Parlange, T. S. Steenhuis.
The course encompasses the full range from simple to complex methods to describe the chemical and water flows on the surface, in the vadose zone, and through the aquifer. Current analytical, semi-analytical, and computer-based techniques are discussed. Both homogeneous and heterogeneous soils are analyzed. Offered alternately with Civil and Environmental Engineering 633—a complementary, but not identical, course.]

[672 Drainage
Spring. 4 credits. Prerequisites: Agricultural and Biological Engineering 371 and two calculus courses. Not offered 1989–90.
Lecs, M W F 10:10; lab, T 1:25–4:25. T. S. Steenhuis.
The physics of groundwater flow with specific reference to tile drainage. Critical review of benefits of drainage as well as a thorough analysis of the design of drainage systems. Effects of drainage on water quality will be discussed. Laboratories are used to measure physical parameters used in drainage designs.]

673 Irrigation Systems
Spring. 3 credits. Prerequisite: permission of instructor.
M W F 10:10. M. F. Walter.
An introduction with a systems perspective to the design and implementation of irrigation. Topics include systems planning and appraisal, irrigation structures and measuring devices, water distribution, and scheduling. Emphasis will be on getting a broad understanding of irrigation systems through the use of case studies.

677 Treatment and Disposal of Agricultural Wastes
Spring. 3 credits. Prerequisite: permission of instructor.
3 lecs, hours to be arranged. W. J. Jewell.
Emphasis is on the causes of agricultural waste problems and the application of fundamentals of treatment and control methods to minimize related pollution. Fundamentals of biological, physical, and chemical pollution control methods are applied to wastes from animals, food production, and food and fiber processing, with actual systems as examples.

678 Nonpoint Source Models
Spring. 3 credits. Prerequisites: computer programming and calculus.
Lecs, M W F 11:15. D. H. Haith.
Development and programming of simulation models for management of water pollution from runoff and percolation. Emphasis is on prediction of water and chemical inputs to surface waters and groundwater. Applications include urban and rural runoff, lake eutrophication, groundwater waste loadings from land disposal sites, pesticides and nutrients in agricultural drainage, irrigation return flows, and watershed stream-flow and sediment yield.

[679 Use of Land for Waste Treatment and Disposal
Spring. 3 credits. Prerequisite: permission of instructor. Not offered 1989–90.
Lecs, T R 3:35–4:50. W. J. Jewell.
Covers social, legal, and technical factors; the properties of land and crop systems that make land application of wastes a viable alternative; and the use of fundamentals in the development of regulations and the design of full-scale units.]

682 Building Environment Control
Spring. 3 credits. Prerequisites: one course in building environment control and a course in heat transfer. Offered alternate years.
Hours to be arranged. L. D. Albright.
Topics include thermal interactions of animals and plants with their environments, time-dependent thermal modeling of buildings, natural ventilation processes in buildings, sensors and controllers, and psychrometric processes.

685 Biological Engineering Analysis
Spring. 4 credits. Prerequisite: Theoretical and Applied Mechanics 310 or permission of instructor.
M W F 1:25–2:40. J. R. Cooke.
Engineering problem-solving strategies and techniques are explored. Students solve several representative engineering problems that inherently involve biological properties. Emphasis is on formulation and solution of mathematical models and the interpretation of results. The student's knowledge of fundamental principles is used extensively.

692 Pavement Engineering (also Civil and Environmental Engineering 643)
Fall. 4 credits. Limited to engineering seniors and graduate students. Prerequisite: one introductory course in soil mechanics or highway engineering.
Lecs, M T R 12:20; lab, M 1:25–4:25. L. H. Irwin.
Application of geotechnical engineering principles to the selection of materials and the design of highway and airfield pavements. Laboratory will provide experience with materials testing, asphalt concrete mix design, and chemical soil stabilization. Topics of discussion will include properties of asphalts, aggregates, and bituminous mixture design; base courses and soil stabilization methods; seal-coat design; design of flexible and rigid pavements; design for frost conditions; and pavement evaluation using nondestructive test methods.

700 General Seminar
Fall. No credit. S-U grades only.
M 12:20. Staff.
Presentation and discussion of research and special developments in agricultural and biological engineering and related fields.

701 Special Topics in Agricultural and Biological Engineering
Fall or spring. 1–6 credits. Prerequisite: permission of instructor. S-U grades optional.
Hours to be arranged. Staff.
Topics are arranged by the staff at the beginning of the term.

750 Orientation for Research
Fall. 1 credit. Limited to newly joining graduate students. S-U grades only.
Lecs, first 7 weeks, M 3:35; remainder to be arranged. W. W. Gunkel.
An introduction to departmental research policy, programs, methodology, resources, and degree candidates' responsibilities and opportunities.

754 Sociotechnical Aspects of Irrigation (also Rural Sociology 754 and Agricultural Economics 754)
Spring. 3 credits.
Hours to be arranged. M. F. Walter, T. S. Steenhuis, R. Barker, E. W. Coward, Jr., N. Uphoff.
Examines irrigated agriculture and its relation to agricultural development. Emphasis on social processes within irrigation systems and interactions with the social setting. The course provides an opportunity to examine systematically the institutional and organizational policy issues associated with the design and operation of systems of irrigated agriculture.

761 Power and Machinery Seminar
Spring. 1 credit. Limited to graduate students. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged. W. W. Gunkel.
Study and discussions of research and new developments in agricultural power and machinery.

771 Soil and Water Engineering Seminar
Fall and spring. 1–3 credits. Prerequisite: graduate status or permission of instructor. S-U grades optional.
Hours to be arranged. T. S. Steenhuis, M. F. Walter, J.-Y. Parlange.
Study and discussion of research or design procedures related to selected topics in irrigation, drainage, erosion control, hydrology, and water quality.

775 Agricultural Waste Management Seminar
Spring. 1 credit. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged. Staff.
Management of agricultural wastes, with emphasis on physical, chemical, biological, and economic factors affecting waste production, treatment and handling, utilization, and disposal.

781 Agricultural Structures and Related Topics Seminar
Spring. 1 credit. Prerequisite: graduate status or permission of instructor. S-U grades only.
Disc to be arranged. K. G. Gebremedhin.
Consideration of farmstead production systems, with emphasis on biological, economic, environmental, and structural requirements.

785 Biological Engineering Seminar
Spring. 1 credit. Prerequisite: graduate status or permission of instructor. S-U grades only.
Disc to be arranged. J. R. Cooke.
The interactions of engineering and biology, especially the environmental aspects of plant, animal, and human physiology, are examined in order to improve communication between engineers and biologists.

AGRICULTURAL ECONOMICS

W. G. Tomek, chair; D. J. Allee, B. L. Anderson, R. D. Aplin, R. Barker, N. L. Bills, D. Blandford, R. N. Boisvert, J. Brake, K. Bryant, J. B. Bugliari, D. L. Call, G. L. Casler, L. D. Chapman, G. J. Conneman, J. Conrad, H. de Gorter, W. Earle, E. E. Figueroa, O. D. Forker, G. A. German, D. A. Grossman, R. Herdt, M. Hubbert, H. M. Kaiser, R. J. Kalter, W. A. Knoblauch, S. C. Kyle, E. L. LaDue, D. Lee, W. H. Lesser, E. W. McLaughlin, R. A. Milligan, T. D. Mount, A. M. Novakovic, P. Pinstrup-Andersen, T. T. Poleman, J. Pratt, C. Ranney, D. G. Sisler, B. F. Stanton, D. Streeter, L. Tauer, E. Thorbecke, C. van Es, G. B. White, L. S. Willett, K. Wing

150 Economics of Agricultural Geography

Fall. 3 credits.
Lecs, M W F 11:15. 2 evening prelims. J. Sinner.

The economics and geography of world agriculture, providing a basis for understanding past development and future changes. Elementary economic principles, historical development, physical geography, and population growth are studied in their relation to agricultural development and the economic problems of farmers. Where possible, current domestic and foreign agricultural issues are used to illustrate principles.

220 Introduction to Business Management

Fall. 3 credits.
Lecs, M W F 10:10 or 11:15; disc, M 2:30–4:25 or 7:30–9:25 p.m. (3 secs); T 8–9:55, 12:20–2:15, 1–2:55, or 2:30–4:25; W 8–9:55, 10:10–12:05, 2:30–4:25, 7:30–9:25 p.m. (2 secs); R 8–9:55 or 2:30–4:25. In weeks when discs are held, there will be no W lecture. Discs are held instead of a lecture in all but four weeks of the term. 2 evening prelims. R. D. Aplin.

Principles and tools useful in performing four major functions of management: planning, organizing, directing and leading, and controlling. Within this framework, consideration is given to the firm's internal and external environments; forms of business ownership; financial statements; cost behavior; and a few key concepts and tools in financial management.

221 Financial Accounting

Spring. 3 credits. Not open to freshmen.
Lecs, M F 10:10 or 11:15; lab, T 10:10–12:05 (2 secs), 12:20–2:15, or 2:30–4:25; W 10:10–12:05 (2 secs), 12:20–2:15 (2 secs), 2:30–4:25 (2 secs), or 7–9 p.m. (3 secs); R 10:10–12:05, 12:20–2:15, or 2:30–4:25. 2 evening prelims and a comprehensive final. M. Hubbert.

A comprehensive introduction to financial accounting concepts and techniques, intended to provide a basic understanding of the accounting cycle, elements of financial statements, and statements interpretation.

240 Marketing

Spring. 3 credits.
Lecs, M W F 11:15; lab, M 2:30–4:25, T 12:20–2:15 or 2:30–4:25, W 2:30–4:25, R 12:20–2:15 or 2:30–4:25, or F 10:10–12:05. In weeks labs are held, there will be no F lecture. G. A. German.

An introductory study of the food marketing system and the society it serves, including the goals and practices of producers and marketers (in such areas as buying and selling, grading, transporting, packaging, and advertising), price-making institutions (such as commodity futures markets), the behavior and purchasing practices of consumers, and the interrelationships among those groups.

252 Natural Resource and Environmental Economics

Spring. 3 credits. Prerequisite: Economics 101.
Lecs, M W F 9:05. D. Chapman.

An introduction to the concepts and methods of analysis in the public and private use of resources, particularly benefit-cost analysis and discounting. Major current problems in utilities, water quality, agriculture, conservation, and global petroleum resources. The growing world trade in resource-intensive manufactured products and the impact on income, employment, and pollution. Comparative resource use and environmental protection in industrialized and developing countries.

302 Farm Business Management

Fall. 4 credits. Not open to freshmen. This course is a prerequisite for Agricultural Economics 402 and 405.
Lecs, M W F 10:10; lab, T W or R 1:25–4:25. On days farms are visited, the lab period is 1:25–5:30. W. A. Knoblauch.

An intensive study of problems associated with planning, organizing, operating, and managing a farm business, with emphasis on the tools of managerial analysis and decision making. Topics include management information systems, business analysis, budgeting, and acquisition, organization, and management of capital, labor, land, and machinery.

310 Introductory Statistics

Spring. 4 credits. Prerequisite: Education 115 or equivalent level of algebra.
Lecs, M W F 1:25; lab T 9:05–11 or 1:25–3:20 (2 labs); W 11:15–1:10 or 2:30–4:25 (2 labs); or R 9:05–11 or 2:30–4:25 (2 labs). Evening exams. C. van Es.

An introduction to statistical methods. Topics to be covered include the descriptive analysis of data, probability concepts and distributions, estimation and hypothesis testing, regression, and correlation analysis. Applications from business, economics, and the biological sciences are used to illustrate the methods covered in the course.

320 Business Law

Fall. 3 credits. Limited to juniors, seniors, and graduate students.
Lecs, M W F 9:05. 1 evening prelim. J. B. Bugliari and D. A. Grossman.

Consideration is given chiefly to legal problems of particular interest to persons who expect to engage in business. Emphasis is on the law pertaining to personal property, contracts, agency, real property, and the landlord-tenant relationship.

321 Law of Business Associations

Spring. 3 credits. Limited to juniors, seniors, and graduate students. Prerequisite: Agricultural Economics 320 or permission of instructor. 321 and 420 may be taken concurrently.
Lec, T R 2:30–4. 1 evening prelim. J. B. Bugliari.

The first portion of this course examines the formation and operation of business enterprises, particularly partnerships and corporations. The second portion of the course will review government regulations and control of business organizations. Special attention will be given to the antitrust laws, consumer protection legislation, and environmental protection legislation.

322 Taxation in Business and Personal Decision Making

Spring. 3 credits. Recommended: background in accounting and business law.
Lecs, M W 2:30–4. D. A. Grossman.

The impact of taxation on business and personal decision making. After a brief discussion of tax policy, an in-depth examination is conducted of federal income and estate and gift taxes affecting individuals and business entities. Both tax management and tax reporting are stressed.

323 Managerial Accounting

Fall. 3 credits. Prerequisite: Agricultural Economics 221 or equivalent.
Lecs, M W 12:20 or 1:25; disc, R 8–9:55,10:10–12:05,12:20–2:15 (2 secs), or 2:30–4:25; or F 10:10–12:05, 12:20–2:15, or 1:25–3:20. 2 evening prelims and a final exam. M. Hubbert.

An introduction to cost accounting that emphasizes the application of accounting concepts to managerial control and decision making. Major topics include product costing, standard costing, cost behavior, cost allocation, budgeting, inventory control, variance analysis, measuring divisional performance, and accounting systems in the manufacturing environment. Limited use of Lotus on the IBM PC.

324 Financial Management

Spring. 4 credits. Prerequisite: Agricultural Economics 220 or equivalent. Recommended: Agricultural Economics 221 and 310 or equivalents.
Lecs, M W F 9:05; disc, W 2:30–4:25 or R 9:05–11, 12:20–2:15, or 2:30–4:25, or F 10:10–12:05 or 12:20–2:15. 2 evening prelims. B. L. Anderson.

Focuses on three major questions facing management: how to evaluate capital investment decisions, how to raise the capital to finance those investments, and how to generate sufficient cash flows to meet the firm's cash obligations. Major topics include methods to analyze capital decisions, impact of taxes, techniques for handling risk and uncertainty, effects of inflation, sources and costs of debt and equity, capital structure, leverage, and working capital management. Microcomputers are used for analyzing financial problems. No previous computer experience is required.

[332 Economics of the Public Sector
Spring. 3 credits. Limited to 150 juniors and seniors. Prerequisite: Economics 101 or equivalent. Not offered 1989-90.

Lecs, T R 12:20–2:15. C. Ranney.

The application of economic concepts to evaluation of the structure and performance of the public sectors of the economy. Emphasis on microeconomic analysis of public finance and public resource allocation. Principal topics: market failure, articulation of public choice and interests, evaluation of public decisions, and current public policy.]

340 Futures and Options Trading
Spring. 2 credits. Restricted to seniors. Prerequisites: Economics 101 and Agricultural Economics 240.

Lec, T R 12:20–2:15. D. Streeter.

The focus of the course is on the use of agricultural financial futures and options as marketing and management tools. A primary objective is to understand how companies, financial institutions, and farm businesses can employ hedging strategies to manage risk. All but the final lecture will be held during weeks 1–7. During weeks 7–15 students will participate in a computerized simulated hedging exercise, with a concluding lecture in week 15.

341 Personal Enterprise and Small Business Management
Spring. 3 credits. Limited to juniors and seniors. Prerequisites: Agricultural Economics 220 and 221 or permission of instructor.

Lec, M W 11:15–12:45 or M W 2:30–4. Staff.

Designed to acquaint students with the role of small business in the American economy. Special emphasis on the problems related to starting a new business, including financing strategic planning, staffing, marketing, and managing growth. The term project will be group development of a business plan. Visiting entrepreneurs will illustrate a variety of business formats.

342 Marketing Management
Fall. 3 credits. Limited to ALS majors. Prerequisites: Agricultural Economics 240 and Economics 101–102.

Lecs, M W F 10:10; disc, R 12:20–1:50 or 2:30–4 (3 secs), F 10:10–11:40 (2 secs), or 12:20–1:50 (2 secs). In weeks discs are held, there is no F lecture. R. Christy.

Deals with principles and practices in the firm's management of the marketing function. Emphasizes the management aspects of marketing by considering sales forecasting and strategies in product and brand selection, pricing, promotion, and channel selection. Identification and generation of economic data necessary for marketing decisions are considered. Public policy and ethical dimensions of marketing are examined.

346 Dairy Markets and Policy
Spring. 2 credits. Limited to juniors and seniors. Prerequisite: Economics 101.

Lecs, T R 9:05. A. M. Novakovic.

A review of the structural characteristics of the dairy industry and an analysis of policy issues, pricing systems, and government programs, including marketing orders, price supports, and import policies.

347 Marketing Fruits, Vegetables, and Ornamental Products
Fall. 3 credits. Prerequisite: Agricultural Economics 240 or equivalent. S-U grades optional.

Lec M W F 12:20. A field trip of one or two days. E. E. Figueroa.

A study of fruits, vegetables, and ornamental markets, including seasonal variations. Role of market intermediaries, role of government agencies, and the price discovery process. Discussion and description of horticultural product market orders in the U. S. The emerging importance of interregional and international markets.

380 Independent Honors Research in Social Science
Fall or spring. 1–6 credits. Limited to students who have met the requirements for the honors program. A maximum of 6 credits may be earned in the honors program.

402 Advanced Farm Business Management
Spring. 3 credits. Prerequisite: Agricultural Economics 302 or equivalent.

Lecs, M W 9:05; disc, W 1:25–3:20. G. L. Casler.

Emphasis is on evaluating the profitability of alternative investments and enterprises. Principal topics include strategic planning, the effects of income taxes on investment decisions, capital investment analysis, linear programming, labor management, and financial risk and uncertainty. Experience in computer applications to farm business management is provided. Previous computer experience is not required.

405 Farm Finance
Spring. 4 credits. Prerequisite: Agricultural Economics 302 or equivalent.

Lecs, T R 11:15, W 1:25; disc, W 2:30–3:20. 2 evening prelims. E. L. LaDue.

The principles and practices used in financing farm businesses, from the perspectives of the farmer and the farm lender. Topics include sources of capital, financing entry into agriculture, financial analysis of a business, capital management, financial statements, credit instruments, loan analysis, financial risk, and leasing.

406 Farm and Rural Real Estate Appraisal
Spring, weeks 7–15. 2 credits. Limited to 45 students. Prerequisites: Agricultural Economics 302 or equivalent and permission of instructor.

Lec, R 11:15; lab, R 1:25–5:30. 6 half-day field trips, 1 all-day field trip. G. J. Conneman.

The basic concepts and principles involved in appraisal. Factors governing the price of farms and rural real estate and methods of valuation are studied. Practice in appraising farms and other rural properties.

407 Advanced Agricultural Finance Seminar
Spring. 2 credits. Limited to 16 seniors with extensive course work in farm management and farm finance. Open by application prior to March 1 of the year before the course is offered.

W 3:35–5:30. E. L. LaDue.

A special program in agricultural finance, conducted with financial support from the Farm Credit System. Includes two days at Farm Credit Banks of Springfield, one week in Farm Credit Association offices, an all-day field trip observing FHA financing during fall term, a four-day trip to financial institutions in New York City during intersession, and lecture-discussions in the spring term. Representatives from banking, agribusiness, finance, and similar areas participate in spring-term lecture-discussion sessions.

408 Seminar in Farm Business Decision Making
Fall (1 week in intersession). 1 credit. Prerequisites: Agricultural Economics 302 and 405 or equivalent, and permission of instructor.

M T W R F 8–5. G. J. Conneman.

Develops method of analyzing farm business management problems. Gives student experience in identifying alternatives in problem solving. Provides opportunities to analyze and evaluate actual farm situations. Two field trips and intensive work with a farm family.

409 Farm Management Workshop
Fall. 1 credit. Limited to seniors and graduate students.

T 12:20-2. B. F. Stanton and staff.

Presentation and interpretation of research in farm management and production economics. Participants conduct seminars reporting on research methodology and results obtained. Students prepare a summary and evaluation of a recent research publication during the semester.

410 Business Statistics
Spring. 3 credits. Prerequisite: Agricultural Economics 310 or equivalent.

Lecs, M W F 10:10. C. van Es.

This course focuses on five major topics used to analyze data from marketing research, business, and economics. Topics studied are: survey sampling procedures, nonparametric methods, index numbers, time series and forecasting, and experimental design and ANOVA. The course will involve a research project designed to give experience in collecting and interpreting data.

411 Financial Management in Farming
Fall. Weeks 1–9. 2 credits. Limited to ALS majors. Prerequisite: Agricultural Economics 405.

Lecs, M W F 1:25. J. R. Brake.

Financial markets and policies affecting agriculture and farmers. How money and capital markets offset credit cost and availability in agriculture. Insurance concepts for farmers. Financial considerations in starting to farm. Issues in choice of farm organizational structure.

412 Introduction to Mathematical Programming
Fall. 3 credits. Primarily for juniors, seniors, and M.S. degree candidates. Prerequisite: Agricultural Economics 310 or equivalent.

Lecs, M W 9:05; lab, W 12:20-2:15. H. M. Kaiser.

This is primarily a course in applied linear programming, but some basic nonlinear programming techniques will be covered. The links between theoretical and empirical models are stressed in this course. Emphasis will be placed on model building, estimation, and interpretation of results. Some topics include applied linear, quadratic, and integer programming to agricultural and nonagricultural decision-making problems.

415 Price Analysis
Fall. 3 credits. Prerequisite: an introductory course in economics, such as Economics 101–102. S-U grades optional.
Lecs, M W F 11:15. L. S. Willett.
The focus of this course is on the analysis of supply and demand characteristics of commodities with particular attention to agricultural products. Institutional aspects of pricing farm and food products, temporal and spatial price relationships, price forecasting, and the economic consequences of pricing decisions are included.

416 Introduction to Econometrics
Spring. 3 credits. Prerequisite: Agricultural Economics 310 or equivalent. Recommended: Agricultural Economics 415.
Lecs, T R 10:10–11:25. J. Pratt.
The course introduces students to basic econometric principles and the use of statistical procedures in empirical studies of demand, supply, and price behavior. Assumptions, properties, and problems encountered in the use of multiple linear regression procedures are discussed, and simultaneous equation models are introduced. Emphasis is given to regression applications in agricultural product markets, business, and consumer demand. Students are required to specify, estimate, and report the results of an empirical model.

418 Information Systems and Decision Analysis
Spring. 3 credits. Prerequisites: Agricultural and Biological Engineering 102 or equivalent, Economics 101 or equivalent, and Agricultural Economics 310.
Lecs, M W 11:15; disc hours to be arranged. D. Streeter.
The focus of the course is on management decision making and the support provided by management information systems. The student will learn the behavioral assumptions made in economics about decision making and the decision rules that result. Techniques for implementing the decision rules will be introduced (decision trees, network analysis, Markov analysis, sensitivity analysis), as well as the statistical techniques (simulation, forecasting) used to produce the information necessary to the decision process. The topics will be discussed in a variety of decision settings (inventory, congestion, planning, and scheduling).

420 Advanced Business Law
Spring. 3 credits. Limited to juniors, seniors, and graduate students.
Lecs, T R 8:30–9:55. One evening prelim. J. B. Bugliari.
Designed to provide a fairly detailed and comprehensive legal background in areas of commercial law affecting the operation of business enterprises. Particular consideration is given to the law pertaining to bailments, sales, secured transactions, bankruptcy, and commercial paper.

422 Estate Planning
Fall. 1 credit. Limited to upperclass students. S-U grades only.
Lec, M 4. J. B. Bugliari.
Fourteen sessions on the various aspects of estate-planning techniques. The law and use of trusts, the law of wills, federal and New York State estate and gift taxes, and probate procedures are covered.

424 Business Policy
Spring. 3 credits. Limited to seniors majoring in business management and marketing.
T R 9:05–10:35, 11:05–12:35, or 2:30–4. R. D. Aplin.
An integrating course that examines business policy formulation and implementation from the standpoint of the general manager of an organization, focusing on decision making and leadership. The course is built around a series of cases. Several guest executives. Emphasizes improving oral and written communication skills.

426 Cooperative Strategies
Spring. 3 credits.. Recommended: Agricultural Economics 220 or equivalent.
Lecs, M W F 12:20. Evening prelim. B. L. Anderson.
Investigates the unique aspects of cooperative business organizations. Topics are approached from the points of view of management, the board of directors, and members and include cooperative principles, legislation, taxation, as well as cooperative management, financial and marketing strategies. Primary focus is on operating cooperatives in agriculture and the strategic alternatives they face.

431 Farm and Food Policies
Fall. 3 credits.
Lecs, T R 9:05; disc, R 11:15 or 1:25, or F 10:10. B. F. Stanton.
The course deals broadly with farm and food policies, including price support and storage or reserve policies, agricultural protection, soil conservation programs, the structure of agriculture, and domestic food subsidy programs. The importance of international trade and agricultural policies in other countries is emphasized.

443 Food-Industry Management
Spring. 4 credits. Limited to juniors and seniors. Prerequisite: Agricultural Economics 448 or 342 or permission of instructor.
Lecs, T R 9:05–10:35; sec, T 2–3:30. G. A. German.
A case-study approach is used to examine the application of management principles and concepts to marketing and distribution problems of the food industry. Cases covering new product introductions, merchandising strategies, and investment decisions are included. Guest speakers from the food industry present case-study solutions at the Tuesday session.

445 Counseling Small Business
Fall. 3 credits. Prerequisites: Agricultural Economics 220, 221, and 341 and permission of instructor.
Lec, M 2:30–4. Staff.
Allows students to serve as consultants to small businesses throughout New York State. Provides the opportunity to identify and confront problems facing small personal enterprises. Encourages the application of basic business courses to an actual business and the witnessing, first hand, of the results of firm-level decision making. Student teams meet with the instructor at predesignated times throughout the semester.

448 Food Merchandising
Fall. 3 credits. Limited to juniors and seniors. Prerequisite: Agricultural Economics 240.
Lecs, T R 10:10–11:25. G. A. German.
Merchandising principles and practices as they apply to food industry situations. The various elements of merchandising are examined, including buying, pricing, advertising, promotion, display, store layout, profit planning and control, and merchandising strategy. The consequences of food industry trends and initiatives for other industry members, public policymakers, and consumers are considered.

[449 Applications in Strategic Marketing
Fall. 2 credits. Prerequisite: Agricultural Economics 342 or permission of instructor. Cost of field trips, about $250. Not offered 1989–90.
W 2:30–4. Two 1-day field trips to the upstate area and a 3-day trip to the New York City area during intersession, just prior to registration. E. W. McLaughlin.
Focuses on the major components of strategic marketing with an applied orientation: product mix, distribution, pricing, advertising and promotion, and market research. Students are given firsthand exposure to a wide range of marketing strategies through field trips, guest lectures, case studies, group exercises, and development of a strategic marketing plan.]

452 Resource Economics
Fall. 3 credits. Prerequisites: Mathematics 111 and Economics 311.
Lecs, T R 10:10; disc, M or T 2:30. J. Conrad.
This course develops economic models for renewable resources, exhaustible resources, and environmental quality. Applications to fisheries, forestry, oil and gas, and air and water pollution are presented. Emphasis is on the microeconomic foundations in resource economics and the policy implications for resource management.

[454 The History and Economics of Whaling in North America (also History 416)
Spring. 4 credits. Prerequisites: Economics 101–102. Offered alternate years. Not offered 1989–90.
Lec, T R 2:30–4:20. D. Usner, J. Conrad.
The whaling industry of 19th-century America is a rich source of documents and data describing the people, resources, and technology that contributed to the development of the United States. Social relations, cross-cultural influences, economic motivations, prices, markets, resource dynamics, and technical change will be examined during the rise and fall of this unique American industry.]

455 Agricultural Law
Spring. 3 credits. Limited to juniors, seniors, and graduate students.
Sems, M W F 10:10. D. A. Grossman.
Law and government regulation as they apply to agriculture and the use of land for agricultural production. An overview of legal issues in installment sales and financing, farm leases, warehousing, cooperatives, employment, soil and water management, farm lands preservation and use, and ownership of animals.

464 Economics of Agricultural Development
Spring. 3 credits. Prerequisites: Agricultural Economics 150, Economics 101–102, or permission of instructor.
Lecs, T R 9:05–10:20. S. Kyle.
This course is designed to provide an understanding of the economics of the agricultural sector in low-income countries. In addition, more general issues of economic development beyond the agricultural sector will be covered in order to provide the necessary context for an understanding of rural problems. Among the areas covered are the nature of development and technical change, welfare and income distribution, land reform, food and nutrition policy, food security and food aid, competition with more developed countries and international markets, the effect of U.S. policy on agricultural development, and the role of international institutions such as the World Bank. Examples from a wide variety of developing countries will be used to illustrate the basis for economic analysis.

497 Special Topics
Fall or spring. Variable credit. Written permission from the staff member who will supervise the work and assign the grade must be attached to course enrollment material.
Hours to be arranged. Staff.
Special projects designed by faculty members to supplement existing classes.

498 Supervised Teaching Experience
Fall or spring. 1–3 credits. Total of 4 credits maximum during undergraduate program.
Hours to be arranged. Staff.
Designed to give qualified undergraduates experience through actual involvement in planning and teaching courses under the supervision of department faculty. Students are expected to actually teach at least one hour per week for each credit awarded. Students cannot receive both pay and credit for the same hours of preparation and teaching.

499 Undergraduate Research
Fall or spring. 1–4 credits. Limited to seniors with grade-point averages of at least 2.7. Prerequisite: written permission of the staff member who will supervise the work and assign the grade; this permission must be attached to course enrollment material. S-U grades optional.
Permits outstanding undergraduates to carry out independent study of suitable problems under appropriate supervision.

[605 Agricultural Finance and Capital Management
Fall. 3 credits. Prerequisite: Agricultural Economics 402 or 405, or equivalent. Offered alternate years. Not offered 1989–90. $25 charge for reading materials; no text.
T R 8:40–9:55. J. Brake, L. Tauer, E. LaDue.
Advanced topics in capital management and financing of agriculture. Special emphasis on current issues. Example topics: farm-sector funds flows, financial risk and decision analysis, agricultural finance policy, financial intermediation and intermediaries, firm growth, inflation investment-replacement models, and selected topics on financing agriculture in developing countries.]

608 Production Economics
Fall. 3 credits. Prerequisite: Economics 311 or equivalent. Recommended: Mathematics 111 or equivalent.
Lecs, M W F 10:10. L. W. Tauer.
The theory of production economics with emphasis on applications to agriculture. Topics include the derivation, estimation, and use of production, cost, profit, demand, and supply functions. Production response over time and under risk is introduced.

630 Policy Analysis I: Welfare Theory, Agriculture, and Trade
Spring. 4 credits. Prerequisites: Agricultural Economics 608 or Consumer Economics 603, Economics 313, or equivalent intermediate micro theory incorporating calculus.
Lecs T R 8–9:55. H. de Gorter.
The first half of the course surveys the theory of welfare economics as a foundation for public policy analysis. Major issues addressed include the problem of social welfare measurement, the choice of welfare criteria, and the choice of market or nonmarket allocation. Basic concepts covered include measurement of welfare change, including the compensation principle, consumer and producer surplus, willingness-to-pay measures, externalities, and the general theory of second-best optima. The second half of the course focuses on public policy analysis as applied to domestic agricultural policy and international trade. The domestic policy component examines major U.S. farm commodity programs and related food and macroeconomic policies and analyzes their effects on producers, consumers, and other groups. The international trade component examines the structure of world agricultural trade, analytical concepts of trade policy analysis, and the principal trade policies employed by countries in international markets.

631 Policy Analysis II: Resources and Agricultural Development
Fall. 4 credits. Prerequisite: Agricultural Economics 630.
Lecs, T R 8–9:55. D. Chapman, D. Blandford.
The first half of this course covers issues related to natural resources. Beginning with an overview of benefit-cost analysis and project evaluation, the course continues by considering global and transnational resource topics including exhaustible and renewable resource theory, externalities, and international environmental problems. Issues related to the role of resources in development. The second half of the semester focuses on the analysis of policies for agricultural growth and development. Theories of growth and agriculture's role in the development process are discussed. Macroeconomic and sectoral policies affecting production, consumption, and trade are evaluated.

640 Analysis of Agricultural Markets
Fall, weeks. 1–7. 2 credits. Prerequisites: Agricultural Economics 415 and 416 or equivalents.
Lecs, T R 12:20–2:15. L. Willett.
This course is about markets for agricultural products. Focus is placed on identifying their distinguishing characteristics, establishing criteria for evaluating performance, analyzing models for price determination and farm-retail marketing margins, and evaluating selected public-policy issues related to market performance.

641 Commodity Futures Markets
Fall, weeks 8–14. 2 credits. Prerequisites: Agricultural Economics 415 and 416 or equivalents. Recommended: Agricultural Economics 640.
Lecs, T R 12:20–2:15. W. G. Tomek.
This course is primarily about markets for agricultural futures contracts. Emphasis is placed on price behavior on cash and futures markets and the relationships among prices. These principles provide a foundation for a discussion of hedging, speculation, and public-policy issues.

643 Export Marketing
Fall. 3 credits. Prerequisite: graduate or upperclass standing. Estimated cost of field trip, $150.
Lec, R 2:30–4:45. Overnight field trip to New York City required. W. H. Lesser.
An exploration of the processes and procedures for export marketing. Emphasis is placed on financing arrangements and on alternative risk-reducing strategies. Organization for export marketing is discussed along with government export-promotion programs. This course is intended to provide practical information on the process of marketing overseas. Students participate in a custom-developed, competitive export-trading simulation.

651 Economics of Resource Use
Fall. 4 credits. Economics 509 or Agricultural Economics 452 recommended.
Lec-sem, hours to be arranged.
D. Chapman.
Introduction to recent literature on theory and applied analysis. Dynamic optimization and resource use, externality theory and its application to environmental economics. Principles of utility regulation. Ecosystem modeling. Economic growth and resource use. Selected topics.

652 Land Economics Problems
Fall or spring. 1 or more credits. Limited to graduate students. Prerequisite: permission of instructor. S-U grades optional.
Hours to be arranged. D. J. Allee.
Special work on any subject in the field of land economics.

660 Food, Population, and Employment
Fall. 4 credits. Enrollment limited to 15 to ensure that students have an opportunity to work individually with instructor.
M W 2:30–4 and an individual weekly meeting with the instructor.
T. T. Poleman.
Designed to introduce first-year graduate students to the interrelated problems of food, population, and employment in developing countries. Food economics and the world food situation are treated as cornerstones. Emphasis is given to the techniques for preparing a research proposal or paper.

[663 Macroeconomic Issues in Agricultural Development
Fall. 3 credits. Prerequisite: permission of instructor. S-U grades optional. Offered alternate years. Not offered 1989–90.
Lec to be arranged. E. Thorbecke.
Issues such as the role of agriculture in economic development, the household farm as a producing and consuming unit, operation of product and factor markets in agricultural and rural areas, structural transformation of agriculture in the process of economic development, theories of agricultural

development, and agricultural and rural development strategies and models. The approach followed is theoretical, quantitative, and empirical.]

664 Microeconomic Issues in Agricultural Development
Spring. 3 credits. Prerequisite: Agricultural Economics 608, Economics 311, or permission of instructor. S-U grades optional.
T R 4:30–5:55. R. Barker.
Issues such as production efficiency, induced technological change, allocation of research resources, and the distribution of benefits from new technology are discussed. The theoretical argument is related to applied research problems.

685 Food and Nutrition Policy (also Nutritional Sciences 685)
Fall. 3 credits. Prerequisites: Consumer Economics 603 or Economics 313 or Agricultural Economics 415 or equivalent, and knowledge of multiple regression.
Lecs, M W 1:25–2:40.
P. Pinstrup-Andersen.
The course will identify the principal links between human nutrition and government action, with emphasis on developing countries. The process of policy formation, including economic and political factors, will be discussed. Political economy issues, including the influence of and conflict among interest groups and rent-seeking behavior related to food and nutrition policies and programs, will be analyzed. The role of nutrition information and surveillance in policy design, implementation, and evaluation will be analyzed along with methodologies for empirical analysis of food and nutrition policy. Findings and analytical methodologies from case studies in developing countries will be used, as appropriate. The role of improved nutrition in economic development both as an indicator of welfare and as a productivity-enhancing factor as well as basic relationships among nutrition, poverty, food, health, and household behavior will be briefly presented at the beginning of the course to provide a context for policy discussions.

699 M.P.S. Research
1–6 credits. Prerequisite: registration as an M.P.S. student. Credit is granted for the M.P.S. project report.

700 Topics in Agricultural Economics
Fall or spring. Limited to graduate students. Credit, class hours, and other details arranged with a faculty member.
This course is used to offer special topics in agricultural economics that are not covered in regular class offerings. More than one topic may be given each semester in different sections. The student must register in the section appropriate to the topic being covered; the section number is provided by the instructor.

708 Advanced Production Economics
Fall. 3 credits. Prerequisite: Agricultural Economics 608, 710, or equivalents; Economics 509 is highly recommended. Offered alternate years.
Hours to be arranged. R. N. Boisvert.
Theoretical and mathematical developments in production economics, with emphasis on estimating micro- and macro-production relationships, scale economies, technical change, factor substitution. Recent developments in flexible functional forms, duality and dynamic adjustment models are emphasized. Discussions of several other selected topics such as risk, supply response, and household production functions change from year to year based on student interest.

710 Econometrics I
Spring. 4 credits. Prerequisite: enough preparation in matrix algebra and statistics (e.g., Statistics 417 and 601) to read J. Johnston, *Econometric Methods*, 3d edition, chapters 5ff.
Lecs, T R 2:30–4:25. W. G. Tomek.
This course provides an intermediate-level treatment of the specification, identification, estimation, and evaluation of econometric models. Common econometric problems are treated, including collinearity, specification error, autocorrelated disturbances, lagged variables, errors in variables, and simultaneity. Students seeking an introduction to econometrics should take Agricultural Economics 416.

711 Econometrics II
Fall. 4 credits. Prerequisite: Agricultural Economics 710 or equivalent. Statistics 417 recommended.
Lecs, T R 10:10–12:05. T. D. Mount.
Coverage beyond that of Agricultural Economics 710 of generalized least squares, testing linear hypotheses, the effects of specification errors, and regression diagnostics. Applications include seemingly unrelated regressions, estimation with pooled data, models with stochastic coefficients, models with limited dependent variables, and distributed lag models.

712 Quantitative Methods I
Fall. 4 credits. Prerequisite: some formal training in matrix algebra. A course at the level of Statistics 417 is highly recommended.
Lecs, M W 9:05–11. R. N. Boisvert.
A comprehensive treatment of linear programming and its extensions, including postoptimality analysis, goal programming, and the transportation model. Special topics in nonlinear programming, including separable, spatial equilibrium and risk programming models. Input-output models and their role in social accounting matrices and computable general equilibrium models are discussed. Applications are made to agricultural, resource, and regional economic problems.

713 Quantitative Methods II
Spring. 4 credits. Prerequisites: Economics 509 and Agricultural Economics 710.
Lecs, W F 9:05–11. J. M. Conrad, T. D. Mount.
This course is concerned with the analysis and optimization of dynamic systems. Course objectives are to (1) present the basic theory of dynamical systems and dynamic optimization, (2) introduce associated methods of numerical and econometric analysis, (3) review some applications of dynamic analysis from various subfields in economics, and thereby (4) equip students with basic theory and methods to perform applied research on dynamic allocation problems.

717 Research Methods in Agricultural Economics
Spring. 2 credits. Limited to graduate students.
M 1:25–3:20. B. F. Stanton, D. G. Sisler.
Discussion of the research process and scientific method as applied in agricultural economics. Topics include problem identification, hypotheses, sources of data, sampling concepts and designs, methods of collecting data, questionnaire design and testing, field organization, and analysis of data. During the semester each student develops a research proposal that may be associated with his or her thesis.

730 Seminar on Agricultural Trade Policy
Spring. 3 credits. Limited to graduate students. Prerequisites: Agricultural Economics 630–631 and basic familiarity with quantitative methods.
F 1:25–4. D. Blandford, D. G. Sisler.
A discussion of selected topics in agricultural trade policy, such as the linkage between domestic agricultural and trade policies, instability and market stabilization, and agricultural trade and development. The preparation of a term paper is an important part of the course.

740 Agricultural Markets and Public Policy
Spring, weeks 1–7. 2 credits. Limited to graduate students. Prerequisite: familiarity with multiple regression techniques at the Agricultural Economics 416 level or higher. Recommended: Agricultural Economics 640.
T R 12:20–2:15. W. H. Lesser.
Develops the concepts and methodology for applying and analyzing the effects of public-policy directives to the improvement of performance in the U.S. food marketing system. Topics include a survey of industrial organization principles, antitrust and other legal controls, and coordination systems in agriculture.

741 Methods of Trade and Commodity Policy Analysis
Spring, weeks 8–14. 2 credits. Limited to graduate students. Prerequisite: familiarity with multiple regression techniques at the level of Statistics and Biometry 601. Recommended: Agricultural Economics 640.
T R 12:20–2:15. D. Blandford.
The nature, use, and usefulness of alternative quantitative methods of trade and commodity policy analysis. Principal topics are the analysis of export supply-import demand for a single country, international commodity models, and macroeconomic or general equilibrium models of commodity trade.

750 Economics of Renewable Resources
Spring. 4 credits. Prerequisites: Economics 509 and 518, or Agricultural Economics 713.
Hours to be arranged. J. M. Conrad.
This course is concerned with the optimal allocation of renewable resources. Bioeconomic models of fishing and forestry are presented along with models of groundwater and residuals (environmental) management. Theory, applications, and management policy are considered.

751 Seminar on Agricultural Policy
Spring. 2 credits. Limited to graduate students. Offered alternate years.
W 12:20–2:15. H. de Gorter.
A review of the professional literature relating to agricultural policy issues and techniques appropriate to the analysis of such issues.

754 Sociotechnical Aspects of Irrigation (also Rural Sociology 754 and Agricultural and Biological Engineering 754)
Spring. 3 credits. S-U grades optional.
Hours to be arranged. R. Barker, E. W. Coward, Jr., N. T. Uphoff, M. F. Walter.
Examines irrigated agriculture and its relation to agricultural development. Emphasis on social processes within irrigation systems and interactions with the social setting. The seminar provides an opportunity to examine systematically the institutional and organizational policy issues associated with the design and operation of systems of irrigated agriculture.

[763 Macro Policy in Developing Countries
Spring. 3 credits. Prerequisites: Economics 509, 510, 513 (may be taken concurrently), or permission of instructor. Offered alternate years. Not offered 1989–90.
Lecs, T R 12:20–1:35. S. Kyle.
This course examines macroeconomics policies in developing countries and their interaction with economic growth, development, and stability. First, theoretical models useful for analysis of macro policies will be covered, followed by an examination of empirical studies. Emphasis will be on research topics of current interest to students and professionals in the field, particularly those relating to the interaction of macro policy with micro and sectoral analysis.]

AGRONOMY

R. J. Wagenet, chair; M. Alexander, P. C. Baveye, D. R. Bouldin, R. B. Bryant, S. J. Colucci, W. J. Cox, S. D. DeGloria, J. D. DiTomaso, J. M. Duxbury, G. A. Ferguson, G. W. Fick, D. L. Grunes, R. R. Hahn, J. L. Hutson, S. D. Klausner, W. W. Knapp, L. V. Kochian, T. A. LaRue, D. J. Lathwell, A. C. Leopold, D. L. Linscott, R. F. Lucey, D. V. Lynch, M. B. McBride, J. Mt. Pleasant, R. L. Obendorf, W. D. Pardee, J. H. Peverly, W. R. Philipson, W. S. Reid, S. J. Riha, T. W. Scott, R. R. Seaney, T. L. Setter, P. L. Steponkus, H. M. van Es, A. Van Wambeke, W. J. Waltman, R. M. Welch, D. S. Wilks, M. J. Wright, M. W. Wysocki, R. W. Zobel

Courses by Subject

Crop Science: 311, 312, 314, 315, 317, 607, 608, 610, 611, 612, 613, 614, 642, 690

Meteorology: 131, 232, 250, 334, 351, 353, 354, 435, 437, 441–442, 447, 450, 451, 452

Remote Sensing: 660, 661, 662

Soil Science: 190, 260, 321, 361, 362, 372, 373, 385, 465, 466, 471, 476, 477, 483, 663, 666, 667, 669, 675, 676, 771, 774

131 Basic Principles of Meteorology
Fall. 3 credits. Limited to 75 students.
Lecs, T R 11:15; lab, T W or R 1:25–4:25. M. W. Wysocki.
A simplified treatment of the structure of the atmosphere: heat balance of the earth; general and secondary circulations; air masses, fronts, and cyclones; and hurricanes, thunderstorms, tornadoes, and atmospheric condensation. In the laboratory, emphasis is on techniques of analysis of weather systems.

190 Food and Fiber Production: Possibilities and Perils
Spring. 2 credits. Limited to 40 students. S-U grades optional.
Lec, T 9:05–9:55; labs, R 9:05–11 or R 1:25–3 :20. T. W. Scott, D. S. Wilks, M. J. Wright.
Crops, climate, and soil are elements of the system that supports civilization. By developing agriculture, people increased their control over crop production. A continual upward trend in population creates the need to explore the limitations of our resources and technology. This course acquaints the student with some important features of crops, climate, soil, and their interactions. The detrimental effects of present agricultural practices on the environment and some proposed solutions will be considered. Laboratory exercises will provide hands-on experience with soil and plant materials and meteorological instruments.

232 Climatology
Spring. 3 credits. Prerequisite: Agronomy 131.
Lecs M W F 11:15. M. W. Wysocki.
The first part of the course is devoted to the description of world climates in terms of the global distribution of radiation, temperature, pressure, wind, precipitation, and air masses. The second part of the course relates climates and climatic anomalies to planetary, regional, and local circulations.

250 Meteorological Observations and Instruments
Spring. 3 credits. Prerequisite: Agronomy 131.
Lecs, M W 12:20; lab, R 1:25–3:20. M. W. Wysocki.
Methods and principles of meteorological measurements and observations, including surface, free-air, and remote systems. Instrument siting, mounting, and protection. Instrument response characteristics, calibration, and standardization. Recorders and data-logging systems. Laboratory exercises in observation and data analysis. Intended to serve as preparation for Observers Examination.

260 Introduction to Soil Science
Spring. 4 credits. Prerequisite: Chemistry 103, 207 or 215. S-U grades optional.
Lecs, M W F 9:05; lab, M T W or R 1:25. Staff.
A comprehensive introduction to the field of soil science, with emphasis on scientific principles and their application to solving practical soil-management problems. The last weeks of the semester will be devoted to several different topics, to provide broad experience in soil science.

311 Grain Crops
Fall. 4 credits. Prerequisite: Agronomy 260 or Biological Sciences 241.
Lecs, M W F 10:10; lab, M or T 1:25–4:25. 1 or 2 field trips during lab periods (until 5 p.m. or on weekends). R. L. Obendorf.
Principles of field-crop growth, development and maturation, species recognition, soil and climatic adaptations, liming and mineral nutrition, weed control, cropping sequences, management systems, and crop improvement are considered. Grain, protein, fiber, and sugar crops are emphasized.

312 Forage Crops
Spring. 4 credits. Prerequisites: Agronomy 260 or Biological Sciences 241 or equivalent. Recommended: Animal Science 112.
Lecs, M W F 11:15; lab, M or T 1:25–4:25. G. W. Fick.
The production and management of crops used for livestock feed are considered in terms of establishment, growth, maintenance, harvesting, and preservation. Forage grasses, forage legumes, and corn are emphasized, and consideration is given to their value as livestock feed in terms of energy, protein, and other nutritional components.

[314 Production of Tropical Crops
Spring. 3 credits. Prerequisite: a course in crop production. Not offered 1989–90.
Lecs, M W F 10:10. Staff.
An introduction to the characteristics and culture of the principal food staple crops of the tropics and subtropics and of some of the crops grown for export. Vegetables and fruits are not emphasized.]

315 Weed Science
Fall. 3 credits. Prerequisite: introductory course in biology or botany.
Lecs, T R 9:05; lab, M, T, or W 2–4:25. J. DiTomaso.
Principles of weed science are examined. Emphasis is on (a) weed ecology, (b) chemistry of herbicides in relation to effects on the environment and plant growth, and (c) control of weeds in crops. Laboratory covers weed identification and ecology, herbicide selectivity, symptomology, and behavior in soil.

317 Seed Science and Technology
Fall. 3 credits. Prerequisite: Biological Sciences 241 or equivalent. Offered alternate years.
Lecs, T R 11:15; lab, R 1:25–4:25; 2 all-day field trips will be scheduled during the semester. A. G. Taylor, Geneva Experiment Station (Ithaca contact, R. L. Obendorf).
The principles and practices involved in the production, harvesting, processing, storage, testing, quality management, certification, and use of high-quality seed from improved cultivars. Information is applicable to various kinds of agricultural seeds.

321 Soil and Water Management
Spring. 2 credits. Prerequisites: Agronomy 190 or 260. Concurrent registration in Agricultural and Biological Engineering 321 required. S-U grades optional.
Lec, M W 9:05; disc, M 1:25–4:25. T. W. Scott, M. F. Walter, R. T. Oglesby.
An interdisciplinary course intended to introduce students to the general principles of soil and water interaction and to the effects of human intervention in these processes. Aspects of soil and water management, including hydrology, soil erosion, irrigation, drainage, and water quality are examined. Case studies from both the United States and the tropics are used to illustrate basic principles.

334 Agricultural Meteorology
Spring. 3 credits. Recommended: a previous course in physics.
T R 10:10–11:25. D. S. Wilks.
An introduction to the relationships of radiant energy, temperature, wind, and moisture in the atmosphere near the ground. The interplay between physical processes of the atmosphere, plant canopies, and soil is examined. Moisture relationships in the atmosphere-soil-plant continuum, the effects of environmental modification, and the bioclimatic requirements of plants are also discussed.

351 Synoptic Meteorology I
Fall. 3 credits. Prerequisites: Agronomy 131 and one year of calculus.
Lecs, T R 9:05; lab, M 1:25–3:20.
S. J. Colucci.
An introduction to the tools and principles of weather forecasting and analysis. Vorticity, divergence, and deformation theorems applied to the problems of cyclogenesis, vertical celocity, and frontogenesis. National Meteorological Center DIFAX products, GOES visible and infrared satellite images, digital and Doppler radar.

353 Forecasting and Dynamics Lab I
Fall. 2 credits. Prerequisites: Agronomy 131 and concurrent registration in Agronomy 441.
Lec, T 12:20; lab, F 1:25–3:20.
M. W. Wysocki.
Weather briefings by the instructor based upon real-time operational guidance. Computer tutorials in thermodynamics, including sounding diagrams, stability indices, and static energy terms.

354 Forecasting and Dynamics Lab II
Spring. 2 credits. Prerequisites: Agronomy 353 and concurrent registration in Agronomy 442.
Lec, T 12:20; lab, F 1:25–3:20.
M. W. Wysocki.
Weather discussions prepared by students. Computer tutorials in hydrodynamics, including vorticity and divergence computation, geostrophic and thermal wind concepts, and Richardson, Reynolds, and Froude numbers.

361 Genesis, Classification, and Geography of Soils
Fall. 4 credits. Prerequisite: Agronomy 260 or consent of instructor. S-U grades optional.
Lecs, M W F 10:10; lab, W 1:25–4:25; all-day field trip required. R. B. Bryant.
The soil as a natural body. Factors and processes of soil formation. Principles of field identification, classification, survey, and interpretation. Geography of major kinds of soil of North America and the world in relation to environment and cultural patterns. Laboratory exercises and field trips assist in identifying and interpreting soils in relation to landscape.

362 Soil Morphology
Fall. 1 credit. Undergraduates only. Recommended for sophomores and juniors.
R 1:25–4:25; all-day field trip required.
R. B. Bryant, W. J. Waltman.
The principles for field identification of soil properties, profiles, and landscapes are presented. A series of soil pits are examined, described, classified, and interpreted in the field.

372 Soil Fertility Management
Fall. 3 credits. Prerequisite: Agronomy 260 or permission of instructor.
M W F 9:05. D. R. Bouldin.
An integrated discussion of soil crop yield relationships, with emphasis on the soil as a source of mineral nutrients for crops and the role of fertilizers and manure in crop production.

373 Soil, Water, and Aquatic Plants
Fall. 3 credits. Prerequisites: Agronomy 260, Biological Sciences 101–102, and Chemistry 103–104 or equivalents.
T R 11:15, R 1:25–4:25. J. H. Peverly.
The success or failure of soil and water management is manifested in streams, wetlands, lakes, and aquifers. Chemical and biological changes downstream are studied and related to agricultural management techniques upstream. Basic chemical and physiological processes are presented and used to suggest appropriate responses to water management problems.

385 Biogeochemical Cycles, Agriculture, and the Environment
Spring. 2 credits. Prerequisites: Chemistry 103 or 207 and Agronomy 260 or equivalent.
Lecs, T R 11:15–12:05. J. M. Duxbury.
The impact of agriculture on aspects of the global biogeochemical cycles of carbon. nitrogen, sulfur, and phosphorus is discussed and illustrated with current agricultural and environmental issues. Topics include sustainable agriculture, effects of nitrogen fixation, acid rain, global warming, and land disposal of wastes.

435 Statistical Methods in Meteorology
Fall. 3 credits. Prerequisite: an introductory course in statistics (e.g., Statistics 215 or Agricultural Economics 310). Familiarity with elementary matrix algebra helpful. Offered alternate years.
T R 10:10–11:25. D. S. Wilks.
Statistical methods used in operational weather forecasting and selected meteorological research applications. Probabilistic vs. categorical forecasts, and subjective vs. objective forecasts. Multiple regression models and the MOS system. Forecast verification techniques and scoring rules. Some statistical characteristics of meteorological data, including probability distributions, intercorrelations, and parametric time series models.

[437 Agrometeorological Decision Analysis
Fall. 3 credits. Prerequisite: Agricultural Economics 310 or Statistics 215, or equivalents. Offered alternate years. Not offered 1989–90.
T R 10:10–11:25. D. S. Wilks.
Application of Statistical Decision Analysis to weather-sensitive agricultural decision problems. Characteristics of categorical and probabilistic weather forecasts, incorporation of forecast information into the decision problem, selection of optimal strategies, forecast value in relation to forecast quality, effects of the decision maker's attitude toward risk, and static vs. dynamic decision-making problems.]

441–442 Theoretical Meteorology I and II
441, fall; 442, spring. 3 credits each semester. Prerequisites: a year each of calculus and physics.
M W F 10:10. W. W. Knapp.
Fall semester topics include thermodynamics of dry air, water vapor and moist air, and hydrostatics and stability. Topics considered in the spring term include meteorological coordinate systems, variation of wind and pressure fields in the vertical, winds in the planetary boundary layer, surfaces of discontinuity, mechanisms of pressure change, and vorticity and circulation.

[447 Physical Meteorology
Fall. 3 credits. Prerequisites: a year each of calculus and physics. Offered alternate years. Not offered 1989–90.
M W F 12:20. W. W. Knapp.
Primarily a survey of natural phenomena of the atmosphere, with emphasis on their underlying physical principles. Topics include composition and structure of the atmosphere, atmospheric optics, acoustics and electricity, solar, and terrestrial radiation, and principles of radar probing of the atmosphere.]

452 Synoptic Meteorology II
Spring. 3 credits. Prerequisites: Agronomy 351, 441, and 442.
Lecs, T R 9:05; lab, M 1:25–3:20.
S. J. Colucci.
Advanced topics in weather prediction. East Coast secondary cyclogenesis. Tropical storm formation. Squall-line formation and flash floods. Lake-effect snowsqualls and downslope windstorms.

465 Soil and Plant Analysis
Spring. 3 credits. Prerequisite: Agronomy 260.
Lec, T R 1:25–2:15; lab, R 2:30–4:20.
G. A. Ferguson.
Intensive and systematic study of the theoretical and practical aspects of soil and plant analysis. Analyses of soil and plant samples are carried out with emphasis on analytical problem solving and evaluation of the experimental data. Sampling philosophy and preliminary treatment of samples is covered. A variety of wet chemistry and instrumental methods are employed. Considerable attention is given to correlation of quantities and chemical forms of elements in soils and plants with plant growth and yield.

466 Soil Chemistry
Spring. 3 credits. Prerequisites: Agronomy 260 and Chemistry 207–208.
Lecs, M W F 9:05. M. B. McBride.
A discussion of the chemical nature and reactions of the mineral and organic components of soil. Topics to be emphasized include mineralogy, cation and anion adsorption, soil acidity, oxidation/reduction reactions, and soil salinity. The relationship of soil chemical properties to fertility will be described.

[471 Geography and Appraisal of Soils of the Tropics
Fall. 3 credits. Prerequisite: Agronomy 260 or equivalent. S-U grades optional. No audits accepted. Not offered 1989–90.
Lecs, T R 10:10; disc, W 2:30–4:25.
A. Van Wambeke.
The character of principal kinds of soils in the major regions of the tropics. Emphasis is on soil properties as a basis for interpretation of crop management requirements and production potential. Lectures introduce principles whose applications are examined through discussions, problem solving, and independent reading.]

476 Soil Microbiology, Lectures
Spring. 3 credits. Prerequisite: Agronomy 260 or Microbiology 290. Offered alternate years.
M W F 10:10. M. Alexander.
A study of the major groups of soil microorganisms, their ecological interrelationships, and the biochemical functions of organisms in soil.

477 The Fate of Chemicals in Soil
Fall. 3 credits. Prerequisites: Agronomy 260 or equivalent and Chemistry 103 or 207.
Lec, M W F 9:05. J. M. Duxbury, M. Alexander, M. B. McBride, R. J. Wagenet.
An integrated discussion of the biological, chemical, and physical processes that determine the fate and environmental impact of chemicals added to soils.

483 Environmental Biophysics
Fall. 4 credits. Prerequisite: Agronomy 260 or equivalent.
Lecs, M W F 11:15. S. J. Riha. Discussion section to be arranged.
Introduction to basic principles of energy and water transfer and storage in soil-plant systems. Energy budgets, soil heat flow, water movement in saturated and unsaturated soils, infiltration, evaporation, and water dynamics and solute transport in the soil-plant-atmosphere continuum will be covered. Applications are considered through extended discussions and problem sets, including exercises emphasizing measurement techniques and data analysis.

497 Special Topics
Fall or spring. 1–6 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade.
Hours to be arranged. Staff.
The topics are arranged at the beginning of the term for individual study or for group discussions.

498 Teaching Experience
Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.
Teaching experience in crop science, meteorology, or soil science is obtained by assisting in the instruction of a departmental course.

499 Undergraduate Research
Fall or spring. Credit to be arranged. Written permission from the staff member who will supervise the work and assign the grade must be attached to course enrollment material.
Hours to be arranged. Staff.
Independent research on current problems selected from any phase of crop science, meteorology, or soil science.

607 Lipid Biochemistry of Crop Plants
Fall. 3 credits. Prerequisite: plant physiology, biochemistry, or permission of instructor. Offered alternate years.
Lecs T R 9:05–10:20. D. V. Lynch.
A comprehensive study of plant lipid biochemistry, emphasizing aspects of lipid metabolism relevant to the physiology and commercial value of crop species. Lipid synthesis/degradation, lipid structure and function, seed oil formation, wax synthesis, and nutritional aspects of plant lipids are among the topics covered.

[608 Water Status in Plants and Soils
Fall. 1 credit. Prerequisite: permission of instructor. S-U grades optional. Offered alternate years. Not offered 1989–90.
Lec, 1 hour to be arranged; lab, R 1:25–4:25 or as arranged. T. L. Setter.
Techniques for field appraisal of the status of water in plants and soil, including methods used in evapotranspiration studies.]

610 Physiology of Environmental Stresses
Spring. 3 credits. Prerequisite: Biological Sciences 242 or 341.
Lecs, T R 10:10–11:25. P. L. Steponkus.
A study of the responses of plants to environmental stresses, including chilling, freezing, high temperature, and drought. Emphasis is on the physiological and biochemical basis of injury and plant resistance mechanisms at the whole-plant, cellular, and molecular levels.

[611 Crop Simulation Modeling
Fall. 3 credits. Prerequisite: Biological Sciences 242 or 341. Recommended: computer programming experience. Offered alternate years. Not offered 1989–90.
M W F 11:15. G. W. Fick.
A study of existing crop models is followed by development and refinement of programs representing students' work. Emphasis is on quantitative formulation and testing of complex hypotheses related to crop growth. Carbon exchange, transpiration, microclimate, soil water supply, root functions, and dry-matter distribution in growing crops are covered.]

[612 Seed Physiology
Spring. 3 credits. Prerequisite: plant physiology. Not offered 1989–90.
T R 8:30–9:55. R. L. Obendorf.
Morphology, physiology, and biochemistry of cereal, legume, and oil-seed formation, composition, storage, and germination. Emphasis is on the deposition of seed reserves during seed formation, stabilization of reserves during storage, and mobilization of reserves during germination. Topics range from on-farm problems to molecular mechanisms.]

613 Physiology and Ecology of Yield
Spring. 3 credits. Prerequisite: plant physiology.
M W F 12:20. T. L. Setter.
A study of the constraints on crop productivity from a physiological perspective. Influence of environment and genetics on the assimilation, translocation, and partitioning of carbon and nitrogen during crop ontogeny. Emphasis on growth processes of vegetative plant organs.

[614 Advances in Weed Science
Spring. 3 credits. Prerequisite: Agronomy 315 or equivalent. Offered alternate years. Not offered 1989–90.
Lec and labs to be arranged.
J. M. DiTomaso.
In-depth examination of the biology and ecology of weed-crop interactions and herbicide behavior in soils and plants. Topics include a detailed understanding of herbicide mode of action, selectivity, resistance, and soil persistence. Important herbicide families will be emphasized, particularly those in current use. Cultural and biological weed control methods, herbicide-stress interactions, groundwater contamination, and public perception of pesticides will also be discussed.]

642 Plant Mineral Nutrition (also Biological Sciences 642)
Spring. 3 credits. Prerequisite: Biological Sciences 341 or equivalent.
Lecs, M W F 10:10–11. L. V. Kochian, R. M. Welch.
A detailed study of the processes by which plants acquire and utilize mineral nutrients from the soil. Topics will include the uptake, translocation, and compartmentation of mineral elements; root-soil interactions; metabolism of mineral elements; the involvement of mineral nutrients in various physiological processes; and nutrition of plants adapted to extreme environmental stresses (e.g., salinity). Specific mineral elements will be emphasized to illustrate the above topics.

660 Remote Sensing Fundamentals (also Civil & Environmental Engineering 610)
Fall. 3 credits. Prerequisite: permission of instructor.
Lecs, T R 10:10; lab, T 2:30–4:25. W. R. Philipson.
An introduction to equipment and methods used in obtaining information about earth resources and the environment from aircraft or satellite. Coverage includes sensors, sensor and ground-data acquisition, data analysis and interpretation, and project design.

661 Remote Sensing: Environmental Applications (also Civil & Environmental Engineering 611)
Spring. 3 credits. Prerequisite: permission of instructor.
Lecs, T R 10:10; lab, T 2:30–4:25 (a second lab sec will be scheduled if more than 15 students register).
W. R. Philipson.
A survey of how remote sensing is applied in various environmental disciplines. Laboratory emphasis is on using aircraft and satellite imagery for inventorying and monitoring surface features in engineering, planning, agriculture, and natural resource assessments.

662 Seminar in Remote Sensing (also Civil & Environmental Engineering 619)
Spring. 1 credit. S-U grades only.
W 4:30. W. R. Philipson.
Lectures on current developments in assessing earth resources or the environment. Each week a different topic on remote sensing or geographic information systems is presented by specialists from government, industry, Cornell, or other research or academic institutions.

[663 Pedology
Spring. 3 credits. Prerequisite: Agronomy 361 or permission of instructor. Offered alternate years. Not offered 1989–90. Textbook recommended, not required.
T R 10:30–12. R. B. Bryant.
Weathering, reactions, and processes of soil genesis. Principles of soil classification and the rationale and utilization of soil taxonomy. Development and significance of major groups of soils of the world.]

666 Advanced Soil Microbiology
Fall. 1 credit. Prerequisite: Agronomy 476 or permission of instructor. S-U grades only for graduate students.
T 12:20. M. Alexander.
Discussions of current topics in special areas of soil microbiology. Particular attention is given to biochemical problems in microbial ecology.

[667 Advanced Soil Physics
Fall. 3 credits. Prerequisites: One year of college physics and Agronomy 483 or permission of instructor. S-U grades optional. Offered alternate years. Not offered 1989–90.
M W F 11:15. P. C. Baveye.
A detailed study of the hydrostatics of aqueous solutions in soils and porous media, with emphasis on fundamental principles. Examination of the molecular aspects of water-solid interactions, including shrink-swell phenomena and the properties of absorbed water. Analysis of equilibrium water adsorption from thermodynamical and mechanistic (molecular) standpoints. Mechanical and thermodynamical analysis of the equilibrium status of aqueous solutions in deformable soils. Formal lectures are complemented by tutorial sessions.]

669 Soil Organic Matter
Spring. 2 or 3 credits. Prerequisites: Agronomy 260 and Chemistry 357–358 or equivalent.
T R 9:05; disc F 2:30–4. J. M. Duxbury.
A discussion of current concepts of the nature, mode of formation, dynamics, and role of organic matter in soils.

[675 Soil and Water Solute Modeling
Spring. 3 credits. Prerequisite: Agronomy 483 or equivalent. Offered alternate years. Not offered 1989–90.
Lecs, T R 1:25–2:45. R. J. Wagenet, S. J. Riha.
Development, derivation, and use of models of water and solute transfer under laboratory and field conditions. Discussion of models that include transport, interaction, and transformation of solutes. Design and interpretation of experiments for model validation.]

[676 Biodegradation of Chemicals
Spring. 2 credits. Prerequisite: Organic chemistry. Offered alternate years. Not offered 1989–90.
Lecs, T R 10:10–11:10. M. Alexander.
A consideration of biological transformations of organic chemicals and toxicants in soil and waters and the biological, biochemical, and environmental factors affecting those transformations.]

690 Root-Soil Interactions
Fall or spring. 1–2 credits. S-U grades optional.
Hours to be arranged. R. W. Zobel.
A topic dealing with root-soil interaction will be selected during the first meeting of the term. Students will prepare one or two seminars based on published work on the topic. Possible topics include root genetics, root morphology, conservation tillage, and soil temperature.

691 Special Topics in Crop Science
Fall or spring. 1–6 credits. S-U grades optional.
Hours to be arranged. Staff.
Study of topics in crop science that are more specialized or different from other courses. Special topics to be offered will depend on staff and student interests.

692 Special Topics in Meteorology
Fall or spring. 1–6 credits. S-U grades optional.
Hours to be arranged. Staff.
Study of topics in meteorology that are more specialized or different from other courses. Special topics to be covered will depend on staff and student interests.

693 Special Topics in Soil Science
Fall or spring. 1–6 credits. S-U grades optional.
Hours to be arranged. Staff.
Study of topics in soil science that are more specialized or different from other courses. Special topics to be covered will depend on staff and student interests.

771 Clay Chemistry
Fall. 3 credits. Prerequisite: one year of physical chemistry or permission of instructor. Offered alternate years.
Lecs, M W F 11:15. M. B. McBride.
A detailed examination of the structure and surface chemistry of minerals common to soils. Ion exchange, mineral-solution equilibria, and adsorption reactions of silicate clays and oxides will be emphasized.

[774 Soil Fertility Advanced Course
Spring. 3 credits. Prerequisite: graduate status with a major or minor in agronomy. Offered alternate years. Not offered 1989–90.
T R 8:30–9:55. D. R. Bouldin.
A study of selected topics in soil-crop relationships, with emphasis on concepts of soil fertility, interpretation of experimental data, and soil fertilizer chemistry.]

790 Agronomy Seminar
Fall or spring. No credit. Required of graduate students majoring or minoring in the department. S-U grades only.
T 4.

791 Meteorology Seminar
Fall or spring. Prerequisite: permission of instructor.
Hours to be announced. Staff.
Subjects such as weather modification, paleoclimatology, and atmospheric pollution.

829 Master's-Level Thesis Research in Crop Science
Fall or spring. Credit by arrangement. Limited to students in the graduate field. S-U grades optional.
Hours by arrangement.

859 Master's-Level Thesis Research in Meteorology
Fall or spring. Credit by arrangement. Limited to students in the graduate field. S-U grades optional.
Hours by arrangement.

889 Master's-Level Thesis Research in Soil Science
Fall or spring. Credit by arrangement. Limited to students in the graduate field. S-U grades optional.
Hours by arrangement.

929 Doctoral-Level Thesis Research in Crop Science
Fall or spring. Credit by arrangement. Limited to students in the graduate field. S-U grades optional. Hours by arrangement.

959 Doctoral-Level Thesis Research in Meteorology
Fall or spring. Credit by arrangement. Limited to students in the graduate field. S-U grades optional.
Hours by arrangement.

989 Doctoral-Level Thesis Research in Soil Science
Fall or spring. Credit by arrangement. Limited to students in the graduate field. S-U grades optional.
Hours by arrangement.

Courses in "Remote Sensing" are also listed under the Department of Civil and Environmental Engineering, in the College of Engineering.

ANIMAL SCIENCES

Department of Animal Science: J. M. Elliot, chair; B. J. Apgar, D. E. Bauman, D. H. Beermann, A. W. Bell, R. W. Blake, R. D. Boyd, W. R. Butler, L. E. Chase, W. B. Currie, D. L. DeVol, H. N. Erb, R. W. Everett, J. D. Ferguson, R. H. Foote, D. G. Fox, D. M. Galton, R. C. Gorewit, W. Hansel, H. F. Hintz, D. E. Hogue, L. Jones, W. G. Merrill, E. A. Oltenacu, P. A. Oltenacu, J. E. Parks, E. J. Pollak, R. L. Quaas, J. B. Russell, S. W. Sabin, H. F. Schryver, R. D. Smith, B. E. Straw, M. L. Thonney, D. R. Van Campen, P. J. Van Soest, R. G. Warner, M. J. Wylie

Department of Poultry and Avian Science: R. E. Austic, chair; P. W. Aho, R. C. Baker, S. E. Bloom, G. F. Combs, Jr., R. R. Dietert, P. A. Johnson, K. Keshavarz, H. G. Ketola, C. C. McCormick, J. A. Marsh, J. M. Regenstein, G. L. Rumsey, C. S. Winstead

100 Domestic Animal Biology I
Fall. 3 credits. S-U grades optional.
Lec, M W F 9:05; lab/disc, T W R 2–4:25. W. B. Currie, M. L. Thonney, and staff.
An introduction to the science of raising animals in the context of commercial animal production. Lectures, labs, and optional discussion sessions address the biology of economically important species (morphology, anatomy, and physiology) and application of the biology to the management of animals within major livestock industries. Topics covered include fundamentals of anatomy, regulatory mechanisms, vital systems, digestion, and metabolism. Students care for small numbers of cattle, sheep, pigs, and chickens in different phases of their life cycle to maximize hands-on contact. Living animals will be used noninvasively, and fresh organs and tissues from dead animals will be used in laboratories.

150 Domestic Animal Biology II
Spring. 3 or 4 credits. Students who have taken Animal Sciences 100 register for 4 credits. Nonmajors and transfer students who have not taken Animal Sciences 100 take Animal Sciences 150 for 3 credits; they may take Animal Sciences 150 for 4 credits if they participate in the discussion group and complete an assigned paper. S-U grades optional.
Lec, M W F 9:05; lab/disc T W R 2–4:25. W. B. Currie and staff.
Second of a two-semester sequence (100/150) applying the basic biology of growth, defense mechanisms, reproduction, and lactation to aspects of the husbandry of animals within major livestock industries. Living animals and tissues/organs from dead animals will be used in laboratories.

212 Livestock Nutrition
Fall. 4 credits. Prerequisite: Chemistry 104 or 208. Recommended: Animal Sciences 100 and 150.
Lecs, M W F 11:15; lab, M T W R or F 1:25–4:25, or R 10:10–12:20.
R. G. Warner.
An introduction to animal nutrition covering fundamentals of nutrition, the nutritive value of feeds, and the application of feeding standards to various forms of production in dairy and beef cattle, sheep, swine, horses, and poultry. Gastrointestinal tract dissections will be made on rodents and chickens. A simple nutritional experiment will be performed using rats and possibly calves, sheep, and pigs.

[213 Nutrition of Companion Animals
Spring, weeks 1–7. 1 credit. Prerequisite: Animal Sciences 212 or equivalent. Offered odd-numbered years only.
W 7:30–9:25 p.m. H. F. Hintz.
Nutrition of companion animals, with emphasis on the dog and cat. Digestive physiology, nutrient requirements, feeding practices, and interactions of nutrition and disease.]

214 Nutrition of Exotic Animals
Spring, weeks 1–7. 1 credit. Prerequisite: Animal Science 212. Offered even-numbered years only.
Lec W 7:30–9:30 p.m. H. F. Hintz.
Principles of nutrition for exotic animals including birds and fish. Nutrient requirements, sources of nutrients, feeding management systems, and ration formulation will be discussed. Signs of nutrient deficiencies and excesses will be described.

[220 Animal Repro and Development
Fall. 4 credits. Each lab limited to 30 students. Prerequisite: a year of college biology or equivalent. Not offered 1989–90.
Lecs, T R 9:05; demonstration and lab, M T W or R 2–4:25. J. Parks.
An introduction to the comparative anatomy and physiology of reproduction of farm animals. The life cycle from fertilization through development and growth to sexual maturity is studied, with emphasis on physiological mechanisms involved, relevant genetic control, and application to fertility regulation of animal and human populations. An audiotutorial laboratory is available for selected lecture and laboratory topics. Dissection and examination of tissues from vertebrate animals will be included in selected laboratory exercises.]

221 Introductory Animal Genetics
Spring. 3 credits. Prerequisite: a year of college biology.
Lecs, T R 9:05; disc, T W R or F 2–4:25.
E. J. Pollak.
An examination of basic genetic principles and their application to the improvement of domestic animals, with emphasis on the effects of selection and mating systems on animal populations.

230 Poultry Biology
Spring. 3 credits.
Lecs, T R 11:15; lab, W 2–4:25. Field trips during lab periods may last longer.
R. E. Austic.
Designed to acquaint the student with the scope of the poultry industry. Emphasis is on the principles of avian biology and their application in the various facets of poultry production. Some laboratory sessions involve dissection and/or the handling of live poultry.

251 Dairy Cattle Selection
Spring. 2 credits.
Lab, W 12:20–4:25. 1 all-day S field trip.
D. M. Galton, C. R. Holtz.
Emphasis on economical and type traits to be used in the selection and evaluation of dairy cattle. Practical sessions include planned trips to dairy herds in the state.

265 Horses
Spring. 3 credits. Prerequisites: Animal Sciences 100 and 150 or permission of instructor. S-U grades optional.
Lecs, T R 10:10; lab, R 1:25–4:25.
H. F. Hintz.
Selection, management, feeding, breeding, and training of light horses.

290 Meat Science
Fall. 3 credits.
Lecs, T R 10:10; lab, M T or W 1:25–4:25.
D. H. Beermann and staff.
An introduction to meat science through a study of the structure, composition, and function of muscle and its conversion to meat. Properties of fresh and processed meat, microbiology, preservation, nutritive value, inspection, and sanitation are also studied. Laboratory exercises include meat-animal slaughter, meat cutting, wholesale and retail cut identification, anatomy, processing, inspection, grading, quality control, and meat merchandising. An all-day field trip to commercial meat plants is taken.

305 Farm Animal Behavior
Spring. 2 credits. Prerequisites: an introductory course in animal physiology and an introductory course in genetics; at least one animal production course is recommended. S-U grades optional.
Lec, R 11:15–12:55. E. A. Oltenacu and K. A. Houpt.
The behavior of production species (avian and mammalian) influences the success of any management program. Students will study behaviors relating to feeding, reproduction, and social interactions of poultry, cattle, sheep, and swine. Management systems for commercial livestock production and their implications for animal behavior and welfare will be stressed.

[321 Seminar: Horse Genetics
Spring. 1 credit. Prerequisite: Animal Sciences 265 or permission of instructor. Recommended: Animal Sciences 221 or Biological Sciences 281. Not offered 1989–90.
M T or W 9:05. Staff.
A discussion of genetics of the horse, with special reference to simply inherited traits and selection for quantitative traits.]

330 Commercial Poultry Production
Fall. 1–2 credits. Prerequisites: Animal Sciences 100, 150, and 230 or permission of instructor. Offered in odd-numbered years.
F 2–4 (occasional field trips run past 4 p.m.). K. Keshavarz.
The course emphasizes production and business management aspects of commercial poultry farm operation and is designed to acquaint the student with current technology involved in commercial poultry production.

[332 Poultry Hygiene and Disease (also Veterinary Medicine 255)
Spring, odd-numbered years. 2 credits. Minimum enrollment, 5 students; maximum enrollment, 15 students. Prerequisites: Microbiology 290 and permission of the instructor.
Lec and lab, W 2:05–4:25.
H. L. Shivaprasad.
Concerns biology of the chicken: salient features of anatomy and physiology; common terms used in pathology; degeneration and necrosis of cells, disturbances of growth; aplasia to neoplasia, inflammation; and definition and types of inflammation, healing, and repair. Principles of the diagnosis, management, and control of diseases and diagnostic procedures, euthanasia, necropsy technique, and laboratory procedures are covered. Considers nutritional deficiency and infectious diseases, including host-parasite relationships; viral, bacterial, fungal, and parasitic diseases; avian immunology and immunologic impairment; and diseases affecting various systems of the body. The course will include many laboratories in which review of anatomy, bleeding, and dissection techniques, and recognition of lesions and their interpretation will be covered.]

340 Decision Analysis in Dairy Systems
Fall. 2 credits. Prerequisites: Animal Sciences 100 and 150. Recommended: Animal Sciences 350 or equivalent.
Lecs, T R 10:10. P. A. Oltenacu.
The concepts of decision making under uncertainty are presented. The course covers model building for a decision problem, assessment and revision of probabilities, value of information, options for making a choice, and preference theory and methods for dealing with risk, such as risk sharing and diversification. The concepts are presented in an animal production context.

350 Dairy Cattle
Fall. 3 credits. S-U grades optional. Recommended: Animal Sciences 150 or equivalent, 212 and 221.
Lecs, T R 10:10; lab, M T R 1:25–4.
D. M. Galton, C. R. Holtz.
Introduction to the background and scientific principles relating to dairy cattle production. Laboratories are designed to provide an understanding of production techniques. This course is a prerequisite for Animal Sciences 355.

355 Dairy Herd Management
Spring. 4 credits. Prerequisites: Animal Sciences 150, 221, and 350, or equivalents. Recommended: Agricultural Economics 302.
Lecs, M W F 11:15; lab, M T 1:25–4:25; plus 1 unscheduled half-day lab period.
W. G. Merrill and staff.
Application of scientific principles to practical herd management, analyses of alternatives, and decision making. Laboratories emphasize practical applications, problem solving, and discussion.

360 Beef Cattle
Spring. 3 credits. Prerequisite: Animal Science 100, 150 or equivalent, 212, 221, or permission of instructor.
Lecs, T R 10:10; lab, W R 2–4:25.
M. L. Thonney.
Emphasis is on the management of reproduction, nutrition, and selection in beef cattle enterprises. A cattle growth model is studied. Laboratories acquaint students with the management skills needed for a beef operation. Students are required to spend several days during the semester feeding and caring for cattle and observing calving.

370 Swine Production
Fall. 3 credits. Limited to 80 students; each lab limited to 40 students. Prerequisites: Animal Science 150 or equivalent, 212, 221, or permission of instructor.
Lecs, T R 11:15; lab, T or W 2–4:25.
R. D. Boyd.
The objective is to provide an opportunity to acquire practical knowledge and a technical basis for making decisions in various types of swine enterprises. Emphasis on the types of production systems; selection and breeding programs; reproductive, farrowing, and lactation management; nutrition; herd health; and housing facilities. Laboratories are designed to extend and apply principles discussed in lecture and to provide students with the opportunity to develop management skills.

[380 Sheep
Fall. 3 credits. Prerequisites: Animal Sciences 100 and 150. Recommended: Animal Sciences 212 and 221. Not offered fall 1989.
Lec, T R 9:05; lab and disc periods, W 1:25–4:25 every other week.
D. E. Hogue.
The breeding, feeding, management, and selection of sheep. Lectures and laboratories are designed to give students a practical knowledge of sheep production as well as the scientific background for improved practices.]

390 Meat Animal Evaluation
Spring. 2 credits. Prerequisites: Animal Sciences 100 and 150 or permission of instructor. Offered even-numbered years.
Lec and lab, W 1:25–4:25.
D. H. Beermann and staff.
Fundamental biological principles of meat animal growth and factors influencing composition are presented. Principles and techniques of meat animal and carcass grading and evaluation are discussed and followed by student evaluation of live animals and the carcasses from them.

392 Animal Growth Biology
Fall. 2 credits. Not open to freshmen; sophomores by permission of instructor only. Prerequisites: one year of college biology and one course in animal or human physiology, Animal Science 212 and 221.
Lec, R 1:25–3:25; disc, F 1:25–2:15.
D. H. Beermann.
A detailed discussion of the anatomy and physiology of growth in domestic farm animals. Cellular aspects of tissue-growth patterns, their relationship to body composition, and measurement of growth and body composition will be discussed. Endocrine, genetic, nutritional, and pharmacological influences on growth, metabolism, and body composition will be emphasized.

400 Tropical Livestock Production
Spring. 3 credits. Prerequisite: Animal Sciences 150 or equivalent, 212, or 221 or permission of instructor.
Lecs, T R 9:05; disc W 1:25–3:20.
R. W. Blake.
An analysis of constraints on livestock production in developing countries of the tropics, economic objectives and risk, and production methods. Emphasis is on strategic use of animal and plant resources, animal performance with inputs restricted, decision making, and alternative systems of production. Principles, real examples, and independent study projects will help identify research to improve food security.

401 Dairy Production Seminar
Spring. 1 credit. Limited to juniors and seniors.
Disc, M 7:30 p.m. D. E. Bauman.
Students, with the help of faculty members, complete a study of the research literature on topics of current interest in the dairy industry. Students make oral and written reports.

402 Seminar in Animal Sciences
Spring. 1 credit. Limited to juniors and seniors. May be repeated. S-U grades optional.
Hours to be arranged. W. R. Butler and staff.
Review of literature pertinent to topics of animal science or reports of undergraduate research and honors projects. Students present oral and written reports.

403 Tropical Forages
Spring. 2 credits. Limited to seniors and graduate students except by permission of instructor. Prerequisites: crop production and livestock nutrition. Offered even-numbered years.
Lecs, T R 12:20. P. J. VanSoest.
An overview of tropical grasslands, seeded pastures, and crop residues as feed resources; grass and legume characteristics; establishment and management of pastures; determination of feeding value forages and crop residues; physiology of digestion of ruminants that affects feeding behavior of various species; problems of chemical inhibitors in plants; and utilization of tropical forages as hay or silage.

410 Principles of Animal Nutrition
Fall. 3 credits. Prerequisite: organic chemistry. Recommended: biochemistry or concurrent registration in a biochemistry course.
M W F 11:15; 2 discs to be arranged. 2 evening prelims to be arranged.
C. C. McCormick.
A fundamental approach to nutrition focusing on the metabolism as well as the biochemical and physiological function of the known nutrients. The basic principles of nutrition are elaborated with examples drawn from a broad range of animal species, including humans. Emphasis is also directed toward nutritional techniques and the application of the topics covered.

415 Poultry Nutrition
Spring. 1 credit. Prerequisite: Animal Sciences 410 or permission of instructor.
F 11:15. G. F. Combs, Jr.
A practical consideration of principles of nutrition applied to feeding poultry, including use of linear programming techniques in diet formulation.

419 Animal Cytogenetics (also Toxicology 419)
Fall. 4 credits. Prerequisites: Animal Sciences 221, Biological Sciences 281, or permission of instructor.
Lec, T R 9:05; disc, T or W 1:25–3:20.
S. E. Bloom.
A study of normal and aberrant chromosomes in animals and man. Lecture topics include chromosome organization, variations in chromosome structure and number, chromosomes in mitosis and meiosis, cytogenetics of abortuses, parthenogenesis, chromosomes in cancer, veterinary and human cytogenetics, genetic engineering, and genetic toxicology. Students investigate topics of their choice for discussions and a research paper.

420 Quantitative Animal Genetics
Fall. 3 credits.
Lecs, T R 11:15; lab, W R or F 2–4:25.
N. B. Cameron.
A consideration of problems involved in improvement of animals, especially farm animals, through application of the theory of quantitative genetics, with emphasis on selection index.

[421 Seminar in Animal Genetics
Fall. 1 credit. Prerequisite: Animal Sciences 221 or concurrent registration in Animal Sciences 420. Not offered 1989–90.
T 12:20. Staff.
A discussion of applications of principles of quantitative genetics and animal breeding to specific types of animals such as dairy animals, meat animals, and horses.]

[422 Methods: Quantitative Genetics
Fall. 1 credit. Prerequisite: Animal Sciences 420 or concurrent registration in Animal Sciences 420. Not offered 1989–90.
R 12:20. Staff.
An introduction to methods of research in quantitative genetics and animal breeding, including estimation of heritability, repeatability, and genetic and phenotypic correlations.]

427 Fundamentals of Endocrinology
Fall. 3 credits. Prerequisite: human or veterinary physiology or permission of instructor.
Lecs, M W F 9:05. P. A. Johnson.
Physiology and regulation of endocrine secretions. Neuroendocrine, reproductive, growth, and metabolic aspects of endocrinology are emphasized. Examples are selected from many animals, including humans.

430 AI and ET of Farm Animals
Fall. 2 credits. Prerequisite: a course in reproductive physiology or permission of instructor.
Lecs, T R 9:05, labs: to be arranged.
R. H. Foote.
Principles and practice of semen handling and evaluation, artificial insemination, freezing of sperm and embryos, embryo evaluation, micromanipulation and transfer in farm animals and rabbits.

431 Embryo Handling and Transfer
Fall. 1 credit. Prerequisites: Animal Sciences 220 and 430 or their equivalent. Permission of instructor must be obtained at course enrollment. S-U grades only. Lab fee.
Lecs, T R 8; labs by arrangement.
R. H. Foote.
Designed to provide students with the requirements for managing animals and embryos in a successful embryo transfer program (5 lectures and films). The practical work consists of superovulation, embryo recovery, evaluation, manipulation, freezing, and transfer.

450 Immunophysiology
Spring. 3 credits. Prerequisites: basic immunology and animal physiology or permission of instructor.
Lecs, M W F 11:15. 2 evening prelims to be arranged. J. A. Marsh.
Emphasis on the development and regulation of the immune system and the physiological parameters affecting or affected by immune function. Major topics include development immunology, immunoregulation, immunological involvement in reproduction and gonadal function, interrelationships between immune and endocrine functioning, and the immunology of aging.

451 Lactation Physiology
Spring. 3 credits. Prerequisite: either Animal Sciences 150 or equivalent or permission of instructor.
Lecs, T R 9:05; lab, R 2–4:25.
R. C. Gorewit.
Emphasis is on mammary gland development, anatomy, physiological control of milk secretion, and synthesis of milk constituents in dairy cattle. Experimental procedures on animals are performed.

456 Dairy Management Fellowship
Fall or spring. 2 credits. Limited to seniors. Prerequisites: Animal Sciences 355, Agricultural Economics 302 or equivalent, and permission of instructor. S-U grades only.
Hours to be arranged. D. M. Galton.
The program is designed for undergraduates who have a sincere interest in dairy farm management. Objectives are to gain further understanding of the integration and application of dairy farm management principles and programs with respect to dairymen's objectives and methodology, to expand the concept of team approach in the development and implementation of management programs, and to gain further understanding of the role of research and industry in agriculture. Students are selected during the spring semester of the junior year according to their commitment to dairy farm management in course program and career goals.

457 Dairy Herd Health
Fall. 1 credit. Prerequisite: must be taken concurrently with Animal Science 456. S-U grades only.
Lec, W 12:20, labs alternate weeks, hours to be arranged. D. M. Galton and staff.
Emphasis on the application of disease control practices and preventive medicine programs in dairy herd health. Laboratories are designed to provide students the opportunity to learn management skills.

486 Immunogenetics (also Biological Sciences 486)
Fall. 3 credits. Limited to seniors (25) and graduate students. Prerequisites: an introductory course in genetics and prior or concurrent enrollment in basic immunology.
Lecs, M W F 10:10. R. R. Dietert.
The genetic control of a variety of cellular antigens and their use in understanding biological and immunological functions. The genetics of antibody diversity, antigen recognition, immune response, transplantation, and disease resistance.

[490 Commercial Meat Processing
Spring. 3 credits. Prerequisite: Animal Sciences 290 or permission of instructor. Not offered 1989–90.
Lecs, T R 9:05; lab, T or R 1:25–4:25. Field trip to commercial meat processing plants. D. H. Beermann.
A study of the classification, formulation, and production of commercially available processed meat products. Physical and chemical characteristics of meat and nonmeat ingredients; their functional properties; various methodologies; microbiology; packaging, handling, and storage; and quality assurance are discussed.]

496 Animal Sciences Honors Seminar
Fall. 1 credit. S-U grades only. Students must be accepted into the Animal Sciences Honors Program.
Disc, M 4–5:30. J. A. Marsh.
The course is designed to provide information and guidance for students enrolled in the honors program in animal sciences and expecting to complete an honors thesis. The course will meet for 1-1/2 hours per week for 8 to 10 consecutive weeks, during which time the following topics will be presented and discussed: requirements and expectations of the honors program, formulating hypotheses, the scientific method, experimental design, data handling and manipulation, library usage and literature search techniques, animals in research, ethics in science, and scientific writing.

497 Special Topics in Animal Science
Fall or spring. 1–3 credits; may be repeated for credit. Intended for students in animal sciences. Prerequisite: permission of instructor. S-U grades optional.
Staff.
May include individual tutorial study or a lecture topic selected by a professor. Since topics may change, the course may be repeated for credit.

498 Undergraduate Teaching
Fall or spring. 1 or 2 credits; 4 credits maximum during undergraduate career. Limited to students with grade-point averages of at least 2.7.
Designed to consolidate the student's knowledge. A participating student assists in teaching a course allied with the student's education and experience. The student is expected to meet regularly with a discussion or laboratory section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

499 Undergraduate Research
Fall or spring. 6 credits maximum during undergraduate career. Not open to students who have earned 6 or more undergraduate research credits elsewhere in the college. Limited to juniors and seniors with grade-point averages of at least 2.7.
Affords opportunities for students to carry out independent research under appropriate supervision. Each student is expected to review pertinent literature, prepare a project outline, conduct the research, and prepare a report.

600 Research
Fall or spring. Credit to be arranged. S-U grades optional.
Hours to be arranged.
All members of animal sciences program area.

[601 Proteins and Amino Acids (also Nutritional Sciences 601)
Fall. 2 credits. Prerequisites: physiology, biochemistry, and nutrition, or permission of instructor. Not offered 1989–90.
Hours to be arranged. R. E. Austic.
A course in amino acid and protein nutrition, with emphasis on the dynamic aspects of protein digestion and amino acid absorption, protein and amino acid metabolism, nutritional interrelationships, assessment of protein quality, amino acid availability, and amino acid requirements.]

604 Vitamins
Fall. 2 credits.
T R 10:10. G. F. Combs, Jr.
A discussion of the chemistry, biochemistry, and physiological functions of the vitamins, with emphasis on nutritional aspects.

605 Forage, Fiber, and the Rumen
Spring. 4 credits. Prerequisites: either general nutrition and biochemistry or permission of instructor. S-U grades optional.
M W F 12:20; disc, W 11:15 or F 1:25.
P. J. Van Soest.
Ruminant nutrition; lower-tract fermentation in monogastrics; nutritional biochemistry of forage plants, fiber, and cellulosic material.

[607 Microbiology of the Rumen
Fall. 3 credits. Prerequisites: general biochemistry and microbiology. Not offered 1989–90.
Lecs, M W F 10:10. J. B. Russell.
Nutrition, biochemistry, physiology, taxonomy, and ecology of rumen microorganisms. Effects of rumen microbial ecology on ruminant nutrition. Manipulation of rumen fermentations to maximize host-animal performance.]

609 Seminar in Poultry Biology
Fall and spring. Limited to graduate students. S-U grades only.
Hours to be arranged. Staff.
A survey of recent literature and research in poultry biology.

610 Seminar
Fall and spring. 1 credit. Required of all graduate students with a major or minor in animal sciences. S-U grades only.
M noon. Department faculty.

613 Forage Analysis
Spring. 2 credits. Prerequisite: permission of instructor. S-U grades optional.
Lab, R 2–4. P. J. Van Soest.
Chemical composition and nutritive evaluation of forage plants and related materials. The course includes a term paper summarizing results of independent laboratory study of either materials or methods.

619 Field of Nutrition Seminar
Fall and spring. No credit. S-U grades only.
M 4:30.
Current research in nutrition is presented by visitors and faculty.

620 Seminar in Animal Breeding
Fall and spring. 1 credit. Limited to graduate students with a major or minor in animal breeding. S-U grades only.
Hours to be arranged.

621 Seminar: Endo/Reprod Biology
Fall and spring. 1 credit. Registration limited to graduate students. Advanced undergraduates welcome to attend. S-U grades only.
W 4:30. W. R. Butler and staff.
Current research in reproductive physiology is presented by staff members, graduate students, and visitors.

630 Bioenergetics/Nutritional Physiology
Spring. 3 credits. Prerequisites: Animal Sciences 410 and biochemistry or physiology, or permission of instructor. S-U grades optional.
Lec, M W R 10:10. A. W. Bell and D. E. Bauman.
An integrated systems approach to the nutritional physiology and energy metabolism of productive animals. Emphasis on extracellular regulation of tissue and organ metabolism of specific nutrients in relation to level and efficiency of milk and meat production. Critical discussion of techniques and approaches to the study of animal bioenergetics.

640 Special Topics in Animal Science
Fall or spring. 1 or more credits. S-U grades optional.
Hours to be arranged. Staff.
Study of topics in animal science more advanced than, or different from, other courses. Subject matter depends on interests of students and availability of staff.

720 Advanced Quantitative Genetics
Spring. 3 credits. Prerequisites: matrix algebra, linear models, and mathematical statistics. S-U grades optional. Offered even-numbered years.
Hours to be arranged. R. L. Quaas.
Estimation of genetic and environmental parameters required to design efficient selection programs. Emphasis is given to interpretation of experimental and survey data with unequal subclass numbers, and prediction of genetic progress resulting from alternative selection methods.

Related Courses in Other Departments

Introductory Animal Physiology (Biological Sciences 311)

Introductory Animal Physiology Laboratory (Biological Sciences 319)

Milk Quality (Food Science 351)

Agriculture in the Developing Nations (International Agriculture 602)

Lipids (Nutritional Sciences 602)

Basic Immunology, Lectures (Veterinary Medicine 315)

Basic Immunology, Laboratory (Veterinary Medicine 316)

The Population Biology of Health and Disease (Veterinary Medicine 330)

Health and Diseases of Animals (Veterinary Medicine 475)

BIOLOGICAL SCIENCES

The program of study in biology is offered by the Division of Biological Sciences. For course descriptions, see the section on the Division of Biological Sciences.

COMMUNICATION

R. D. Colle, chair; N. E. Awa, B. O. Earle, D. Fraleigh, G. Gay, C. J. Glynn, D. A. Grossman, J. E. Hardy, B. Lewenstein, D. G. McDonald, R. D. Martin, R. E. Ostman, R. Roe, T. M. Russo, C. Scherer, D. F. Schwartz, M. A. Shapiro, P. Stepp, R. B. Thompson, L. VanBuskirk, W. B. Ward, S. Warland, S. A. White, C. Whittle, A. M. Wilkinson, J. P. Yarbrough

The middle and last digits of course numbers are used to denote specific areas:

00–09	Speech communication
10–19	Interpersonal communication
20–29	Mass communication
30–39	Visual communication and graphic design
40–49	Electronic media
50–59	Journalistic writing
60–66	Professional writing
67–69	Editing
70–79	Communication planning and strategy (advertising and public relations)
80–89	Research methods and interdisciplinary courses
90–94	Special topics and seminars
95–99	Individualized study

101–109 Rhetorical Scholarship Lab
Fall and spring. Maximum 1 credit per semester; may be repeated up to 6 credits in different labs. Limited to 20 communication majors or students with permission of instructor. S-U grades only.
Lec, hours to be arranged. P. Stepp and staff.
Students research and analyze contemporary issues to identify facts and derive the underlying values. Research will be used to write lines of argument, cases for debate, and speeches for public address, or to analyze pieces of literature to understand the author's intent. Analyses will be used to develop approaches to the oral presentation of the literature.

101 Debate: Affirmative Case

102 Debate: Value Objections

103 Debate: Briefs

104 Public Address: Persuasion

105 Public Address: Rhetorical Criticism

106 Public Address: Informative

107 Oral Interpretation: Prose

108 Oral Interpretation: Poetry

109 Oral Interpretation: Dramatic Duo

116 Theories of Human Communication
Spring or summer. 3 credits. Not open to first-semester freshmen. S-U grades optional.
Spring: lecs, M W 12:20; disc., F 12:20. R. Roe
Designed to introduce students to the basic areas of study common in communication theory and research. Basic ideas and theories about language, interpersonal communication, small-group communication, nonverbal communication, organizational communication, and the mass media will be covered.

120 Introduction to Mass Media
Fall or summer. 3 credits. S-U grades optional.
Fall: lecs, M W F 12:20. D. McDonald.
History, processes, philosophies, policies, and functions of U.S. communication media. The media are examined individually and collectively in regard to content, economics, production, effects of messages, regulation, and other contemporary issues.

150 Writing for Media
Fall, spring, or summer. 3 credits. Limited to communication majors—freshmen and transfers—fall and spring; open enrollment in summer.
Fall: Lec, T 9:05–11; lab, R 9:05–11 or R 11:15–1:10. M. Shapiro. Spring: Lec,T 8–10; lab 1, W 8–10; lab 2, R 8–10. B. Lewenstein.
Basic writing for print and broadcast. A back-to-basics approach to writing for clarity and style, using news and feature writing as a framework. Media form and style are analyzed. Weekly writing assignments, both in and outside of class, are given.

161 Writing in the Biological Sciences
Fall. 3 credits. Freshman Seminar designed for College of Agriculture and Life Sciences students. Concurrent registration is required in Biological Sciences 101–102, 103–104, 105–106, or 109–110.
M W F 11:15. B. Lewenstein.
Factual, informative writing based on information and laboratory experiences in biology. Emphasis on writing rather than subject matter and on objective observation rather than subjective personal experience. Discussion of effective sentence and paragraph structure, organization, usage, grammatical structure, meaning of words, and punctuation. Objective is clear, concise, concrete writing.

190 Communication Perspectives Seminar
Fall. 1 credit. S-U grades optional. Possible field trip(s).
Lec, F 1:25. B. O. Earle and staff.
Forum to discuss contemporary and future role of communication in society. Presentations by Cornell faculty and staff members, and by professionals in the field. Topics will be selected from areas such as new technology, constitutional and policy issues, career opportunities, professionalism and ethics, societal changes and implications. Open to freshman/transfer students in the Department of Communication.

201 Oral Communication
Fall, spring, or summer. 3 credits. Each section limited to 24 students. Preference given to sophomores, juniors, and seniors. Students missing the first two class meetings without university excuse are dropped so others may register. No student will be added or dropped after the second week of classes. $10 copying and materials fee charges.
Disc, M W F 8; M 8 and W F 9:05; M 9:05 and W F 8; W M F 9:05; M 9:05 and W F 10:10; M 9:05 and W F 11:15; M 9:05 and W F 12:20; M W F 10:10; M 10:10 and W F 11:15; M F 11:15 and W 1:25; M F 12:20 and W 1:25; M 12:20 and W F 9:05; M 12:20 and W F 10:10; M W F 1:25; M T W 12:20; T R 9:05 and W 12:20; T R 10:10 and W 12:20; T R 10:10 and W 1:25; T R 11:15 and W 12:20; T R 11:15 and W 1:25; T W R 12:20 and W 1:25; T W R 1:25; M 10:10 and T R 9:05; M T R 10:10. Some section times may be omitted in some semesters. R. B. Thompson, B. O. Earle, D. Fraleigh, R. Roe, T. Russo, P. Stepp, S. Warland, and staff.
Through theory and practice students develop self-confidence and competence in researching, organizing, and presenting material to audiences. Students give four graded speeches, write short papers, perform speaker evaluations, and engage in other speech-related activities.

203 Argumentation and Debate
Fall. 3 credits. Prerequisite: Communication 201.
T R 12:20–1:45. P. Stepp and D. Fraleigh.
The student will learn the principles of argumentation and the rules of debate. Classroom debates on the CEDA national topic will provide experience in critical thinking, rapid organization of thoughts, employment of research, and writing and speaking in a logical, persuasive manner.

204 Effective Listening
Fall, spring, or summer. 3 credits. Limited to 25 nonfreshman students per section. No students accepted or allowed to drop after the second week of classes.
Lec, M 1:25–2:40; lab, T, W, R, or F 1:25–2:40. Evening prelim: fall, Oct. 19 and Nov. 16; spring, March 8 and Apr. 19. S. Warland.
Lecture and sections are used to present an analysis of the process of listening, to identify barriers to effective listening, and to develop students' listening skills. Topics include audiology, cultural contents, intercultural communication, linguistics, therapeutic listening, and critical analysis of information. Students are involved in skill-building exercises and in writing self-analytical papers, as well as attending seminars.

205 Parliamentary Procedure
Fall. 3 credits. Each section is limited to 40 nonfreshman students. No adds allowed after the second week of classes.
Lec, T 1:25; sec, T or R 2:30–4:25. D. Fraleigh.
A study of parliamentary procedure, with an emphasis on rules applicable to oral communication activities such as discussion, meetings, and legislative debates. Techniques for effective meetings (including alternatives to formal parliamentary procedure) discussed. Sections emphasize participation in discussions governed by parliamentary law and meeting simulations. Each student will chair meetings. Outside assignments include meeting observations and a paper.

230 Visual Communication
Fall. 3 credits. Limited to nonfreshmen and communication freshmen. Not recommended for design or art majors. Cost of individual project materials, $20-$30.
Lec, T R 9:05; computer lab 1, T 10:10–12:05, lab 2, R 1:25–3:20, lab 3, R 3:35–5:30, lab 4, F 10:10–12:05. C. Scherer.
A basic course in the use and importance of visual communication. Course focuses on objectives, audiences, and methods of visual production. Particular emphasis is placed on the visual communication of scientific and technical information. The laboratory concentrates on the use of computers for production of visual materials. Practical projects are assigned.

232 Art of Publication
Fall and spring. 3 credits. Each lab limited to 30 nonfreshman students. Students missing the first two classes without university excuse are dropped so others may register. Project materials cost $30–$50.
Fall: lec, T R 1:25; lab, T or R 2:30–4:25; spring: lec, M W 1:25; lab, M or W 2:30–4:25. Staff.
A basic course designed to explore visual concepts that increase communication effectiveness through the printed word. The importance of selecting and coordinating format, layout, typography, and illustrations is stressed. Lectures, a field trip, in-class laboratory assignments, and outside projects examine opportunities and problems in publication design and production.

234 Photo Communication
Spring and summer. 2 credits. A lecture course for those with limited experience in photography. Students are expected to supply their own cameras.
T 1:25–4:25. Staff.
Basic photography; photojournalism is emphasized during the latter part of the course.

250 Newswriting for Newspapers
Fall or spring. 3 credits. Limited to 30 students. Prerequisite: Comm 150, major in communication, or permission of instructor. Keyboarding ability essential.
Lec, R 1:25–2:20; lab, R 2:30–4:25, plus out-of-class writing assignments. Staff.
Writing and analyzing news stories. A study of the elements that make news, sources of news, interviewing, writing style and structure, press problems, and press-society relations. Concentration on newswriting as it is practiced by newspapers in the United States. Two writing assignments each week, one done in class, one done out of class.

272 Principles of Public Relations and Advertising
Fall. 3 credits. Preference given to ALS students. Not open to freshmen.
Lecs, M W F 1:25. Staff.
Survey of the fields of public relations and advertising. Descriptions of organizations, jobs, and functions in the industry. The roles of public relations and advertising in society, the economic system, and organizations. Psychological and sociological principles as formulations for appeals. Strategies for media selection and message execution. Introduction to research and regulation.

301 Business and Professional Speaking
Fall or spring. 3 credits. Prerequisite: Communication 201.
Fall: lec, M 11:15; lab, T or W 11:15–1:10 or R 12:20–2:15. Spring: lec, M 11:15; lab, T 11:15–1:10, W 10:10–12:05 or R 12:20–2:15. B. O. Earle.
The study and practice of oral communication skills used in organizations, including speeches, interviews, reports, and discussions. It is expected that students will develop the analytical and presentation skills needed in business and professional careers.

[314 Small-Group Communication
Spring. 3 credits. Limited to juniors and seniors. Prerequisite: Communication 116 or permission of instructor. Not offered 1989–90.
T R 1:25–3. N. E. Awa.
Exploration of the principles, values, and limitations of group discussion in democratic systems. Principles are put into practice in decision-making and problem-solving groups.]

316 Rhetorical Theory
Fall. 3 credits. Limited to 20 communication majors. Prerequisites: Communication 116 and 201 or permission of instructor.
M W F 1:25. R. Thompson.
Considers current views of rhetoric in historical perspective. Shows how assumptions about communication both shape the worldview of the communicator and either aid or hinder the reaching of various communication goals. Treats historical figures briefly; focuses on contemporary thinkers such as Toulmin, Ong, Ehninger, Richards, Kuhn. Second half of course taught in seminar format.

342 Electronic Media
Fall. 3 credits. Limited to 18 communication majors. Prerequisites: Comm 120 and 150.
Lec, T 1:25; lab, R 1:30–3:30. T. Russo.
The techniques of audio and video message design and production. Emphasis on development of pre- and postproduction skills needed for the development of effective audio/video production. Students complete exercises designed to develop specific competencies and work on projects from conception through production.

[344 Radio Writing and Production
Fall. 3 credits. Limited to 30 communication majors. Prerequisite: Communication 342. Not offered 1989–90.
Lec, M W 1:25; lab, W 2:30–4:25. Staff.
Scripting and recording various public information formats for possible use on local and state radio stations. Students create complete broadcasting plans and materials for public and private organizations.]

[346 Television Writing and Production
Spring (odd-numbered years). 3 credits. Limited to 30 communication majors. Prerequisite: Communication 342. Not offered 1989–90.
Lec, T R 1:25; lab, T 2:30–4:25. D. McDonald.
Television and video production. Students gain experience in studio and field production. Lectures concentrate on developing a sense of project planning and production aesthetics; lab concentration is on producing full-scale information, documentary, or public affairs programs from development of the idea through research, scripting, planning, and production.]

348 Video Communication
Fall or summer. 3 credits. Prerequisites: Communication 116, 230, 342, and permission of instructor.
R 1:25–4:25. S. White.
An overview of video communication applications. Examination of relevant organizational and visual communication theory. Development of basic competency with portable videotape recording, equipment, audio and visual input to video and production, and postproduction planning and editing techniques.

350 Writing for Magazines
Fall or spring. 3 credits. Limited to 25 juniors, seniors, and graduate students, or others with permission of instructor. No drops after third week. Extensive out-of-class writing assignments.
Fall: M 1:25–4:25, W. B. Ward; spring: T R 11:15–12:45. Staff.
A course in nonfiction freelance writing for magazines. Intensive fact writing to help students communicate more effectively through the medium of the printed word in magazines. Art and techniques of good writing are studied; magazines in many fields of interest are reviewed. All articles are analyzed and returned to the student to rewrite and submit to a magazine.

352 Science Writing for the Mass Media
Fall. 3 credits. Not open to freshmen. Limited to 25 students. No drops after third week.
Lecs, M W F 9:05 plus out-of-class writing assignments. B. Lewenstein.
Writing to explain and simplify scientific and technical topics for newspaper and magazine readers, radio listeners, television viewers, and educational-material consumers. Includes frequent writing assignments. Students learn interviewing and research methods that ensure technical accuracy. Students should become familiar with the public policy and institutional milieu that affects science writing.

354 Print Media Laboratory
Fall. 3 credits. Limited to junior, senior, and graduate communication majors. Prerequisite: Communication 232, 250, or 350.
R 1:25–4:25. J. E. Hardy and staff.
Writing, editing, and layout principles practiced in publishing the *Cornell Countryman*. Some additional outside work sessions may be required. Students will use microcomputers.

356 Print Media Laboratory
Spring. 3 credits. Limited to junior, senior, and graduate communication majors. Prerequisite: Communication 232, 250, or 350.
R 1:25–4:25. J. E. Hardy and staff.
A continuation of Communication 354. Students will use microcomputers.

360 Scientific Writing for Public Information
Fall, spring, or summer. 3 credits. Limited to 25 nonfreshman or graduate students per section. Prerequisite: any college-level writing course.
Fall: lecs, M W F 9:05 (L. VanBuskirk); T R 9:05 and W 11:15 (J. E. Hardy); T R 10:10 and W 12:20 (J. E. Hardy). Spring: M W F 9:05 (L. VanBuskirk), T R 10:10 and W 12:20 (J. E. Hardy).
An intensive course in simplifying scientific and technical material for specific audiences within the general public. Weekly assignments include instructions, descriptions, explanations, and summaries in such formats as the newsletter, brochure, and report. Audience analysis will be emphasized. Not oriented to the mass media.

363 Organizational Writing
Fall, spring, or summer. 3 credits. Limited to 25 junior, senior, or graduate students per section. Prerequisite: any college-level writing course.
M W F 9:05, A. M. Wilkinson; M W F 11:15 and 12:20, L. VanBuskirk.
Students write as members of different organizations, in the position of supervisor, subordinate, colleague, and representative of business, government, community, and other organizations. Emphasis on adapting tone to the audience and the purpose of the message. Weekly writing assignments include various kinds of internal and external reports, memoranda, proposals, and letters. Assignments based on case studies.

[365 Writing in the Sciences and Engineering
Spring. 3 credits. Limited to 25 junior, senior, or graduate students per section. Prerequisite: any college-level writing course. Not offered 1989–90.
M W F 10:10. A. M. Wilkinson.
Students write scientific or technical material for colleagues in their own field. The objective is clear, concise writing, with attention to grammatical construction, usage, paragraph development, and organization. Weekly writing assignments include scientific or technical instructions, descriptions of equipment and procedures, definition and explanation of concepts, graphic presentations and discussion of data, abstract and summary, memorandum, research proposal, progress report, and research report.]

368 Editing
Spring. 3 credits. Limited to 25 junior, senior, or graduate students. Prerequisite: Communication 250, 350, 352, 360, or 365.
W F 10:10–11:25. J. E. Hardy.
Students will follow the process that takes a manuscript from final draft to page proof. Emphasis will be on copy editing, proofreading, fitting copy, working with authors, making editorial decisions, and developing skill in critical reading. Appropriate for any student who expects to work with manuscripts or do editorial work.

372 Advanced Advertising
Fall and spring. 3 credits. Prerequisites: Communication 272 and communication or marketing major.
Lecs, M W 2:30–3:20; labs, M W 3:20–4:25. C. Whittle.
A continuation of Communication 272. Examination of the qualitative and quantitative aspects of the mass media and how they are evaluated by advertisers. Function of media strategy in the marketing mix survey of advertising from the viewpoints of consumers. Introduction to research in advertising, with emphasis on identifying and predicting advertising effectiveness. Investigation into the planning, creation, and evaluation of advertisements and advertising campaigns.

375 Communication Planning and Strategy I
Spring. 3 credits. Limited to 35 juniors and seniors. Prerequisite: Communication 272 or permission of instructor.
Lec, M W 10:10; disc, F 10:10 or 11:15. C. Glynn.
Theories that guide and influence the solutions to public relations and public information problems in agriculture, business education, government, and social welfare organizations. Examination of the process of the formation of public opinion. Discussion of research techniques and communication tools used in communication planning, and fundamentals of developing a communication plan. Case studies and projects.

376 Communication Planning and Strategy II
Fall. 3 credits. Limited to 25 juniors and seniors. Prerequisite: Communication 375. Communication 382 strongly recommended.
Lec and lab, T R 10:10–11:40. C. Glynn.
A continuation of Communication 375. Focus is on the development and implementation of actual communication campaigns. Students work closely with a community organization in designing and implementing a communication program.

380 Independent Honors Research in Social Science
Fall or spring. 1–6 credits. Limited to undergraduates who have met the requirements for the honors program.
N. E. Awa.

382 Survey Research Methods
Fall or spring. 3 credits. Limited to 20 junior, senior, or graduate communication majors; others by permission of instructor. Prerequisite: Communication 116 or 120 or permission of instructor.
Fall: M W 12:20, lab F 12:20–2:15, P. Yarbrough; spring: M W 11:15, lab F 11:15–1:10. R. Ostman.
Analysis of public opinion polls, market research, media audience ratings, readership surveys, and communication impact designs. Development of class research project from research question to final report. Instruction in computer use of Statistical Package for the Social Sciences (SPSS) to assist in data analysis. Familiarity with basic statistical concepts helpful.

410 Organizational Communication
Fall. 3 credits. Labs limited to 15 junior, senior, or graduate communication students; others by permission. Prerequisite: Communication 116 or equivalent.
Lec, T R 12:20; lab 1, T 2:30–4:20, lab 2, W 1:30–3:20; lab 3, R 1:30–3:20.
D. Schwartz.
Study of managerial communication practices in formal organizations, with emphasis on communication between supervisor and subordinate; examination of the structure and function of planned and unplanned organizational communication networks. Case studies analyzed in lab.

416 Psychology of Communication
Fall. 3 credits. Prerequisite: Communication 116 or permission of instructor.
T R 10:10–11:30. N. E. Awa.
An advanced multidisciplinary study of communication theory. Topics include personal interaction, channels of communication, and effectiveness of messages. Study includes intensive analysis of major communication theorists.

418 Persuasion
Spring. 3 credits. Prerequisite: Communication 116 or permission of instructor.
Lecs, M W F 11:15. M. Shapiro.
The course explores the influence of communication in persuasion and attitude change. Topics may include persuasion as it applies to mass communication, advertising, public communication, or interpersonal communication.

420 Media Industries
Spring, even-numbered years. 3 credits. Limited to communication majors. Prerequisites: Communication 120 and 272.
T R 1:25–3:20. D. McDonald.
The workings and functions of mass media industries. Emphasis is placed on the structure of media industries, audience research, media economics programming, and the organization of content production. For several projects, students will use microcomputers and work with data supplied by an audience research firm.

[421 Broadcast Media Laboratory
Fall. 2 credits. Limited to junior and senior communication majors. Prerequisite: Communication 344 or 346. Not offered 1989–90.
Emphasis on production of television and radio programs for various audiences. Course work is done primarily through individual tutorial arrangement.]

[423 Broadcast Media Laboratory
Spring. 2 credits. Not offered 1989–90.
Hours to be arranged.
A continuation of Communication 421.]

428 Communication Law
Fall. 3 credits. Limited to junior, senior, and graduate students.
M W F 11:15. D. A. Grossman.
A practical survey of the law governing mass media, primarily for those working in the field. Coverage includes restraints on news gathering and publication, privacy, defamation, copyright, broadcast licensing, access, and other issues of current interest.

439 Interactive Multimedia: Design and Research Issues
Fall. 3 credits. Prerequisite: permission of instructor.
Lec, T 1:25–4:25; lab TBA. Geri Gay.
An overview of interactive multimedia technologies (videodisc, DC-ROM, digital video interactive [DVI], computer graphics, and text). Course will focus on theories and research applicable to interactive multimedia such as visualization, learner control, mental models, knowledge representations, and information processing. Course will emphasize interactive multimedia design, application, and evaluation.

490 Special Topics in Communication
Fall, spring, or summer. 1–3 credits variable. S-U grades optional. Prerequisite: permission of instructor.
Hours to be arranged. Staff.
Study of topics in communication not otherwise provided by a department course and determined by the interest of the faculty and students.

496 Internship
Fall, spring, or summer. 1–3 credits. Students must apply to department internship committee no later than the spring pre-course-enrollment period for a fall internship or the fall pre-course-enrollment period for a spring or summer internship. Prerequisites: communication junior or senior, 3.0 average in communication courses, and approval of committee. S-U grades only.
Lec, one hour per week to be arranged.
C. Whittle.
Structured, on-the-job learning experience under supervision of professionals in a cooperating organization. Students have a faculty course supervisor, who must be approved by the department internship committee. The faculty course supervisor awards the credit and grade (S-U only). A learning contract is written between the faculty supervisor and student, stating the conditions of the work assignment, supervision, and reporting. Minimum of 60 on-the-job hours per credit granted. May be repeated to a maximum of 6 credits.

497 Independent Study
Fall or spring. 1–3 credits; may be repeated to 6 credits with a different supervising faculty member. Prerequisite: 3.0 cumulative average. Undergraduates must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade.
Staff.
Group or individual study under faculty supervision. Work should concentrate on locating, assimilating, synthesizing, and reporting existing knowledge on a selected topic. Attempts to implement this knowledge in a practical application are desirable.

498 Communication Teaching Experience
Fall or spring. 1–3 credits; may be repeated to 6 credits. Limited to juniors and seniors. Intended for undergraduates desiring classroom teaching experience. Prerequisite: 3.0 cumulative average (2.5 if teaching assistant for a skill development course) and permission of the faculty member who will supervise the work and assign the grade.
Hours to be arranged. Staff.
Periodic meetings with the instructor cover realization of course objectives, evaluation of teaching methods, and student feedback. In addition to aiding with the actual instruction, each student prepares a paper on some aspect of the course.

499 Independent Research
Fall or spring. 1–3 credits; may be repeated to 6 credits. Limited to seniors and graduate students. Prerequisite: 3.0 cumulative average. Seniors must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade. Students must use the faculty member's section number to register.
Staff.
Permits outstanding students to conduct laboratory or field research in communication under appropriate faculty supervision. The research should be scientific: systematic, controlled, empirical. Research goals should include description, prediction, explanation, or policy orientation and should generate new knowledge.

610 Organizational Communication
Spring. 3 credits. Open to seniors.
T R 12:20–2:15. D. Schwartz.
Study of interpersonal communication systems in organizations. Methods for analyzing organizational and human communication effectiveness, including communication audits and network analysis.

611 Communication in Organizations
Fall. 3 credits. Prerequisite: Communication 610 or permission of instructor.
M 1:25–4:25. S. White.
Review of theories, research, and practical systems as they relate to human communication effectiveness in organizations. Includes components of interpersonal communication, intragroup and intergroup communication, communication processes involved in organizational goal setting, renewal, and change.

612 Intercultural and Development Communication
Fall. 3 credits.
T 1:25–4:30. N. E. Awa.
A systematic analysis of sociocultural and psycholinguistic obstacles to effective communication between cultures, subcultures, and ethnic and identity groups. Also examined are the subtleties and complexities of nonverbal behavior in cross-cultural transactions. Examples are drawn from ethnolinguistic and cross-cultural studies.

[616 Interpersonal Communication
Spring. 3 credits. Limited to graduate students in communication; others by permission of instructor. Not offered 1989–90.
M W 10:10–12. N. E. Awa.
A study of recent advances in interpersonal communication and social cognition. Theories and research in relational development. Human understanding of social events in an interpersonal context is explored.]

620 Public Opinion and Communication
Fall. 3 credits. Graduate students and advanced undergraduates.
T 1:25–4:25. C. Glynn.
Examination of the concept *public opinion*: investigation of how it is measured and applied in society. Analysis of relationships between public opinion and communication. Practical applications.

[624 Communication in the Developing Nations
Spring. 3 credits. Open to seniors. Not offered 1989–90.
Lec, M 1:25–4:25. R. D. Colle.
An examination of existing communication patterns and systems and their contributions to the development process. Attention is given to the interaction between communication systems and national development in primarily agrarian societies.]

626 Impact of Communication Technologies
Spring. 3 credits. Open to seniors. Offered alternate years.
W F 12:20–2:15. P. Yarbrough.
A study of emerging technologies of communication, such as computer-based information systems and satellites and their potentials for influencing communication processes and social systems. Also examines the impacts of previous communication innovations from cave painting to television.

665 Scientific Writing for Scientists
Fall. 3 credits. Prerequisites: research in progress and permission of instructor.
T R 8:30–9:55. A. M. Wilkinson.
Workshop for students with research in progress. Discussion and lectures on writing a journal article, thesis, report, and proposal; on objectives in scientific writing, relation of rhetoric and linguistics to scientific writing, process of publication and reviewing, and preparation of tables and illustrations; and on advanced and special problems in organization, paragraph development, sentence structure, and usage.

666 Perspectives on Science Writing
Spring. 3 credits. Open to graduate students and advanced undergraduates (with permission) from all departments.
M W F 10:10. B. Lewenstein.
A graduate reading course that uses various approaches to understand science writing for the general public as it appears in the mass media. Among the perspectives are history, anthropology, sociology, philosophy, institutional analysis, literary analysis, and critical journalism. As an ancillary to the primary goals of the course, students will also learn basic techniques of science writing.

676 Communication Planning and Strategy
Spring. 3 credits. Primarily for graduate students but open to seniors.
T R 10:10–12. C. Scherer.
Seminar in the planning of communication activities for the support of directed social-change programs. Examines communication and social theories, case studies, and planning models. Participants produce a comprehensive communication plan designed to solve a significant (real) communication problem of interest to them. Case studies and discussion focus on communication problems from nutrition and health, rural development programs, marketing, nonformal education programs, and corporate and government public information campaigns.

680 Studies in Communication
Fall. 3 credits. Limited to graduate students in communication; others by permission of instructor.
T 10:10–12. P. Yarbrough.
A review of classical and contemporary research in communication, including key concepts and areas of investigation. An exploration of the scope of the field and the interrelationships of its various branches.

681 Communication Effects and the Individual
Spring. 3 credits. Prerequisite: graduate students in communication; others by permission of instructor.
Lecs, T 2:30–3:20 and R 2:30–4:25.
M. Shapiro.
An introduction to theory and research in communication, focusing on the mental processes of the communicating individual. Discussions and readings will include how individuals process and remember communication information, how communication information is used in decision processes, how motivation influences processing of mass communication information, and how developmental processes influence processing and use of mass communication information.

682 Methods of Communication Research
Fall. 3 credits. Limited to graduate students.
M W 10:10–12. R. E. Ostman.
An analysis of the methods used in communication research. Emphasis is on understanding the rationale for experimental, descriptive (empirical and nonempirical), and historical-critical research methods.

683 Survey Research Methods in Communication
Spring. 3 credits. Prerequisite: Communication 682 or equivalent.
Lec, M W 1:25–3:20. D. McDonald.
Practical experience in survey techniques in communication research. Course topics include design and measurement, data collection, data preparation, data analysis, and interpretation of results. Secondary analyses of survey data are conducted within each topic area.

685 Training and Development: Theory and Practice (also Education 685, International Agriculture 685 and Industrial and Labor Relations 658)
Spring and summer. 4 credits. S-U grades optional. Charge for materials, $45.
F 9:05–12:05. Communication Graduate Center, N. Awa, D. Deshler, W. Frank.
Analysis, design, conduct, administration, and evaluation of training programs for the development of human resources in small-farm agriculture, rural health and nutrition, literacy and nonformal education, and general community development. Designed for scientists, administrators, educator-trainers, and social organizers in rural and agricultural development programs in the U.S. and abroad.

694 Seminar: Communication Issues
Fall and spring. No credit. S-U grades only.
Alternate F 2:30. S. White and C. Scherer.
A departmental seminar for students and faculty on contemporary issues in communication.

792 Advanced Communication Studies
Fall or spring. 3 credits. Limited to communication graduate students. May not be repeated. Students must use the faculty member's section number to register.
Graduate faculty.
Independent studies and projects are carried out in conjunction with selected undergraduate courses.

794 Seminar in Communication Issues
Fall, spring, or summer. 1–3 credits. Prerequisite: permission of instructor.
Hours to be arranged.
Small group study of topical issue(s) in communication not otherwise examined in a graduate field course.

797 Graduate Independent Study
Fall, spring, or summer. 1–3 credits. Prerequisite: permission of instructor.
Hours to be arranged.
Individual study concentrating on locating, assimilating, synthesizing, and reporting existing knowledge on a selected topic.

798 Communication Teaching Laboratory
Fall and spring. 1–3 credits each semester. May be repeated once. Limited to graduate students. Prerequisite: permission of the faculty member who will supervise the work and assign the grade. Students must use the faculty member's section number to register.
Graduate faculty.
Designed primarily for graduate students who want experience in teaching communication courses. Students work with an instructor in developing course objectives and philosophy, planning, and teaching.

799 Graduate Research
Fall, spring, or summer. 1–3 credits. Prerequisite: appropriate communication graduate course work or permission of instructor.
Hours to be arranged.
Small-group or individual research based on original, empirical, data-based designs regarding topical issues in communication not otherwise examined in a graduate field course.

899 Directed Graduate Study
Fall or spring. 3–6 credits. S-U grades only. Students must use the faculty member's section number to register.
Graduate faculty.

EDUCATION

R. E. Ripple, chair; J. P. Bail, A. L. Berkey, R. L. Bruce, W. S. Carlsen, J. Confrey, H. R. Cushman, D. Deshler, W. E. Drake, J. A. Dunn, J. R. Egner, G. Gay, J. H. Gould, D. B. Gowin, E. J. Haller, D. E. Hedlund, J. McGonigal, J. Millman, D. H. Monk, J. D. Novak, G. J. Posner, D. E. Schrader, K. A. Strike, H. D. Sutphin, D. J. Trumbull, J. D. Volmink, H. L. Wardeberg

005 Basic Review Mathematics
Fall. 3 credits (this credit is not counted toward the 120 credits required for the degree). Primarily for entering students.
Fall: M W F 9:05 or 12:20; J. Confrey and J. D. Volmink.
Introduction to concepts necessary for success in Education 115 and basic statistics courses. Topics include problem solving, ratios and proportions, factoring and solving algebraic equations, graphing linear and quadratic equations, and trigonometry. Considerable emphasis is placed on learning to learn mathematics for understanding and on comprehending word problems.

115 Introductory College Mathematics
Fall or spring. 4 credits.
Fall: lecs, M W 11:15 or 12:20; labs, R 8, 10:10, 12:20 or F 10:10, 12:20, 2:30.
Spring: lecs, M W F 9:05; lab: T 9:05, 10:10, 11:15, or 12:20 or R 10:10, 11:15, or 12:20. J. Confrey and J. D. Volmink.
Designed to give students with sound high school mathematics backgrounds a unified treatment of the basic concepts of college algebra, trigonometry, and geometry. Considerable emphasis is placed on the concept of function, graphing, problem solving, and applications. Selected software is used to strengthen and integrate the mathematical topics covered.

120 Education for Empowerment
Spring. 1–3 credits.
T R 2:30–4. Staff.
A modular course, with each module spanning 5 weeks for 1 credit. Common themes running through the modules include human learning, teaching strategies, political/social/economic factors affecting education. The course provides an opportunity to sample different areas of study and to gain knowledge and awareness of one's own educational processes.

210 Psychology of Learning and Memory
Fall. 3 credits. Prerequisite: introductory psychology.
M W F 10:10. J. A. Dunn.
This course deals with contemporary theories of learning, issues in the study of learning, and application of the principles of learning to the management of teaching and learning. Practical applications of research findings will be emphasized. One or more experimental projects and the use of microcomputers will be required. Not acceptable as a substitute for Education 311.

240 The Art of Teaching
Fall and spring. 3 credits.
Lec, T 2:30–4:25, fieldwork to be arranged. J. R. Egner, G. J. Posner, D. J. Tumbull, H. L. Wardeberg, and staff.
This course is designed for all students interested in finding out more about teaching. Students engage in field experiences to find out what teaching involves (minimum of two hours a week). Possible field experiences range from large group to tutorial situations, from preschool to adult education, from traditional school subject matters to recreational and vocational areas, and from school-based to nonformal situations. Class work builds on those experiences and provides skills and concepts to make the field experiences more profitable.

247 Instructional Application of Microcomputers and Related Technologies
Spring. 2–3 credits. Not available to students who have completed ABEN 102 or NR 107.
R 2:30–3:45; lab to be arranged.
H. D. Sutphin.
This course provides an introduction to instructional applications and strategies for using microcomputers and related technologies in public and private education in the private sector. The course also helps students learn to use technologies to enhance their college studies. Wordprocessing, spreadsheets, databases, hypertext, electronic bibliographical searching, networking, and desktop publishing are covered. Module A (1 credit) is the first seven weeks of the semester, focused on Macintosh technology. Module B (1 credit) is the second seven weeks, focused on IBM-compatible and related technologies. For Module C (1 credit) students propose and complete an approved special project related to the class.

[271 Sociology of Education
Fall. 3 credits. S-U grades optional. Not offered 1989–90.
T R 10:10–11:30. E. J. Haller
An introduction to the sociological study of schooling and education. Topics include the effects of social factors on educational achievement, the norms and values learned as part of the process of schooling, the relations between students and teachers, and the school's relations to the economic and political systems. All levels of education, from elementary school to the university, are considered.]

283 Education and Cultural Process in Rural Development
Fall. 4 credits.
T R 1:25–3:20. Staff.
This course is an introduction to the social and behavioral science side of rural and agricultural development. Students will study human behavior as it occurs in typical interfaces between key groups like peasants and government officers, farmers and extension agents, rural female and male development workers, academicians and practitioners, administrators/supervisors and field workers, generalists and specialists, rural teachers and parents, merchants and farmers. A problem-solving approach will be used to help students identify factors inhibiting human interaction and to design approaches for dealing with such factors.

284 Introduction to U.S. Cooperative Extension
Fall. 3 credits.
T 3:35–4:25, R 2:30–4:25. J. H. Gould.
History, programs, policy analysis, organization, and future role of cooperative extension in the United States. The role of the change agent, extension program development process, education techniques, communication skills, and volunteer involvement will be stressed. For students interested in a field of practice that makes use of undergraduate majors in ALS or the College of Human Ecology and for international students interested in an introduction to the U.S. extension experience.

301 Knowing and Learning in Science and Mathematics
Fall. 3 credits. Prerequisite: enrollment in science/mathematics certification program or permission of instructor.
M W F 2:30. D. J. Trumbull.
Students examine both current notions in the history and philosophy of science that explain how knowledge within a discipline develops and current theory and research that examines the individual's acquisition of knowledge. This material serves as a basis for students to conduct clinical interviews under the direct supervision of program staff. During the course students examine their own understanding of their major as the first step in their preparation as teachers.

302 Observing Science and Math Instruction
Spring. 3 credits. Prerequisite: Education 301 or permission of instructor.
Lec, W 2–4:25. W. S. Carlsen and J. Confrey.
The study of a variety of methods for recording and understanding science and mathematics teaching and learning. By reading and conducting research from a variety of analytic/interpretive paradigms, students will approach the familiar world of the secondary classroom with fresh perspectives. The course will include a final project that involves observing and evaluating a case of teaching. Students enrolled in teacher education programs will be expected to focus on their own teaching for the final project.

310 Psychology of Instructional System Design
Fall. 2–3 credits. Prerequisite: Education 210 or permission of instructor.
M W 11:15, hour to be arranged.
J. A. Dunn.
The course reviews the relevance of theories of learning and issues in the study of learning to the technology of instruction. Various examples of instructional systems will be considered. Student projects and laboratory exercises will be required.

311 Educational Psychology
Fall or spring. 3 credits. Prerequisite: introductory psychology. S-U grades optional in fall; letter grade only in spring.
Fall: M W 11:15, F to be arranged; D. E. Schrader and staff. Spring: M W F 10:10. J. A. Dunn.
An introductory survey course. Emphasis is on human learning and the educational process from a psychological point of view. The course is set in a broadly based teaching-learning context appropriate for prospective teachers, youth group leaders, community leaders, and those in the service-helping professions.

312 Learning to Learn
Spring. 3 credits. Prerequisite: one or more courses in psychology or educational psychology
T R 9:05. J. D. Novak.
This course is intended for persons interested in the improvement of their learning strategies and the application of new ideas and methods to improve educational programs. Lectures and discussions are based on assigned readings and the contributions of class

members. The major focus of the course is how and why concepts play a central role in human learning. Concept mapping and other strategies for educating will be used. Students will apply principles and methodologies in a project related to their interests.

317 Psychology of Adolescence
Spring. 3 credits. Prerequisite: introductory psychology. S-U grades optional.
M W F 11:15. D. E. Schrader and staff.
A survey of the nature of adolescent development, with emphasis on causal factors of adolescent behavior. Focus is on an examination of the interrelationships among the major aspects of adolescent development, an examination of some of the dominant themes of adolescence, acquaintance with research on adolescent development, and implications for the educational process.

331 Introduction to Agricultural and Extension Education
Fall. 2 credits.
Lec, M 1:25–3:25; lab to be arranged.
W. E. Drake and staff.
The course is intended for persons interested in careers as professional educators in agriculture. Investigates careers as a secondary school or two-year college teacher, cooperative extension agent, or educator in agriculture business and industry. The course emphasizes career information, methodology, and introductory teaching experiences. Class activities include presentations by resource persons currently in teaching and extension careers, field trips, and microteaching experiences.

332 Instructional Methods in Agricultural and Extension Education
Spring. 3 credits. Prerequisite: permission of instructor.
M 2–4:25 and F 12:20. H. Cushman, W. Drake, J. Gould
Selection, practice, and evaluation of methods in agricultural and extension education will be stressed. The course will focus on both general teaching strategies and methodology unique to teaching in either schools or extension. Course activities include microteaching and/or field experience during arranged times.

335 Youth Organizations
Spring. 3 credits. Prerequisite: introductory psychology or permission of instructor.
Lecs, T R 10:10; lab to be arranged.
J. P. Bail, J. H. Gould.
The role of selected youth organizations in providing educational experiences for youth. Factors affecting membership, purposes, design, operation, and administration are surveyed, emphasizing the roles an adult volunteer leader may play. The course is designed to give students an in-depth, learning-by-doing experience of how youth organizations function. Field experience with a recognized youth organization is required.

352 Reading Statistics
Fall or spring. 1 credit. Prerequisite for spring: concurrent registration in Education 353.
Fall: T 12:20; spring: T R 8:30–9. Staff.
An introduction to statistical vocabulary and symbolism frequently used in reporting empirical research in education and other social sciences. Students are taught how to comprehend statistical terminology and results.

[353 Introduction to Educational Statistics
Spring. 3 credits. Enrollment limited to 40 students. Prerequisite: Education 352 or concurrent registration, or permission of instructor. Not offered 1989–90.
T R 9:05–11. J. Millman.
A study of common univariate and multivariate statistical procedures encountered in educational and psychological inquiry. Meaning of concepts and mastery of course content is emphasized; computational details are not. Microcomputers are used extensively in class to develop understanding of the properties of statistical indices.]

370 Issues in Educational Policy
Spring. 3 credits.
T R 10:10–11:30. K. A. Strike.
An examination of selected policy issues in current education. Included are such topics as equality of educational opportunity; student, parent, and teacher rights; and educational politics. Issues are treated from legal, sociological, and economic perspectives.

378 Political Economy of Education
Fall. 3 credits. S-U grades optional. Prerequisites: one introductory level course in either government or economics, or prior permission of instructor.
T 2:30–4:25, R 2:30–3:20. D. H. Monk.
A policy oriented examination of educational systems with an emphasis on political and economic perspectives. Attention will be paid to both external and internal aspects of educational activities. Specific topics will include the changing contributions of education to earnings, school-community relations, power within educational organizations, the impact of technology in the workplace and in classrooms, and the sources and impact of educational costs. A variety of education settings will be examined including higher education and non-formal education.

380 Independent Honors Research in Social Science
Fall or spring. 1–6 credits. Limited to students who have met requirements for the honors program. S-U grades optional. A maximum of 6 credits may be earned in the honors program.
Staff.

401 Our Physical Environment
Fall or spring. 3 credits. Prerequisite: permission of instructor. Charge for photo supplies, approximately $7.
T 1:25–4:25. V. N. Rockcastle.
A practical, relatively nonmathematical study of some basic relationships and physical interactions in the environment, with emphasis on physics and earth science. Attention is paid to analysis for understanding and techniques for teaching. A two-week session on photography and an individual research project are included. Useful for teachers and environmental educators.

[411 Introduction to Educational Measurement
Fall. 3 credits. Not offered 1989–90.
T 9:05–11, R 9:05–9:55. J. Millman.
Presents practices and theories of the measurement of human knowledge and performance. Students will be expected to acquire the practical skills of planning and constructing tests for a variety of purposes, interpreting and using test results, evaluating commercially available instruments, and the like. Students will also be expected to discuss intelligently a myriad of social, ethical, legal, and technical issues associated with educational testing. One course in statistics or concurrent registration in Education 352 is recommended but is not required.]

413 Psychology of Human Interaction
Fall. 3 credits. Enrollment limited. Prerequisite: permission of instructor. Fee, $5.
T R 10:10–12:05. D. E. Hedlund.
Designed to develop skills for, and understanding of, effective interpersonal communication and interaction. Appropriate for students in the helping professions, education, and areas involving management of human resources.

414 Counseling Psychology
Spring. 4 credits. Limited to 30 students. Prerequisites: introductory psychology, social or personality psychology, and Education 413.
T R 10:10–12:05. D. E. Hedlund.
The processes of counseling are examined from various theoretical perspectives. Typical adult counseling issues are examined, and implications are drawn for counseling strategies with an adult population, including psychological assessment, establishing therapeutic goals, intervention strategies, and evaluation of outcomes. Alternative models of service delivery, such as outreach, consultation, and psychoeducation, are emphasized.

420 Field Experience
Fall or spring. 1–4 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade.
Staff.
Students may engage in planned, semiprofessional, or professional practice in an educational enterprise. Each student prepares a plan of action including rationale, purposes, and procedures and arranges with a faculty member to supervise and evaluate the field experience.

430 Special Problems in Agricultural Education
Fall, spring, or summer. 1–3 credits. S-U grades optional.
Fall and summer: hours to be arranged; spring: T 8. H. R. Cushman.
An opportunity to study individually selected problems in agricultural education.

432 Teaching Agriculture: Methods, Materials, Practice
Fall. 9 credits. Prerequisites: Education 332 and concurrent registration in Education 430 and 499.
M T W R F 8–3. A. L. Berkey and staff.
Directed participation in teaching agriculture at the secondary school level. Program includes a four-day intensive on-campus period and periodic seminars addressing selected methods and materials in teaching agriculture, combined with a 14-week period in a student teaching center. Includes evaluation of area resources, instructional materials and facilities, planning and executing instruction, directing work experience, and advising youth organizations.

445 Curriculum Design Workshop
Fall. 3 credits. Education 644 may be taken concurrently.
T R 10:10–11:30. G. J. Posner.
A general practical approach to course planning. Readings, group discussions, workshops, and individual conferences centering on each student's project. This project consists of designing a course in a subject area for an age level and an institutional setting of the student's choosing.

[457 Discourse Analysis
Fall. 3 credits. Offered alternate years. Not offered 1989–90.
Lec, T R 2:30–3:45. W. S. Carlsen.
An introduction to the sociolinguistics of education, this course begins with a series of readings and discussions on the language of the classroom and, through a series of practical exercises, prepares students to analyze language in projects of their own design. In the context of classrooms and schools, we will consider among other issues: participation structures, propositional analysis, questioning, turn-taking, and the ways teachers and students negotiate meanings during lessons. Many of the cases and exemplars in the lab will be taken from science and mathematics classrooms, and special attention will be paid to communicative patterns in the small-group activities that often characterize excellent science and mathematics teaching.]

472 Philosophy of Education
Fall. 3 credits.
T 2:30–4:25. K. A. Strike.
A study of central issues in the philosophy of education. Questions of ethics, political philosophy, and the theory of knowledge are examined and linked to current educational issues.

473 Contemporary Philosophy of Education
Spring. 3 credits.
M W 11:15, plus additional work to be arranged. D. B. Gowin.
The emphasis in this course is the architectonics of meaning as a guide to philosophizing about education, our topic. We begin with the fact that philosophers disagree, as do experts in all fields. Every discipline exhibits competing philosophical principles. The appeal to facts to settle disagreements fails because some philosophical principle is necessary to give meaning to facts. Philosophy concerns itself with problems we can neither solve nor abandon. Each year the readings in the course will change as we seek to use texts that are the most up-to-date and also the most fundamental in philosophy. Thus, the course may be taken more than once. The curriculum is emergent.

477 Law and Educational Policy
Fall. 3 credits.
M 2:30–4:25. K. A. Strike.
A study of recent federal court decisions concerning education. Emphasis on examining legal issues against a background of related educational issues and in terms of the consequences of legal decisions for the development and operation of educational institutions.

481 Educating for Community Action
Spring. 3 credits.
T R 11:15–1:10. R. L. Bruce.
The design and execution of educational aspects of community-action and nonformal education programs. Deals with the identification and statement of educational goals, selection of teaching strategies, and evaluation of outcomes.

482 Introduction to Adult Education
Fall. 3 credits. S-U grades optional.
T R 12:20–2:15. D. Deshler.
Focuses on the broad aspects of adult education: scope and history of adult-education programs, philosophy and principles, perspective of the adult learner, media and methods of instruction, and program development. Opportunities are provided for observation of adult-education programs in community organizations and agencies.

483 Comparative Studies in Adult Education
Spring. 3 credits. S-U grades optional.
W 7:30–10:30 p.m. D. Deshler.
Focuses on the variety of adult-education programs in countries around the world. Literature on comparative adult education, international conferences on adult education, UNESCO adult-education publications, and international community development are analyzed in relationship to each student's exploration of adult education in two countries. Description of adult education in other countries is shared by international students.

497 Independent Study
Fall or spring. 1–3 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade.
Staff.
A student may, with approval of a faculty adviser, study a problem or topic not covered in a regular course or may undertake tutorial study of an independent nature in an area of educational interest.

498 Undergraduate Teaching
Fall or spring. 1 or 2 credits; 4 credits maximum during undergraduate career. Limited to students with grade-point averages of at least 2.7. S-U grades optional.
Staff.
Participating students assist in teaching a course allied with their education and experience. Students are expected to meet regularly with a discussion or laboratory section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

499 Undergraduate Research
Fall or spring. 6 credits maximum during undergraduate career. Not open to students who have earned 6 or more undergraduate research credits elsewhere in the college. Limited to juniors and seniors with grade-point averages of at least 2.7.
Staff.
Affords opportunities for students to carry out independent research under appropriate supervision. Each student is expected to review pertinent literature, prepare a project outline, conduct the research, and prepare a report.

547 Improvement of College Teaching
Fall, spring, or summer. 2 credits.
D. B. Gowin.
Concepts of teaching, learning, curriculum, and governance are used to guide practical activities that enhance faculty competence. Recent studies of concept mapping and learning, structure of knowledge, science teaching, adult learning, and evaluation provide a conceptual basis for improving teaching.

590 Special Topics in Education
Fall, spring, or summer. 1–3 credits. Prerequisite: permission of instructor. S-U grades optional. Hours to be arranged.
Staff.
Topics to be announced.

601 Secondary Science and Mathematics Teaching Practicum
Fall or spring. 3 credits. Prerequisite: permission of instructor. Letter grades only. For graduate students enrolled in the Teacher Education in Science and Mathematics Program.
M T W R F 8–3. D. J. Trumbull and staff.
Supervised student teaching in science or mathematics at the secondary level. Program includes teaching at a local school for ten weeks.

602 Teaching Science/Mathematics: Methods, Materials, Practice
Fall. 9 credits. Prerequisite: concurrent enrollment in Education 601 or permission of instructor.
Lec, M F 9–12 and 1–3, first 5 weeks; last 10 weeks to be arranged. G. J. Posner and staff.
The course begins with five weeks of intensive consideration of theoretical frameworks relevant to all aspects of student teaching. Assignments and a weekly seminar during the next ten weeks require students to use those theories to develop and evaluate teaching materials and practices. Students will complete an extensive portfolio documenting their work.

603 Teaching Mathematics
Spring. 3 credits.
M 2–4:25. J. Confrey.
Current research in mathematics education will be examined in order to develop a picture of the mathematics classroom that integrates subject matter, student conceptions, affective variables, and issues in the social context of learning mathematics. Special topics will include research on problem solving, women and mathematics, misconceptions, and research on teaching.

606 Seminar in Science and Mathematics Education
Fall or spring. 1 credit. S-U grades only.
Fall R 3:35; spring R 4:30. W. S. Carlsen and J. D. Novak.
Explores various interests in science, mathematics, and environmental education. Discussions center around curriculum development, research and thesis writing, current problems, and current literature.

609 Educational Ethnography
Spring. 3 credits. Prerequisite: course in research methods or measurement or permission of instructor.
M W 2:30–4. D. J. Trumbull.
The course will study educational ethnography as a form of interpretive research, a perspective that attends to the complex interactions between researcher, researched, and context and accepts the centrality of meaning-making in the conduct of human affairs. Students will examine some of the philosophical debates about research approaches and will discuss research methods as they relate to the aims and assumptions of interpretive research. Students will conduct a joint research project during the course of the semester.

611 Educational Psychology
Fall. 3 credits. Prerequisite: introductory psychology. S-U grades optional.
M 12:20–1:10; W 12:20–2:15.
D. E. Schrader.
A basic survey course for graduate students. Emphasis on psychological factors involved in human learning and the educational process. Set in a broad-based conceptual model of any behavioral setting for learning. Appropriate for those seeking an introduction to educational psychology or a refresher course in contemporary educational psychology.

613 Theory and Methods for Education
Fall. 3 credits. Prerequisite: Education 311 or 611 or permission of instructor.
T R 9:05. J. D. Novak.
Presents a coherent theory of education combining concepts from philosophy, psychology of learning, curriculum, and instruction. New educational methods, including concept mapping and clinical interviews, will be presented. Students will gain competence by applying concepts and methods in a project related to their interests. Classes include discussion of student-initiated questions and use of videotape to analyze educational techniques.

620 Internship In Education
Fall or spring. 2–6 credits. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for supervising the work.
Staff.
An opportunity for practical experience in educational professions development.

630 Special Problems in Agricultural and Occupational Education
Fall or spring; may also be offered in summer. 1–3 credits. S-U grades optional.
Hours to be arranged. A. L. Berkey and staff.
The course provides an opportunity for graduate-level study of individually selected problems and issues in agricultural and occupational education. Designed for experienced teachers.

632 Teaching Agricultural and Occupational Education
Spring. 3 credits. Prerequisite: an introductory course in teaching methods or permission of instructor.
M 8–10. A. L. Berkey.
The focus of the course is on the selection, use, and evaluation of methods and materials for teaching occupational subjects. Methods for both group and laboratory instruction are covered. Opportunity is provided for students to develop teaching competencies based on their individual needs and interests. Development of self-evaluation skills is included. A class project on the development of instructional materials is required.

633 Curriculum in Agricultural and Occupational Education
Fall. 3 credits.
T 1:25–3:20; labs to be arranged.
W. E. Drake.
Current situations affecting occupational education curricula are examined. Principles, objectives, and sources of information are developed for planning curricula. Strategies for developing occupational courses are examined. Consideration is given to planning, developing, and managing work experience programs. Participants have an opportunity to observe ongoing programs at the secondary and two-year college levels and to pursue individual interests in curriculum improvement.

643 Structure of Knowledge and Curriculum
Spring. 3 credits. Prerequisite: permission of instructor.
M W 12:20–2:15. D. B. Gowin.
Curriculum studies are the opening door to the four commonplaces of educating: curriculum, teaching, learning, and governance. A theory of educating explains the relations among these educational variables. Practice in concept mapping and Vee diagramming is required to achieve proficiency in curriculum analysis and curriculum construction. A theory and method for the analysis of the structure of knowledge is presented.

644 Curriculum Theory and Analysis
Fall. 3 credits.
M W 10:10–11:30. G. J. Posner.
An examination of the basic elements involved in making curriculum decisions and an analysis of current approaches to curriculum. The course focuses on the assumptions underlying any curriculum. The major task of each student is to choose and conduct an in-depth analysis of a curriculum. This course is the basic graduate course in curriculum.

647 Instructional Technologies: Analysis and Practices
Spring. 2–4 credits. Prerequisite: skills in statistics and research design. Letter grade only.
R 2:30–3:45; lab to be arranged.
H. D. Sutphin.
Current research and literature on instructional computing and related technologies in the public and private sectors will be examined. Students complete a group research project on educational technologies and meet for five seminar sessions to earn 2 credits. The research experience includes design, data collection, input, analysis, and synthesis. Concurrent attendance in ED 247 Modules A and B is required (2 credits); or 247 may be taken as a prerequisite.

650 Methods of Educational Inquiry
Fall. 1 credit.
T 2:30–3:20. D. J. Trumbull.
A survey of approaches to inquiry in the social sciences, including experimental and comparative designs, survey research, case study, simulation, philosophical and historical inquiry, content analysis, and secondary data analysis. The course is intended to broaden the student's views of appropriate methods of disciplined inquiry.

651 Writing a Thesis Proposal
Fall. 1 credit. S-U grades only.
T 3:35. W. S. Carlsen.
Procedures for developing and writing a master's or doctoral thesis proposal. Emphasis will be given to identifying a significant topic, conducting and describing a group minireserach study, recognizing weaknesses in illustrative proposals, and clear and concise writing. Students will be provided ample assistance in constructing a brief thesis proposal of their own.

654 Evaluation for Program Management
Spring. 3 credits. S-U grades optional.
M 1:25–4:25. R. L. Bruce.
The course will consist of three modules, each for one hour of credit. (1) Evaluation as a programming function: fitting an evaluation to decision needs; program monitoring; evaluation and information systems. No prerequisite. (2) Evaluation models: comparative examination of various models and their implications for practice. No prerequisite. (3) Practicum in program evaluation: directed practice in the design and conduct of a "live" evaluation. Prerequisite: module 1.

[659 Special Topics in Research Methods
Spring. 2–3 credits. Prerequisite: permission of instructor. S-U grades only. Not offered 1989–90.
Hours to be arranged. J. Millman.
Consideration of new techniques and current topics in educational research design, measurement, or evaluation of programs, products, and personnel.]

661 Administration of Educational Organizations
Fall. 3 credits.
W 3:35–6. J. R. Egner
Perspectives on the administration of educational organizations. Consideration of social science, legal and ethical theories, and their application to both public schools and higher education. Intended for students who are considering careers as educational administrators, as well as for those who want to further their understanding of schools as organizations.

664 Educational Finance
Fall. 3 credits. S-U grades optional.
R 3:35–6. D. H. Monk.
An analysis of the distribution and utilization of public and private resources for educational purposes. The discussion will revolve around the issues of equity, efficiency, and freedom of choice. Alternative methods of financing schools will be evaluated, and the perplexing legal and moral issues raised by such questions as "Who pays?" and "Who benefits?" will be discussed. Specific attention will be given to budgeting, accountability, and productivity. An opportunity for individuals to focus on their own areas of interest, such as occupational education, the two-year college, or secondary or higher education.

665 Administrative Decision Making
Spring. 3 credits. S-U grades optional.
W 3:35–6. D. H. Monk.
An introduction to decision making theory and its relevance to the field of educational administration. Specific applications will be made to the study and improvement of productivity within educational systems. A wide variety of educational settings will be considered, including higher education and non-formal education.

673 Seminar in Dewey's Philosophy of Education
Fall. 3 credits. S-U grades optional.
R 3–5. D. B. Gowin.
Dewey's corpus of philosophical works has been given new life by contemporary philosophers (Richard Rorty, Richard Bernstein, James Gouinlock, and Walter Watson). After fifty years or so of inattention, Dewey is now acknowledged as a "philosophic genius" of the twentieth century (along with Wittgenstein and Heidegger). Education and democracy are central to Dewey's thought; this seminar is an exploration of theory, method, and practical educative consequences of Dewey's views. The Dewey Center edition of original works is now available in Cornell libraries.

[674 History of American Education
Fall. 3 credits. Not offered 1989–90.
M 3:35–5:15. Staff.
An examination of American schools, colleges, and other educative agencies from colonial beginnings to the present. An attempt is made to view education in the context of the evolution of American norms and values.]

678 Planning Educational Systems
Spring. 3 credits. S-U grades optional.
T 2:30–4:25. D. H. Monk.
A seminar focused on a comparative analysis of educational planning as it is practiced in both industrialized and developing nations. Topics will include manpower planning, the social demand approach to educational planning, benefit-cost analysis, and incentive models of planning. Attention will be given to case studies that will be selected in accordance with students' interests. The political and economic implications of attempts to plan education will be emphasized.

679 Policy Issues in Higher Education
Spring. 3 credits. S-U grades optional.
T 11:15–1:15. J. R. Egner
Deals with administration of higher educational organizations. Current approaches to planning and analysis of special problems.

680 Foundations of Extension Adult Education
Fall. 3 credits. Limited to 20 students. S-U grades optional.
F 9:05–12:10. D. Deshler.
An analysis of alternative purposes, nature, and scope of extension, adult, and continuing education programs in the United States and abroad, with emphasis on the relationship of programs to historical, cultural, political, and social settings. Definitions, conceptual controversies, philosophical issues, and current research directions will be examined through a seminar approach.

[681 Designing Extension and Continuing Education Programs
Fall. 3 credits. Prerequisite: permission of instructor. Not offered 1989–90.
T 1:25–4. R. L. Bruce.
Designed to help students understand the concepts, principles, and procedures relevant to developing programs and curricula for the continuing education of adults. Emphasis is on such key areas as the nature and role of programming, situation analysis and needs identification, choosing among alternative courses of action, stating program objectives, and program organization.]

682 Community Education and Development
Fall. 3 credits. For students who have interest or experience in education or development programs in which community is an important concern.
W 2:30–5. Staff.
An examination of the concept of community; changes in community life; the analysis of community; alternative strategies for community development; patterns of response to community by universities, colleges, schools, cooperative extension, and government service agencies; and such functional dimensions of community education programming as participatory decision making, volunteers, leadership development, council formation and function, interagency coordination, and change-agent roles.

[683 Administration of Nonformal Education
Spring. 3 credits. Not offered 1989–90.
W 1:25–4. Staff.
An overview of selected theories, principles, and strategies applicable to management of decentralized, professionally staffed, nonformal educational organizations and change agencies. Content includes management functions, managerial leadership, management by objectives, and decision-making strategies. Particular attention is given to leadership of organizations with volunteer staff.]

684 Adult Education Programs: Organization and Direction
Spring. 3 credits.
F 1:25–4:25. H. R. Cushman.
Alternative procedural models for organizing and conducting adult occupational education courses are presented. Guidelines and procedures for implementing the models in secondary and postsecondary school settings are emphasized.

685 Training and Development: Theory and Practice (also Communication 685, International Agriculture 685 and Industrial and Labor Relations 658)
Spring and summer. 4 credits. S-U grades optional. Charge for materials, $45.
F 9:05–12:05. Communication Graduate Center. N. Awa, D. Deshler, W. Frank.
Analysis, design, conduct, administration, and evaluation of training programs for the development of human resources in small-farm agriculture, rural health and nutrition, literacy and nonformal education, and general community development. Designed for scientists, administrators, educator-trainers, and social organizers in rural and agricultural development programs in the U.S. and abroad.

690 Research Seminar
Fall and/or spring. No credit.
T 12:20. J. P. Bail.
Presentation of current research in the field of education by graduate students and staff. Opportunities to discuss methodology, findings, and other aspects of research.

711 Contemporary Issues in Educational Psychology
Spring. 2–3 credits.
M W 11:15. 1 hour to be arranged. J. A. Dunn.
This is a graduate-level seminar dealing with key issues in contemporary psychology having implications for educational practice and research. Topics will vary from year to year. Students may take the course more than once.

715 Seminar in Psychology and Education
Fall or spring. Variable credit. Prerequisite: permission of instructor.
W 1:25–3:25. D E. Hedlund.
Selected topics focusing on the interaction of theoretical and research developments in psychology and education.

718 Adult Learning and Development
Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional. Offered alternate years.
Hours to be arranged. R. E. Ripple, R. L. Bruce.
Deals with adult development and learning behavior from points of view of educational psychology, social psychology, and sociology. Inferences are drawn from theory and research to the practice of adult continuing education. Appropriate for graduate students in educational psychology, extension and continuing education, and community service education, and for others interested in adult learning and development.

719 Seminar in Educational Psychology
Fall. 1 credit. S-U only.
W 12:20. J. A. Dunn.
Presentation and discussion of current professional topics in educational psychology. Current research and theoretical controversies in the field will be covered.

730 Seminar in Agricultural and Occupational Education
Spring. 2 credits. S-U grades optional.
R 8–9:55. H. D. Sutphin and staff.
For master's degree candidates who have had teaching experience and doctoral candidates with majors or minors in agricultural and occupational education. Emphasis is on current problems and research. Includes discussion and analysis of student research proposals.

735 Teacher Preparation in Agriculture
Fall. 3 credits. Prerequisite: teaching experience in agriculture.
W 1:25–3:20. A. L. Berkey.
For persons with teaching experience interested in the preparation of occupational teachers. Involvement in the Cornell program of teacher preparation in agriculture is expected.

736 Occupational Education Program: Administration and Supervision
Spring. 3 credits.
T 3:35–6; special sessions to be arranged. J. P. Bail.
Practices and procedures of organizing, administering, and supervising programs of occupational education at the secondary and postsecondary level are stressed. The role of the director in providing leadership in improving instruction, designing programs, and using resources at federal, state, and local levels is considered.

739 Evaluating Programs in Occupational Education
Spring. 3 credits. Offered alternate years.
T 1:25–3:20; labs to be arranged.
W. E. Drake.
This course examines objectives, criteria, and strategies for evaluating programs of occupational education in secondary and postsecondary schools. Evaluation models, case studies, and evaluation as a function of program planning are considered. Participants examine the roles of supervision in evaluation and have

an opportunity to develop and apply evaluative instruments. Field trips and resource persons provide opportunities to observe actual evaluation problems and procedures.

745 Seminar in Curriculum Theory and Research
Spring. 3 credits. Prerequisite: Education 644, or permission of instructor.
W 8–11. G. J. Posner.
Theoretical issues in curriculum and appropriate areas for curriculum research are discussed. Two current topics of interest are the hidden curriculum and school reform. Both topics serve to uncover the relation between ideology and research.

750 Conceptual Problems in Educational Inquiry
Fall. 3 credits. S-U grades optional.
R 12:20–2:15. D. B. Gowin.
A constructionist view (as opposed to the conventional foundationalist viewpoint) of creating knowledge and value claims is the starting point of this seminar. We will be concerned with the conceptual principles (both normative and scientific) that guide research such that knowing and valuing are integrated in research. A view of theory-driven programmatic research is presented. We will read recent works in women's way of knowing, in children's clever misconceptions of science and math, alternative ways of knowing peace and war, and Hispanic minorities' view of knowing. Familiarity with master's and doctoral dissertation work of the past fifteen years at Cornell is expected. Copies are available in the libraries.

[751 Quantitative Approaches to Qualitative Data Analysis
Spring. 3 credits. Prerequisite: Education 353 or equivalent. Offered alternate years. Not offered 1989–90.
Lec, T 10:10, R 10:10–12:05.
W. S. Carlsen.
This course focuses on techniques for analyzing and reporting interpretive research data. Although we will consider some general analytic methods (e.g., constant comparative analysis) and their theoretical foundations, the emphasis in this course will be on categorical, computational, and graphical approaches to constructing meaning from rich interpretive data sets. This course is intended to complement but not replace the study of discipline-specific interpretive approaches like ethnography, historiography, and sociolinguistics.]

[762 Research in Educational Administration
Spring. 3 credits. Prerequisite: one course in elementary statistics or permission of instructor. S-U grades only. Not offered 1989–90.
Hours to be arranged. E. J. Haller.
An analysis and critique of current research in educational administration. Discussion of research priorities and strategies. For graduate students interested in research on problems of educational administration. Students will carry out a small-scale empirical research project.]

772 Seminar in Philosophy of Education
Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional.
Hours to be arranged. K. A. Strike.
Topics to be announced.

782 Behavioral Change in International Rural Modernization
Fall. 3 credits. For students who have interest or experience in international rural development or community development.
Staff.
An exploration of the social psychological aspects of socioeconomic development, focusing on individual modernity, values-beliefs-motives, achievement motivation, entrepreneurship, innovativeness, expectancies, and self-efficacy, and the applied orientations of indigenous learning and knowledge systems, adoption behavior under conditions of risk and uncertainty, appropriate social-educational-biomechanical technology, communication-diffusion of innovations, and development education.

783 Comparative Extension Education Systems
Spring. 3 credits. Prerequisite: Education 782 or permission of instructor.
R 1:25–4:25. Staff.
Extension education in the developing nations is studied using, as an analytical frame of reference, a hypothetical model comprising such components as community organization, community-based learning, indigenous facilitators and leaders, extension generalists and specialists, training, and research-extension linkages. Case materials on alternative extension models and intercountry experiences provide an empirical base.

[784 Technology-Focused Decision Making: Models for Extension Educators
Fall. 3 credits. Not offered 1989–90.
M 12:20–2:15. R. Bruce, J. McGonigal.
The educational and program management decisions involved in the adoption of educational technology in extension, rural development, and nonformal education programs are reviewed, and a variety of decision-making approaches is explored. An overall problem-solving method with case study illustrations is used. Consideration is given to structure and operating style of the educational organization, as well as to the characteristics of the technology under consideration. The course makes use of recent literature and continuously updated files on current developments in technology applications.]

800 Master's-Level Thesis Research
Fall or spring. Credit to be arranged. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for guiding the work.
Staff.

900 Doctoral-Level Thesis Research
Fall or spring. Credit to be arranged. Limited to students working on theses or other research and development projects. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for guiding the work
Staff.

Related Course in Another Department
Historical Roots of Modern Psychology (Psychology 490)

ENTOMOLOGY

R. A. Morse, chair; W. L. Brown, Jr., G. C. Eickwort, P. P. Feeny, W. T. Johnson, J. P. Kramer, J. K. Liebherr, B. L. Peckarsky, D. Pimentel, E. M. Raffensperger, R. B. Root, R. T. Roush, D. A. Rutz, J. P. Sanderson, J. G. Scott, E. J. Shields, M. J. Tauber, W. M. Tingey, S. Via, Q. D. Wheeler

Emeritus professors: J. E. Dewey, J. G. Franclemont, G. G. Gyrisco, A. A. Muka, C. E. Palm, R. L. Patton, L. L. Pechuman, W. A. Rawlins, M. Semel, E. H. Smith, R. G. Young

Courses by Subject

Apiculture: 260, 262, 264
Behavior: 662
Ecology: 370, 455, 464, 470, 471, 664, 672
Introductory courses: 200, 212
Medical entomology and pathology: 452, 453, 454, 653
Morphology: 322
Pest management: 241, 342, 443, 444, 472, 640, 677
Physiology and toxicology: 411, 483, 685, 690
Systematics and acarology: 331, 332, 621, 630, 631, 633, 634, 636, 674, 710

200 Cultural Entomology
Fall. 2 credits. S-U grades optional. Intended for students in all colleges.
Lecs, T R 10:10. E. M. Raffensperger.
A presentation of the insects, with attention to their roles in nature and in civilization. Biological, historical, social, economic, and cultural aspects are discussed.

212 Insect Biology
Fall. 4 credits. Prerequisites: Biological Sciences 101–102 (may be taken concurrently) or equivalent.
Lecs, W F 11:15; lab, M T or W 1:25–4:25.
G. C. Eickwort.
Introduces the science of entomology by focusing on basic principles of systematics, morphology, physiology, behavior, and ecology of insects. The laboratory in early fall includes field trips to collect and study insects in the natural environment. A small collection emphasizing ecological and taxonomic categories is required.

241 Applied Entomology
Spring. 3 credits. Prerequisites: Biological Sciences 101–102 or equivalent.
1 Lecs, T R 10:10; lab, T W or R 2–4:25.
E. M. Raffensperger.
A compendium of the insects associated with crops and farm animals. Discussions of insect pest management requirements on farm and in garden, along with descriptions of control methods, materials, and equipment.

260 Introductory Beekeeping
Fall. 2 credits.
Lecs,T R 11:15. R. A. Morse.
Introduces the fundamentals of practical beekeeping, including the life history, physiology, and behavior of honey bees. The classical experiments on the dance language and the role of pheromones are reviewed. Some lectures are devoted to pollination of agricultural crops and the production of honey and beeswax.

262 The Biology of the Honey Bee
Fall. 1 credit. Limited to 10 students.
Prerequisite: permission of instructor.
Labs, afternoons or weekends to be arranged; course will meet in Sept. and Oct. only. R. A. Morse.
A series of laboratories in which students perform some of the classical experiments on honey bee behavior. Various techniques used in bee research are introduced.

264 Practical Beekeeping
Fall. 1 credit. Limited to 20 students.
Prerequisite: Entomology 260 (may be taken concurrently).
Lab, R 2–4:25. R. A. Morse.
This course consists of fourteen laboratory sessions to acquaint students with practical methods of colony management. Laboratories involve actual work with honey bee colonies and equipment. Some of the topics covered are management of bees for apple pollination, honey harvesting and processing, and disease identification and control.

[322 Insect Morphology
Fall. 5 credits. Prerequisite: Entomology 212 or 241. Offered alternate years. Not offered 1989–90.
Lecs, M W F 9:05; labs, M F 1:25–4:25. G. C. Eickwort.
An introduction to the external and internal anatomy of insects, with emphasis on the comparative and functional aspects. The laboratory is devoted largely to dissection.]

331 Introductory Insect Systematics
Spring. 4 credits. Prerequisite: Entomology 212.
Lecs, T R 10:10; labs,T R 1:25–4:25. W. L. Brown.
An introduction to the classification, evolutionary history, and distribution of the insects. Laboratory practice in the identification of orders, families, and representative genera of insects; methods of collection, preservation, and study. Lectures on theory and practice of insect systematics and major features of insect evolution. Insect collections are required.

[332 Systematics Discussion Group
Spring. 1 credit. Prerequisite: concurrent enrollment in Entomology 331 or permission of instructor. S-U grades only. Offered alternate years. Not offered 1989–90.
Disc, hours to be arranged. Q. D. Wheeler.
Readings and discussion on topics in systematics coordinated with the lecture series in Entomology 331.]

342 Special Topics in Economic Entomology
Hours to be arranged.
Staff.
Topics to be announced.

[370 Pesticides and the Environment (also Toxicology 370)
Fall. 2 credits. Prerequisites: Biological Sciences 101–102 or equivalent. Not offered 1989–90.
Lecs, T R 9:05. J. G. Scott.
A survey of the different types of pesticides, their uses, properties, and effects on the environment. Discussion of the risks, benefits, regulation, and current controversies associated with pesticide use.]

[441 Seminar in Insect Pest Management
Spring. 1 credit. Limited to 10 students.
Prerequisite: Entomology 241 or 444 or permission of instructor. S-U grades only. Not offered 1989–90.
Hours to be arranged. A. M. Shelton.
Discussion of current topics in pest management, with an emphasis on insect pest management.]

[443 Pathology and Entomology of Trees and Shrubs (also Plant Pathology 443)
Fall. 5 credits. Prerequisites: Plant Pathology 301 and Entomology 241 or equivalent.
Offered alternate years. Not offered 1989–90.
Lecs, M W F 10:10; labs, W F 1:25–4:25. Evening prelims. W. T. Johnson, G. W. Hudler.
For students preparing for careers in horticulture, urban forestry, and pest management. Deals with the nature, diagnosis, assessment, and treatment of diseases and arthropod pests of trees and shrubs. Forest, shade, and ornamental plants are considered.]

[444 Integrated Pest Management (also Plant Pathology 444)
Fall. 4 credits. Prerequisites: Biological Sciences 260 or 360, Entomology 212 or 241, and Plant Pathology 301 or their equivalents or permission of instructor. Not offered 1989–90.
Lecs, M W F 9:05; lab, M or W 1:25–4:25. Evening prelims. P. A. Arneson.
Lectures integrate the principles of pest control, ecology, and economics in the management of pest-crop systems. Laboratories consist of exercises to reinforce concepts presented in lecture and demonstrate pest monitoring techniques and the application of computer technology to management problems.]

[452 Medical Entomology
Fall. 3 credits. Prerequisites: Entomology 212 or permission of instructor. Offered alternate years. Not offered 1989–90.
Lecs, T R 10:10; lab, R 1:25–4:25. Staff.
A survey of arthropods of public health and veterinary importance, with emphasis on transmission dynamics of pathogens, bionomics of vector populations, and current control concepts. Morphology and taxonomy of selected groups are examined in the laboratory, with additional exercises in vector-pathogen relationships and epidemiological techniques.]

[453 Insect Pathology
Spring. 4 credits. Prerequisite: Entomology 212 or 241 or permission of instructor. Recommended: a course in microbiology.
Offered alternate years. Not offered 1989–90.
Lecs, M W 10:10; lab, R 1:25–4:25. J. P. Kramer.
A survey of the diseases of insects caused by viruses, bacteria, fungi, and protozoans and a consideration of the role of microbial diseases in natural and applied insect control. Laboratory investigations center around living insect-pathogen associations and the consequences of these associations for both insect and microbe.]

[454 Insect Pathology Seminar
Spring. 1 credit. Prerequisite: Entomology 453. S-U grades only. Offered alternate years. Not offered 1989–90.
Hours to be arranged. J. P. Kramer.
Presentations, discussions, and analyses of current topics by the participants. Focus centers on microbial diseases of insects.]

455 Insect Ecology, Lectures (also Biological Sciences 455)
Fall. 3 credits. Prerequisites: Biological Sciences 261 and Entomology 212 or their equivalents. Offered alternate years.
Lecs, W F 11:15 and 1 hour of discussion weekly to be arranged. R. B. Root.
Ecological and evolutionary principles are integrated by thorough examination of outstanding investigations. Topics discussed include the factors responsible for the great diversity of insects, adaptive syndromes associated with climate, natural history of arthropod guilds, impact of insects on terrestrial vegetation, population regulation, and the contrast between natural and managed ecosystems.

464 Microevolution and Macroevolution (also Biological Sciences 464)
Spring. 4 credits. Prerequisite: Biological Sciences 378 or consent of instructor. S-U grades optional with permission of instructor. Offered alternate years. Limited to 25 students.
Lecs, T R 10:10–11:30; disc, 1 hr/wk to be arranged. A. McCune, S. Via.
An advanced course in evolutionary biology integrating macroevolutionary and microevolutionary approaches. Areas of emphasis include patterns and processes of speciation, phylogeny reconstruction in populations and higher taxa, the origins and fate of variation, and causes of major evolutionary transitions. Discussion of these problems will involve data and approaches from genetics, morphology, systematics, paleobiology, development, and ecology.

[470 Ecological Genetics (also Biological Sciences 470)
Spring. 4 credits. Prerequisite: Biological Sciences 378 or consent of instructor. S-U grades optional. Offered alternate years. Not offered 1989–90.
Lecs, T R 10:10–11:30; disc, 1 hr/wk to be arranged. S. Via.
A study of the relationships between genetic and ecological processes in populations. Topics include consequences of genetic variation in age-structured populations, demographic concepts of fitness, evaluation of methods for measuring genetic variation and natural selection on ecologically important traits, genetics of competitive ability and predator avoidance, genetic and ecological aspects of phenotypic plasticity, character displacement, maintenance of genetic variability, and limits to selection. We will consider how theory can be used to formulate hypotheses about evolutionary mechanisms in natural populations and evaluate experiments designed to test such hypotheses.]

471 Freshwater Invertebrate Ecology and Systematics
Spring. 5 credits. Recommended: Entomology 212, Biological Sciences 261 or 262, and 462 or 464.
Lecs, T R 9:05; labs, T R 1:25–4:25. One evening prelim. B. L. Peckarsky.
The lecture explores the life histories, behavior, feeding ecology, and factors affecting distribution, abundance, and community structure of macroscopic freshwater invertebrates with an emphasis on insects. The laboratory involves field collections and laboratory identification of invertebrates and stresses the use of keys. Students may elect to conduct ecological field projects or to prepare a collection of freshwater invertebrates.

472 Genetics of Pest Management
Fall. 4 credits. Prerequisite: Biological Sciences 281 or equivalent. S-U grades optional.
Lecs, T R 12:20–1:45; lab to be arranged (3 hours). R. T. Roush.
A detailed survey of the application of genetics to pest management. Includes discussion of host plant resistance, pesticide resistance, insect mass rearing technology, autocidal controls (e.g., sterile males), and the establishment and genetic improvement of biological control agents, with examples from plant pathology, weed science, and entomology.

483 Insect Physiology
Spring. 4 credits. Prerequisite: Entomology 212 or permission of instructor.
Lecs, M W F 11:15; lab, W 1:25–4:25. Staff.
An introduction to the often unique ways in which insects have met their basic needs. Each organ system is examined with emphasis on basic principles and specific examples. The student will also be introduced to some common methods used in physiological research and to the critical reading of scientific literature.

497 Special Topics for Undergraduates
Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work.
Staff.

498 Undergraduate Teaching
Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Undergraduate teaching assistance in an entomology course by agreement with the instructor. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise their work.
Staff.

499 Undergraduate Research
Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work.
Staff.

621 Acarology
Fall. 4 credits. Prerequisites: Entomology 212 and permission of instructor. Offered alternate years.
Lecs, M W 9:05; lab, M 1:25–4:25. G. C. Eickwort.
An introduction to the taxonomy, morphology, and bionomics of mites and ticks, with emphasis on taxa of economic importance. A collection is required.

[630 Field Entomology
Spring. 2 credits. Prerequisites: Entomology 331 and permission of instructors. Offered alternate years. S-U grades optional. Not offered 1989–90.
Hours to be arranged. J. K. Liebherr, Q. D. Wheeler.
The course will be comprised of weekly meetings and an intensive two-week field trip. Evening meetings before the field trip will orient participants to chosen field sites, which will then be surveyed using advanced collecting techniques. After the trip, material will be processed for inclusion in the Cornell University Insect Collection. Students will be responsible for food costs while traveling to and from the field sites.]

[631 Systematics of the Coleoptera
Fall. 4 credits. Prerequisite: Entomology 331. Offered alternate years. Not offered 1989–90.
Lecs, M W 12:20; labs, M W 1:25–4:25. S field trips. Q. D. Wheeler.
A comprehensive review of the comparative morphology, phylogenetic relationships, classification, natural history, and distribution of the Coleoptera, including adult and immature stages. Laboratory practice in identification and methods for collection and study of beetles. A collection is required.]

[633 Systematics of the Diptera and Hymenoptera
Spring. 3 credits. Prerequisite: Entomology 331. Offered alternate years. Not offered 1989–90.
Lec and two labs, hours to be arranged. W. L. Brown.
Lectures on the classification, evolution, and bionomics of the Diptera and Hymenoptera. Laboratory studies on the literature, characters, and classification of representative genera and species of these orders, based on adult and immature stages.]

634 Special Topics in Systematic Entomology
Fall or spring; taught on demand. 2–4 credits. Prerequisite: permission of instructor.
Hours to be arranged. Staff.
Lectures on the classification, evolution, and bionomics of selected taxa, with accompanying laboratory studies on identification and comparative morphology. Collections sometimes required.

636 Seminar in Systematic Entomology
Fall or spring. 1 credit. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged. Staff.
Discussion of current topics in systematic entomology. Topics to be announced, including current theoretical issues in insect classification, evolution, and biogeography.

640 Pest Management: Quantitative Aspects
Fall. 3 credits. Prerequisites: Entomology 444 and a course in statistics. Recommended: an introductory course in computer science. S-U grades optional. Offered alternate years.
Lecs and disc,T R 10:10–12:15. J. P. Nyrop.
Quantitative aspects of the development of pest and agricultural resource management systems. Systems analysis, modeling and simulation, sampling, quantitative biological research, and economics are covered in lectures. Discussions of philosophical issues and current and classical literature.

[653 Advanced Insect Pathology
Fall. 3 credits. Prerequisite: Entomology 453, Microbiology 290, or permission of instructor. S-U grades optional. Not offered 1989–90.
Hours to be arranged for lec and lab. D. W. Roberts.
Detailed presentations on the major diseases of insects caused by viruses, bacteria, fungi, protozoa, and nematodes. Emphasis will be on host-pathogen interactions, including at the cellular level. Also, molecular genetics and epizoological principles will be discussed. Laboratories will include practical aspects (such as bioassays) of working with each group.]

[662 Insect Behavior Seminar
Spring. 2 credits. Prerequisites: permission of instructors and Entomology 212 and Biological Sciences 221 or equivalents. S-U grades optional. Offered alternate years. Not offered 1989–90.
Hours to be arranged. G. C. Eickwort, M. J. Tauber.]

664 Insect-Plant Interactions Seminar (also Biological Sciences 664)
Spring. 2 credits. Limited to 15 students. Prerequisites: entomology, ecology, evolution, organic chemistry, and written permission of instructor. S-U grades optional. Offered alternate years.
One evening a week, to be arranged. P. P. Feeny.
For graduate students and seniors. Presentations and discussions by students on the evolution of patterns of interaction between plants and insects, emphasizing critical evaluation of concepts and evidence.

672 Seminar in Aquatic Ecology
Spring. 1 credit. Prerequisites: permission of instructor and either Entomology 471 or Biological Sciences 462, 464. S-U grades optional. Offered alternate years.
Hours to be arranged. B. L. Peckarsky.
Discussion and analysis of current topics in the ecology of streams and lakes, including synthesis of key papers in the literature. Reports on personal research or ideas by students are encouraged.

674 Principles of Systematics (also Biological Sciences 674)
Spring. 4 credits. Prerequisite: Entomology 331 or introductory systematics course in another field of biological sciences. Offered alternate years.
Lecs-disc-labs, M W 1:25–4:25. Staff (Q. D. Wheeler, coordinator).
An introduction to modern theory and methods of systematic biology. Lectures, readings, and discussions on theoretical systematics, including species concepts, classification, phylogenetics, and biogeography. Laboratories include various methods of analysis of data (e.g., cladistic hand and computer methods, numerical methods). Part of the grade is based on a final paper.

677 Biological Control
Fall. 3 credits. Prerequisites: Entomology 212, Biological Sciences 261, and permission of instructor. Offered alternate years.
Lecs, T R 9:05; lab, T 2–4:25. M. J. Tauber.
Theory and method of biological control of arthropod pests and weeds. Laboratory includes studies with living parasitoids and predators.

685 Seminar in Insect Physiology
Spring. 1 credit. S-U grades optional. Prerequisite: permission of instructor.
Hours to be arranged. Staff.

[690 Insect Toxicology and Insecticidal Chemistry (also Toxicology 690)
Spring. 4 credits. Prerequisites: general chemistry and organic chemistry. Undergraduate students by permission of instructor. Offered alternate years. Not offered 1989–90.
Lecs, M W F 9:05; lab, day to be arranged, 1:25–4:25. J. G. Scott.
The chemistry of insecticides and their metabolism and mode of action in insects and mammals.]

707 Special Topics for Graduate Students
Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Not for thesis research.
Staff.

708 Graduate Research
Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Not for thesis research.
Staff.

709 Teaching Entomology
Credit to be arranged.
Staff.
Teaching entomology or for extension training.

710 Curation in Entomology
Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged. J. K. Liebherr and staff.
The range of curatorial techniques required to operate an institutional insect collection will be investigated by working with staff. Curation of a specific taxon of interest will comprise part of the course of study.

800 Master's-Level Thesis Research
Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional.
Staff.

900 Doctoral-Level Thesis Research
Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional.
Staff.

Jugatae Seminar
Fall and spring.
M 4–5.
A seminar conducted by Jugatae, the entomology club of Cornell University, to discuss topics of interest to its members and guests.

FLORICULTURE AND ORNAMENTAL HORTICULTURE: HORTICULTURAL SCIENCES

G. L. Good, chair; M. I. Adleman, N. L. Bassuk, A. M. Elliot, C. C. Fischer, C. F. Gortzig, J. Gruttadaurio, N. W. Hummel, Jr., T. H. Johnson, R. E. Kozlowski, D. W Krall, R. J. Lambert, R. W. Langhans, A. S. Lieberman, L. J. Mirin, R. G. Mower, K. W. Mudge, J. C. Neal, A. M. Petrovic, D. A. Rakow, R. T. Trancik, P. J. Trowbridge, T. C. Weiler, T. H. Whitlow

Courses by Subject

Commercial floriculture-crop production: 410, 411
Floral design: 205, 210
Freehand drawing and illustration: see the section below, "Freehand Drawing and Scientific Illustration"
Horticultural physiology: 400, 405, 605
Horticultural sales and service businesses: 425
Independent study, research and teaching in floriculture and ornamental horticulture: 495, 496, 497, 498, 499, 500, 700, 800, 900
Introductory courses: 101,102
Landscape architecture (professionally accredited program): see the section below, "Landscape Architecture"
Landscape horticulture: Hort. Sci. 435, Landscape Architecture 140, 205, 220, 310, 312, 475, 521, 522
Nursery-crop production: 420
Plant materials: 230, 300, 301, 335, 342, 430
Postharvest physiology of horticultural crops: 315
Retail floriculture: 205, 210, 425
Seminars in floriculture and ornamental horticulture: 495, 600.
Turfgrass management: 435, 440

101 Introduction to Horticultural Science
Fall. 4 credits.
Lecs, M W F 10:10; lab, W 2–4:25.
C. F. Gortzig.
An introduction to horticulture in all of its components: floriculture, landscape horticulture, pomology vegetable crops, and related professional and commercial fields. Emphasis is on the history, geography, and literature of the field; the structure and organization of the component industries, institutions, and professions; and the role of science and technology in the continuing development of horticultural practice. Field trips are taken to horticultural firms, institutions, and historic sites.

205 Floral Design
Fall or spring. 2 credits. Each studio is limited to 22 students. Prerequisite: permission of instructor, with preference given to plant science majors, then to students in education, design, and journalism. Charge to purchase instructional plant materials that the student will keep: $75. Enrolled students who do not attend the first session and fail to notify the secretary in 20 Plant Science Building of their absence will automatically be dropped.
T or R 1:25–4:25. C. C. Fischer.
A study of the established floral design techniques of this country, presenting the principles and the mechanics of the art to prepare the student to design for varying themes and occasions. Other aspects include selection, preparation, and factors affecting keeping-quality of plant materials. Emphasizes the economical use of all supplies.

210 Floral Design: Intermediate
Fall. 2 credits. Prerequisite: Horticultural Sciences 205 or permission of instructor; preference given to students planning a career in retail horticulture. Charge to purchase instructional plant materials that the student will keep: $75.
Studio W 1:25–4:25. C. C. Fischer.
Advanced study of the art of floral design. The students assist in scheduling the design themes and occasions for floral display during the semester. Enrolled students who do not attend the first session and fail to report their absence to the secretary in 20 Plant Science Building will automatically be dropped.

230 Woody Plant Materials
Spring. 4 credits. Fee for lecture-laboratory manual: $25.
Lecs, T R 9:05; lab, T 2–4:25 and W or F 2–4:25. R. G. Mower.
A study of the trees, shrubs, ground covers, and vines used in landscape plantings. Emphasis is on winter identification and values for use as landscape material.

300 Garden and Interior Plants I
Fall. 3 credits. Fee for lecture-laboratory manual: $25.
Lecs, T R 10:10; lab, T 2–4:25.
R. G. Mower.
A study of ornamental plants used in garden and interior situations. The first seven weeks cover primarily herbaceous annuals and perennials, with the laboratory devoted to various practical gardening activities. The remainder of the semester covers the major kinds of foliage and flowering plants used in the home and in other interior landscape situations. Emphasis is on identification, use, and general cultural requirements.

301 Garden and Interior Plants II
Spring. 3 credits. Prerequisite: Horticultural Sciences 300 or permission of instructor. Fee for lecture-laboratory manual: $25.
Lecs, M W 11:15; lab, M 2–4:25.
R. G. Mower.
A continuation of Horticultural Sciences 300. The first seven weeks are devoted to a further study of interior plants, with emphasis on specialized groups of interior plants such as orchids, cacti and succulents, gesneriads, ferns, palms, and bromeliads. The second seven weeks are devoted to outdoor herbaceous plants, such as tulips, daffodils, crocuses, and irises, as well as other spring-blooming bulbs and perennial plants. Outdoor laboratories emphasize practical gardening activities appropriate to the spring season.

315 Postharvest Physiology and Storage of Horticultural Crops
Fall. 3 credits. Prerequisite: one horticulture course or permission of instructor.
Lecs, M W 9:05; lab, W 1:30–4. F. W. Liu.
The physiology—transpiration, respiration, ethylene synthesis and action, maturation, ripening, and senescence—of fruits, vegetables, flowers and ornamental crops is studied. Environmental factors influencing the physiological process, thus affecting the quality and marketability of the products, are considered. The principles and methods of harvesting, cleaning, grading, packing, precooling, waxing, sanitation, and transportation of the products are studied. Storage methods, including common storage, refrigerated storage, controlled-atmosphere storage, and hypobaric storage, are discussed.

335 Woody Plant Materials for Landscape Use
Fall. 3 credits. Limited to 30 students. Primarily for landscape architecture majors. Fee for lecture-laboratory manual, $25.
Lec, M W 9:05; lab, R 1:25–4:25.
R. G. Mower.
A study of the trees, shrubs, vines, and ground covers used in landscape plantings in the northeastern United States. Emphasis is on leaf identification and on characteristics that determine the usefulness of each as landscape subjects.

[342 Taxonomy of Cultivated Plants (also Biological Sciences 342)
Spring. 4 credits. Not offered 1989–90.
Lecs, M W 10:10; labs, M W 2–4:25.
A study of ferns and seed plants, their relationships and their classification into families and genera, emphasizing cultivated plants. Emphasis is on gaining proficiency in identifying distinguishing families and in preparing and using analytical keys. Attention is also given to the economic importance of taxa, to the basic taxonomic literature, and to the elements of nomenclature.]

400 Principles of Plant Propagation
Fall. 3 credits. Prerequisites: Biological Sciences 242 and 244 or another course in plant physiology. A field-trip fee will be charged.
Lecs, T R 8; lab, R 1:25–4:25.
K. W. Mudge.
Propagation of plants using vegetative techniques including cuttage, graftage, tissue culture, and propagation from seed. Physiological, environmental, and anatomical principles are stressed rather than hands-on techniques. Examples include horticultural, agronomic, and forestry crops.

[405 Physiology of Horticultural Plants
Spring. 4 credits. Prerequisites: Biological Sciences 242 and 244; 341 or permission of instructor. Not offered 1989–90.
Lec, M W F 8; lab to be arranged. Staff.
A study of the physiology of growth and development of horticultural plants in response to their environment.]

410 Principles of Florist-Crop Production
Spring. 4 credits. Limited to 40 students. Preference given to juniors. Prerequisites: Horticultural Sciences 400 and Biological Sciences 242 and 244 (may be taken concurrently), or equivalent, or permission of instructor. Offered 1990 and alternate years. Cost for field trip and special laboratory supplies: $60.
Lecs, M W F 8; lab, R 2–4:25.
T. C. Weiler.
A study of commercial production of florist crops with emphasis on their culture as influenced by greenhouse environment. Three field trips are made to commercial greenhouses.

411 Greenhouse Production Management
Spring. 4 credits. Primarily for seniors. Prerequisite: an elementary course in horticulture or equivalent. Cost of field trips: $150.
Lecs, T R 10:10–12:05; lab, 3 hours to be scheduled. Two field trips.
R. W. Langhans.
Intended to provide the latest information on efficient operation and administration of a commercial greenhouse, outside the sphere of production methods for specific crops. Consideration is given to the industry, centers of production, competition, location, types of structures, heating, ventilation, cooling, fertilizing, watering systems, and business analysis and management.

420 Principles of Nursery-Crop Production
Fall. 4 credits. Prerequisite: Horticultural Sciences 400.
Lecs, M W F 9:05; lab, M 2–4:25; field trips are included. G. L. Good.
Principles of commercial production of nursery crops to marketable stage, including postharvest handling and storage. Term project is required. Field trips are made to commercial nurseries.

425 Horticultural Sales and Service Businesses
Spring. 4 credits. Prerequisites: Agricultural Economics 240 and 347 or permission of instructor. Cost of field trips approximately $150.
Lecs, M W F 10:10; lab 1:25–4:25.
C. F. Gortzig.
A study of the application of horticultural, marketing, and management principles and practices in the operation of horticultural sales and service firms, e.g., garden centers, retail florist and nursery stores, wholesale marketing operations, mail order businesses, mass markets, interior and outdoor landscape service and related firms. Field trips are taken to commercial operations.

430 Special Topics in Ornamental Plants
Fall or spring. Credit to be arranged. Primarily for upperclass floriculture and ornamental horticulture majors. Prerequisites: Horticultural Sciences 230, 300, 301, 335, or the equivalent, and permission of instructor.
Hours to be arranged. R. G. Mower.
Topical subjects in plant materials. Independent and group study of important groups of woody and herbaceous plant materials not considered in other courses. The topic is given in the supplementary announcement.

435 Landscape Management
Fall. 4 credits. Prerequisites: Horticultural Sciences 230 or 335, and Biological Sciences 241 or permission of instructor. Biological Sciences 242 and 244 are desirable but not required.
Lec, M W F 12:20–1:10; lab T 1:25–4:25.
D. A. Rakow.
A study of the practices involved in the planting and maintenance of ornamental plants in the landscape. The two major emphases will be woody plants and turfgrass. The lectures will focus on the physiological bases for and logistics of essential management principles. The focus in the labs will be on hands-on practice.

440 Turfgrass Management
Fall. 3 credits. Prerequisites: Horticultural Sciences 435 or concurrent registration in Horticultural Sciences 435 and permission of instructor.
Lecs, T R 9:05; lab, R 10:10–12:05.
A. M. Petrovic.
Study of the scientific principles involved in the management of golf courses, athletic fields, parks, industrial grounds, and sod production. Emphasis is placed on pest management, irrigation design, and field diagnostic technology.

495 Undergraduate Seminar
Fall or spring. May be taken for one to three credits per semester. S-U grades only. Graduate students should enroll in Horticultural Sciences 600.
R 12:20. D. W. Krall, D. A. Rakow.
Undergraduate participation in departmental weekly seminar series.

496 Internship in Horticultural Sciences
Fall or spring. Credit variable. S-U grades optional. Prerequisite: permission of student's adviser in advance of participation in internship programs. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their study and assign their grade.
Staff.

497 Independent Study in Horticultural Sciences
Fall or spring. Credit variable. S-U grades optional. Prerequisite: permission of instructor(s). Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their study and assign their grade. Independent study in horticultural sciences under the direction of one or more staff members.

498 Undergraduate Teaching Experience
Fall or spring. Credit variable. S-U grades optional. Prerequisites: previous enrollment in course to be taught or equivalent, and written permission of the instructor. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their teaching experience and assign their grade.
Hours to be arranged.
Designed to give qualified undergraduate students teaching experience through actual involvement in planning and teaching horticultural sciences courses under the supervision of departmental faculty members. This experience may include leading discussion sections; preparing, assisting in, or teaching laboratories; and tutoring.

499 Undergraduate Research
Fall or spring. Credit variable. S-U grades optional. Prerequisite: permission of instructor. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their research and assign their grade.
Staff.
Undergraduate research projects in horticultural sciences.

500 Master of Professional Studies (Agriculture) Project
Fall or spring. 1–6 credits. (6 credits maximum toward MPS [Agriculture] degree). S-U grades optional.
Hours to be arranged. Graduate faculty.
A comprehensive project emphasizing the application of floricultural and ornamental horticultural principles and practices to professional horticultural teaching, extension, and research programs and situations. Required of Masters of Professional Studies (Agriculture) candidates in the field.

600 Seminar
Fall or spring. Open for credit to graduate students only. Undergraduates should register for Horticultural Sciences 495. S-U grades only. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the student's committee chair.
R 12:20. D. W. Krall and D. A. Rakow.
Graduate student participation in departmental weekly seminar series.

[605 Current Topics in Floricultural and Ornamental Horticultural Physiology
Spring. Variable credit. Prerequisite: permission of instructor. Not offered 1989–90.
Hours to be arranged. Staff.
Discussions of modern concepts, research, and commercial problems as reflected in current horticultural literature.]

629 Special Topics in Plant Science Extension (also Plant Breeding 629)
Spring. 2 credits.
F 1:25–4:25. W. D. Pardee.
Designed for graduate students and advanced undergraduates to provide a broader knowledge of cooperative extension philosophy and methods. Developed for students interested in extension and research in public and commercial organizations. Topics relate to extension in other countries as well as in the United States.

700 Graduate Teaching Experience
Fall or spring. Credit variable. Open only to graduate students. Undergraduates should enroll in Horticultural Sciences 498. S-U grades optional. Prerequisite: permission of instructor. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their teaching and assign their grade.
Hours to be arranged.
Designed to give graduate students teaching experience through actual involvement in planning and teaching courses under the supervision of departmental faculty members. The experience may include leading discussion sections; preparing, assisting in, or teaching laboratories; and tutoring.

800 Thesis Research, Master of Science
Fall or spring. Credit to be arranged. S-U grades only. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their research and assign their grade.
Staff.

900 Thesis Research, Doctor of Philosophy
Fall or spring. Credit to be arranged. S-U grades only. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their research and assign their grade.
Staff.
See also other courses in Horticultural Sciences.

Freehand Drawing and Scientific Illustration

109 Nature Drawing
Fall. 3 credits. Limited to 25 students. S-U grades optional.
M W F 10:10–12:05. R. J. Lambert.
A beginning course with emphasis on the drawing of natural forms: plants, animals, and landscapes. Of particular interest to students in floriculture and ornamental horticulture, landscape architecture, biological sciences, nature education, etc. Outside field notebook assignments.

111 Freehand Drawing
Fall or spring. 3 credits. Each section limited to 25 students. S-U grades optional. Credit may not be received for both Freehand Drawing 109 and 111.
Fall: lec, R 10:10; studios, T 9:05–11, R 1:25–4. Spring: permission of instructor required (registration must specify lecture hour and all studio hours). Lec, T or W 10:10, plus 5 additional studio hours to be scheduled in 2- or 3-hour blocks during M T W R F 9:05–12:20 and T 1:25–4. A. Elliot.
Developing accuracy of observation and a personal graphic vocabulary. Freehand perspective and its uses in establishing design and spatial relationships, practice in figure and landscape drawing, form vs. value drawing. Weekly outside sketchbook assignments.

210 Architectural Sketching in Watercolor
Summer. 3 credits. S-U grades optional.
M T W R F 11:30–12:45. R. J. Lambert.
Practice in outdoor architectural sketching, primarily in watercolor, but including pen and ink, pencil, and colored pencil. Studio will develop working sketches into complete renderings. Principles of perspective are taught and applied. For any student who wishes to develop skill in handling watercolor. Outside-of-class sketchbook work required.

211 Freehand Drawing and Illustration
Fall. 2 credits. Prerequisite: Freehand Drawing 111 or equivalent. S-U grades optional.
6 studio hours scheduled in 2- or 3-hour units between 9:05 and 12:05 M T W R F. R. J. Lambert.
Progression to the organization of complete illustrations. Subject matter largely from sketchbooks, still life, and imagination. Composition, perspective, and ways of rendering in different media are considered.

214 Watercolor
Spring. 2 credits. Prerequisite: Freehand Drawing 111 or equivalent. S-U grades optional.
6 studio hours scheduled in 2- or 3-hour units between 9:05 and 12:05 M T W R F. R. J. Lambert.
A survey of watercolor techniques. Subject matter largely still life, sketchbook, and on-the-spot outdoor painting.

316 Advanced Drawing
Fall or spring. 2 credits. Prerequisite: Freehand Drawing 211 or permission of instructor. S-U grades optional.
6 hours to be arranged. A. Elliot or R. J. Lambert.
For students who want to attain proficiency in a particular type of illustration or technique.

417 Scientific Illustration
Fall. 2 credits. Prerequisite: Freehand Drawing 211 or 316 or equivalent. S-U grades optional for graduate students only.
6 studio hours scheduled between 9:05 and 12:05 M W F. A. Elliot.
A survey of methods of illustration. Training in techniques of accurate representation in media suitable for reproduction processes, including pen and ink, scratchboard, wash, and mixed media.

Landscape Architecture

100 Landscape Architecture Freshman Orientation
Fall. 1 credit. Limited to freshman majors. S-U grades only.
T 2–4. M. I. Adleman.
Introduction to resources supporting Landscape Architecture at Cornell.

140 Landscape Design Studio
Spring. 4 credits. Limited to approximately 15 students; primarily for nonmajors and freshman landscape architecture students. Prerequisite: permission of instructor. Lab fee, $20.
Lecs, T R 1:25; studio, T R 2:30–4:25. D. W. Krall.
Fundamentals of landscape design applied to residential and other small-scale site-planning projects. Work in the studio introduces course participant to the design process, design principles, construction materials, planting design, and graphics.

201 Theory and Application Studio
Fall. 6 credits. Limited to landscape architecture majors. Cost of basic drafting equipment and supplies, about $200; expenses for field trip, about $200.
M W F 1:25–4:25. Required field trip. M. I. Adleman.
Basic design principles and processes applied to the design of the outdoor environment. Studio projects focus on the analysis, organization, and form of outdoor space through the use of three-dimensional components including structures, vegetation, and earthform.

202 Project Design and Site-Planning Studio
Spring. 6 credits. Prerequisite: LA 201 with a grade of C or better. Cost of drafting supplies, about $100.
M W F 1:25–4:25. T. H. Johnson.
Site design and planning for parks, housing, and architectural ensembles. Basic theory, historic precedents, and the design process are correlated with garden landscapes, open-space systems, earth form, vegetation, and circulation systems.

205 Graphic Communication
Fall. 3 credits. Prerequisite: concurrent enrollment in LA 201 or LA 501 or permission of instructor. Cost of supplies, about $30.
Lecs, T R 9:05–11. T. H. Johnson.
Basic skills in graphic presentation, including pencil-and-ink drawing and drafting techniques applicable to landscape architecture projects. Freehand drawing, orthographic projection, axonometric projection, and lettering are covered in the course.

220 Principles of Spatial Design and Aesthetics (also City and Regional Planning 481)
Fall. 3 credits.
Lecs, M W 10:10; disc, F 10:10. R. T. Trancik.
Basic principles involved in design theory, interpretation, and methodology as they are applied to shaping the outdoor environment. Students are introduced to spatial design vocabularies for a variety of environmental scales and spatial types.

301 Natural Systems and Planting Design Studio
Fall. 6 credits. Prerequisite: LA 202 with a grade of C or better. Lab fee $20; cost of drafting supplies, about $100; expenses for field trip, about $200.
Lecs, M W F 1:25; studios, M W F 2:30–4:25. Required 5-day field trip. D. W. Krall.
The application of planning processes and techniques at a regional scale. Students examine the management of landscape units within physiographic and/or politically defined areas using state-of-the-art methodologies.

***302 Urban Landscape Systems Studio**
Spring. 6 credits.
L. Mirin.

310 Site Construction
Spring. 4 credits. Prerequisite: permission of instructor. Fee $20.
Lecs, M W 9:05; studio,T R 9:05–11. P. J. Trowbridge.
Construction materials, specifications, cost estimates, and methods used by landscape architects in project implementation. The course includes lectures, studio problems, and development of construction documentation for a selected project.

312 Site Engineering for Landscape Architects
Spring. 4 credits. Prerequisite: completion of LA 310 with a grade of C or better.
Lecs, M W 9:05; studios, M W 10:10–12:05. M. I. Adleman.
Lectures and studio projects focusing on the development of a working knowledge of site grading, earthwork, storm-water management, site irrigation, site layout, and road alignment.

401 Advanced Project Design and Graphics Studio
Fall. 6 credits. Prerequisites: LA 205 with a grade of C or better and LA 302 with a grade of C or better. Cost of supplies, about $100; basic expenses for field trip, about $200.
M W F 1:25–4:25. Required field trip. R. T. Trancik.
A sequence of projects introducing students to advanced skills in spatial design, and historic precedent in an urban context.

402 Senior Project Studio
Spring. 6 credits. Prerequisite: completion of LA 401 or of the Denmark landscape architecture studio with a grade of C or better. Cost of supplies and reproductions, about $200.
M W F 1:25–4:25. M. I. Adleman.
Site design and construction developed for a specific project as an evaluation of each student's professional competency in landscape architecture.

412 Professional Practice
Spring. 1 credit.
Lec. F 11:15. K. Wolf.
Presents the student with a comprehensive understanding of the role of the professional landscape architect and the problems and opportunities one may encounter in an office or other professional situations. Topics discussed include practice diversity, marketing professional services, office and project management, construction management, computers in the profession, and ethics.

490 Special Topics in Landscape Architecture
Fall or spring. 1–3 credits; may be repeated for credit. S-U grades optional.
Staff.
Topical subjects in landscape architectural design, theory, history, or technology. Group study of topics not considered in other courses.

497 Independent Study in Landscape Architecture
Fall or spring. 1–5 credits; may be repeated for credit. S-U grades optional.
Staff.
Work on special topics by individuals or small groups.

***501 Theory and Application Studio**
Fall. 6 credits.
L. Mirin.

502 Project Design and Site-Planning Studio
Spring. 6 credits. Limited to graduate students. Cost of drafting supplies, about $100.
Lecs, M W F 1:25; studios, M W F 2:30–4:25. D. W. Krall.
The studio will focus on the spatial design of project-scale site development. Students will develop their expertise in applying the design theory, vocabulary, and graphic expression introduced in LA 501.

***520 Contemporary Issues in Landscape Architecture**
Fall. 2 credits.
L. Mirin.
*Offered through the College of Architecture, Art, and Planning.

***521 History of European Landscape Architecture**
Fall. 3 credits.
L. Mirin.

***522 History of American Landscape Architecture**
Spring. 3 credits.
L. Mirin.

531 Regional Landscape Planning I
Fall. 4 credits. Prerequisite: permission of instructor.
Lecs, T R F 9:05 plus 1 hour disc to be arranged. A. S. Lieberman.
Landscape ecology as a basis for regional landscape planning. Regional landscape planning strategies and methods that have been developed and employed in North America, Europe, Australia, and the Middle East. This course is intended to provide a base for understanding the utilization of landscape ecological knowledge in the planning process. It is presented through a series of lectures, readings, class discussions, exercises, and review of case studies. The course is directed to graduate students in landscape architecture, architecture, city and regional planning, ecology, international studies, international agriculture and rural development, and natural resources.

601 Advanced Project Design Studio
Fall. 6 credits. Limited to graduate students. Cost of supplies, about $100; expenses for field trip, about $200.
M T R 1:25–4:25. Required field trip. T. H. Johnson.
Advanced studio linking master planning and detail design sequences while including diverse issues such as design research, project management, and environmental impact.

602 Urban Systems Studio (also City and Regional Planning 555)
Spring. 6 credits. Limited to graduate students. Cost of drafting supplies, about $100.
M T R 1:25–4:25. R. T. Trancik and staff.
Application of urban-design and town-planning techniques to specific contemporary problems of city environments. Issues of urbanism are investigated and applied to physical design interventions and spatial typologies involving the street, square, block, garden, and park systems. Urban land-use development and public and private implementation of urban-design plans are examined. This is a specially arranged collaborative studio with the Department of City and Regional Planning.

611 Site Engineering for Landscape Architects
Fall. 4 credits.
Lec, M W 9:05; studios M W 10:10–12:05. M. I. Adleman.
Lectures and studio projects focusing on the development of a working knowledge of site grading, earthwork, storm-water management, and road alignment.

***621 Summer Internship Seminar**
Fall. 2 credits.
L. Mirin.

634 Landscape Architectural Research
Spring. 3 credits.
M W 10:10. T. H. Johnson.
An introduction to general research methods and to the diversity of landscape architectural research. Focus will be on practical, descriptive, qualitative, and archival methods as a bridge between the design professions and the traditional research professions.

***650 Fieldwork or Workshop in Landscape Architecture**
Fall or spring. 1–5 credits.
L. J. Mirin.

690 Independent Study in Landscape Ecology and Regional Landscape Planning
Fall. 1–3 credits. Limited to 7 students. Prerequisite: permission of instructor. S-U grades optional.
A. S. Lieberman.
This course is designed to allow students who have taken LA 531 to engage in advanced readings and research in the human ecosystem science of landscape ecology. Also designed for other students who wish to gain familiarity with the conceptual and practical tools offered by landscape ecology. Open to graduate students in landscape architecture, city and regional planning, ecology, international studies, international agriculture and rural development, and natural resources. The course allows participants to engage in research or study leading to thesis preparation.

701 Natural Systems and Planting Design Studio
Fall. 6 credits. Limited to graduate students. Cost of drafting supplies, about $100; expenses for field trip, about $200.
M W F 1:25–4:25. Required field trip. P. J. Trowbridge.
An application of design and planning methods within large physiographic or political units. Course participants will be engaged in the use of soil maps, aerial photographs, remote-sensed images, census data, and techniques for manipulating large, complex data bases. The course focuses specifically on plant communities.

800 Master's Thesis in Landscape Architecture
Fall or spring. 9 credits.
Hours to be arranged. Staff.
Independent research, under faculty guidance leading to the development of a comprehensive and defensible design or study related to the field of landscape architecture. Work is expected to be completed in final semester of residency.

*Offered through the College of Architecture, Art, and Planning

FOOD SCIENCE

R. A. Ledford, chair; R. C. Baker D. K. Bandler, D. M. Barbano, C. A. Batt, D. H. Beermann, J. Brady, A. K. Datta, D. C. Graham, R. B. Gravani, P. F. Hopper, J. H. Hotchkiss, J. E. Kinsella, H. T. Lawless, E. A. Leonard, F.W. Liu, D. D. Miller, N. N. Potter, J. M. Regenstein, S. S. H. Rizvi, J. W. Sherbon, R. R. Zall

100 Introductory Food Science
Fall. 3 credits.
M W F 10:10. N. N. Potter.
A comprehensive introduction to food science and technology—its scope, principles, and practices. Topics are constituent properties; methods of preservation; the major food groups, including their handling and processing; and current problems such as chemical additives and world feeding needs. Interrelationships between chemical and physical properties, processing, nutrition, and food quality are stressed.

101 Topics in Food Science
Fall. 1 credit. Limited to food science majors taking Food Science 100. Prerequisite: Food Science 100. A required companion course to Food Science 100.
Lec and disc, F 11:15. N. N. Potter and staff. Members of the staff lecture and lead discussion on selected topics.

150 Food Choices and Issues
Spring. 2 credits. S-U grades optional.
Lecs, T R 12:20. D. Miller, R. B. Gravani, and staff.
This course provides nonmajors with the knowledge they need to make appropriate food choices. Lectures will emphasize: concepts necessary for selecting nutritious diets and interpreting popular nutrition literature; the impact of food science and technology on food choices; the quality characteristics of the major food commodity groups; current issues affecting food choices, availability, and distribution.

210 Food Analysis
Spring. 3 credits. Prerequisite: Chemistry 104 or 208.
Lecs, M F 12:20; lab, M F 1:25–4:25. J. W. Sherbon.
Designed to acquaint the student with chemical tests used by food analysts. Emphasis is on understanding and use of good analytical techniques, including gravimetric, volumetric, and spectrophotometric methods. Procedures for screening, routine quality control, and official tests for fats, proteins, carbohydrates, and selected minor nutrients are introduced.

220 Food Science for Industry
Fall. 2 credits.
Lec and lab, F 12:20–4:25. Field trips. R. C. Baker.
Provides understanding of food industry operations. Half the laboratories are production of food products (such as sausages and pastries) by students and half are visits to commercial plants producing those products. One or two longer field trips will be offered.

247 Postharvest Food Systems
Fall. 2 credits. Prerequisite: freshman chemistry. S-U grades optional.
T R 10:10. M. C. Bourne and staff.
An interdisciplinary course designed for all undergraduate and graduate students in ALS that describes postharvest food losses and methods to reduce the loss. Topics include storage and care of unprocessed and minimally processed foods such as cereal grains, fruits, vegetables, tubers, and fish; biology and control of fungi, insects, and vertebrates in foods; chemical causes of quality loss; simple drying and storage practices; effects of climate; and economic and social factors affecting food preservation and storage. Emphasis is given to the problems in developing countries.

[301 Nutritional Aspects of Raw and Processed Foods (also Nutritional Sciences 301)
Spring. 3 credits. Prerequisites: organic chemistry and Food Science 100 or Nutritional Sciences 115. S-U grades optional. Not offered 1989–90.
M W F 9:05. D. D. Miller.
An evaluation of factors affecting the nutritional quality of foods and diets. Nutritional quality is defined. Methods and approaches for assessing nutritional quality are presented. Factors that may alter the nutritional quality of foods and food supplies (e.g., agricultural practices, processing, storage, cooking, government regulations, new technologies, fortification) are discussed.]

311 Milk and Frozen Desserts
Fall. 2 credits. Prerequisite: Food Science 322 or permission of instructor. Offered alternate years.
Lec, R 12:20; lab, R 1:25. J. W. Sherbon.
Deals with the principles and practices of processing fluid milk products and frozen desserts. The chemical, microbiological, and technological aspects of processing these dairy products are considered.

312 Technology of Poultry, Fish, and Other Meats
Fall. 3 credits. Prerequisite: organic chemistry.
Lec, T R 8–9:55. J. M. Regenstein.
Intended to give a unified introduction to the food technology of poultry, seafood. and other meats and to relate the underlying chemistry, biochemistry, and physiology of muscle to these technologies. Social, political, and economic factors will be discussed in terms of their effects on the technology.

321 Food Engineering I
Fall. 4 credits. Prerequisites: physics and Food Science 100.
Lecs, M W F 11:15; lab, T 1:25–4:25. S. S. H. Rizvi.
Intended to give food science students an introduction to the engineering aspects of food processes and equipment. Emphasis on the fundamental concepts of momentum, heat, and mass-transport processes.

322 Food Processing I
Spring. 3 credits. Prerequisites: Food Science 100 and 321 and Microbiology 290 and 291.
Lecs, T R 10:10; lab, T 1:25–4:25. N. N. Potter, R. R. Zall.
Deals with the principles and practices of concentration, drying, and freezing applied to foods. Current processing methods and their relations to the chemistry, microbiology, and technology of raw materials and final products are discussed.

331 Statistical Quality Control of Food Processing
Spring. 1 credit. Prerequisite: Agricultural Economics 310 or equivalent.
Lab, R 1:25–4:25. G. Houghton.
An introduction to the statistical tools used to control quality in food-processing plants. Topics covered include estimating product variability, estimating shelf life, using control charts, and doing acceptance sampling.

351 Milk Quality
Spring. 1 credit. Prerequisite: Animal Science 350 or equivalent or permission of instructor.
F 12:20. D. K. Bandler.
Focuses on the important aspects of farm sanitation and milk handling as they affect milk flavor and quality. The course is an overview of quality control tests, basic microbiology, cleaning and sanitizing, and special problems in manufacturing and marketing fresh and storable dairy products.

394 Food Microbiology Lectures
Fall. 2 credits. Prerequisites: Microbiology 290 and 291.
M W 12:20. D. C. Graham, C. A. Batt, R. B. Gravani.
The major families of microorganisms of importance in foods are studied systematically, with emphasis on the roles of those organisms in food preservation, food fermentations, and public health.

395 Food Microbiology Laboratory
Fall. 2 credits. Graduate students must have permission of the instructor.
M W 2–4:25. R. A. Ledford.
Work includes study of the physiological characteristics of representative food microorganisms, practice in using general and special methods for microbiological testing and control of food products, and practice in isolating and characterizing organisms of importance in foods.

396 Food Sanitation as Related to Public Health and Food Plant Processing
Spring. 2 credits. Prerequisite: Food Science 100.
Lec, T R 9:05. R. R. Zall.
Deals with measures essential in producing and processing wholesome and safe foods. Rules and regulations of the Food and Drug Administration, the U.S. Department of Agriculture, and other organizations important to the food industry are covered. Sanitation practices as they relate to plant construction, unit operation, and storage practices are discussed.

400 Senior Seminar in Food Science and Technology
Spring. 1 credit. Limited to seniors.
Lec, M 4:30. R. A. Ledford, D. K. Bandler.
With assistance of faculty members, students complete a study of the literature on topics of current interest in food science and technology. Students make oral and written reports.

401 Concepts of Product Development
Spring. 2 credits. Prerequisite: Food Science 100 or equivalent. Offered alternate years.
M W 9:05–9:55. J. H. Hotchkiss.
A discussion of the sequence of events in developing and marketing new food products. Topics include packaging and labeling, food additive and ingredient regulations, taste panels, market testing, market research, and patents.

402 Product Development Laboratory
Spring. 2 credits. Limited to food science majors. Prerequisites: concurrent registration in Food Science 401 and permission of instructor. S-U grades optional. Offered alternate years.
Labs, T R 8–9:55. J. H. Hotchkiss.
Emphasis is on gaining practical experience in the development of new foods.

[403 International Food Science and Development
Spring. 3 credits. Offered alternate years. Not offered 1989–90.
Lecs, T R 8:30–9:55. D. C. Graham.
A critical evaluation of humanity's needs for food in the world and the international food technologies, organizations, and policies to meet such needs. Novel extrusion, ultrafiltration, and fermentation food processes and basic nutrient foods for developing countries are described.]

[404 Technology of Lipid Foods
Spring. 2 credits. Prerequisite: Biological Sciences 231. Offered alternate years. Not offered 1989–90.
Lec, M 12:20; lab, M 1:25–4:25. J. W. Sherbon.
Sources and utilization of food fats and the technologies of extraction and processing will be studied. The functional properties of fats as food ingredients will be covered. Special features of the chemical and physical reactions of fats will be stressed throughout the term.]

405 Waste Management and Energy Conservation
Spring. 2 credits. Prerequisite: FS 100 or its equivalent. Offered alternate years.
Lec, M 12:20, lab, M 2–4:25. R. R. Zall.
Field trips, laboratories, and demonstrations. Deals with the principles and practices related to managing, reducing, and reclaiming wastes from food plants and other unit operations important to the food industry. Selected types of methods used to conserve energy will be covered.

406 Food Processing Fermentations Lectures
Fall. 2 credits. Prerequisite: background in microbiology.
Lecs, T R 11:15. R. A. Ledford.
Principles and practices of lactic acid fermentation processes as they apply to cheeses, cultured dairy foods, meats, vegetables, and related products.

[408 Food Processing Fermentations Laboratory
Fall. 2 credits. Enrollment limited. Prerequisite: concurrent registration in Food Science 406. Offered alternate years. Not offered 1989–90.
Lab, T 1:25–4:25. Staff.
Laboratory exercises and demonstrations in the making of cheeses and cultured dairy foods and related products. A field trip provides additional experience.]

409 Food Chemistry
Spring. 4 credits. Prerequisite: introductory biochemistry.
Lecs, T R 11:15–1:10. J. E. Kinsella, J. M. Regenstein, J. P. VanBuren.
Deals with the relationship between the chemical composition and chemical and physical properties of foods. Attention is given to the interactions among the components of food. The effects of processing on quality, functional attributes and nutrient bioavailability are emphasized.

410 Sensory Evaluations of Foods
Fall. 3 credits. Prerequisite: statistics.
Lecs, M W F 10:10. H. T. Lawless.
Deals with the sensory techniques used in evaluating the flavor, color, and texture of foods and the evaluation of consumer acceptance. Includes methods for measuring these qualities, underlying psychological principles, statistical methods for analyzing results, and establishing a full-service sensory evaluation program.

[411 Food Mycology
Fall. 3 credits. Prerequisite: Microbiology 290 or 291 or equivalent. Recommended: Microbiology 394. Offered alternate years. Not offered 1989–90.
Lecs, T R 11:15; lab, W 1:25–4:25. D. C. Graham.
To acquaint students with important fungi, from the standpoint of their beneficial as well as their harmful effects in food production, preservation, and spoilage. Laboratories deal with morphology, physiology, culture and isolation, identification of fungi, and isolation and quantification of fungal toxins.]

415 Principles of Food Packaging
Fall. 3 credits.
M W F 9:05. J. H. Hotchkiss.
The chemical and physical properties and manufacture of the basic material used to construct packaging are discussed. Specific packages currently used for individual food commodity groups are also presented with emphasis on newer technologies. Economics, design, and regulation of food packaging are briefly presented.

[416 Food Packaging Laboratory
Spring. 2 credits. Prerequisite: Food Science 415. Offered alternate years. Not offered 1989–90.
Lec, F 8; lab to be arranged. J. H. Hotchkiss.
A laboratory course designed to introduce several testing methods used to evaluate adequacy of food packaging. Emphases are on physical testing methods of packaging materials and the evaluation of total packages. Students will design and build a new food package.]

419 Food Chemistry Laboratory
Spring. 2 credits. Prerequisites: Biological Sciences 330 or 331 and concurrent registration in Food Science 409.
Lab, W 12:20–4:25. D. D. Miller.
Intended to complement Food Science 409 in developing an understanding of the chemistry of food. Laboratory exercises deal with the chemical properties of food components and changes these components undergo in processing and storage. The relationship between the chemical composition of foods and functional, nutritional, and organoleptic properties is stressed.

421 Food Processing II
Fall. 2 credits. Prerequisite: Food Science 322.
Lecs, T 10:10; lab, R 1:25. S. S. H. Rizvi.
Principles and practices of thermal processing of foods, with emphasis on kinetics of destruction of microorganisms and quality factors. Laboratory measurement of kinetic data, retort processing, and lethality evaluation.

422 Food Engineering II
Spring. 3 credits. Prerequisite: Food Science 421.
Lecs, M W F 10:10. S. S. H. Rizvi, M. R. McLellan.
Application of transport and unit operations to food processes. Engineering aspects of food plant operations and automation, with emphasis on future directions.

456 Advanced Concepts in Sensory Evaluation
Spring. 2 credits. Prerequisite: Food Science 410.
Lecs, F 1:25–3:25. H. T. Lawless.
Readings and discussions of primary source materials in sensory evaluation, including historical perspectives, psychophysics, perceptual biases, human information processing. Concepts influencing detection of sensory differences, use of rating scales, and characterization of sensory properties will be emphasized.

496 Extension Methods in Food Science
Fall. 2 credits. Offered in alternate years.
F 1:25–4:25. D. K. Bandler.
A series of lectures, demonstrations, and practical exercises to improve the basic communication skills of the food scientist. The course will deal specifically with presenting scientific data in oral, visual, and written form.

497 Special Topics in Food Science
Fall or spring. 3 credits maximum. Prerequisite: permission of instructor. S-U grades optional.
Staff.
For the food science student. May include individual tutorial study, a special lecture topic selected by a professor or a group of students, or selected lectures of a course already offered. As topics may be changed, the course may be repeated for credit.

499 Undergraduate Research in Food Science
Fall or spring. 4 credits maximum. S-U grades optional. Students must attach to their course enrollment materials written permission from the staff member who will supervise the work and assign the grade. Except for students enrolled in the honors program, credit will be limited to 4 credits total.
Hours to be arranged. Staff.
Independent study.

600 Seminar
Fall or spring. 1 credit. Required of all food science graduate students. S-U grades only.

[601 Food Protein Chemistry
Fall. 3 credits. Not offered 1989–90. Limited to graduate students and to seniors with permission of instructor. Prerequisite: Food Science 409 or equivalent.
Lecs, M W F 9:05. J. M. Regenstein.
The chemistry and physical chemistry of proteins are discussed critically with respect to current methods of characterizing and purifying proteins. Food protein functionality is emphasized.]

602 Computers in Food Laboratories
Fall. 3 credits. Prerequisite: introductory physics.
Lec, M 12:20; 2 labs per week, hours to be arranged. G. Houghton.
An introduction to computers as tools for data acquisition, process control, and data analysis in food science. Independently scheduled labs will teach basic analog and digital electronics, computer function and programming, the interfacing of computers with laboratory and industrial equipment, and the use of data analysis software. A background in computers or electronics is not required.

[604 Chemistry of Dairy Products
Fall. 2 credits. Limited to 16 students. Prerequisites: organic chemistry, biochemistry, knowledge of dairy-product manufacturing procedures, and permission of instructor. Offered alternate years. Not offered 1989–90.
Lecs, F 1:25–3:30. D. M. Barbano.
A detailed study of milk constituents and their properties. Properties of various milk constituents are related to observed physical and chemical changes that occur in dairy products during and after processing. This course will emphasize current research in dairy chemistry.]

[605 Physical Chemistry of Food Components
Fall. 3 credits. Prerequisite: an undergraduate course in physical chemistry. Offered alternate years. Not offered 1989–90.
Lecs, M W F 10:10. J. W. Brady.
This course will cover the physical properties of food molecules. Emphasis will be placed on the molecular basis of structural characteristics; colloidal properties; molecular interactions; foams, gels; and water binding of foods.]

[606 Instrumental Methods
Fall. 3 credits. Prerequisite: permission of instructor. Offered alternate years. Not offered 1989–90.
Lecs, M W 8; lab, M 1:25–3:20, alternate weeks. J. W. Sherbon.
Deals with instrumental methods widely used in research and industry. Includes chromatography, spectroscopy, electrophoresis, and thermal analysis. The stress is on the theoretical and practical aspects of the material presented. After the introduction, students will schedule laboratory time at their convenience.]

607 Advanced Food Microbiology
Spring. 2 credits. Prerequisites: food microbiology, genetics (preferred). Offered alternate years.
M W 11:15. C. A. Batt.
Primary emphasis will be to review new methods for detecting microorganisms and their products by DNA-DNA hybridization, monoclonal antibodies, etc. The theory and application of genetic engineering for improvement of microorganisms used in the food and other industries will be addressed.

608 Food Color and Food Pigments
Fall. 1 credit. Prerequisite: organic chemistry. Offered alternate years.
Lec, F 11:15. J. P. VanBuren.
A survey of chemical and physical properties of the major intrinsic food pigments and their stability during processing and storage. Chemical and physical origins of color. Food color as an indicator of other food qualities. Color and pigments of selected commodities are examined.

[609 Rheology
Spring. 3 credits. Prerequisites: Food Science 321 and 605 or permission of instructor. Not offered 1989–90.
Lec, M W 11:15; lab, R 1:25–4:25. Staff.
Fundamental concepts of rheology applied to foods, with emphasis on the relations between molecular structure and rheological behavior. The laboratory will cover the main rheological techniques. Examples of rheological behavior of gels, suspensions, emulsions, doughs.]

610 Introductory Chemical and Environmental Toxicology (also Toxicology 610)
Fall. 3 credits. Prerequisites: biochemistry and animal physiology.
Lecs, M W F 11:15. J. H. Hotchkiss and staff.
Introduction to the concepts and essentials of toxicology. The various biological responses to toxicants and the *in vivo* and *in vitro* methods of assessing toxicity, as well as the role of epidemiology, will be discussed. The chemical and biological factors that affect toxicity and specific sources of toxicants, including air pollution, agriculture, industrial processes, foods, naturally occurring toxicants, and social poisons will be presented. Regulation of toxic materials will be introduced.

[615 Secondary Plant Metabolites in Foods
Fall. 1 credit. Prerequisite: Biological Sciences 330 or 331. Offered alternate years. Not offered 1989–90
Lec, F 9:05. G. Hrazdina.
Deals with the chemistry and biochemistry of secondary plant metabolites (chlorophyll, lignin, flavonoids, alkaloids, terpenes, carotenoids, steroids, and cyanogenic glycosides) and their importance to food products. Emphasis is on the chemical and biochemical properties of these compounds, their occurrence in edible plants, their reactions, and influence on food products.]

620 Food Carbohydrates (also Nutritional Sciences 620)
Spring. 2 credits. Limited to qualified seniors and graduate students. Prerequisite: Biological Sciences 330 or equivalent. Offered alternate years.
Lecs, T R 10:10. B. A. Lewis, J. W. Brady.
A consideration of the chemistry of carbohydrates, including sugars, starches, pectins, hemicelluloses, gums, and other complex carbohydrates. Emphasis is on the intrinsic chemistry and functionality in food systems and the changes occurring during food processing and storage.

665 Engineering Properties of Foods (also Agricultural and Biological Engineering 665)
Fall. 2 credits. Prerequisite: course in transport processes or unit operations as applied to foods; or permission of instructor. Offered alternate years.
Lecs, T R 12:20. S. S. H. Rizvi, A. K. Datta.
Theories and methods of measurement and prediction of rheological, thermal, and mass transport properties of foods and biomaterial systems. Emphasis is on physical-mathematical basis of measurement as well as the prediction processes. Examples of appropriate use of these properties in engineering design and analysis of food processes will also be provided.

800 Research
Fall or spring. Credit to be arranged. Maximum credit, 10/semester. Limited to master's and doctoral candidates with permission of the graduate field member concerned. S-U grades only.

Related Courses in Other Departments

Computing in Agricultural and Biological Engineering (ABEN 151)

Food Engineering: Design of Equipment and Processes (ABEN 466)

Marketing (Agricultural Economics 240)

Food Industry Management (Agricultural Economics 443)

Meat Science (Animal Science 290)

Commercial Meat Processing (Animal Science 490)

Advanced General Microbiology Lectures (Microbiology 390)

Fundamentals of Postharvest Physiology: Handling and Storage of Horticultural Crops (Horticultural Sciences 315)

Handling and Storage of Vegetables (Horticultural Sciences 325)

Quality of Horticultural Crops during Marketing (Horticultural Sciences 330)

Economic Fruits of the World (Horticultural Sciences 215)

HORTICULTURAL SCIENCES

Department Chairs

Floriculture and Ornamental Horticulture: G. L. Good

Pomology: G. H. Oberly

Vegetable Crops: E. E. Ewing

Horticultural Sciences courses at Cornell University are taught by the faculties of the three departments listed above and the Department of Horticultural Sciences at the N.Y.S. Agricultural Experiment Station at Geneva. Descriptions of each course appear under the department whose name appears in parentheses after the horticultural sciences course number below (e.g., the description for Horticultural Science 200 appears under Pomology).

Horticultural Sciences Courses

101 (FOH) Introduction to Horticultural Science

102 (VC) General Horticulture

200 (POM) Introductory Pomology

205 (FOH) Floral Design: Introduction

210 (FOH) Floral Design: Intermediate

215 (POM) Economic Fruits of the World

220 (VC) Vegetable Types and Identification

225 (VC) Commercial Vegetable Crops

230 (FOH) Woody Plant Materials

300 (FOH) Garden and Interior Plants I

301 (FOH) Garden and Interior Plants II

315 (FOH, VC, POM) Postharvest Physiology and Storage of Horticultural Crops

325 (VC) Practical Aspects of Postharvest Handling of Horticultural Crops

335 (FOH) Woody Plant Materials for Landscape Use

[342 (FOH) (also Biological Sciences 342) Taxonomy of Cultivated Plants]

345 (POM) Fruit Tree Nursery Operation

[350 (POM) Small Fruits]

355 (POM) Viticulture

[360 (POM) Fruit Crop Systematics]

[365 (POM) Utilization of Fruit Crops]

[370 (POM) Fruit Variety Improvement]

400 (FOH) Principles of Plant Propagation

[405 (FOH) Physiology of Horticultural Plants]

410 (FOH) Principles of Florist Crop Production

411 (FOH) Greenhouse Production Management

420 (FOH) Principles of Nursery Crop Production

425 (FOH) Horticultural Sales and Service Businesses

430 (FOH) Special Topics In Ornamental Plants

435 (FOH) Landscape Management

440 (FOH) Turfgrass Management

[445 (POM) Orchard Management I]

450 (POM) Orchard Management II

455 (VC) Vegetable Crop Physiology

460 (VC) Plant-Plant Interactions

[465 (VC) Vegetable Varieties and Their Evaluation]

[470 (POM) Special Topics in Experimental Pomology]

495 (FOH, POM, VC) Undergraduate Seminar

496 (FOH, VC) Internship in Horticultural Sciences

497 (FOH, POM, VC) Independent Study in Horticultural Sciences

498 (FOH, VC) Undergraduate Teaching Experience

499 (FOH, POM, VC) Undergraduate Research

500 (FOH, POM, VC) Master of Professional Studies (Agriculture) Project

600 (FOH) Seminar in Floriculture and Ornamental Horticulture

601 (POM) Seminar in Pomology

602 (VC) Seminar in Vegetable Crops

[605 (FOH) Current Topics in Floricultural and Ornamental Horticultural Physiology]

610 (POM) Growth and Development of Woody Plants

615 (VC) Quantitative Methods in Horticultural Research

620 (POM) Developing Effective Horticultural Research Programs

[625 (VC) Advanced Postharvest Physiology of Horticultural Crops]

629 (FOH, VC) (also Plant Breeding 629) Special Topics in Plant Science Extension

630 (POM) Current Topics in Postharvest Horticulture

700 (FOH, POM, VC) Graduate Teaching Experience

800 (FOH, POM, VC) Thesis Research, Master of Science

900 (FOH, POM, VC) Thesis Research, Doctor of Philosophy

INTERNATIONAL AGRICULTURE

300 Perspectives in International Agriculture and Rural Development
Fall. 2 credits.
F 1:25–3:20. E. C. Erickson and staff.
A forum to discuss both contemporary and future world food issues and the need for an integrated, multidisciplinary team approach in helping farmers and rural development planners adjust to the ever-changing food needs of the world.

402 Agriculture in Tropical America
Fall. 2 credits. Prerequisite: upper class or graduate standing. Letter grades only.
F 1:25–3:20. H. D. Thurston and staff.
A preparatory course for participation in International Agriculture 602. Physical resources, vegetation, history, crop and animal production, and various social and economic aspects of agriculture in tropical America will be discussed.

403 Traditional Agriculture in Developing Countries
Fall. 1 credit. S-U only.
T 8–8:50. H. D. Thurston and staff.
Today, perhaps over half of the world's arable land is farmed by traditional farmers. They developed sustainable agriculture practices which allowed them to produce food and fiber for millennia with few outside inputs. Many of these practices have been forgotten in developed countries but are still used by many traditional, subsistence, or partially subsistence farmers in developing countries. The course will examine traditional systems from several disciplinary points of view.

599 International Agriculture and Rural Development Project Paper
Fall and spring. 1–6 credits. Limited to M.P.S. candidates in international agriculture and rural development. S-U grades only.
Staff.

600 Seminar: International Agriculture
Fall and spring. No credit. S-U grades only.
Third and fourth W of each month, 4–5.
Staff.
The seminar focuses on developing an understanding of the nature and interrelatedness of agricultural development and the social sciences, plant and animal sciences, foods and nutrition, and natural resources.

602 Agriculture in the Developing Nations
Spring. 3 credits. Prerequisites: International Agriculture 402 and permission of instructors. Cost of field-study trip includes air fare and $400 for lodging, meals, and personal expenses.
T R 2:30–4:25 until midterm only.
R. W. Blake and staff.
Oriented to provide students an opportunity to observe agricultural development in a tropical environment and promote interdisciplinary exchange among staff and students. The two-week field-study trip during January to Latin American countries is followed by discussions and assignments dealing with problems in agriculture and livestock production in the context of social and economic conditions.

603 Administration of Agricultural and Rural Development (also Government 692 and Management NBA 588)
Spring. 4 credits.
T 2:30–5:30. M. J. Esman, E. B. Oyer, N. T. Uphoff, L. W. Zuidema.
An intercollege course designed to provide graduate students with a multidisciplinary perspective on the administration of agricultural and rural development activities in developing countries. The course is oriented to students trained in agricultural and social sciences who are likely to occupy administrative roles during their professional careers.

[604 Seminar on African Agriculture and Rural Development
Fall. 2 credits. S-U grades optional. Offered alternate years. Not offered 1989–90.
M 1:25–3:20. F. W. Young.
Strategies for increasing food production and raising rural incomes in Africa. Topics include cropping systems in Africa and the role of agricultural technology in increasing yields and improving livestock production; strategies for improving human nutrition; food storage and mechanization; rural employment projects; alternative rural development strategies; and experience with World Bank and other internationally funded rural development projects.]

[606 Farming Systems Research
Fall. 3 credits. Not offered 1989–90.
T 2:30–4:25, R 12:30–1:25. R. Barker and staff.
An interdisciplinary course focusing on the development of agricultural technologies and policies designed to assist small-scale farmers in developing countries. Techniques for gathering information, specifying research problems, and analyzing and interpreting data will be explored. The involvement of farmers in the research process is stressed.]

650 Special Topics in International Agricultural and Rural Development
Fall and spring. 1–3 credits
Staff.
A seminar on current themes of agricultural and rural development. Specific content varies each semester.

685 Training and Development: Theory and Practice (also Communication 685, Education 685 and Industrial and Labor Relations 658)
Spring and summer. 4 credits. S-U grades optional. Charge for materials $45.
F 9:05–12:05. At Communication Graduate Center. N. E. Awa, D. Deshler, W. W. Frank.
Analysis, design, and administration of training programs for the development of human resources in small-farm agriculture, rural health and nutrition, literacy as nonformal education, and general community development. Designed for scientists, administrators, educator-trainers, and social organizers in rural and agricultural development programs in the U.S. and abroad.

695 International Nutrition, Agriculture, and Development (also Nutritional Sciences 695)
Spring. 3 credits.
W F 11:15–12:45. T. Brun and staff.
A course concentrating on the major issues in food and nutrition policies as they relate to agriculture, including Africa's nutritional and agricultural decline, lessons from socialist countries, the cash- versus food-crop debate, land reform, Green Revolution, and nutrition impact of agricultural programs. Emphasis will be on agricultural policies leading to growth with equity.

703 Seminar for Special Projects in Agricultural and Rural Development
Spring. 1 credit. Required for graduate students enrolled in the M.P.S. (Agr.) degree program and majoring in international agricultural and rural development; others with permission of the program director. S-U grades only.
M 12:20. L. W. Zuidema.
The seminar provides students with the opportunity to present their special projects. It also serves as a forum for discussion of current issues in low-income agricultural and rural development, with particular attention to interdisciplinary complexities.

Related Courses in Other Departments

Political Economy of Ideology and Development in Africa (Africana Studies and Research Center 400)

Political Theory, Planning, and Development in Africa (Africana Studies and Research Center 500)

Economics of Agricultural Geography (Agricultural Economics 150)

Economics of Agricultural Development (Agricultural Economics 464)

Food, Population, and Employment (Agricultural Economics 660)

[Macroeconomic Issues in Agricultural Development (Agricultural Economics 663) Not offered 1988–89.]

Microeconomic Issues in Agricultural Development (Agricultural Economics 664)

Seminar on Agricultural Trade Policy (Agricultural Economics 730)

[Production of Tropical Crops (Agronomy 314) Not offered 1989–90.]

[Geography and Appraisal of Soils of the Tropics (Agronomy 471) Not offered 1989–90.]

Tropical Livestock Production (Animal Science 400)

Tropical Forages (Animal Sciences 403)

Southeast Asia Seminar: Country Seminar (Asian Studies 601 and 602)

Ethnobotany (Biological Sciences 246)

Food, Agriculture, and Society (Biological Sciences 469)

Seminar in Science and Technology Policy in Developing Nations (City and Regional Planning

Seminar in Policy Planning in Developing Nations: Technology Transfer and Adaption (City and Regional Planning 772)

Seminar in Project Planning in Developing Countries (City and Regional Planning 773)

Intercultural and Development Communication (Communication 612)

Communication in the Developing Nations (Communication 624)

Planning Educational Systems (Education 678)

[Designing Extension and Continuing Education Programs (Education 681) Not offered 1989–90.]

Community Education and Development (Education 682)

Behavioral Change in International Rural Modernization (Education 782)

Comparative Extension Education Systems (Education 783)

Postharvest Food Systems (Food Science 247)

International Food Sciences and Development (Food Science 403)

Ethics and Public Life (Philosophy 247)

Political Economy of Change: Rural Development in the Third World (Government 648)

Regional Landscape Planning I (Landscape Architecture 531)

Regional Landscape Planning II (Landscape Architecture 532)

International Environmental Issues (Natural Resources 400)

National and International Food Economics (Nutritional Sciences 457)

International Nutrition Problems, Policy, and Programs (Nutritional Sciences 680)

Seminar in International Nutrition and Development Policy (Nutritional Sciences 695)

Special Topics in International Nutrition (Nutritional Sciences 699)

Plant Diseases in Tropical Agriculture (Plant Pathology 655)

Economic Fruits of the World (Horticultural Sciences 215)

Rural Sociology and Agrarian Problems (Rural Sociology 205)

[Social Indicators and Data Management (Rural Sociology 213) Not offered 1989–90.]

Social and Demographic Changes in Asia (Rural Sociology 439)

Rural Social Stratification (Rural Sociology 445)

Contemporary Sociological Theories of Development (Rural Sociology 606)

[Social Organization of Agriculture (Rural Sociology 650) Not offered 1989–90.]

The Political Economy of Policies and Planning in Third World States (Rural Sociology 675)

[Design and Data Analysis in Development Research (Rural Sociology 715) Not offered 1989–90.]

[Social Movements in Agrarian Society (Rural Sociology 723) Not offered 1989–90.]

Sociotechnical Aspects of Irrigation (Rural Sociology 754, Agricultural Economics 754, and Agricultural and Biological Engineering 754)

LANDSCAPE ARCHITECTURE

The Landscape Architecture Program at Cornell is sponsored by the College of Agriculture and Life Sciences through the Department of Floriculture and Ornamental Horticulture and the College of Architecture, Art, and Planning. For course descriptions, see the listings under the Department of Floriculture and Ornamental Horticulture.

MICROBIOLOGY

W. C. Ghiorse, chair, R. P. Mortlock, C. M. Rehkugler, V. J. Stewart, M. L. Tortorello, S. C. Winans, S. H. Zinder

290 General Microbiology Lectures
Fall, spring, or summer. 3 credits. Prerequisites: Biological Sciences 101–102 and 103–104 and Chemistry 104 or 208. Recommended: concurrent registration in Microbiology 291.
M W F 11:15. Three evening exams.
M. L. Tortorello and M. Cordts.
A study of the basic principles and relationships in the field of microbiology, with fundamentals necessary for further work in the subject.

291 General Microbiology Laboratory
Fall or spring, 2 credits. Summer, 3 credits. Prerequisite: Microbiology 290 (may be taken concurrently).
M W 2–4:25 or 7–9:30 p.m. (spring only), or T R 8–10:30,11:15–1:45, or 2–4:25.
C. M. Rehkugler.
A study of the basic principles and techniques of laboratory practice in microbiology, and fundamentals necessary for further work in the subject.

292 General Microbiology Discussion
Spring. 1 credit. Prerequisite: Microbiology 290 (may be taken concurrently). S-U grades only.
Hours to be arranged. C. M. Rehkugler and E. Seacord.
A series of discussion groups in specialized areas of microbiology to complement Microbiology 290.

314 Tissue Culture Techniques and Applications
Fall. 2 credits. Prerequisites: Microbiology 290 and 291 or permission of instructor.
F 1:25–2:30; lab exercises with follow-up work done independently, F 2:30–4:30.
C. M. Rehkugler.
A series of lectures and demonstrations dealing with cell culture methods especially those required to culture cells of animals from different tissue origins. The application of cell culture to the study of bacterial diseases, virus replication, and the production of biologicals is considered.

[336 Applied and Industrial Microbiology
Fall. 3 credits. Prerequisites: Microbiology 290 and organic chemistry. Not offered 1989–90.
T R 10:10–11:25. Staff.
A survey of the microbiology of industrial fermentations and public health aspects of water and wastewater.]

390 Advanced General Microbiology Lectures
Fall. 3 credits. Prerequisites: Microbiology 290 and 291 and organic chemistry. Biochemistry 330 or equivalent recommended. May be taken without Microbiology 391.
M W F 11:15. S. H. Zinder.
A consideration of the physiology, ecology, genetics, and practical potential of important groups of bacteria. Topics include molecular methods for determining bacterial phylogeny and taxonomy, and the evolution of diverse mechanisms of energy conservation, fixation of carbon and nitrogen, and adaptation to extreme environments.

391 Advanced General Microbiology Laboratory
Fall. 2 credits. Prerequisites: Microbiology 390 (may be taken concurrently) and permission of instructor.
M W 2–4:25. S. H. Zinder.
Intended as a laboratory complementing Microbiology 390. The enrichment, isolation, characterization, and study of bacteria included in Microbiology 390.

400 Seminar in Microbiology
Fall. 1 credit. Limited to undergraduate students specializing in microbiology. Required for microbiology students in their junior year. S-U grades only. The course cannot be used to fulfill the specialization requirement.
W 12:20. Staff.
A series of lecures and seminars designed to present students with laboratory safety training and acquaint them with research projects in microbiology on Cornell campus.

412–413 Clinical Microbiology
412, fall; 413, spring. Credit to be arranged. Prerequisite: permission of instructor.
Hours to be arranged. R. P. Mortlock.
Training and practical experience in clinical microbiology in the hospital laboratory of the Cornell Medical College and New York Hospital in New York City. Emphasis will be upon developing students' capability in the isolation and rapid identification of organisms from various types of clinical specimens. This course is intended to prepare the student for state and federal licensing in various areas of clinical microbiology.

480 Microbial Physiology Lectures
Spring. 3 credits. Prerequisites: Microbiology 290 and 291 or equivalent and biochemistry. Micro 390 recommended. S-U grades optional for students not specializing in microbiology.
M W F 11:15. R. P. Mortlock.
The concern is with the physiological functions of microorganisms. Consideration is given to chemical structure, regulation, growth, and the energy metabolism of prokaryotic organisms. Special attention given to those aspects of microbial metabolism and carbohydrate catabolism not normally studied closely in biochemistry courses.

481 Microbial Physiology Laboratory
Spring. 3 credits. Limited to 12 students. Prerequisites: Microbiology 480 (may be taken concurrently) and permission of instructor. S-U grades optional.
T R 12:20–4:25. R. P. Mortlock.
The laboratory component of Microbiology 480. Deals with laboratory experiments and techniques used in studying the enzymology and physiological characteristics of microorganisms.

484 Prokaryotic Cytology Lectures
Spring. 3 credits. Prerequisites: Microbiology 390 and biochemistry. S-U grades optional.
M W F 10:10. W. C. Ghiorse.
Morphology, ultrastructure, macromolecular organization and life cycles of prokaryotic cells are considered with regard to chemical composition and physiological function of cellular components.

485 Prokaryotic Cytology Laboratory
Spring. 1 or 2 credits. Enrollment limited. Prerequisites: Microbiology 484 or concurrent enrollment, and permission of instructor.
Hours to be arranged. W. C. Ghiorse.
Proper use and theory of microscopes; cytological and cytochemical techniques for light and electron microscopy that are applicable to the study of prokaryotic cells.

498 Teaching Experience
Fall or spring. 1–3 credits. Enrollment limited. Prerequisites: previous enrollment in the course to be taught or equivalent, and written permission of instructor. S-U grades with permission of instructor.
Hours to be arranged. Staff.
Designed to give qualified undergraduate students teaching experience through actual involvement in planning and teaching microbiology courses under supervision of departmental faculty. This experience may include leading a discussion group; preparing, assisting, or teaching a microbiology laboratory; or tutoring. Microbiology courses currently offering such experience include 291 and 292. This course cannot be used to fulfill the specialization requirement.

499 Research in Microbiology
Fall or spring. 1–3 credits. Undergraduates must attach to their course enrollment materials written permission of the staff member who will supervise the work and assign the grade. This course cannot be used to fulfill the specialization requirement.
Hours to be arranged. Staff.

[694 Bacterial Diversity
Offered by special arrangement; see instructor. 4 credits. Prerequisites: Microbiology 290 and 291, and Biological Sciences 330 or 331 or equivalent. Not offered 1989–90.
Hours to be arranged. Staff.
Physiology, ecology, and morphology of selected groups of bacteria, including the methanogenic bacteria, spirochetes, nitrogen-fixing bacteria, photosynthetic bacteria, thermophilic bacteria, myxobacteria, and others. Behavior of bacteria in response to environmental stimuli.]

695 Advanced Microbial Genetics Lectures
Fall. 3 credits. Prerequisites: Biological Sciences 281 and 633 or permission of instructor. Recommended: Biological Sciences 485.
Lec, T R 10:10–11:25. V. J. Stewart.
Current themes in prokaryotic genetics are considered in detail through examination of the primary literature. Topics include recombination and genetic exchange, transposons, mutagenesis and DNA repair, pathway-specific and global regulation of gene expression, and differentiation. Emphasis is on coordinated studies that derive complementary information from both *in vivo* and *in vitro* techniques.

[696 Advanced Microbial Genetics Laboratory
Fall. 2 credits. Prerequisites: Microbiology 291, Biological Sciences 281, and permission of instructor. Corequisite: Microbiology 695 or Biological Sciences 485. Primarily for microbiology and genetics graduate students and for microbiology undergraduate students. Enrollment is limited to eight students. Admission to the course is dependent upon the results of a personal interview with the instructor, which must be held before the first day of classes. *There is no admission to the course without the interview.* Students are urged to interview during preregistration. Not offered 1989–90.
Lab, T R 1:25–4:25; disc, F 10:10.
V. J. Stewart.
Theory and practice of prokaryotic genetics as applied to Escherichia coli. Topics include isolating, characterizing, and mapping mutations; using transposons as mutagens and as linked selectable markers; constructing operon and gene fusions; and using selected recombinant DNA methods for gene isolation and analysis.]

699 Microbiology Seminar
Fall and spring. Required of all graduate students in the Department of Microbiology and open to all who are interested.
Hours to be arranged. Staff.

731–736 Current Topics in Microbiology
Fall, 731, 733, and 735; spring, 732, 734, and 736. 1/2 or 1 credit for each topic. May be repeated for credit. (Students registering for 1/2 credit should not fill in the credit-hour column on the optical-mark registration form; the computer is programmed to register students automatically for 1/2 credit.) Designed primarily for graduate students in microbiology. Prerequisite: upper-level courses in microbiology. S-U grades only.
Hours to be arranged. Staff.
Lectures and seminars on special topics in microbiology.

791 Graduate Seminar in Microbiology
Fall and spring. 1 credit each semester. All students in the Graduate Field of Microbiology must enroll for at least their first three semesters in residence. Students will be expected to lead discussions on recent primary literature in microbiology. S-U grades only.
Hours to be arranged. Staff.

792 Graduate Research Seminar in Microbiology
Fall and spring. 1 credit each semester. Required of all graduate students in microbiology; a seminar relating to the research activities of those enrolled. Students who have completed the Microbiology 791 series requirement are required to present a seminar concerning their research interests and activities at least once each year. S-U grades only.
Hours to be arranged. Staff.

Related Courses in Other Departments

Bioprocessing Applications in Agriculture (Agricultural and Biological Engineering 467)

Soil Microbiology (Agronomy 476)

Advanced Soil Microbiology (Agronomy 666)

[Microbiology of the Rumen (Animal Science 607)
Not offered 1989–90.]

Microbial Genetics, Lectures (Biological Sciences 485)

Microbial Genetics, Laboratory (Biological Sciences 487)

Introduction to Bioprocess Engineering (Chemical Engineering 643)

Controlled Cultivation of Microbial Cells (Chemical Engineering 646)

Insect Pathology (Entomology 453)

Food Microbiology Lectures (Food Science 394)

Food Microbiology Laboratory (Food Science 395)

Food Mycology (Food Science 411)

[Advanced Food Microbiology Lectures (Food Science 607)
Not offered 1988–89.]

Basic Immunology, Lectures (Veterinary Medicine 315 and Biological Sciences 305)

Basic Immunology, Laboratory (Veterinary Medicine 316 and Biological Sciences 307)

Pathogenic Microbiology (Veterinary Medicine 317)

Advanced Work in Bacteriology, Virology, or Immunology (Veterinary Medicine 707)

Advanced Animal Virology, Lectures (Veterinary Medicine 708)

NATURAL RESOURCES

J. P. Lassoie, chair; R. A. Baer, H. B. Brumsted, D. J. Decker, T. J. Fahey, T. A. Gavin, J. W. Gillett, J. W. Kelley, B. A. Knuth, M. E. Krasny, C. C. Krueger, R. J. McNeil, R. A. Malecki, A. N. Moen, R. T. Oglesby, M. E. Richmond, C. L. Schofield, C. R. Smith, L. H. Weinstein, B. T. Wilkins, W. D. Youngs

100 Principles of Conservation
Fall. 3 credits. Limited to students specializing in natural resources. Not open to students who have passed Natural Resources 201.
Lecs, M W F 9:05; 1-hr disc to be arranged. R. T. Oglesby.
The nature of natural resources, how they are managed, and their interactions with individuals and societies are considered. Case histories and demonstrations will be used to illustrate both principles and practices. Emphasis will be on management of renewable resources based on ecological and cultural perspectives.

106 Management Using Common Software
Spring, first half of term. 1 credit. Prerequisite: Natural Resources 100 or permission of instructor.
Lec 10:10. B. Wilkins.
Emphasizes important resource-management elements facilitated by use of IBM PC and Macintosh. Processes include those facilitated by spreadsheets, database systems, and technical writing. No prior knowledge of computers is required.

107 Management Using Database System
Spring. 2 credits. Prerequisite: Natural Resources 100 or concurrent registration in Natural Resources 106 or permission of instructor.
Lec to be arranged; lab to be arranged. B. Wilkins.
Ten assignments requiring use of spreadsheets, database systems, and technical writing help develop students' ability to analyze data and prepare written materials to aid in management of natural resources. No prior knowledge of computers is required. Concurrent registration in NR 106 would be appropriate for many first-year students but is not required. This course is not open to those who have taken Ed 447 or Ag Eng 102.

201 Environmental Conservation
Spring. 3 credits.
Lecs, M W F 10:10; 1-hr disc to be arranged. T. J. Fahey.
A survey course intended for students in any year and major. Designed to provide information and to stimulate ideas as an aid to understanding the major environmental problems facing spaceship Earth. A topical approach with representative case histories is taken. Topics include global changes—CO_2, ozone, and climate; population growth and the world food problem; energy resources and alternatives; mineral resources and recycling; land use in urban and rural landscapes; air, water, and soil pollution; and endangered species and wildlands.

210 Introductory Field Biology
Fall. 4 credits. Limited to 45 students. Open to sophomores and juniors with an adviser in Natural Resources *or* by permission of instructor. Prerequisites: Biological Sciences 101 and 102 or equivalent. Cost of field trips, approximately $10.
Lec, W 9:05; labs, M W 1:25–4:25. 2 overnight field trips required.
T. A. Gavin.
Introduction to methods of inventorying and identifying plants and animals. Approximately 150 species of vertebrates and 75 species of woody plants found in New York State are covered. Selected aspects of current ecological thinking, relevant to problems in assessment of the distribution and abundance of organisms, are stressed. The interaction of students with biological events in the field and accurate recording of these events are emphasized.

250 Introduction to Wildlife Biology
Spring, first third of term. 1 credit.
Lecs, M W F 8. T. A. Gavin.
An introduction to biological topics relevant to informed management of wildlife; emphasis will be on the *population* as the unit of interest. An overview of the history of wildlife management in North America will illustrate the importance of the interaction between biological and nonbiological factors on wildlife. However, this course is about wildlife biology, not wildlife management, which is treated in Natural Resources 308 and 410.

251 Introduction to Fishery Biology
Spring, weeks 6–10. 1 credit.
Lecs, M W F 8. Staff.
Subject areas that form the basis of fishery biology are introduced by staff member working in that particular area. The areas included are limnology, insect biology, biology of fishes, genetics, life history, population biology, environmental impacts, policy, and management.

252 Introduction to Forest Science
Spring, last third of term. 1 credit. Prerequisite: Natural Resources 210 or permission of instructor.
Lecs, M W F 8. J. P. Lassoie.
Appreciation of forests as a natural resource. Introduction to the importance of ecology, tree biology, and environment as bases for forest management and silviculture. Emphasis is on the forests of the northeastern United States.

270 Bird Biology and Conservation
Spring. 2 credits.
Lec, T R 11:15–12:05. C. Smith.
A survey course for majors and nonmajors, focusing on birds and the ways they illustrate general principles of behavior, ecology, management, and conservation at the organism, population, and community levels. Topics covered will emphasize attributes of birds that can be observed directly by the student. Current resource-management issues relevant to birds will be explored in the contexts of habitat management, tropical deforestation, the design and management of natural preserves, endangered species management, and the economic importance of bird study as an outdoor recreational activity.

271 Bird Biology and Conservation Laboratory
Spring. 1 credit. Concurrent enrollment in Natural Resources 270 required.
Six Saturday-morning field trips plus three indoor labs. C. Smith.
A field-oriented course designed to teach skills of bird observation and identification based on the integration of field marks, songs and calls, and habitat cues. Topics covered will include the choice and effective use of field guides, binoculars, and other aids to bird identification; procedures for taking and organizing field notes; the relationships of birds to their habitats and to other birds; and methods and procedures for censusing and surveying songbird populations. Students are expected to provide their own binoculars for field use.

302 Forest Ecology
Fall. 4 credits. Cost of trip, no more than $20.
Lecs, M W F 11:15; lab, M 12:20–4:25.
1 weekend trip S through M. T. J. Fahey.
Analysis of the distribution, structure, and dynamics of forest ecosystems. All laboratory sessions in the field. One weekend field trip to the Adirondacks or other forest region.

303 Woodlot Management
Fall. 3 credits. Letter grades only.
Lecs, T R 10:10; lab, R 12:20–4:25.
J. W. Kelley.
A practical, field-oriented course emphasizing multiple purpose management of small nonindustrial private forestland in the northeastern United States.

304 Wildlife Ecology
Spring. 3 credits. Prerequisites: general biology and at least one course in computer programming or proficiency.
Lec, M W F 11:15. Labs to be arranged.
A. Moen.
This course focuses on the physiological, behavioral, and population characteristics of wild species, interactions among species, and their relationships with range characteristics and resources. Computer modeling is an integral part of the course.

305 Maple Syrup Production
Spring. 2 credits. Limited to 20 students. Prerequisite: permission of instructor. Letter grades only.
T 12:20–4:25 (preliminary seminars followed by several half-days of fieldwork during the maple season).
J. Kelley.
Students work in most phases of the Arnot Forest maple operation and learn modern sap-collecting techniques and quality control in making syrup.

306 Coastal and Oceanic Law and Policy
Summer. 1 credit. A special 1-week course offered at Cornell's Shoals Marine Laboratory (SML), on an island off Portmouth, N.H. For more details and an application, consult the SML office, G14 Stimson Hall. Estimated cost (includes tuition, room and board, and ferry transportation), $675.
Daily lecs and discs for 1 week.
SML faculty.
Intended for persons interested in careers in management of marine or coastal resources or in the natural sciences. Subjects include law and policy related to ocean dumping, marine sanctuaries, environmental impact statements, water and air pollution, fisheries management, offshore gas and oil production, and territorial jurisdiction. Lectures on the status and history of law are accompanied by discussion of relevant policy and analysis of the efficacy of various legal techniques. A case study that requires extensive use of the laboratory's library and personnel is assigned. The week concludes with a mock hearing.

308 Natural Resources Management
Fall. 3 credits. Prerequisite: junior standing; introductory ecology or permission of instructor.
M W F 10:10. B. A. Knuth.
Introduction to management of natural resources with a focus on fish, wildlife, and forest resources. Emphasis is placed on concepts necessary to formulate and achieve specific management goals and objectives. Topics include historical overview; planning processes and the management cycle; ecological, social, and institutional dimensions; jurisdiction, allocation, and ownership; decision making; the future. Focus is on state-level management of natural resources geared toward multiple interests.

[331 Beyond the Year 2000 (also Government 331)
Spring. 4 credits. Not offered 1989–90.
Hours to be arranged. E. Kenworthy, B. Gibson.
This course explores present projections of where the world will be twenty-five years from now, drawing on computer and other analyses of present trends regarding environmental and social conditions. An evaluation of these projections will be coupled with an analysis of what it would take to get a future we prefer over the future that appears likely.]

400 International Environmental Issues
Fall. 3 credits. Limited to 30 students. Prerequisite: junior standing or above.
Lecs, M W F 12:20. R. J. McNeil.
International aspects of the preservation and development of environmental and natural resources. Concepts include development, resource ownership, exploitation, compensation, and preservation. Cultural differences in attitudes and behavior toward environment. Management practices under different cultural, economic, and social systems. Will cover current issues such as acid precipitation; management of migratory whales, fish, and waterfowl; Antarctic development; global energy issues; and preservation of fragile and endangered resources. Lecture and discussion, term paper, and examinations.

401 Environmental and Natural Resources Policies
Fall or spring. 3 or 4 credits. Prerequisites: junior standing and participation in Cornell-in-Washington Program.
Lab to be arranged. R. J. McNeil and staff.
Concepts and principles fundamental to the environmental policy process. Biological and ecological principles central to decision making in the natural resources arena, particularly at the national and international levels. Role of the legal system in the policy process; roles of citizen organizations, lobbyists, bureaucrats, legislators. Case studies, interviews with Washington officials, several short papers, one exam. A fourth credit available requires a more extensive written assignment and an oral presentation.

402 Natural Resources Policy, Planning, and Politics
Spring. 3 credits. Prerequisites: junior standing and permission of instructor.
Lec, January 2-week intersession; one 2-hr. orientation session in Dec. and four 2-hr. seminars in Jan. and Feb.
R. J. McNeil and staff.
An introduction to the environmental policy process and its conceptual framework. Recognition of phenomena identified as natural resources or environmental problems and issues; steps leading to legislation or regulations to solve problems; implementation and evaluation stages; role of the legal system; roles of citizens, lobbyists, government actors. Case studies; presentations by and discussions with about twenty prominent Washington policy makers appearing as guest lecturers. Required interviews, term paper, oral reports. Several meetings in Ithaca before and after intensive January session in Washington.

[406 Conducting Marine and Natural Resource Extension Programs
Spring. 3 credits. Not offered 1989–90.
Lec and rec. One weekend field trip.
B. T. Wilkins.
Extension programs stimulate and help citizens use current research knowledge to reach decisions on the management of natural resources. The course provides an overview of the constructs used in this emerging natural resource field, and gives students experience in components important in conducting such efforts.]

407 Religion, Ethics, and the Environment
Spring. 3 credits. For juniors, seniors, and graduate students; others by permission only. S-U grades optional.
T R 9:05, 1-hr. disc to be arranged. R. A. Baer.
A study of how religion (mainly Christianity and Judaism), philosophy, and ethics affect our understanding and treatment of nature. The terms religion, value, knowledge, nature, and the public interest are examined in detail. Particular themes include the structure of modern science, play and work, and human finitude and death. Also, responsibility to future generations, limiting growth and questions of distributive justice, and world population and global hunger.

410 Principles of Wildlife Management
Spring. 3 credits. Prerequisite: introductory biology. Junior, senior, graduate level standing.
M W F 9:05. A. N. Moen.
In-depth analyses of the ecological basis for decision making in wildlife management, computer simulations of management problems and effects of options.

414 Selected Topics in Wildlife Resource Policy
Spring. 2 credits. Intended for juniors, seniors, and graduate students. Prerequisite: Natural Resources 410 or equivalent or permission of instructor. Cost of field trips, no more than $25.
Time to be arranged. Several field trips usually taken weekdays; one overnight field trip to Albany. H. B. Brumsted.
A seminar devoted to analysis of selected current policy issues in wildlife management. Particular attention is given to citizen roles in policy development.

[417 Wetland Resources
Summer, 1 week at Shoals. 1 credit. Not offered 1989–90.
R. A. Malecki.
For description, see listing under "Courses in Marine Science," in the section on the Division of Biological Sciences.]

438 Fishery Management
Spring. 3 credits. Prerequisite: Natural Resources 440 or permission of instructor.
Lecs, T R 8 plus discs. C. C. Krueger.
Introduction to management as an adaptive process that focuses on achievement of goals. Coverage includes sport and commercial fisheries. Topics include setting goals and objectives, regulations, habitat management, population control, stocking, and management of trout, reservoirs, the Great Lakes, and Pacific halibut. Ecological, social, political, and economic aspects of those topics are discussed.

440 Fishery Science
Fall. 3 credits. For juniors and seniors majoring in fishery science; others by permission of instructor. Prerequisites: a year of statistics and calculus. Offered alternate years.
M W F 12:20. W. D. Youngs.
Principles and theories involved in dynamics of fish populations. Methods of obtaining and evaluating statistics of growth, population size, mortality, yield, and production are considered.

[442 Techniques in Fishery Science
Fall. 5 credits. Limited to 15 upperclass and graduate fishery students. Offered 1990–91. Cost of field trips, no more than $30.
T R 1:25–4:25; 1 or more weekend field trips. C. C. Krueger.
Emphasis is on methods of collecting data on attributes of fish populations and their habitat. Topics include passive and active fish-capture methods, tagging and marking, and physical and chemical habitat measurements. Assumptions and limitations inherent in data sets, research planning, and scientific report writing are also discussed. Several field trips provide hands-on experience in data collection on streams and lakes.]

492 Contemporary Issues Seminars: Integrating Sociological and Biological Approaches to Natural Resource Management
Fall. 2 credits.
Hours to be arranged. C. Geisler and T. Gavin.
Conservation biology is a rapidly spreading subfield of biology actively engaging professionals from the biological sciences in the conservation of biotic diversity. This course examines such conservation from both biological and sociological perspectives in the belief that both are essential to successful conservation biology. Students will become sophisticated in social, cultural, and institutional factors, which are integrated through rarely explored dimensions of species and habitat protection policies.

493 Research in Policy and Human Studies in Natural Resource Management
Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional.
R. A. Baer, H. B. Brumsted, D. J. Decker, B. A. Knuth, R. J. McNeil, B. T. Wilkins.

494 Research in Fishery Science
Fall or spring. Credit to be arranged. S-U grades optional.
Hours to be arranged. J. L. Forney, C. C. Krueger, R. T. Oglesby, C. L. Schofield, W. D. Youngs.

495 Research in Wildlife Science
Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional.
H. B. Brumsted, T. A. Gavin, R. A. Malecki, A. N. Moen, M. E. Richmond.

496 Research in Forestry
Fall or spring. Credit to be arranged. S-U grades; letter grade by permission of instructor.
Hours to be arranged. T. J. Fahey, J. P. Lassoie, L. H. Weinstein.

498 Teaching in Natural Resources
Fall and spring. 1–4 credits. Prerequisite: permission of instructor.
Staff.
Course designed to give students an opportunity to obtain teaching experience by assisting in labs, field trips for designated sections, discussions, and grading. Students will gain insights into the organization, preparation, and execution of course plans through application and discussions with instructor.

500 Professional Projects—M.P.S.
Fall and spring. Credit to be arranged. Limited to graduate students working on professional master's projects. S-U grades only.
Staff.

601 Seminar on Selected Topics in Fishery Biology
Fall or spring. 1 credit. S-U grades optional.
Hours to be arranged. Staff.

603 Habitat Ecology
Spring. 1 or 2 credits. Limited to 12 seniors and graduate students majoring in natural resources or biological sciences. Prerequisite: permission of instructor. Cost of field trips, no more than $20.
W 12:20–3. M. E. Richmond.
This course requires an understanding of broad ecological concepts relative to plant-wildlife interactions. The concepts of niche, habitat, and ecotope are addressed from the standpoint of island biogeographic principles, structural and spatial heterogeneity of the vegetation, community productivity, and temporal change. Major landforms and plant-animal communities of the northeastern United States will be discussed and visited during weekend field trips as scheduling permits. Paper required for 2-credit option.

604 Seminar on Selected Topics in Resource Policy and Planning
Fall. 1 credit. S-U grades only.
Hours to be arranged. Staff.
Primarily for graduate students with a major or minor in resource policy and planning and upper level undergraduates with a strong interest in policy analysis. Topics vary with staff involved.

[606 Marine Resources Policies
Spring. 2 credits. Prerequisite: at least one related course such as Natural Resources 308, 438; or permission of instructor. S-U grades optional. Not offered 1989–90.
W 1:30–3:30. B. T. Wilkins.
A seminar discussing the law and issues concerning current marine policy questions, such as coastal zone management, marine fish regulations, marine mammal protection, and wetland preservation.]

607 Ecotoxicology
Spring. 3 credits. Prerequisites: graduate or senior status and two 300-level courses in chemistry, biochemistry, or toxicology.
Lecs, M W F 11:15. J. W. Gillett.
Lectures, readings, and special guests focus on the principles of effects of toxic chemicals on natural ecosystems, their components, and processes. Major topics include fate and transport of chemicals (chemodynamics), comparative biochemical toxicology, ecosystem process analysis, simulation through mathematical and physical (microcosm) models, and relationships to regulation and environmental management.

[608 Resource Policy and Administration
Fall. 3 credits. Prerequisite: graduate standing; juniors and seniors with instructor's permission. Not offered 1989–90.
T R 2:30–3:45. B. A. Knuth.
An examination, through lectures, readings, and discussions, of policy, planning, and administration relating to natural resource management in the public domain. Emphasis is on concepts relevant to policy formulation, implementation, and evaluation with specific applications from fisheries, wildlife, forest and

water resource management. Topics include bureaucracies and organizational effectiveness, professionalism and ethics, policymaking process and philosophies, comprehensive planning, problem-solving and decision aids including mediation, impact assessment, benefit/cost analysis, risk assessment and management, and group decision processes.]

610 Conservation Seminar
Fall and spring. No credit. All graduate students in natural resources are expected to participate.
Hours to be arranged. Staff.

611 Seminar in Environmental Values
Fall. 3 credits. For graduate students, seniors, and juniors. S-U grades optional.
W 1:25–3:50. R. A. Baer.
Moral concerns relative to agriculture and/or the environment. In successive years, the seminar will focus on such topics as (1) natural resources management and the concept of the public interest, (2) land use ethics, (3) formulating natural resource policy in a democratic and pluralistic society, and (4) responsibility to future generations.

612 Wildlife Science Seminar
Fall and spring. 1 credit. Prerequisite: permission of instructor. S-U grades optional.
Hours to be arranged. Wildlife science faculty.
Discussion of individual research or current problems in wildlife science.

615 Seminar in Agroforestry
Spring. 2 credits. Prerequisites: senior or graduate standing and permission of instructor.
Lec, M 7–9 p.m. J. P. Lassoie.
An interdisciplinary course intended to introduce students to the general principles and types of agroforestry systems. Agronomic, forestry, socioeconomic, and institutional factors are considered through the use of case studies. Conceptual and methodological approaches to agroforestry research design and program development are stressed. A presentation during the seminar and a short library research paper are required of all enrolled.

616 Forest Science and Management Seminar
Fall/spring. 1 credit. Permission of instructor.
Staff.
Selected readings and discussions of research and/or current problems in forest science and management.

800 Master's Thesis Research
Fall and spring. Credit to be arranged. Limited to graduate students working on master's thesis research. S-U grades only.
Staff.

900 Ph.D. Thesis Research
Fall and spring. Credit to be arranged. Limited to graduate students working on Ph.D. thesis research. S-U grades only.
Staff.

Related Courses in Other Departments
See department advisers and curriculum materials for information about other related courses.

Environmental Policy (Agriculture and Life Sciences 661, Biological Sciences 661, and Biology and Society 461)

Resource Economics (Agricultural Economics 150, 252, 332, 452, 631, 651, 652, 750)

The Vertebrates (Biological Sciences 274)

Limnology (Biological Sciences 462)

Mammalogy (Biological Sciences 471)

Ornithology (Biological Sciences 475)

Biology of Fishes (Biological Sciences 476)

Insect Biology (Entomology 212)

Public Administration (City and Regional Planning 643)

Policy Analysis (City and Regional Planning 720)

Soil Science (Agronomy 260, 361)

International Development (City and Regional Planning 777, Government 648)

Environmental Planning Law (Law 660, City and Regional Planning 653, 656)

Political Economy and Political Theory (City and Regional Planning 719, Government 428)

Philosophy 381—Philosophy of Science

PLANT BREEDING

W. R. Coffman, chair; R. E. Anderson, E. D. Earle, H. L. Everett, C. C. Lowe, H. M. Munger, R. P. Murphy, M. A. Mutschler, W. D. Pardee, O. H. Pearson, R. L. Plaisted, R. R. Seaney, M. E. Smith, M. E. Sorrells, J. C. Steffens, S. D. Tanksley, D. R. Viands, D. H. Wallace

Biometry courses are listed under "Statistics and Biometry."

201 Introduction to Plant Breeding
Spring. 2 credits. Prerequisite: one year of introductory biology.
Lecs, T R 11:15. W. R. Coffman.
The contributions of plant breeding to national and international development. An overview of genetics, breeding methods, systems, and operational procedures for producing commercial crop varieties are considered along with the major breeding objectives.

225 Plant Genetics
Spring. 4 credits. Prerequisite: one year of introductory biology or permission of instructor. Limited to 50 students.
Lecs, M W F 9:05; lab, T or W 1:25; lab section assignments at first lecture. Labs start first week. M. A. Mutschler.
An overview of genetic principles is related to plant sciences. Mendelian inheritance and cell mechanics, DNA as genetic material, genetic fine structure and gene regulation, gene recombination, linkage and mapping, gene interaction, extranuclear inheritance, environmental effect on phenotypic expression, gene mutation and chromosomal aberrations, variation in chromosome numbers, genes in populations, multiple gene inheritance, tissue culture, and genetic engineering. Students conduct an independent inheritance project with *Brassica campestris*. The course may not be used to fulfill the genetics requirement for students in the Division of Biological Sciences.

401 Plant Cell and Tissue Culture
Fall. 2 credits. Prerequisites: a course in plant physiology, cell biology, or genetics, or permission of instructor.
Lecs, T R 10:10. E. D. Earle.
Lectures and demonstrations dealing with the techniques of plant tissue, cell, protoplast, embryo, and anther culture and the applications of those techniques to biological and agricultural studies. Methods for plant improvement via manipulations of cultured cells will be discussed.

402 Plant Tissue Culture Laboratory
Fall. 1 credit. Enrollment limited. Prerequisites: Plant Breeding 401 (may be taken concurrently) *and* written permission of instructor.
W 1:25–4:25 plus 1 hr. to be arranged, alternate weeks. E. D. Earle.
Laboratory exercises complementing Plant Breeding 401. Techniques for establishing, evaluating, and utilizing plant organ, embryo, callus, cell, protoplast, and anther cultures will be covered. Experiments will use a broad range of plant materials.

496 Internship in Plant Breeding
Fall or spring. Credits variable, may be repeated to a maximum of 6. Minimum of 60 on-the-job hours per credit granted. Prerequisites: permission of adviser and enrollment during the pre-enrollment period of the semester before the internship. Student must be a plant breeding junior or senior with a minimum 3.0 average in plant breeding courses. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their study and assign their credits and grade. S-U grades only.
Staff.
On-the-job learning experience under the supervision of professionals in a cooperating organization. A learning contract is written between the faculty supervisor and student, stating the conditions of the work assignment, supervision, and reporting.

497 Special Topics for Undergraduates
Fall or spring. Credits variable, may be repeated to a maximum of 6. Prerequisite: permission of instructor. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their study and assign their credits and grade. S-U optional.
Staff.

498 Undergraduate Teaching
Fall or spring. Credits variable, may be repeated to a maximum of 6. Prerequisites: permission of instructor, and previous enrollment in course to be taught or equivalent. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their study and assign their credits and grade. S-U optional.
Staff.
Undergraduate teaching assistance in a plant breeding course. Teaching experience may include leading a discussion section, preparing and teaching laboratories, and tutoring.

499 Undergraduate Research
Fall or spring. Credits variable, may be repeated to a maximum of 6. Prerequisite: permission of instructor. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their study and assign their credits and grade. S-U optional.
Staff.
Undergraduate research projects in plant breeding.

603 Methods of Plant Breeding
Fall. 3 credits. Prerequisites: Biological Sciences 281 or Plant Breeding 225 or equivalent and an introductory course in crop production.
M W F 11:15. M. E. Smith.
Breeding methods, systems, and operational procedures for producing commercial crop varieties are considered in detail. Emphasis is on an integrated, interdisciplinary approach to major breeding objectives, including agronomic characteristics, quality characteristics, and biotic and abiotic tolerances. Inbreeding methods, population genetics, population improvement, and breeding methods for special situations will be covered.

604 Methods of Plant Breeding Laboratory
Fall. 2 credits. Prerequisite: Plant Breeding 603 or equivalent.
T R 1:25–4:15. M. E. Sorrells and R. E. Anderson.
Field trips to public and private plant breeding programs. Discussion of breeding methods used, overall goals, selection and screening techniques, and variety and germ plasm release. Uses of computers in plant breeding research. Organization and presentation of a comprehensive breeding program on a chosen crop.

605 Physiological Genetics of Plant Adaptation and Yield
Spring. 1 credit. Prerequisite: genetics or plant breeding, or permission of instructor. Offered alternate years.
R 10:10. D. H. Wallace.
The physiology and genetics of yield accumulation and of cultivar adaptation are explored. Biological relationships between adaptation and yield are studied. Early and modern literature on breeding for adaptation and yield in any environment are compared.

[608 Biochemical Approaches in Plant Breeding
Fall. 2 credits. Prerequisite: Biological Sciences 330, 331, or permission of instructor. Not offered 1989–90.
M W 10:10. J. C. Steffens.
A review of biochemical, spectroscopic, and immunological techniques used in the analysis, selection, and generation of crop plants. Examples from current literature and possible applications of new technologies will be discussed. Critical assessment of appropriate means of targeting biochemical plant breeding problems will be discussed.]

622 Seminar
Fall or spring. 1 credit. S-U grades only.
T 12:20. Staff and graduate students.

629 Special Topics in Plant Science Extension
Spring. 2 credits.
F 1:25–4:25. W. D. Pardee.
Designed for graduate students and advanced undergraduates to provide a broader knowledge of cooperative extension philosophy and methods. Developed for students interested in extension and research in public and commercial organizations. Topics relate to extension in other countries as well as in the United States.

650 Special Problems in Research and Teaching
Fall or spring. 1 or more credits. Prerequisite: permission of instructor supervising the research or teaching.
Staff.

653 Plant Molecular Genetics (also Biological Sciences 653)
Spring. 3 credits. Prerequisites: Biological Sciences 281, and 330 or 331, or their equivalents.
Lecs, T R 10:10–11:30. S. D.Tanksley, M. R. Hanson, J. B. Nasrallah, P. Palukaitis.
A review of the organization, function, and evolution of genetic information in higher plants. An in-depth treatment of the organization of the chloroplast, mitochondrial, and nuclear genomes as well as their interactions. Current information on gene regulation in higher plants is also discussed.

[716 Perspectives in Plant Breeding Strategies
Spring. 3 credits. S-U grades optional. Prerequisite: Plant Breeding 603. Not offered 1989–90.
T 1:25–2:15, R 12:20–2:15. M. E. Sorrells.
Selection techniques and breeding objectives, methods, and strategies for both self- and cross-pollinated crops are reviewed and discussed. Extensive outside reading is required. Emphasis is on discussion and evaluation of selected benchmark papers and current literature.]

717 Quantitative Genetics in Plant Breeding
Spring, even years. 3 credits. Prerequisites: Plant Breeding 603 and Statistics 601. S-U grades only.
T R 8:30–9:55. D. R. Viands, R. L. Plaisted.
Discussion of quantitative genetics to help make decisions for more efficient plant breeding. Specific topics include components of variance (estimated from mating designs), gene pool development, linkage, heritability, phenotypic and genotypic correlation coefficients, and theoretical gain from selection. During one period, plants in the greenhouse will be evaluated to provide data for computing quantitative genetic parameters.

PLANT PATHOLOGY

W. E. Fry, chair; J. R. Aist, P. A. Arneson, S. V. Beer, G. C. Bergstrom, B. B. Brodie, A. R. Collmer, S. M. Gray, R. K. Horst, G. W. Hudler, H. W. Israel, M. P. Ko, R. P. Korf, J. W. Lorbeer, R. Loria, M. T. McGrath, M. G. Milgroom, E. B. Nelson, P. F. Palukaitis, W. A. Sinclair, S. A. Slack, H. D. Thurston, O. C. Yoder, M. Zaitlin, T. A. Zitter

301 Introductory Plant Pathology
Fall. 4 credits. Prerequisites: Biological Sciences 101–102 and 103–104, or 105–106 or 109–110. Recommended: Biological Sciences 241 or equivalent.
Lecs, T R 11:15; lab, M T W or R 1:25–4:25 and one period weekly, scheduled at the convenience of the student. W. A. Sinclair.
An introduction to the theory and practice of plant pathology with emphasis in lectures on principles that govern interactions of plants and pathogens and in laboratories on diagnostic criteria, life cycles of pathogens, and epidemiological phenomena and control. Specific aspects considered in detail include fungi, bacteria, nematodes, viruses, and mycoplasmas as plant pathogens; attack and resistance mechanisms; environmental influences; disease forecasting and loss assessment; development of resistant plants; and chemical and biological control.

[309 Introductory Mycology
Fall. 3 credits. Prerequisite: a year of biology or equivalent. Not offered 1989–90.
Lecs, T R 9:05–9:55; labs, R 1:25–4:25. R. P. Korf.
An introduction to fungi, emphasizing biology, comparative morphology, and taxonomy.]

319 Field Mycology
Fall. 1 or 2 credits. Prerequisite: CALS biology students, PP 309 or equivalent; others by permission of instructor.
Lab, W 1:25–4:25 and 7:30–9:30 p.m. R. P. Korf.
Study of mushrooms and other fungi on 7 field excursions followed by 7 evening labs devoted to identification and study of collections under the microscope. Emphasis on ecology, biology, and means of identification. Students electing 2 credits attend 12 additional labs to prepare special project. There are no lectures; grades will be determined on basis of laboratory final and, for 2 credits, also on special project report.

402 Plant Disease Control
Spring. 3 credits. Prerequisite: Plant Pathology 301 or equivalent.
Lecs, T R 11:15; lab and rec, T W 1:25–4:25. P. A. Arneson.
This course complements Plant Pathology 301 with an in-depth presentation of the principles and practices of plant disease control that builds on students' knowledge of diseases and their causal agents. General principles and concepts, illustrated by specific examples, are presented. Students write a term paper applying those principles to a specific disease-control problem. The laboratories provide practical experience in diagnosis and disease-control techniques.

411 Plant Disease Diagnosis
Fall. 3 credits. For senior undergraduates specializing in plant pathology or pest management and for graduate students with a major or minor in plant pathology or plant protection. Limited to 20 students. Prerequisites: Plant Pathology 301 or equivalent *and* permission of instructor.
Lec, M 11:15; lab, M W 1:25–4:25.
G. W. Hudler.
A method for diagnosis of plant disease is presented with emphasis on contemporary laboratory techniques and effective use of the literature.

[443 Pathology and Entomology of Trees and Shrubs (also Entomology 443)
Fall. 5 credits. Prerequisites: Plant Pathology 301 and Entomology 241 or equivalents. Offered alternate years. Not offered 1989–90.
Lecs, M W F 10:10; labs, T R 1:25–4:25 or W F 1:25–4:25. Evening prelims.
W. T. Johnson, G. W. Hudler.
For students preparing for careers in horticulture, urban forestry, and pest management. Deals with the nature, diagnosis, assessment, and treatment of diseases and anthropod pests of trees and shrubs. Forest, shade, and ornamental plants are considered.]

[444 Integrated Pest Management (also Entomology 444)
Fall. 4 credits. Prerequisites: Biological Sciences 261, Entomology 212 or 241, and Plant Pathology 301 or their equivalents or permission of instructor. Not offered 1989–90.
Lecs, M W F 9:05; lab, M or W 1:25–4:25.
P. A. Arneson.
Lectures integrate the principles of pest control, ecology, and economics in the management of pest crop systems. Laboratories consist of exercises to reinforce concepts presented in lecture and demonstrate pest monitoring techniques and the application of computer technology to management problems.]

497 Special Topics
Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.
An opportunity for independent study of a special topic in mycology or plant pathology under the direction of a faculty member.

498 Teaching Experience
Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.
Undergraduate teaching assistance in a mycology or plant pathology course by mutual agreement with the instructor.

499 Undergraduate Research
Fall or spring. 3–5 credits. S-U grades optional.
Hours to be arranged. Staff.
An opportunity for research experience under the direction of a faculty member.

642–661 Special Topics Series
Unless otherwise indicated, the following description applies to courses 642–661. Fall or spring. 1 credit. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged.
Weekly discussions of current topics in special areas of plant pathology and mycology. Students are required to do extensive reading of current literature and to present oral and written reports.

642 Plant Disease Epidemiology
Fall.
T 12:20. M. G. Milgroom.

644 Ecology of Soil-Borne Pathogens
Fall.
M 4. E. B. Nelson.

645 Plant Virology
Fall.
F 12:20. S. M. Gray.

646 Plant Nematology
Fall and spring.
W 12:20. M. P. Ko, B. B. Brodie.

647 Bacterial Plant Diseases
Spring.
M 11:15. S. V. Beer.

648 Molecular Plant Pathology
Fall and spring.
R 12:20. H. D. VanEtten, O. C. Yoder.

649 Mycology Conferences
Spring. 2 credits.
Lec, F 10:10; lab, F 1:25. R. P. Korf.
Ascomytes, including lichens, Basidiomycota, excluding rusts.

650 Diseases of Vegetable Crops
Fall.
W 4. J. W. Lorbeer, T. A. Zitter.

651 Diseases of Fruit-Tree Crops
Fall. For graduate students and advanced undergraduates with a particular interest in fruit. Autotutorial slide and tape sets.
Hours to be arranged. P. A. Arneson.
Covers the economic importance, causal agents, symptoms, disease cycle, and control measures for the major diseases of tree fruit in the Northeast.

652 Field Crop Pathology
Spring.
W 8. G. C. Bergstrom.

653 Dendropathology
Spring.
W 4. G. W. Hudler, W. A. Sinclair.

654 Diseases of Florist Crops
Spring.
F 12:20. R. K. Horst.

655 Plant Diseases in Tropical Agriculture
Spring
T 12:20. H. D. Thurston.

661 Diagnostic Lab Experience
Summer and fall. 2 credits.
T. A. Zitter.
For graduate students and advanced undergraduates with a special interest in diagnosing plant diseases. Students will work in the Diagnostic Laboratory (Plant Pathology Department) under supervision of the diagnostician. Students may choose to work on a wide array of plant material or to concentrate on a particular commodity. Priority will be given to graduate students in plant pathology and plant protection.

681 Plant Pathology Seminar
Fall and spring. 1 credit. Required of all plant pathology majors. S-U grades only.
T 4:30–5:30. Staff.

701 Concepts of Plant Pathology: Organismal Aspects
Spring. 3 credits. For graduate students with majors or minors in plant pathology; others by permission. Prerequisites: Plant Pathology 301 or equivalent and permission of instructor.
Lecs, T R 9; lab-disc, R 2–4:25.
A. R. Collmer.
Concepts in host-pathogen relationships with emphasis on roles of molecules and cells in determining the outcome of an interaction. Genetic, molecular biological, physiological, and cell biological approaches to experimental analysis of exemplary host-pathogen systems will be considered. Historical perspectives and recent research will be reviewed and analyzed. Students prepare and review mock grant proposals.

702 Concepts of Plant Pathology: Population Aspects
Spring. 3 credits. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: Plant Pathology 301 and permission of instructor.
Lec, T R 8; lab, T 2–4:25.
M. G. Milgroom.
Theory and concepts in epidemiology and population biology of plant diseases. Topics include: population dynamics of pathogens in time and space, interactions of pathogen and plant populations, disease in natural communities, and applications of theory and modeling to disease management. The laboratory period will be for discussions and exercises that illustrate concepts introduced in lectures.

[705 Phytovirology
Spring. 2 credits. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: Plant Pathology 301 or equivalent. Offered alternate years. Not offered 1989–90.
Lec, T R 10:10. M. Zaitlin.
This course considers plant viruses and the diseases they cause. Consideration is given to virus structure and composition, classification, replication, effects on hosts, modes of transmission, and the relationships of these aspects to principles of diagnosis and control.]

706 Phytonematology
Fall. 2 credits. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: Plant Pathology 301 or equivalent or permission of instructor.
Lec, R 11:15; lab, R 1:25–4:25. M. P. Ko.
Deals with morphology, anatomy, biology, physiology, ecology, detection and identification of plant pathogenic nematodes, evaluation of population data, interactions between nematodes and other plant pathogens, and methods of assessment of pathogenicity and plant damage.

707 Phytobacteriology
Fall. 2 credits. Prerequisites: general microbiology, lectures and laboratory; Introductory Plant Pathology.
Lec, W 9:05; lab, W 1:25–4:25.
S. V. Beer.
A consideration of the prokaryotes that cause disease in plants and examples of the diseases they cause. The course emphasizes properties of bacterial pathogens that affect disease, methods for manipulation of the pathogens, and recent developments in phytobacteriology. The current state of knowledge of important phytopathogenic genera including their genetics and mechanisms of pathogenesis will be reviewed. Laboratory practice in isolation, inoculation, identification, genetics, and physiology is included.

709 Phytomycology
Spring. 2 credits. For graduate students with a major or minor in mycology or plant pathology; others by permission. Prerequisites: Plant Pathology 301 and 309 or equivalents, and permission of instructor.
Lec, F 1:25–2:30; lab, 2:30–4:30.
J. W. Lorbeer.
Provides basic information on the biology of plant pathogenic fungi with selected emphasis on the structure, ecology, genetics, life cycles, and disease cycles of representative genera and species.

735 Advanced Plant Virology
Spring. 3 credits. Prerequisite: permission of instructors. Offered alternate years.
3 lecs, hours to be arranged.
P. Palukaitis, M. Zaitlin.
Topics in plant virology, with an emphasis placed on student discussion of current literature. Topics included are viral infection process, viral and viroid replication, viral movement, viral genes and their products, cross protection, detection of viruses, and the use of viruses as vectors for introducing genetic material into plants.

[738 Molecular Mechanisms of Pathogenesis
Fall. 2 credits. For graduate students with a special interest in molecular mechanisms of pathogenesis. Prerequisite: permission of instructor. S-U grades only. Not offered 1989–90.
Hours to be arranged. O. C. Yoder and staff.
This course deals with the molecular properties of both microorganisms and higher plants that control the development of host-parasite relationships. Contemporary molecular hypotheses are related to genetic mechanisms of pathogenesis. Emphasis is placed on a critical evaluation of the data that are used to support each specific hypothesis.]

739 Advanced Mycology
Spring. 4 credits. Prerequisites: Plant Pathology 309 or equivalent, a course in genetics, and permission of instructor.
Lec, M 10:10; labs, M W 1:25–4:25, and an additional 3-hr. period to be arranged. R. P. Korf.
A detailed study of the taxonomy, nomenclature, and biology of two major groups of fungi (rusts and fungi imperfecti).

[756 Advanced Plant Nematology
Fall. 3 credits. For graduate students with a major in plant pathology and special interest in nematology. Prerequisite: permission of instructor. Offered alternate years. Not offered 1989–90.
Hours to be arranged. M. P. Ko, B. B. Brodie.]

797 Special Topics
Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.
An opportunity for independent study of a special topic.

799 Graduate Research
Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.

POMOLOGY: HORTICULTURAL SCIENCES

G. H. Oberly, chair; R. L. Andersen, G. D. Blanpied, S. K. Brown, L. L. Creasy, J. N. Cummins, A. N. Lakso, F. W. Liu, R. M. Pool, L. E. Powell, M. P. Pritts, W. C. Stiles

200 Introductory Pomology
Fall or spring. 3 credits. S-U grades only for graduate students.
Lecs, T R 8; lab, T 2–4:25. One half-day field trip required. G. H. Oberly.
A study of the general principles and practices of fruit culture and their relation to the underlying sciences. Included are tree fruits, grapes, and small fruits. Topics covered include propagation, varieties, crop management, and growth and fruiting habits. Practical work is presented in grafting, pruning, site and soil selection, and planting.

215 Economic Fruits of the World
Spring. 3 credits. S-U optional. Offered alternate years.
Lecs, M W 10:10; lab, R 1:25–4:25.
F. W. Liu.
A broad view of world pomology is given. The distribution, production, and utilization of about one hundred species of fruit crops are discussed. The more important subtropical and tropical fruits such as citrus, banana, pineapple, coconut, mango, avocado, coffee, and cacao are studied in more detail. Many other less important ones are studied briefly. Methods of fruit growing in tropical and subtropical regions are shown in slides. Laboratory studies include the morphology, anatomy, postharvest handling, and taste of many subtropical and tropical fruits.

315 Postharvest Physiology and Storage of Horticultural Crops
Fall. 3 credits. Prerequisite: one horticultural course or permission of instructor.
Lecs, M W 9:05; lab, W 1:30–4. F. W. Liu.
The physiology—transpiration, respiration, ethylene synthesis and action, maturation, ripening, and senescence—of fruits, vegetables, flowers, and ornamental crops is studied. Environmental factors influencing the physiological process, thus affecting the quality and marketability of the products, are considered. The principles and methods of harvesting, cleaning, grading, packing, precooling, waxing, sanitation, and transportation of the products are studied. Storage methods, including common storage, refrigerated storage, controlled-atmosphere storage, and hypobaric storage, are discussed.

345 Fruit-Tree Nursery Operation
Spring, first 4-1/2 weeks. 1 credit. Prerequisite: Horticultural Sciences 200 or permission of instructor. S-U grades optional. Offered alternate years.
Lecs, M W 9:05; lab, W 2–4:25.
J. N. Cummins.
This course is intended to familiarize the fruit producer with the operations and problems of the fruit-tree nursery. Topics include production objectives, management decisions, and cultural aspects of nursery operation. Techniques of grafting, budding, pest identification, inspection, and grading of fruit-free planting stocks are included.

[350 Small Fruits
Fall. 3 credits. Offered alternate years. Not offered 1989–90.
Lecs, M W 8; lab, M 2–4:25. M. P. Pritts.
A study of the evolution, breeding history, and biology of strawberries, raspberries, blueberries, and bushberries and of cultural practices used to maximize production. Emphasis will be placed on understanding how cultural practices influence growth, development, and fruiting and protect these species from diseases and insects.]

355 Viticulture
Fall. 3 credits. Prerequisite: Horticultural Sciences 200 or permission of instructor. Offered alternate years.
Lecs, T R 9:05; lab, R 2–4:25; S field trips in early fall will replace several laboratory meetings. R. M. Pool.
Viticulture, with emphasis on the viticulture of the Great Lakes region, is presented as a series of interrelated decisions on varieties, sites, vine management, and vine protection. Those decisions are based on ampelography, meteorology, soils, vine and grape anatomy and physiology, as well as protection of the vine and grapes from injuries, primarily from diseases and insects.

[360 Fruit Crop Systematics
Fall, first 4-1/2 weeks. 1 credit. Prerequisite: Horticultural Sciences 200 or permission of instructor. S-U grades optional. Offered alternate years. Not offered 1989–90.
Lecs, T R 9:05; lab, R 2–4:25.
G. H. Oberly.
The classification of fruit species is considered from a botanical and production viewpoint. The course deals with the identification and naming of fruit species and varieties and their botanical classification.]

[365 Utilization of Fruit Crops
Fall, middle 4-1/2 weeks. 1 credit. Prerequisite: Horticultural Sciences 200 or permission of instructor. S-U grades optional. Offered alternate years. Not offered 1989–90.
Lecs, T R 9:05; lab, R 1:30–4; 2 field trips, R 12:30–5:30. F. W. Liu.
A consideration of the fate of fruits produced for processing. The coverage of fruit products is generally limited to those commercially grown and processed in New York State. Although the discussion includes methods of canning, freezing, dehydration, and other types of processing, emphasis is on the quality requirement and proper handling of raw materials and how they affect the quality of end products.]

[370 Fruit Variety Improvement
Fall, last 4-1/4 weeks. 1 credit. Prerequisite: Horticultural Sciences 200 or permission of instructor. S-U grades optional. Offered alternate years. Not offered 1989–90.
Lecs, T R 9:05; lab, R 2–4:25.
S. K. Brown and R. L. Andersen.
The techniques and limitations of producing new varieties of perennial fruit crops are considered.]

[445 Orchard Management I
Spring. 3 credits. Prerequisite: Horticultural Sciences 200. Offered alternate years. Not offered 1989–90.
Lecs, M W 8; lab, M 1:25–4:25.
L. E. Powell, W. C. Stiles.
A treatment of problems of concern to fruit growers, such as site selection, planting and pruning systems, water relations, cold hardiness, dormancy, flowering, and fruiting. Physiological and practical aspects are emphasized.]

450 Orchard Management II
Fall. 3 credits. Prerequisite: Horticultural Sciences 200. Offered alternate years.
Lecs, M W 8; lab, M 1:25–4:25.
G. H. Oberly, L. L. Creasy.
A continuation of the principles of pomology presented in Horticultural Sciences 445. Subjects include the later stages of fruit maturation, quality, harvesting, aspects of tree nutrition, protection from pests, and regulatory policies affecting fruit production and sale.

[470 Special Topics in Experimental Pomology
Spring. 3 credits. Open to undergraduates by permission. Offered alternate years. Not offered 1989–90.
Hours to be arranged. Staff.
Selected topics are considered with respect to the current literature or experimental techniques. Topics reflect the research interests of the professors who participate.]

495 Undergraduate Seminar
Spring. 1 credit (may be taken twice for credit). Prerequisite: a course in pomology. S-U grades only.
Hours to be arranged. Staff.
Seminar topics and speakers selected and arranged by the students on subject areas related to pomology.

497 Independent Study in Pomology
Fall or spring. 1 or more credits: may be repeated for credit. S-U grades optional. Prerequisite: a student must satisfy the faculty member with whom he or she will work that his or her background warrants the choice of project. Undergraduates must attach to their course enrollment materials written permission from the faculty member who will supervise their work and grade their project.
Staff.
Individual or small-group study and special projects in pomology and related areas.

499 Undergraduate Research
Fall or spring. 2 or more credits. Prerequisite: a course in advanced pomology. S-U grades optional. Students must attach to their course enrollment materials written permission from the staff member who will supervise the work and assign the grade.
Staff.

500 Master of Professional Studies (Agriculture) Project
Fall or spring. 1–6 credits. S-U grades optional.
Hours to be arranged. Staff.
A comprehensive project emphasizing the application of pomological principles and practices to professional pomology teaching, extension, and research programs. Required of Master of Professional Studies (Agriculture) candidates in the field.

601 Graduate Seminar
Fall. 1 credit. S-U grades only.
Hours to be arranged. Staff.
Reports by students on current research or literature in experimental pomology or related areas.

610 Growth and Development of Woody Plants
Spring. 2 credits. Prerequisite: introductory plant physiology. Offered alternate years.
T R 9:05. L. E. Powell.
An advanced course dealing with physiological, morphological, and biochemical changes during development, beginning with the seed and advancing through the mature reproductive plant. Hormonal control mechanisms are emphasized.

620 Developing Effective Horticultural Research Programs
Spring. 2 credits. Undergraduates admitted by permission of instructor. S-U grades optional. Offered alternate years.
Hours to be arranged. A. N. Lakso.
A course emphasizing the development and management of career-long research programs in horticulture for Ph.D. students. Invited faculty and administrators will lead discussions on topics such as grants, funding, and personnel management. Each student will be required to prepare a term paper and make an oral presentation on a grant proposal related to horticulture.

630 Current Topics in Postharvest Horticulture
Fall or spring. 1 credit. Prerequisite: permission of instructor.
Hours to be arranged. G. D. Blanpied.
Graduate students and staff report and discuss current topics in postharvest biology and technology of horticultural crops.

700 Teaching Experience
Fall or spring. 1 credit. S-U grades only. Prerequisite: permission of instructor.
Hours to be arranged. Staff.
Designed to acquaint pomology graduate students with the methods and materials involved in teaching. The student participates in the design, delivery, and evaluation of segments of a departmental course.

800 Master's Thesis Research
Fall or spring. Credit to be arranged. S-U grades only.
Hours to be arranged. Staff.

900 Doctoral Thesis Research
Fall or spring. Credit to be arranged. S-U grades only.
Hours to be arranged. Staff.

Related Courses in Another Department

General Horticulture (Horticultural Sciences 102)

Quality of Horticultural Crops During Marketing (Horticultural Sciences 330)

Advanced Postharvest Physiology of Horticultural Crops (Horticultural Sciences 625)

POULTRY AND AVIAN SCIENCES

R. E. Austic, chair; P. W. Aho, R. C. Baker, S. E. Bloom, G. F. Combs, Jr., R. R. Dietert, P. A. Johnson, I. K. Keshavarz, H. G. Ketola, C. C. McCormick, J. A. Marsh, J. M. Regenstein, G. L. Rumsey, C. S. Winstead

The faculty members in the Department of Poultry and Avian Sciences are responsible for courses taught in several areas, including animal sciences, biological sciences food science, and nutritional sciences. See the particular sections on those subjects for courses.

RURAL SOCIOLOGY

D. L. Poston, chair; D. L. Brown, F. H. Buttel, E. W. Coward, Jr., P. R. Eberts, C. Erickson, S. Feldman, J. D. Francis, C. C. Geisler, D. T. Gurak, M. M. Kritz, T. A. Hirschl, T. A. Lyson, P. McMichael, J. M. Stycos, F. W. Young

Note: Students seeking to fulfill their group C requirements may do so through several courses: Rural Sociology 101, 102, 201, 205, 206 and 208. Rural Sociology 101, Rural Sociology 102, and Sociology 101 have very similar contents.

101 Introduction to Sociology
Fall or spring. 3 credits. (See Sociology 101 as an alternative.) May not be taken after RS 102.
Fall: Lecs, T R 10:10; disc and lab, M 9:05, 10:10, 12:20; R 11:15, 12:20; F 10:10, 12:20. E. C. Erickson and staff.
Spring: Lecs, T R 10:10; disc: M or F 9:05, 10:10, 11:15, 12:20, 1:25, or 2:30. T. A. Lyson.
A survey of major concepts and theories in sociology and an examination of major social forces and institutions shaping modern societies. The major topics include culture and socialization, social stratification and social class, age and gender inequality, economy and society, politics and the state, urbanization and demographic change, social change and international development, the rural-urban transition, and war and peace.

[102 Introduction to Rural Sociology
Spring. 3 credits. May not be taken after RS 101. S-U grades optional. Will not be offered 1989–90.
Lecs, T R 10:10; disc, M or F 9:05, 10:10, 11:15, 12:20, 1:25, or 2:30. T. A. Lyson.
This course provides a general introduction to the field of rural sociology. It is organized as a skills course as well as a survey course. The focus will be on giving students fundamental skills with which to decode the social world, including an understanding of the basic philosophical and theoretical underpinnings of the discipline and an exposure to the various types of data and methods sociologists use to describe and explain behavior. Special attention is paid to the agricultural sector and problems of rural development in the United States.]

103 Introduction to Sociology with Computers
Fall. 3 credits. Prerequisites: none; designed for students with computer interests and for social science majors. May not be taken after RS 101 or RS 102. Not approved for college distribution credit.
T R 11:15; lab T 12:20–1:10. P. Eberts.
Course examines major social institutions and processes and how they affect people as individuals and members of groups and societies. The social factors and institutions emphasized are family and marital conditions, racial stratification, religion, power structures and political participation, age and life course, sexual identity, bureaucracies and organizational affiliations, and social class and mobility. Weekly discussion and laboratory sessions provide students with computing skills for analyzing the influences of these factors on individuals and societies.

104 Proseminar: Issues and Problems in Rural Society
Fall. 1 credit. S-U grades only.
R 12:20–1:25. Staff.
Introduces students to subject matter of concern to both applied and academic rural sociologists. Focuses on such subjects as migrant workers, agribusiness, rural poverty, rural-to-urban migration, rural development, agricultural research and people, community development, and small farmers in the less-developed nations. These topics are explored through the use of films and group discussion.

175 Issues in Contemporary American Indian Societies
Spring. 3 credits. S-U grades optional.
W 7 p.m. R. Venables.
American Indian people are confronted with a myriad of special circumstances that impinge upon their everyday lives. The purpose of this course is to present background to these issues and give perspective from an American Indian point of view. Early history and the postcontact period will be reviewed with an emphasis given to developments since 1890. Topics such as land claims, treaties, education, mineral and water rights, social problems, militant organizations, and civil rights will be covered, with guest lecturers and media presentations giving added impact.

201 Population Dynamics (also Sociology 205)
Spring. 3 credits. S-U grades optional. ALS students must register for this course as Rural Sociology 201.
T R 1:25–2:40. J. M. Stycos.
An introduction to population studies, which include the determinants and consequences of population change. The primary focus is on the influences of demographic dynamics on society and the economy, with emphasis on marriage, family formation, mortality, crime and deviance, migration, and marketing behavior.

205 Rural Sociology and International Development
Spring. 3 credits.
M W F 10:10. P. McMichael.
This course is concerned with global food security issues. While our primary focus is on the varying capacities for food production and supply in Third World regions, we shall be taking into consideration the role of metropolitan agencies and the changing role of the U.S. as the world's "breadbasket." We consider food systems comparatively, in terms of differences among world regions and between peasant agricultures and modern "industrial" agricultures. We examine the nature of peasant society and consider how traditional rural systems have responded to their exposure to international forces—such as the expansion of export agriculture, development agencies, local bureaucracies, the current "debt crisis," and technologies such as the Green Revolution. The focus will be on the changing social organization of food systems, and the implications for food security.

206 Gender and Society
Fall. 3 credits.
M W F 10:10. B. Miller.
Course will familiarize students with social and behavioral similarities/differences between females and males and the degree that biological, psychoanalytic, social psychological, and sociological perspectives help understand the differences. Objectives will be met through lectures, readings, films, participant observations, and personal experiences. Special attention given to gender role behavior in the U.S. and China.

[208 Technology and Society
Fall. 3 credits. Not offered 1989–90.
M W F 10:10. C. G. Geisler.
The relationship between technology and society is among the most pervasive concerns of our time. Ultimately, what makes a technology useful or "appropriate" is a sociological question. Lectures and readings review classical debates regarding technology and society. Herein, students compare high technologies and appropriate technologies, identify problems associated with technology transfer to other societies, and create a list of important criteria by which technologies are judged appropriate or inappropriate using numerous case studies.]

[213 Social Indicators and Data Management
Spring. 3 credits. Not offered 1989–90.
M W F 11:15. F. W. Young.
A survey of definitions and measures of "social indicators." General principles of social-indicator research will be illustrated from data on both developed and less-developed countries in the areas of poverty and level of living, physical quality of life, inequality, and environmental problems. The course will examine measures based on census data, informant surveys, and household surveys, with an emphasis on simple and low-cost techniques. One-third of the course will be devoted to data management, using SPSS and microcomputers.]

[242 American Indian Philosophies I: Power and World Views
Fall. 3 credits. Enrollment limited to 20 students. Not offered 1989–90.
T R 10:10–11:25. Staff.
This course is designed to facilitate an understanding of the world views of American Indians of the past and present. The goal is to provoke edifying discourse that will enable American Indian beliefs concerning the workings of the universe and the relationship of human beings to nature to be understood on their own terms.]

[243 American Indian Philosophies II: Native Voices
Spring. 3 credits. Enrollment limited to 20 students. Not offered 1989–90.
T R 10:10–11:25. Staff.
An exploration of the diverse expressions of philosophy to be found in the words of American Indians. Novels, political treatises, speeches, autobiographies, and other sources reflecting Indian attitudes on a variety of subjects will be examined for beauty and power of expression as well as to identify recurring themes.]

250 Farming as an Occupation
Spring. 1 credit.
R 12:20–1:25. E. C. Erickson.
The occupation of farming will be examined through such topics as how farm and family tasks are coordinated, the most important decisions in farming, how a woman gets established in farming, what determines what can be done in a farm operation, how farm people retire, what constitutes success in farming, and how farming differs from other occupations.

301 Theories of Society (also Sociology 401)
Fall. 4 credits. Prerequisites: Rural Sociology 101 and 102, or Sociology 101. S-U grades optional.
T R 3:35–5:20. P. R. Eberts.
A seminar for juniors, seniors, and beginning graduate students, especially in rural sociology and sociology. A survey of major theoretical approaches to the study of society and social institutions, with emphasis on (1) the central concepts of the sociological tradition, (2) major classical theorists (Marx, Durkheim, Weber) and contemporary counterparts, and (3) application of the classical ideas in contemporary research. Applications of theories of society to current research and social problems will be stressed.

[302 Population Problems
Spring. 3 credits. Not offered 1989–90.
T R 10:35–12:10. Staff.
The practical and scientific significance of population growth and composition. Fertility, migration, and mortality in relation to social and cultural factors and in relation to questions of population policy. National and international data receive equal emphasis.]

324 Environment and Society
Fall. 3 credits.
M W F 1:25. F. H. Buttel.
An exploration of various sociological approaches to the study of society and its physical environment and an analysis of major issues relating to the interaction of societies and their resource bases—particularly overpopulation, the energy and food crises, the limits-to-growth debate, the conduct of political struggles over energy and environmental policy, and the impacts of technological and social change in agriculture on environmental quality.

[367 American Indian Tribal Governments
Fall. 3 credits. Not offered 1989–90.
W 7:30–9:55 p. m. Staff.
This course focuses on the structure of contemporary tribal governments and the ways in which those governments approach the issues confronting their constituents. The effects of European contact on traditional political organizations are detailed, as are the present-day relationships of tribal governments to federal and state governments.]

[370 Social Structure of Industrial Change
Fall. 3 credits. Not offered 1989–90.
M W F 11:15. T. A. Lyson.
The course is organized around four substantive themes. First, it begins with an examination of the social and economic structures of preindustrial, industrial, and postindustrial societies. The second part of the course looks at the linkages between industries and occupations. The third part of the course deals with patterns of regional industrial development and change in the United States. The fourth segment of the course introduces the student to a range of topics that are currently in vogue among researchers and policy makers in this area.]

380 Independent Honors Research in Social Science
Fall and spring. 1–6 credits. Limited to students who have met the requirements for the honors program. A maximum of 6 credits may be earned in the honors program.
Staff.
Students must submit written proposals by the third week of the semester of their senior year to the departmental honors committee representative, T. Hirschl.

[405 Agriculture, Society, and Biotechnology (also Biology and Society 408)
Spring. 3 credits. Prerequisites: two courses in the social sciences and three courses in the biological or agricultural sciences. Not offered 1989–90.
W 1:25–4:25. F. H. Buttel.
An examination of socioeconomic aspects of biotechnology in the context of historical patterns of technological change in agriculture in developed and developing countries. The major topics covered include the social organization of biotechnology research, industry-university relationships, and the potential socioeconomic impacts of biotechnology on agriculture.]

408 Human Fertility in Developing Nations
Fall. 3–4 credits. S-U grades optional.
R 3–5. J. M. Stycos.
A review of the major literature dealing with the social causation of variation in human fertility. Emphasis will be on international comparisons and on the methodology of field research.

[418 Population Policy
Fall. 3 credits. Not offered 1989–90.
R 1:25–4:25. J. M. Stycos.
The ways in which societies try to affect demographic trends. Special focus is on government policies and programs to reduce fertility.]

[425 Gender Relations and Social Change
Fall. 3 credits. Not offered 1989–90.
T R 1:25–3. S. Feldman.
A comparative analysis of women's contribution to domestic/household and agricultural labor as productive practices change. The course emphasizes the configuration of various economic and social sectors and their realignments within and between countries. Changes occur in response to technology transfer, the transformation of the labor market, the international division of labor, and changing family relations.]

430 Migration and Population Distribution
Fall. 3 credits.
T R 8–9:55. D. L. Brown.
This course analyzes the determinants and consequences of internal migration in urban and rural areas of the United States and other industrial nations. Economic and demographic inter-relationships will be emphasized as will implications of changes in population size and composition for labor supply, the demand for goods and services, and infrastructure. Public policy implications of the interrelationships will be investigated.

[436 Small Towns in Metropolitan Society: Changing Structures and Quality of Life
Spring. 2 or 3 credits. S-U grades optional. Prerequisite: a social science course. Not offered 1989–90.
T 3:35–5:20. P. R. Eberts.
Examination of recent social dynamics in small towns, including experiences of resurgence in attractiveness and a simultaneous transformation in small town character and quality of life. Analysis of data on personal computers is combined with theoretical explanations in exploring trends. Key analyses focus on causes and effects of new industrial and communication technologies, population migration, business locations, housing, family stresses, human service networks, educational attainment, local politics, and personal well-being, happiness, and satisfaction.]

438 Social Demography
Fall. 3 credits.
T R 11:15–12:30. D. T. Gurak.
A survey of the methods, theories, and problems of contemporary demography. Special attention is directed to the social determinants and consequences of fertility, mortality, and migration. The populations of both developed and developing areas are examined.

[439 Social and Demographic Changes in Southeast Asia
Spring. 3 credits. Prerequisite: Rural Sociology 201. Not offered 1989–90.
W 1:25–4:25. D. Poston.
The course will be devoted to demographic and social change in Asia, with special attention to China (PRC & ROC), India, Korea, and Thailand. The course will survey population trends, including fertility, mortality, marriage, migration, and urbanization in Asia, with special attention directed to the above four countries. Demographic and sociological theories and methods will be introduced to understand contemporary studies of demographic change in these four countries in particular and in Asia in general. A basic course in statistics is recommended.]

[440 The Social Impact of Rapid Resource Development
Spring. 3 credits. Not offered 1989–90.
T R 12:20–1:35. C. Geisler.
The seminar defines social-impact assessment (SIA), places it in the context of contemporary theories of development, and identifies alternative SIA models. Focus is on the SIA experiences of various groups and constituencies, including indigenous people at home and abroad. Students will learn certain practical research skills needed in doing SIA and will participate in an SIA simulation exercise.]

442 American Indian Philosophies: Selected Topics
Spring. 3 credits. S-U grades optional. Prerequisite: Rural Sociology or Anthropology 242 or 243, or Rural Sociology 175, or ALS 100, or permission of instructor.
Lec. T 1:25–4:25. R. Venables.
The course provides an opportunity for students to pursue topics of interest from American Indian Philosophies I and II or other introductory American Indian studies courses in greater depth. The specific topics to be investigated will be selected by the students in consultation with the instructor prior to the beginning of the semester.

445 Rural Social Stratification
Spring. 3 credits. Letter grades only.
T R 10:10–11:40. S. Feldman.
This course reviews the classical and contemporary theoretical debates in the areas of peasant studies and social stratification. Comparisons are drawn between agriculturally dominant and advanced industrial societies. Also examined are the social organization of agricultural enterprises; the relationship among market and nonmarket, and agricultural and nonagricultural activities; and the proletarianization debate.

475 Global Patterns of International Migration
Spring. 3 credits. Prerequisite: RS 101 or RS 102 or RS 103.
M W F 9:05–9:55. M. Kritz.
A comparative approach will be taken in looking at international migration patterns in different countries and regions, assessing how migration flows are changing in an increasingly interdependent world. Various types of international migration (e.g. permanent, refugee, labor, illegal, brain drain, etc.) will be looked at from the perspective of both the receiving and sending countries and their policy, economic, and social correlates reviewed.

[481 Techniques of Demographic Analysis
Spring. 3 credits. Not offered 1989–90.
M W F 11:15. Staff.
A description of the nature of demographic data and the specific techniques used in their analysis. Mortality, fertility, migration, and population projection are covered, as well as applications of demographic techniques to other types of data.]

[490 Mortality and Morbidity
Spring. 3 credits. Prerequisite: introductory sociology course or permission of instructor. Not offered 1989–90.
M W F 11:15. D. Gurak.
Course surveys existing theories, methodological techniques, and research results relating to how social, economic, and cultural structures and processes affect survival chances in diverse societies. A comparative framework is presented and the utility of existing knowledge for policy-related applications in different societies is assessed. Attention is given to the problems associated with imputing causality in morbidity and mortality data.]

492 Contemporary Issues Seminars: Developments in the Pacific Rim
Fall. 1–2 credits.
T 2:30–3:30. P. McMichael.
Pacific Rim dynamics challenge U.S. supremacy, Western conceptions of modernization, and "Third World" unity. We relate these trends to regional political, economic, and cultural forces, including the Japanese model, the "Newly Industrializing Countries" (e.g., South Korea, Taiwan), the "third tier" countries (e.g., Indonesia, the Philippines), and emerging Chinese markets.

492 Contemporary Issues Seminars: Integrating Sociological and Biological Approaches to Natural Resource Management
Fall. 2 credits.
Hours to be arranged. C. Geisler and T. Gavin.
Conservation biology is a rapidly spreading subfield of biology actively engaging professionals from the biological sciences in the conservation of endangered species and their habitats. This course examines such conservation from both biological and sociological perspectives in the belief that both are essential to successful conservation biology. Students will become sophisticated in social, cultural, and institutional factors which are integral though rarely explored dimensions of species and habitat protection policies.

497 Informal Study
Fall or spring. 3 credits (may be repeated for credit). Undergraduates must attach to their course enrollment materials written permission from the faculty member who will supervise the work and assign the grade. S-U grades optional.
Staff.
Informal study may include a reading course, research experience, or public service experience.

[603 Classical Sociological Theory
Fall. 4 credits. S-U grades optional. Prerequisites: open to graduate students and undergraduates with permission of instructor. Not offered 1989–90.
T R 3:35–5:30. F. Buttel.
An overview of the main streams of classical sociological thought, focusing on the work of Marx, Durkheim, and Weber. Emphasis is placed on the concepts, method, and ontological posture of the three major classical sociological theorists, on rival interpretations of their theoretical systems within the contemporary sociological community, and on the implications of classical thought for contemporary development theories.]

606 Contemporary Sociological Theories of Development
Fall. 3 credits.
M W F 11:15. F. W. Young.
A survey of theory, empirical studies, and policy prescriptions as applied to communities and regions, especially those in less-developed countries. Social ecology, the Weberian tradition, dependency/political economy, and structural theory are compared.

[618 Research Design
Fall. 4 credits. Prerequisite: a statistics course. Not offered 1989–90.
T R 1:25–3:30. J. D. Francis.
First of a two-semester sequence (may be taken individually) in introductory graduate methods. Discusses problems of measurement, the design of instruments, and problems of reliability and validity. Common forms of measuring instruments are discussed. Concludes with an introduction to factor analysis. Students apply principles to development of several common types of scales. Computers will be used extensively.]

[619 Research Design II
Spring. 4 credits. Prerequisite: an introductory methods course and a statistics course. Not offered 1989–90.
T R 1:25–3:30. J. D. Francis.
The second part of the two-semester sequence in introductory graduate methods deals with principles of design, especially nonexperimental designs, with emphasis on an intermediate-level treatment of the following topics: regression, analysis of variance, analysis of covariance, and causal models. Special emphasis is given to use of categorical variables in regression. Students develop and examine several analytical models using actual data to familiarize themselves with data handling and processing. Extensive use of computers.]

640 Community and Changing Property Institutions
Fall. 3 credits.
W 7:30–10:30. C. C. Geisler.
The seminar acquaints students with the evolution of property rights, beginning in antiquity, and with the close association between changing property forms and community types as recognized by both classical and contemporary sociologists. Readings will cover land-use regulation and property rights, common property issues and the land ethic.

641 Politics and Economics of Rural and Regional Development
Fall. 3 credits. Limited to upperclass or graduate students. S-U grades optional.
M 12:20–2:50. T. A. Lyson.
A survey of social, political, and economic factors in regional development. Theories and case studies from demography, human ecology, social organization, and planning are used to examine the emergence or retardation of regions and their implications for contemporary developing and developed societies.

[642 Regional Systems and Policy Analysis
Spring. 3 credits. Prerequisites: a social or economic theory course and statistics, or permission of instructor. S-U grades optional. Not offered 1989–90.
Lec, F 2:20–4:30; disc to be arranged.
P. R. Eberts.
A systems analysis of theoretical and research problems arising from localities' changing social organization. Major theories are examined with attention to their compatibility with modern policy analytic techniques. Topics covered center on the interplay of economic, social-class, and political activities in localities.]

643 Land Reform Old and New
Spring. 3 credits.
R 2:30–5. C. C. Geisler.
Land reform continues to be a major cornerstone of development planning. Between 1980 and 2000 the number of landless and near-landless in the Third World will approach one billion. Though land reform is a principal source of hope for the landless, its meanings are many and its models are controversial. The seminar acquaints students with land reform in antiquity as well as in contemporary settings (e.g., Japan, the Philippines, Israel, India, Brazil, Mexico, the Soviet Union, and the United States). Perennial issues of equity, efficiency, and sustainability will be discussed in each of these case study areas.

645 Rural Social Stratification
Spring. 3 credits.
T R 10:10–11:40. S. Feldman.
This advanced seminar examines theories of rural stratification in agricultural and advanced industrial societies, highlighting the classical and contemporary debates surrounding the relationships between agricultural and industrial productive relations. Theories of agrarian change are also examined, and discussion will draw on the role of state policy and practice in shaping agrarian relations.

[650 Social Organization of Agriculture
Fall. 3 credits. Not offered 1989–90.
W 1:25–4:25. Staff.
Concentrates on a small number of significant commercial crops, examining the institutions and relationships involved in the production process: research, credit, distribution of inputs, the farm operation, processing, transportation, and marketing. Patterns at the farm and community level, including topics such as settlement, land tenure, ethnic groups, class structures, methods of cooperation, small farmers, labor problems, and information networks. Ecological and physical constraints on production. Emphasis on the influence of national and international structures—political, social, and economic—on the production process, including the role of government and quasi-government units. Examines the historical circumstances giving rise to the present crop systems. Consideration of what rearrangement of the political, social, and economic structures, both domestic and international, are required for change in crop systems, improvement in production, and increased social welfare.]

651 Sociology of Agriculture
Fall. 3 credits. Prerequisite: graduate standing.
M 7:30–10:30 p.m. F. Buttel.
An analysis of the structural transformations of agriculture in advanced industrial countries during the nineteenth and twentieth centuries, particularly in terms of the role of the state and technical change in agricultural development. This course emphasizes the historical roots of the socioeconomic problems of contemporary agriculture and examines the prospects for, and limitations of, various strategies for ameliorating those problems.

655 Advanced Techniques of Demographic Analysis
Spring. 3 credits. Prerequisites: RS 481 or CEH 438, graduate standing or permission of instructor.
T R 11:15–12:30. D. T. Gurak.
An examination of analytical techniques that assumes a basic knowledge of demographic data and research methodology. Life tables, demographic estimates with incomplete data, survey techniques to supplement inadequate vital registration systems, and multivariate procedures are among the topics to be covered.

675 The Political Economy of Policy and Planning in Third World States
Fall. 3 credits.
T R 10:10–11:25. S. Feldman.
This course examines the structure and formation of national development priorities in Third World countries in the context of the internationalization and politicization of policy and planning agendas. The course draws on themes in development theory and theories of the state and social organization and is comparative in focus. Major topics considered are the role of international financial institutions and multinational corporations in shaping national policy, national fiscal and administrative crises, forms of colonial and authoritarian regimes, and the state-class relation in shaping policy and planning outcomes.

690 Human Ecological Theory
Spring. 3 credits. Prerequisite: graduate standing or permission of instructor.
W 1:25–3:55. D. L. Poston.
This course presents and reviews the theoretical perspective and tradition of human ecology in sociology, beginning with Durkheim, through the Chicago school (McKenzie, Park and Burgess), to the neo-orthodox positions of Hawley, Duncan, Schnore, Gibbs, Martin, and others. Similarities and differences between the ecological paradigm and Marxian theory are presented. Sociological and demographic research incorporating ecological theory is analyzed and reviewed. Employment of ecological approaches in other disciplines (principally anthropology and geography) is discussed. Application of the ecological orientation to social and economic development is presented.

706 State, Economy, and Society
Fall. 3 credits. Recommended: one graduate-level course in classical sociological theory.
W 1:25–4:25. P. McMichael.
Reviews major issues concerning the relations between political and economic institutions, including the political-economic methodologies of the classical sociological theorists, the instrumentalist-structuralist debate on the nature of the state, theories of crisis in advanced capitalism, and the controversies among theorists of unequal exchange, dependency, and imperialism in the world system.

[715 Design and Data Analysis in Development Research
Spring. 3 credits. Prerequisites: previous course work in scaling and statistics. Not offered 1989–90.
T R 1:25–3:30. F. W. Young.
This seminar/practicum focuses on the research sequence that leads to defensible conclusions. Topics include a review of classical research design and alternatives to it, the varieties of data for development research, measurement, controls, interactions and contexts, and organizing the argument. Illustrations and exercises will cover a range of data types and problems: subnational comparisons, informant surveys of rural communities, and household surveys of nutrition. The term paper is a research proposal.]

718 Multidimensional Measurement and Classification
Fall. 4 credits. Prerequisite: previous course work in scaling and statistics.,
T R 1:25–3:30. J. D. Francis.
An advanced course in measurement and scaling, building from work by Thurstone, Guttman, and Coombs to multidimensional measurements. Topics include philosophy of factor analysis, factor analytic models, factoring design, and comparison with factor analytic models. Cluster analysis, multidimensional scaling, and discriminate analyses are the other major topics discussed. As matrix algebra is an integral part of these procedures, class time is devoted to that topic. Computers are used to analyze fit to models.

719 Regression and Path Analysis
Spring. 4 credits. Prerequisites: two courses in statistics and one in methods.
T R 1:25–3:30. J. D. Francis.
The first part of the course reviews multiple regression theory and procedures, after which extensions of those models to categorical data are discussed. Consideration is given to violations of assumptions and their effects. Then more-advanced regression concepts and estimation techniques are discussed. The middle third of the course deals with logit, probit, and log linear models. The last part deals with recursive and nonrecursive path models. Time-series analysis is the last topic discussed. Computerized laboratories are an integral part of the course.

[721 Ecological Perspectives on Social Change
Spring. 3 credits. Not offered 1989–90.
Hours to be arranged. E. W. Coward, Jr.
Reviews major theoretical traditions in the analysis of societal-environmental relationships and applies these perspectives to public policy and development problems. The theoretical perspectives explored are drawn from human ecology, ecological anthropology, and environmental sociology. Policy issues from developed and developing country settings are examined using ecological perspectives.]

[723 Social Movements in Agrarian Society
Spring. 3 credits. Not offered 1989–90.
W 1:25–4. F. W. Young.
The seminar moves from a critical review of current explanatory formats (resource-mobilization, political economy, structuralist) to a research practicum focused on ethnoregional movements, illustrating the possibilities of comparative research based on descriptive accounts. Those movements are associated with agricultural and industrial change, as well as shifts in the regional ethnic/class system.]

[730 Issues in the Sociology of Development
Fall. 3 credits. S-U grades optional. Prerequisite: one graduate course in sociological theory. Offered alternate years. Not offered 1989–90.
W 1:25–4:25. P. McMichael.
This seminar examines emerging substantive issues in the sociology of development. The goal is twofold: (1) to analyze contemporary Third World trends (e.g., in development policy, agrarian reform, industrialization, state-building, food security), and world systemic trends influencing Third World development possibilities; and (2) to re-evaluate development theories in the light of current transformations.]

[741 Community Development and Local Control
Spring. 3 credits. Not offered 1989–90.
W 1:30–4:30. C. C. Geisler.
Theories of community growth and decline and the current debate over the place of local control in community development in general are considered. Salient themes include the role of neopopulism in community development, changing institutions of property as community development occurs, and changing definitions of *community*.]

[751 Applications of Sociology to Development Programs
Fall. 3 credits. Not offered 1989–90.
R 1:25–4:25. E. C. Erickson.
A consideration of problems of implementing change strategies at national, regional, and institutional levels, especially as they relate to rural development. Focus is also on institutional constraints on the sociologist as a researcher, as a strategist, and as a participant and on the different contexts within which developmental change occurs.]

754 Sociotechnical Aspects of Irrigation (also Agricultural Economics 754 and Agricultural and Biological Engineering 754)
Spring. 3 credits. S-U grades optional.
Hours to be arranged. R. Barker, N. T. Uphoff, M. Walter.
Examines irrigated agriculture and its relation to agricultural development. Emphasis on social processes within irrigation systems and interactions with the social setting. The seminar provides an opportunity to examine systematically the institutional and organizational policy issues associated with the design and operation of systems of irrigated agriculture.

771 Special Seminar
Fall or spring. Credit to be arranged. Limited to graduate students; others by permission of instructor.

791 Teaching Experience
Fall or spring. 1–3 credits. Limited to graduate students. S-U grades only.
Staff.
Participation in the ongoing teaching program of the department.

792 Public Service Experience
Fall or spring. Credit to be arranged. Limited to graduate students. S-U grades optional.
Staff.
Participation in the ongoing public service activities of the department.

871–874 Informal Study
Fall or spring. Credit to be arranged. Limited to master's and doctoral degree candidates with permission of the graduate field member concerned. S-U grades optional.

871 Rural Sociology

872 Development Sociology

873 Organization Behavior and Social Action

874 Methods of Sociological Research

881 Research
Fall or spring. Credit to be arranged. Limited to master's and doctoral degree candidates with permission of the graduate field member concerned. S-U grades optional.

STATISTICS AND BIOMETRY

C. E. McCulloch, chair; N. S. Altman, G. C. Casella, C. Castillo-Chavez, S. J. Schwager, S. R. Searle

Courses in statistics and biometry are offered by the Department of Plant Breeding and Biometry.

200 Statistics and the World We Live In
Spring. 3 credits.
Lecs, T R 10:10–11:25; disc, T 1:25 or 2:30, or W 1:25 or 2:30, or R 9:05. Staff.
Major concepts and approaches of statistics are presented at an introductory level. Three broad areas are covered: collecting data, organizing data, and drawing conclusions from data. Topics include sampling, statistical experimentation and design, measurement, tables, graphs, measures of center and spread, probability, the normal curve, confidence intervals, and statistical tests.

215 Introduction to Statistical Methods
Fall. 3 credits. Prerequisite: Statistics 200 is recommended for students with no prior experience in data collection and interpretation.
Lecs, M W F 11:15; lab, 1 hr. to be arranged. Staff.
Statistical methods are developed and used to analyze data arising from the biological sciences. Topics include elementary statistical graphics, point and confidence interval estimation, hypothesis testing, t-tests, correlation, simple linear regression, and possibly analysis of variance and multiple regression. Statistical computing is taught and used throughout the course. Emphasis is on proper use of statistical methodology and interpretation of statistical analyses.

408 Theory of Probability
Fall. 4 credits. Prerequisite: Mathematics 112, 122, or 192, or permission of instructor.
Lecs, M W F 10:10; disc, M 3:35–5. Staff.
An introduction to probability theory: foundations, combinatorics, random variables and their probability distributions, expectations, generating functions, and limit theory. Biological and statistical applications are the focus. Can serve as either a one-semester introduction to probability or a foundation for a course in the theory of statistics.

409 Theory of Statistics
Spring. 4 credits. Prerequisite: Statistics 408 or equivalent.
Lecs, M W F 10:10; disc, M 3:35–5. Staff.
The concepts developed in Statistics 408 are applied to provide an introduction to the classical theory of parametric statistical inference. Topics include sampling distributions, parameter estimation, hypothesis testing, and linear regression. Students seeking applied courses in statistical methodology should consider Statistics 601–602.

417 Matrix Algebra
Fall. 3 credits. Prerequisite: precalculus mathematics.
Lecs, M W F 8; disc, M 1:25–3:10.
C. Cavillo-Chavez.
Definitions, basic operations and arithmetic, determinants, and the inverse matrix. Rank, linear dependence, canonical forms, linear equations, generalized inverses and eigenroots and vectors. Emphasis is on understanding basic ideas and on developing skills for applying matrix algebra.

495 Statistical Consulting
Fall. 2 credits. S-U grades only. Limited to undergraduates. Prerequisites: Statistics 409 and 602 and permission of instructor.
Lec, W 1:25–2:15 plus 1 hr. of consulting to be arranged. N. S. Altman.
Participation in the Biometrics Unit consulting service: faculty-supervised statistical consulting with researchers from other disciplines. Discussion sessions for joint consideration of selected consultations encountered during previous weeks.

497 Special Topics
Fall or spring. 1–3 credits. S-U grades optional.
Staff.
Can consist of individual tutorial study or a course of lectures (or both) selected by the faculty. Since topics may change from year to year, this course may be repeated for credit.

498 Supervised Teaching
Fall or spring. 2 credits. S-U grades only. Limited to statistics and biometry undergraduates.
Staff.
Students assist in teaching a course appropriate to their previous training. Students will meet with a discussion or laboratory section and regularly discuss objectives with the course instructor.

499 Undergraduate Research
Fall or spring. 1–3 credits. Limited to statistics and biometry undergraduates. Prerequisite: permission of faculty member directing research
Staff.

600 Statistics Seminar
Fall or spring. 1 credit. S-U grades only.
W 3–4:30. Staff.

601 Statistical Methods I
Fall. 4 credits. Limited to graduate students; others by permission of the instructor.
Lecs, M W F 12:20; lab, M 2:30–4, 7:30–9 p.m., or T 10:10–11:40, 12:20–1:50, 2:30–4. G. C. Casella.
Statistical methods are developed and used to analyze data arising from a wide variety of applications. Topics include descriptive statistics, point and interval estimation, hypothesis testing, inference for a single population, comparisons between two populations, one- and two-way analysis of variance, comparisons among population means, analysis of categorical data, and correlation and regression analysis. Interactive computing is introduced through MINITAB statistical software. Emphasis is on basic principles and criteria for selection of statistical techniques.

602 Statistical Methods II
Spring. 4 credits. Limited to graduate students; others by permission of instructor. Prerequisite: Statistics 601 or equivalent.
Lecs, M W F 11:15; lab, M 2:30–4:25 or 7:30–9:25 p.m., and T 10:10–12:05 or 12:20–2:15. N. S. Altman.
A continuation of Statistics 601. Emphasis is on the use of multiple regression analysis, analysis of variance, and related techniques to analyze data in a variety of situations. Topics include an introduction to data collection techniques; least squares estimation; multiple regression; model selection techniques; detection of influential points, goodness-of-fit criteria; principles of experimental design; analysis of variance for a number of designs, including multi-way factorial, nested, and split plot designs; comparing two or more regression lines; and analysis of covariance. Emphasis is on appropriate design of studies prior to data collection, and the appropriate application and interpretation of statistical techniques. For practical applications, computing is done with the SAS statistical package.

[603 Statistical Methods III
Fall. 3 credits. Prerequisite: Statistics 601 and 602 or permission of instructor. Offered if a sufficient number of students are interested. Offered alternate years. Not offered 1989–90. Principles of scientific experimentation, experiment design, sample surveys and questionnaire design, statistical aspects of survival analysis, life tables, statistical analyses for clinical trials; categorical data analysis, including logistic regression, loglinear models, combining contingency tables, and application to case control studies; multivariate analysis; and space-time clustering.]

604 Statistical Methods IV: Applied Design
3 credits. Prerequisites: Statistics and Biometry 601 and 602 or permission of instructor.
Lecs M W F 9:05; lab M 2:30–3:20.
G. C. Casella.
Applications of experimental design including such advanced designs as split plots, incomplete blocks, fractional factorials. Use of the computer for both design and analysis will be stressed, with emphasis on solutions of real data problems.

605 Applied Regression Analysis
Fall, 1/3 of the term. 1 credit. Prerequisites: Statistics 409 and 602. Offered alternate years.
N. S. Altman.
A continuation of Statistics 602, with emphasis on data analysis including logistic and nonlinear regression.

[606 Sampling Biological Populations
Fall. 1/3 of the term. 1 credit. Prerequisite: Statistics 601 or equivalent. Not offered 1989–90.
Standard methods of sample-survey design and estimation are presented, including stratified random sampling, cluster sampling, double sampling, and variable probability sampling. Special emphasis given to methods of particular utility or specifically designed for biological sampling. Examples are taken from forestry, fisheries, and other biological areas.]

607 Nonparametric and Distribution-Free Statistical Methods
Spring, 1/3 of the term. 1 credit. S-U grades optional. Prerequisite: Statistics 601 or equivalent.
Staff.
Nonparametric and distribution-free alternatives to normal-theory testing procedures are presented: sign or rank tests for one or two populations; analyses for completely randomized and randomized blocks designs; comparisons among several means; correlation and regression; goodness-of-fit; and tests based on randomization of the data.

639 Epidemiology Seminar (also Nutritional Sciences 639)
Fall and spring. 1 credit. S-U grades only. Limited to graduate students; others by permission of instructor
M 12:20. Staff.
This course will develop skills in the preparation and interpretation of epidemiological data by discussing current research topics and issues.

[662 Mathematical Ecology (also Biological Sciences 662)
Spring. 3 credits. Prerequisites: a year of calculus and a course in probability. Offered alternate years. Not offered 1989–90.
Lecs, M W F 12:20. C. Castillo-Chavez.
Mathematical and statistical analysis of populations and communities: theory and methods. Spatial and temporal pattern analysis, deterministic and stochastic models of population dynamics. Model formulation, parameter estimation, and simulation and analytical techniques.]

697 Special Topics in Statistics and Biometry
Fall, spring, or summer. 1–3 credits. S-U grades optional.
Staff.
Can consist of individual tutorial study or a course of lectures (or both) selected by the faculty. Since topics may change from year to year, this course may be repeated for credit.

[701 Advanced Biometry
Spring. 3 credits. Prerequisites: Statistics 409 and 602. Limited to graduate students; others by permission of instructor. Not offered 1989–90.
Bioassay methods, including parametric and nonparametric statistical analyses of quantal and graded response to controlled levels of single and multifactor stimuli; directional statistics as applied to animal orientation experiments; compartment models and analyses; enzyme kinetics and pharmacokinetic analysis; and bioavailability.]

[717 Linear Models
Spring. 3 credits. S-U grades only. Prerequisites: Statistics 409 or equivalent and Statistics 417 and 602. Offered alternate years. Not offered 1989–90.
Analysis of variance and estimation procedures for unequal-subclass-numbers data. Cell means models for the 1-way classification, nested classifications, and the 2-way crossed classification, both with and without interactions; introduction to multinormal variables and the distribution of quadratic forms. The general linear model (in matrix and vector form), estimable functions, and testable hypotheses. Overparameterized models, restricted models, multifactor cases, covariables, computing.]

[718 Variance Components
Spring. 2 credits. S-U grades only. Prerequisite: Statistics 717. Offered alternate years. Not offered 1989–90.
Several methods of estimating variance components are explained and compared: for balanced data (equal subclass numbers), the analysis of variance method; for unbalanced data (unequal subclass numbers), the three Henderson methods and the methods of maximum likelihood, restricted maximum likelihood, and minimum norm quadratic unbiasedness. Also included: estimation from mixed models, prediction of random variables, the dispersion-mean model, and computer package output for variance component estimation.]

795 Statistical Consulting
Fall. 2 credits. S-U grades only. Limited to graduate students.
Lec, W 1:25 and 1 hr. of consulting to be arranged. Staff.
Participation in the Biometrics Unit consulting service: faculty-supervised statistical consulting with researchers from other disciplines. Discussion sessions for joint consideration of selected consultations encountered by the service during previous weeks. Since consultations usually change from semester to semester, this course may be repeated for credit.

899 Research
Fall or spring. Credit to be arranged. S-U grades only. Limited to candidates for graduate degrees. Prerequisite: permission of the graduate field member concerned. Research at the M.S. level.

999 Research
Fall or spring. Credit to be arranged. S-U grades only. Limited to candidates for graduate degrees. Prerequisite: permission of the graduate field member concerned. Research at the Ph.D. level.

VEGETABLE CROPS: HORTICULTURAL SCIENCES

E. E. Ewing, chair; R. R. Bellinder, L. Ellerbrock, D. Halseth, J. R. Hicks, D. Lisk, P. M. Ludford, P. L. Minotti, M. A. Mutschler, J. Sieczka, L. D. Topoleski, D. H. Wallace, H. C. Wien, D. A. Wilcox-Lee, D. Wolfe

102 General Horticulture
Spring. 4 credits. Each lab limited to 25 students.
Lecs, M W F 10:10; lab, M T W 2–4:25. L. D. Topoleski.
Acquaints the student with applied and basic horticulture. Primarily for students who want a general knowledge of the subject or who want to specialize in horticulture but have a limited background in practical experience or training in plant science. Includes flower, fruit, and vegetable growing and gardening techniques.

220 Vegetable Types and Identification
Fall. 2 credits.
T 2–4:25. L. D. Topoleski.
Acquaints the student with the vegetable species grown in the Northeast and the pests and disorders encountered in their production. Subjects covered include identification of economically destructive weeds, diseases and insects of vegetables, identification of vegetable and weed seeds, seedlings, nutrient deficiencies, vegetable judging, grading, and grade defects.

225 Commercial Vegetable Crops
Fall. 4 credits. Field trip fee, no more than $20.
Lecs, M W F 11:15; lab, W 2–4:25; 1 S field trip and 3 field trips (Sept.), W 11:15–6. L. A. Ellerbrock.
Intended for those interested in the commercial vegetable industry from the viewpoint of production, processing, marketing, or the related service industries. Topics included are techniques, problems, and trends in the culture, harvesting, and storage of the major vegetable crops, including potatoes and dry beans.

315 Postharvest Physiology and Storage of Horticultural Crops
Fall. 3 credits. Prerequisite: a course in floriculture, pomology, or vegetable crops, or permission of instructor.
Lecs, M W 9:05; lab, W 1:30–4. F. W. Liu.
The physiology—transpiration, respiration, ethylene synthesis and action, maturation, ripening, and senescence—of fruits, vegetables, flowers, and ornamental crops are studied. Environmental factors influencing the physiological process, thus affecting the quality and marketability of the products, are considered. The principles and methods of harvesting, cleaning, grading, packing, precooling, waxing, sanitation, and transportation of the products are studied. Storage methods, including common storage, refrigerated storage, controlled-atmosphere storage, and hypobaric storage, are discussed.

325 Practical Aspects of Postharvest Handling of Horticultural Crops
Spring. 3 credits.
Lecs, M W 9:05; lab, T 1:25–3:55.
J. R. Hicks.
A study of changes that occur in horticultural crops between harvest and consumer. Practices that affect the rate of change and the final effect on quality of the commodity are discussed. Maturity/quality indices, preharvest treatments, and harvesting/handling practices and storage/transportation requirements of selected horticultural crops are covered. The effect of marketing orders, marketing chains, market requirements, quarantine, and pest eradication procedures is emphasized.

455 Vegetable Crop Physiology
Fall. 5 credits. Prerequisites: Horticultural Sciences 225 and Biological Sciences 242, or equivalents.
Lecs, M W F 10:10; lab, M 2–4:25; disc, R or F 1, 2, or 3. H. C. Wien, P. L. Minotti.
Subjects include mineral nutrition as influenced by fertilization programs and crop sequence, nutrient interactions and induced deficiencies, growth and development, flowering, fruit setting, growth correlation, senescence, sex expression, photoperiodism, vernalization, and environmental factors affecting growth.

460 Plant-Plant Interactions
Spring. 3 credits. Prerequisite: any crop production course or permission of instructor.
Lecs, M W 8; disc, to be arranged. Each disc section limited to 6 students.
P. L. Minotti.
The manner in which plants interfere or positively interact with other plants is examined with primary emphasis on crop situations rather than natural plant communities. Competitive and chemical interactions are considered between weeds and crops, crops and associate crops, and between individuals in monoculture.

[465 Vegetable Varieties and Their Evaluation
Fall. Weeks 1–7. 2 credits. Prerequisite: Horticultural Sciences 225 or permission of instructor. S-U grades only. Offered alternate years. Not offered 1989–90.
Lecs, W F 8; lab, F 1:25–4:25.
D. W. Wolfe and H. C. Wien.
Principles of vegetable variety evaluation and selection of techniques in relation to program objectives. Morphology, yield, and quality of selected crops will be studied in the field. The seed industry will be briefly discussed.]

495 Undergraduate Seminar
Spring. 1 credit (may be taken twice for credit). Prerequisite: a course in vegetable crops. S-U grades only.
Hours to be arranged. Staff.
Seminar topics and speakers selected and arranged by the students on subject areas related to vegetable crops.

496 Internship in Horticultural Sciences
Fall or spring. Credit variable. S-U grades optional. Prerequisite: permission of student's adviser in advance of participation in internship programs. Students must attach to their course enrollment materials a "CALS Independent Study, Research, or Teaching" form signed by the staff member who will supervise their internship and assign their grade.
Staff.

497 Independent Study in Horticultural Sciences
Fall or spring. Credit variable. S-U grades optional. Prerequisite: permission of instructor(s). Students must attach to their course enrollment materials a "CALS Independent Study, Research, or Teaching" form signed by the staff member who will supervise their research and assign their grade.
Independent study in horticultural sciences under the direction of one or more staff members.

498 Undergraduate Teaching Experience
Fall or spring. Credit variable. S-U grades optional. Prerequisites: previous enrollment in course to be taught or equivalent, and written permission of the instructor. Students must attach to their course enrollment materials a "CALS Independent Study, Research, or Teaching" form signed by the staff member who will supervise their research and assign their grade.
Hours to be arranged.
Designed to give qualified undergraduate students teaching experience through actual involvement in planning and teaching horticultural science courses under supervision of departmental faculty. This experience may include leading discussion sections; preparing, assisting in, or teaching laboratories; and tutoring.

499 Undergraduate Research
Fall or spring. 1 or more credits, by arrangement. Written permission from staff member directing the work must be obtained before course enrollment.
Hours to be arranged. Staff.
Special problems may be elected in any line of vegetable work.

500 Master of Professional Studies (Agriculture) Project
Fall or spring. 1–6 credits. S-U grades optional.
Hours to be arranged. Graduate faculty.
A comprehensive project emphasizing the application of horticultural principles and practices to professional horticultural teaching, extension, and research programs and situations. Required of Master of Professional Studies (Agriculture) candidates in the field.

602 Seminar in Vegetable Crops
Fall or spring. 1 credit. Required of graduate students majoring or minoring in vegetable crops. Limited to graduate students. S-U grades only.
R 4:30. Staff.

615 Quantitative Methods in Horticultural Research
Spring. Weeks 1–9. 2 credits. Prerequisite: Statistics 601. Statistics 602 or permission of instructor. S-U grades only. Offered alternate years.
T R 10:10–12:05. D. W. Wolfe.
Advantages and limitations of conventional experimental designs and analyses of greenhouse and field (including on-farm) experiments. Use and interpretation of plant growth analysis techniques. Discussions will include critical analysis of published data and research in progress.

[625 Advanced Postharvest Physiology of Horticultural Crops
Spring. 3 credits. Prerequisite: Horticultural Sciences 315 (also Agricultural and Biological Engineering 319). Offered alternate years. Not offered 1989–90.
Lecs, T R 10:10. Disc session to be arranged. P. M. Ludford.
Physiological and biochemical aspects of growth and maturation, ripening, and senescence of harvested horticultural plant parts. Topics include morphological and compositional changes during ripening and storage life, some physiological disorders, aspects of hormone action and interactions, and a consideration control.]

629 Special Topics in Plant Science Extension (also Plant Breeding 629)

700 Graduate Teaching Experience
Fall, spring. 1 or more credits by arrangement with instructor.
Hours to be arranged. Staff.
Participation in the teaching program of the department.

800 (801) Thesis Research, Master of Science
Fall or spring. Credit to be arranged. S-U grades only.
Hours to be arranged. Staff.

900 (901) Thesis Research, Doctor of Philosophy
Fall or spring. Credit to be arranged. S-U grades only.
Hours to be arranged. Staff.

FACULTY ROSTER

Abawi, George S., Ph.D., Cornell U. Prof., Plant Pathology (Geneva)
Acree, Terry E., Ph.D., Cornell U. Prof., Food Science, and Technology (Geneva)
Adleman, Marvin I., M. L. A., Harvard U. Prof., Floriculture and Ornamental Horticulture
Agnello, Arthur M., Ph.D., North Carolina State U. Asst. Prof., Entomology (Geneva)
Aist, James R., Ph.D., U. of Wisconsin. Prof., Plant Pathology
Albright, Louis D., Ph.D., Cornell U. Prof., Agricultural and Biological Engineering
Aldwinckle, Herbert S., Ph.D., U. of London (England). Prof., Plant Pathology (Geneva)
Alexander, Martin, Ph.D., U. of Wisconsin. Liberty Hyde Bailey. Professor of Soil Science, Agronomy
Allee, David J., Ph.D., Cornell U. Prof., Agricultural Economics
Altman, Naomi S., Ph.D., Stanford U. Asst. Prof., Plant Breeding and Biometry
Andersen, Robert L., Ph.D., U. of Minnesota. Prof., Horticultural Sciences (Geneva)
Anderson, Bruce L., Ph.D., U. of California at Berkeley. Assoc. Prof., Agricultural Economics
Aneshansley, Daniel J., Ph.D., Cornell U. Assoc. Prof., Agricultural and Biological Engineering
Apgar, Barbara J., Ph.D., Cornell U. Asst. Prof., Animal Science
Aplin, Richard D., Ph.D., Cornell U. Prof., Agricultural Economics
Ameson, Phil A., Ph.D., U. of Wisconsin. Assoc. Prof., Plant Pathology
Austic, Richard E., Ph.D., U. of California at Davis. Prof., Poultry and Avian Sciences
Awa, Njoku E., Ph.D., Cornell U. Assoc. Prof., Communication

Baer, Richard A., Ph.D., Harvard U. Prof., Natural Resources
Bail, Joe P., Ph.D., Michigan State U. Prof., Education
Bandler, David K., M.P.S., Cornell U. Prof., Food Science
Barbano, David M., Ph.D., Cornell U. Assoc. Prof., Food Science
Barker, Randolph, Ph.D., Iowa State U. Prof., Agricultural Economics
Bartsch, James A., Ph.D., Purdue U. Assoc. Prof., Agricultural and Biological Engineering
Bassuk, Nina L. Ph.D., U. of London (England). Assoc. Prof., Floriculture and Ornamental Horticulture
Batt, Carl A., Ph.D., Rutgers U. Asst. Prof., Food Science
Bauman, Dale E., Ph.D., U. of Illinois. Prof., Animal Science
Baveye, Philippe C., Ph.D., U. of California at Riverside. Asst. Prof., Agronomy
Bechinski, Edward J., Ph.D., Iowa State U. Asst. Prof., Entomology
Becker, Robert F., M.S., U. of New Hampshire. Assoc. Prof., Horticultural Sciences (Geneva)
Beer, Steven V., Ph.D., U. of California at Davis. Assoc. Prof., Plant Pathology
Beermann, Donald H., Ph.D., U. of Wisconsin. Assoc. Prof., Animal Science
Bell, Alan W., Ph.D., U. of Glasgow (Scotland). Assoc. Prof., Animal Science
Bellinder, Robin R., Ph.D., Virginia Polytechnic Inst. and State U. Asst. Prof., Vegetable Crops
Bergstrom, Gary C., Ph.D., U. of Kentucky. Assoc. Prof., Plant Pathology
Berkey, Arthur L., Ph.D., Michigan State U. Prof., Education
Bills, Nelson L., Ph.D., Washington State U. Assoc. Prof., Agricultural Economics
Blake, Robert W., Ph.D., North Carolina State U. Assoc. Prof., Animal Science
Blandford, David, Ph.D., Manchester U. (England). Prof., Agricultural Economics
Blanpied, George D., Ph.D., Michigan State U. Prof., Pomology
Bloom, Stephen E., Ph.D., Penn State U. Prof., Poultry and Avian Sciences
Boisvert, Richard N., Ph.D., U. of Minnesota. Prof., Agricultural Economics
Bouldin, David R., Ph.D., Iowa State U. Prof., Agronomy
Bourke, John B., Ph.D., Oregon State U. Prof., Food Science and Technology (Geneva)
Bourne, Malcolm C., Ph.D., U. of California at Davis. Prof., Food Science and Technology (Geneva)
Boyd, R. Dean, Ph.D., U. of Nebraska. Assoc. Prof., Animal Science
Brady, John W., Jr., Ph.D., SUNY at Stonybrook. Assoc. Prof., Food Science
Brake, John R., Ph.D., North Carolina State U. W.I. Myers Professor of Agricultural Finance, Agricultural Economics
Broadway, Roxanne M., Ph.D., U. of California at Davis. Asst. Prof., Entomology (Geneva)
Brown, David L., Ph.D., U. of Wisconsin. Professor, Rural Sociology
Brown, Susan K., Ph.D., U. of California at Davis. Asst. Prof., Horticultural Sciences (Geneva)
Brown, William L., Jr., Ph.D., Harvard U. Prof., Entomology
Bruce, Robert L., Ph.D., Cornell U. Prof., Education
Brumsted, Harlan B., Ph.D., Cornell U. Assoc. Prof., Natural Resources
Bryant, Ray B., Ph.D., Purdue U. Assoc. Prof., Agronomy
Bugliari, Joseph B., L. L. B. Cornell U. Prof., Agricultural Economics
Burr, Thomas J., Ph.D., U. of California at Berkeley. Assoc. Prof., Plant Pathology (Geneva)
Butler, Walter R., Ph.D., Purdue U. Assoc. Prof., Animal Science
Buttel, Frederick H., Ph.D., U. of Wisconsin. Prof., Rural Sociology
Call, David L., Ph.D., Cornell U. Prof., Agricultural Economics
Campbell, Joseph K., M.S., Cornell U. Prof., Agricultural and Biological Engineering
Carlsen, William S., Ph.D., Stanford U. Asst. Prof., Education
Casella, George, Ph.D., Purdue U. Assoc. Prof., Plant Breeding and Biometry
Casler, George L., Ph.D., Purdue U. Prof., Agricultural Economics
Castillo-Chavez, Carlos, Ph.D., U. of Wisconsin. Asst. Prof., Plant Breeding and Biometry
Chapman, Lewis D., Ph.D., U. of California at Berkeley. Prof., Agricultural Economics
Chase, Larry E., Ph.D., Pennsylvania State U. Assoc. Prof., Animal Science
Coffman, William R., Ph.D., Cornell U. Prof., Plant Breeding and Biometry
Colle, Royal D., Ph.D., Cornell U. Prof., Communication
Collmer, Alan R., Ph.D., Cornell U. Assoc. Prof., Plant Pathology
Colucci, Stephen J., Ph.D., SUNY. Asst. Prof., Agronomy
Combs, Gerald F., Jr., Ph.D., Cornell U. Assoc. Prof., Poultry and Avian Sciences
Confrey, Jere, Ph.D., Cornell U. Asst. Prof., Education
Conneman, George J., Ph.D., Pennsylvania State U. Prof., Agricultural Economics
Conrad, Jon M., Ph.D., U. of Wisconsin. Prof., Agricultural Economics
Cooke, J. Robert, Ph.D., North Carolina State U. Prof., Agricultural and Biological Engineering
Coward, E. Walter, Ph.D., Iowa State U. Prof., Rural Sociology
Cox, William J., Ph.D., Oregon State U. Asst. Prof., Agronomy
Creasy, Leroy L., Ph.D., U. of California at Davis. Prof., Pomology
Cummins, James N., Ph.D., Southern Illinois U. Prof., Horticultural Sciences (Geneva)
Currie, W. Bruce, Ph.D., Macquarie U. (Australia) Assoc. Prof., Animal Science
Cushman, Harold R., Ph.D., Cornell U. Prof., Education
Datta, Ashim K., Ph.D., U. of Florida. Asst. Prof., Agricultural and Biological Engineering
Decker, Daniel J., Ph.D., Cornell U. Asst. Prof., Natural Resources
DeGloria, Stephen D., Ph.D., U. of California at Berkeley. Asst. Prof., Agronomy
de Gorter, Harry, Ph.D., U. of California at Berkeley. Asst. Prof., Agricultural Economics
Dennehy, Timothy J., Ph.D., U. of California at Davis. Asst. Prof., Entomology (Geneva)
Derksen, Richard C., Ph.D., U. of Illinois. Asst. Prof., Agricultural and Biological Engineering
Deshler, J. David, Ed.D., U. of California at Los Angeles. Assoc. Prof., Education
DeVol, David L., Ph.D., U. of Illinois. Asst. Prof., Animal Science
Dickson, Michael H., Ph.D., Michigan State U. Prof., Horticultural Sciences (Geneva)
Dietert, Rodney R., Ph.D., U. of Texas at Austin. Assoc. Prof., Poultry and Avian Sciences
Dillard, Helene R., Ph.D., U. of California at Berkeley. Asst. Prof., Plant Pathology (Geneva)
DiTomaso, Joseph M., Ph.D., U. of California at Davis. Asst. Prof., Agronomy
Downing, Donald L., Ph.D., U. of Georgia. Prof., Food Science and Technology (Geneva)
Drake, William E., Ph.D., Michigan State U. Prof., Education
Dunn, James A., Ph.D., U. of Michigan. Prof., Education
Duxbury, John M., Ph.D., U. of Birmingham (England). Prof., Agronomy
Earle, Elizabeth D., Ph.D., Harvard U. Prof., Plant Breeding and Biometry
Eberts, Paul R., Ph.D., U. of Michigan. Assoc. Prof., Rural Sociology
Eckenrode, Charles J., Jr., Ph.D., U. of Wisconsin. Prof., Entomology (Geneva)
Egner, Joan R., Ed.D., Cornell U. Prof., Education
Eickwort, George C., Ph.D., U. of Kansas. Prof., Entomology
Ellerbrock, LeRoy A., Ph.D., Cornell U. Assoc. Prof., Vegetable Crops
Elliot, J. Murray, Ph.D., Cornell U. Prof., Animal Science
Erickson, Eugene C., Ph.D., Michigan State U. Prof., Rural Sociology
Everett, Robert W., Ph.D., Michigan State U. Prof., Animal Science
Ewing, Elmer E., Ph.D., Cornell U. Prof., Vegetable Crops
Fahey, Timothy J., Ph.D., U. of Wyoming. Assoc. Prof., Natural Resources
Feldman, Rochelle, Ph.D., U. of Connecticut. Asst. Prof., Rural Sociology
Ferguson, Gregory A., Ph.D., U. of Arizona. Asst. Prof., Agronomy
Ferguson, James D., V.M.D., U. of Pennsylvania. Asst. Prof., Animal Science
Fick, Gary W., Ph.D., U. of California at Davis. Prof., Agronomy
Figueroa, Enrique E., Ph.D., U. of California at Davis. Asst. Prof., Agricultural Economics
Fiori, Bart J., Ph.D., Cornell U. Assoc. Prof., Entomology (Geneva)
Fischer, Charles C., M.S., Michigan State U. Assoc. Prof., Floriculture and Ornamental Horticulture
Foote, Robert H., Ph.D., Cornell U. Jacob Gould Schurman Professor, Animal Science
Forker, Olan D., Ph.D., U. of California at Berkeley. Prof., Agricultural Economics
Forshey, Chester G., Ph.D., Ohio State U. Prof., Horticultural Sciences (Geneva)
Forsline, Philip L., M.S., U. of Minnesota. Asst. Prof., Horticultural Sciences (Geneva)
Fox, Danny G., Ph.D., Ohio State U. Prof., Animal Science
Francis, Joe D., Ph.D., U. of Missouri. Assoc. Prof., Rural Sociology
Fry, William E., Ph.D., Cornell U. Prof., Plant Pathology
Furry, Ronald B., Ph.D., Iowa State U. Prof., Agricultural and Biological Engineering
Galton, David M., Ph.D., Ohio State U. Assoc. Prof., Animal Science
Gavin, Thomas A., Ph.D., Oregon State U. Assoc. Prof., Natural Resources
Gay, Geraldine K., Ph.D., Cornell U. Asst. Prof., Communication
Gebremedhin, Kifle G., Ph.D., U. of Wisconsin. Assoc. Prof., Agricultural and Biological Engineering

Geisler, Charles C., Ph.D., U. of Wisconsin. Assoc. Prof., Rural Sociology
German, Gene A., Ph.D., Cornell U. Assoc. Prof., Agricultural Economics
Ghiorse, William C., Ph.D., Rensselaer Polytechnic Inst. Assoc. Prof., Microbiology
Gillett, James W., Ph.D., U. of California at Berkeley. Prof., Natural Resources
Glynn, Carroll, Ph.D., U. of Wisconsin. Asst. Prof., Communication
Gonsalves, Dennis, Ph.D., U. of California at Davis. Prof., Plant Pathology (Geneva)
Good, George L., Ph.D., Cornell U. Prof., Floriculture and Ornamental Horticulture
Gorewit, Ronald C., Ph.D., Michigan State U. Assoc. Prof., Animal Science
Gortzig, Carl F., Ph.D., Michigan State U. Prof., Floriculture and Ornamental Horticulture
Gowin, D. Bob, Ph.D., Yale U. Prof., Education
Graham, Donald C., Ph.D., Cornell U. Assoc. Prof., Food Science
Gravani, Robert B., Ph.D., Cornell U. Assoc. Prof., Food Science
Gray, Stewart M., Ph.D., North Carolina State U. Asst. Prof., Plant Pathology
Grunes, David L., Ph.D., U. of California at Berkeley. Prof., Agronomy
Guest, Richard W., M.S., North Dakota Coll. Prof., Agricultural and Biological Engineering
Gunkel, Wesley W., Ph.D., Michigan State U. Prof., Agricultural and Biological Engineering
Gurak, Douglas T., Ph.D., U. of Wisconsin. Assoc. Prof., Rural Sociology
Hahn, Russell R., Ph.D., Texas A. & M. U. Assoc. Prof., Agronomy
Haith, Douglas A., Ph.D., Cornell U. Prof., Agricultural and Biological Engineering
Haller, Emil J., Ph.D., U. of Chicago. Prof., Education
Halseth, Donald E., Ph.D., Cornell U. Asst. Prof., Vegetable Crops
Hang, Yong D., Ph.D., McGill U. (Canada). Assoc. Prof., Food Science and Technology (Geneva)
Harman, Gary E., Ph.D., Oregon State U. Prof., Horticultural Sciences (Geneva)
Hedlund, Dalva E., Ph.D., Colorado State U. Assoc. Prof., Education
Henick-Kling, Thomas, Ph.D., U. of Adelaide (Australia). Asst. Prof., Food Science and Technology (Geneva)
Hicks, James R., Ph.D., U. of Maryland. Assoc. Prof., Vegetable Crops
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