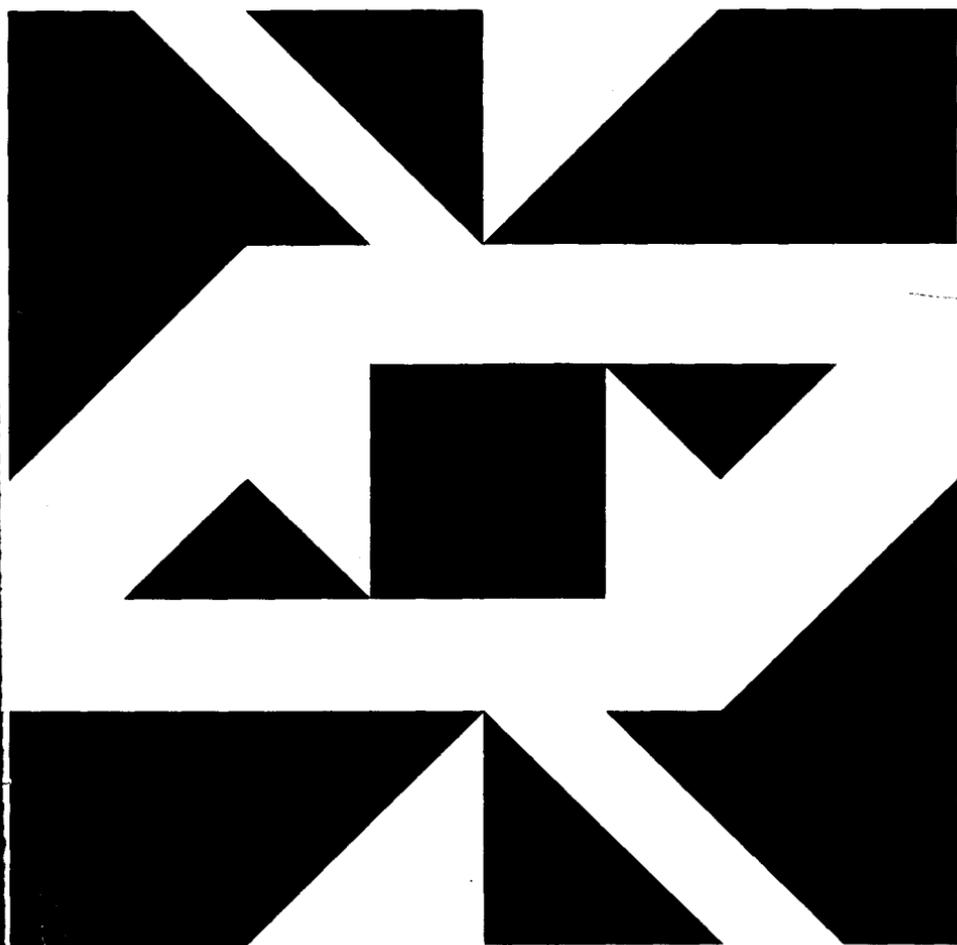


UNIVERSITY
OF MINNESOTA
BULLETIN

1977-1979

AUGUST 9, 1977

COLLEGE OF AGRICULTURE



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College of Agriculture

UNIVERSITY OF MINNESOTA

How to Use This Bulletin

This bulletin is the official source of information about the College of Agriculture. Maintain a personal copy as a guide in planning your course of study. The bulletin describes the major curricular areas, learning opportunities, degree requirements, courses, and academic regulations for the undergraduate programs of the college.

The bulletin contains current information as of the time of publication. Information about subsequent curriculum and course changes will be available in the College of Agriculture Office (277 Coffey Hall), in departmental offices, or from the student's adviser.

Other Sources of Information—All students should also read the *General Information Bulletin* as a supplement to this bulletin. In addition, some students may want to refer to bulletins of other collegiate units such as the College of Business Administration, College of Education, College of Liberal Arts, Institute of Technology, or School of Journalism and Mass Communication. These bulletins may be obtained by writing to the Office of Admissions and Records, 110 Williamson Hall, 231 Pillsbury Drive S.E., University of Minnesota, Minneapolis, Minnesota 55455.

The *Class Schedule* is distributed each quarter with registration materials. It lists course offerings with class hours, rooms, instructors, and prerequisites. Its closing pages contain registration instructions, final examination schedules, and other pertinent information.

The Official Daily Bulletin column printed in the *Minnesota Daily* contains announcements about University courses, study opportunities, meetings, and activities. Students are expected to be aware of any announcements that affect them.

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College of Agriculture

I. PROGRAM REQUIREMENTS

Objectives of the Programs in the College of Agriculture

The College of Agriculture provides undergraduate instruction focused on professional training for the agriculture industry. The objectives of this instruction are to prepare professional agriculturists whose goals will be: to assure agriculture's maximum contribution to the nation's economy; to improve the diet, health, and well-being of people; to help rural communities adjust to change; and to assist in formulating sound public policy relating to agriculture and natural resources.

Realizing the broad-ranging impact of agriculture, the faculty has established these curriculum objectives for agriculture students:

1. To understand the fundamentals of the biological, physical, and social sciences that form the fabric of modern agriculture.
2. To explore areas of study that record human experience and understanding so that students' personal lives will become enriched and they can contribute effectively to the welfare of the greater community.
3. To attain competence in a specialized area defined by the college, required for responsible professional activity in the agriculture or business community.
4. To gain a foundation for graduate study in agricultural and related fields.

For information about the college contact the College of Agriculture Office, 277 Coffey Hall, 1420 Eckles Avenue, University of Minnesota, St. Paul, Minnesota 55108; (612) 373-0921.

Curricular Philosophy

Ever-increasing quantities of food and fiber are required by Americans and the remainder of the world. These products are supplied by fewer persons in this country than ever before. Technology applied to agriculture, from development of sophisticated machines and equipment to increased quantity and quality of crops and livestock, will account for this needed production boost. Advances in techniques of agriculture production management have moved farming into the class of large business management. The nonfarming segments of agriculture—manufacturing, processing, distribution, services, and conservation of natural resources—reflect the diversity of modern agriculture.

As a science and an industry, agriculture is a dynamic profession that presents challenging opportunities in a variety of areas. In response to this diversity, the College of Agriculture has designed its curricula along six broad divisions containing 22 major areas. The programs accommodate students with various personal and professional goals, and are described in this section.

The six broad curricula and the 22 associated majors are:

1. Agricultural Business Administration
Agricultural Business Administration

Program Requirements

2. Agricultural Science and Industries
 - Agricultural Economics
 - Agricultural Education
 - Agricultural Engineering Technology
 - Agronomy
 - Animal Science
 - Entomology
 - Horticulture
 - Plant Health Technology
 - Soil Science
3. Communication Science
 - Agricultural Journalism
 - Technical Communication
4. Fisheries and Wildlife
 - Fisheries
 - Wildlife
5. Food Science and Nutrition
 - Consumer Food Science
 - Food Science and Technology
 - Hospitality and Food Service Management
 - Nutrition and Dietetics
6. Resource and Community Development
 - Economics of Public Services
 - Landscape Architecture
 - Resource Economics
 - Recreation Resource Management (only through the College of Forestry)
 - Soil and Water Resource Management

Departments and Majors

The six curricular areas represent academic divisions of the college. For administrative purposes, the college is divided into 12 departments that supervise course offerings in each curricular area. The 12 departments and corresponding majors offered through each are:

1. Agricultural and Applied Economics
 - Agricultural Business Administration
 - Agricultural Economics
 - Economics of Public Services
 - Resource Economics
2. Agricultural Education
 - Agricultural Education
3. Agricultural Engineering
 - Agricultural Engineering Technology
 - Soil and Water Resource Management
4. Agronomy and Plant Genetics
 - Agronomy

5. Animal Science
Animal Science
6. Entomology, Fisheries, and Wildlife
Entomology
Fisheries
Wildlife
7. Food Science and Nutrition
Consumer Food Science
Food Science and Technology
Hospitality and Food Service Management
Nutrition and Dietetics
8. Horticultural Science and Landscape Architecture
Horticulture
Landscape Architecture
9. Information and Agricultural Journalism
Agricultural Journalism
10. Plant Pathology
Plant Health Technology
11. Rhetoric
Technical Communication
12. Soil Science
Soil Science
Soil and Water Resource Management

Degrees Offered

Baccalaureate Degrees—The curricula in agriculture all lead to the bachelor of science degree. Several majors and degrees are offered jointly or in cooperation with other colleges in the University. These include:

- Agricultural Business Administration—College of Business Administration
(bachelor of agricultural business administration)
- Agricultural Education—College of Education (bachelor of science)
- Agricultural Journalism—School of Journalism and Mass Communication
(bachelor of arts)
- Landscape Architecture—Institute of Technology (bachelor of landscape architecture)

Postbaccalaureate Degree—In addition to the above, the College of Agriculture offers the master of agriculture degree, a professional, non-research-oriented degree designed for those who seek postbaccalaureate education to further advance their professional competence in agriculture. See Master of Agriculture Program in section III of this bulletin.

Graduate Degrees—The departments in the College of Agriculture, through the Graduate School, also offer the master of science and the doctor of philosophy degrees. For information about these programs see the *Graduate School Bulletin*.

Special Learning Opportunities—PEP

Junior and senior students enrolled in curricula offered by the College of Agriculture may voluntarily participate in the Professional Experience Program (PEP). This program is designed for students who wish to reinforce their academic experience by working in an area related to their course of study. Students work for a period of 12 weeks during fall, winter, or spring quarters of the academic year or during the summer.

A maximum of 6 credits is awarded to students satisfactorily completing the program. Grading is on the S-N system. Generally students are paid by industries, producers, and agencies participating in the program. Students must register for the program through Continuing Education and Extension and pay fees on a per credit basis. The course offerings do not appear in the class schedules. Departments offering the PEP option list it as course number 5000 in the Course Listings section of this bulletin. For additional information, students should consult their adviser or inquire at the college office, 277 Coffey Hall.



CURRICULA IN AGRICULTURE

Agricultural Business Administration

The agricultural business administration program is offered jointly with the College of Business Administration. It is designed to prepare students for employment as managers, administrators, or managerial-related positions in agribusiness. Examples of such employment areas are commodity trading and analysis, finance, management, marketing, sales management, administration, public and industrial relations, production management, economic and statistical analysis, operations research and reporting, managerial accounting, and transportation analysis. Students may seek employment in the above areas after receiving their baccalaureate degree or may use this training as preparatory to graduate study leading to research, teaching, and continuing education positions in academic institutions, research agencies, and industry.

The major emphasis is on economic analysis and business organization and management principles relating to agricultural businesses and industries involved in the manufacture and supply of materials for farm production (feed, seed, fertilizers, machinery, equipment, and pharmaceuticals), and the assembly, processing, marketing, transporting, and distribution of food and fiber products. The program includes a professional balance between agricultural and applied economics and business administration, with a limited amount of agricultural science. An opportunity exists for students to elect a variety of courses at the junior-senior level to accommodate their diverse interests and needs.

In the first 2 years, students register and pay fees in the College of Agriculture. In the last 2 years, they register jointly in the College of Agriculture and in the College of Business Administration and pay the fees of the latter. At least 90 credits and a grade point average of 2.00 are required for admission to the junior year and for joint registration. Students must meet the all-college requirements for graduation from the College of Agriculture. Students completing the program, which totals 192 credits, will receive the degree of bachelor of agricultural business administration.

Program Requirements for AGRICULTURAL BUSINESS ADMINISTRATION

A. Communication, Language, Symbolic Systems—25 credits

English, Communication (8)

Rhet 1101, 1102

Public Speaking (4)

Rhet 1222

Professional Communications (8)

Rhet 3551 or 3562; plus 4 credits to be chosen from among 3254, 3257, 3266, or 5561

College Algebra, Analytic Geometry (5)

Math 1111

B. Physical and Biological Sciences—20 credits

Credits to be selected from the following: BioC 1301, 1302; Biol 1011, 1103, 1106; EBB 3004; Chem 1001, 1002, 1004, 1005; Geo 1001; MicB 3103; Phys 1031, 1032.

C. Man and Society—15 credits

Sociology (4)

Soc 1001 or 1651

Program Requirements

Psychology (5)

Psy 1001

Plus 6 credits in social science areas:

No more than two courses in any one discipline: anthropology, history, geography, political science, AgEc 3040. Economics and other agricultural economics courses are excluded.

D. Artistic Expression—8 credits

Rhet 1301, 1302; or see CLE list of suggested courses in section III of this bulletin.

E. Economics and Accounting Principles—17 credits

AgEc 1020, 1030 (9)

Acct 1050, 1051 (8)

F. Quantitative Analysis—4 credits

QA 1050 (4)

G. Agricultural Science—20 credits

Credits to be selected from among at least three departments or two major agricultural science areas other than agricultural economics. These courses should preferably be general (service) type courses offered specifically for non-majors in that department or area.

H. Economic Theory and Agricultural Economics—33 credits

AgEc 3101-3102 or Econ 3101-3102, AgEc 1400, 3500, 3710; plus 12 credits in economics and/or agricultural economics.

I. Business Administration—20 credits

Mgmt 3001, Mgmt 3004 or AgEc 3290; plus 12 credits from among the following: BLaw 3058, Tran 3054, IR 3002, Mktg 3000, Ins 3100, IR 3010, BFin 3000, OAM 3055. Also MIS 3099 is recommended.

J. Free Electives—30 credits

Recommended: Rhet 3562, 3254, or 3266; or see the CLE list of suggested courses in section III of this bulletin; other courses from agricultural economics, economics, and College of Business Administration.

Total Credits for Program—192

Agricultural Science and Industries

The curriculum in agricultural science and industries is intended for students who are interested in pursuing careers in the production, processing, marketing, or distribution of agricultural and horticultural commodities. The curriculum also provides an excellent background for farm operation and farm management or for graduate studies in a wide variety of disciplines in the agricultural sciences and agricultural and applied economics. Specific career opportunities for each of the majors offered under this curriculum are described in the program listings below.

Courses required for this curriculum have been selected to assist the student in obtaining the background in the biological and physical sciences and the skills in oral and written communication that are essential to studies in scientific and professional agriculture. This background is designed to prepare students to adapt and apply biological, physical, and economic principles to problems encountered in agricultural science, production, and management. The additional requirements in the areas of Man and Society and Artistic Expression serve to broaden the education-

al background of students in the social sciences, humanities, literature, and the arts, to better equip students to make contributions to society and to their personal well-being.

The breadth of course work possible in this curriculum (one-third of the total credits are elective) offers the student an opportunity to develop an individualized plan of study. Considerable flexibility in programming is provided in order to accommodate the different levels of preparation, aptitudes, and interests of students. Each student should work out a program of study within this curriculum in consultation with a major adviser. Some modifications in the requirements for the curriculum may be permitted when the student has a definite objective.

In addition to the curriculum requirements listed below, a student must complete a course of study leading to a major in an academic discipline. A minimum of 36 credits is required for a major. Courses to meet this minimum requirement may be selected from separate disciplines but must clearly form a coherent program that contributes to a balanced training in the student's chosen area of interest. A random assortment of courses taken in several disciplines would not meet this requirement. Specific course requirements for each major are described below. Areas of specialization within a major permit greater concentration of study in the discipline.

Program Requirements for AGRICULTURAL SCIENCE AND INDUSTRIES

A. Communication, Language, Symbolic Systems—21 credits

English, Communication (8)

Rhet 1101, 1102

Public Speaking (4)

Rhet 1222

Professional Writing or Scientific and Technical Writing (4)

Rhet 3551 or 3562

College Algebra (5)

Math 1111

B. Physical, Biological, and Analytical Sciences—38-45 credits

Courses required of all students (28-35 credits):

Chem 1001 (5), BioC 1301 (5), BioC 1302 (3)

(or) Chem 1001 (5), Chem 1002 (5), BioC 1302 (3)

(or) Chem 1004 (5), Chem 1005 (5), BioC 1301 (5)

(or) Chem 1004 (5), Chem 1005 (5), Chem 3301, 3305 (5), Chem 3302, 3306 (5)¹

Biology (10)

Biol 1011 (5) and either 1103 (5) or 1106 (5)

Physics (5)

Phys 1031

In addition to the above courses, students must take at least 10 additional credits in the physical, biological, and analytical sciences. These credits must be selected from among the following:

Chem 1006, 3001-3305, 3302-3306

BioC 1302, 1303

Biol 1103, 1106, 3021, 3032

Math—any course that requires 1111 or 1201 as a prerequisite

QA 3053

AgEc 5020

AgEn 1030

Phys 1032

MicB 3103

¹This series is recommended for students who plan to enter Graduate School.

Program Requirements

GCB 3022
Geo 1001
EBB 3004

C. Man and Society—14 credits (no more than two courses in any one discipline; e.g., history, economics)

The Analysis of Human Behavior and Institutions

AgEc 1020 (5)

The Development of Civilization: Historical and Philosophic Studies

D. Artistic Expression—8 credits

Literature, arts; or see CLE list of suggested courses in section III of this bulletin.

E. Requirements in the Major

Majors offered under this curriculum are listed below with information concerning career objectives and course requirements for each. Descriptions of courses required for each major can be found in section II of this bulletin.

F. Electives

Total Credits for Program—192

AGRICULTURAL ECONOMICS

Students who plan to work in economic or business management phases of agricultural production or industries related to agriculture, where a rather extensive knowledge of the technical aspects of the work is involved, will find a concentration in agricultural economics useful. (Students who expect to be employed in business management and who desire less technical training in agriculture may find the curriculum in agricultural business administration more suitable. Either program will be appropriate for students who plan to pursue graduate work in agricultural economics.)

The major specifies 9 credits in AgEc 1250 and 3101 for all programs. Students complete one of three areas of emphasis within the general area of agricultural economics, and these are illustrated below. Other emphases are possible, however, and the requirements for such a program will be developed for the individual student. In general, in addition to the 36-credit requirement beyond principles in agricultural and applied economics or economics, students must take 4 credits in statistics and at least 27 credits in agricultural science selected from among at least three departments or major agricultural science areas other than agricultural economics. Up to 9 credits from one of these three agricultural science areas can be used as an area of emphasis within the agricultural economics major to fulfill the 36-credit requirement for the major. In the Man and Society category, a minimum of 15 credits in addition to economic principles is required.

The three suggested areas of emphasis for the remaining 27 credits are:

Agriculture Finance—27 credits

AgEc 3102—Macroeconomic Theory (4)

AgEc 3500—Farm and Agribusiness Finance (5)

AgEc 5500—Advance Agriculture Finance (4)

Plus two courses from agriculture economics (7-8):

AgEc 1400, 3290, 3820, 3860, 5440, 5480, 5600

Plus 6-7 credits from agriculture economics, economics, or business finance

Agriculture Marketing—27 credits

AgEc 1400—Agricultural Markets and Prices (4)

Plus 10-12 credits from agriculture economics:

AgEc 3420, 3430, 3440, 3820, 5400, 5440, 5480

Plus 11-13 credits from agriculture economics or economics

Farm Management—27 credits

AgEc 3820—Farm Management Economics (4)

AgEc 3830—Organizing the Farm Business for Entry, Growth, and Transfer
(4)

AgEc 3860—Farm Business Planning (3)

Plus two courses from agriculture economics (7-8):

AgEc 1400, 3420, 3430, 3440, 5480

Plus 8-9 credits from agriculture economics; recommended are:

AgEc 3500, 3850, 5020, 5840

AGRICULTURAL EDUCATION

The major in agricultural education, offered jointly with the College of Education, is designed for the student who plans to teach agriculture or horticulture in public schools, area vocational-technical institutes, or community colleges in Minnesota. The program provides comprehensive training in agriculture and permits emphasis in animal science, agronomy, agricultural economics, horticulture, soils, and mechanized agriculture for those preparing for extension work, other professional careers in the field, or farming. It also offers the special training in education necessary for recommendation for licensure as an instructor of agriculture or horticulture.

In the third quarter of the sophomore year, students should apply at the Office of Admissions and Records, 130 Coffey Hall, St. Paul campus, for joint registration in the College of Education in one of the combined curricula. They then complete the admission requirements of the College of Education, which include health and psychological examinations and interviews.

To be eligible, the student must have a grade point average (GPA) of at least 2.00 for all courses taken at this University and at least a 2.30 for technical agriculture courses as follows:

Horticulture Education Specialization: 2.30 GPA in courses in entomology, forestry, horticulture, mechanized agriculture, plant pathology, agricultural economics, and soils.

Agricultural Education Specialization: 2.30 GPA in courses in agricultural economics, agronomy, animal science, entomology, food science, forestry, horticulture, agricultural journalism, mechanized agriculture, plant pathology, soils, and veterinary medicine.

The same grade point averages are required for later admission to student teaching and for graduation.

Students applying for the agricultural education specialization must have a satisfactory background in agriculture. Those entering the horticultural education specialization must have adequate experience in horticulture or must be employed for the equivalent of 3 months, full time, in an appropriate occupation before receiving the B.S. degree. Both curricula require a minimum of 80 credits in technical agriculture and a total of 192 quarter credits for graduation.

Each student is expected to complete the liberal education distribution requirements as detailed for the agricultural science and industries curriculum.

Program Requirements

Common Requirements

Professional Education Courses—30 credits minimum

- AgEd 1001—Introduction to Agricultural Education (1)
- AgEd 1010—History and Philosophy of Vocational and Community Education (3)
- AgEd 3010—Organization and Direction of FFA Activities (2)
- AgEd 3031—Student Teaching in Agriculture (8)
- AgEd 3041—Practicum: Agricultural Education Technology (SOEP) (1)
- AgEd 5028—Teaching Methods in Agricultural Education (5)
- AgEd 5061—Program Planning and Evaluation (3)
- AgEd 5071—Supervised Occupational Experiences in Agriculture (3)
- SeEd 3155—Introduction to Secondary School Teaching (5)

Special Requirements for All Students—10 credits

- PubH 3004—Basic Concepts in Personal and Community Health (4)
- Physical education (3)
- PsyF 3380—Introduction to Human Relations (3)

Vocational Agriculture Specialization

In addition to the common requirements listed above, students choosing this option must complete:

Major Courses—80 credits minimum

- AgEc 1020—Principles of Macroeconomics (5)
- AgEc 1030—Principles of Microeconomics (4)
- AgEc 3820—Farm Management Economics (4)
- AgEc 3850—Farm Business and Enterprise Analysis (4)
- Soil 1122—Introduction to Soil Science (4)
- Agro 1010—Principles of Agronomy (4)
- PIPa 1001—Introduction to Plant Pathology (5)
- Hort 1001—Fundamentals of Horticulture (4)
- Ent 1005—Economic Entomology (4)
- AnSc 1100—Introduction to Animal Science (5)
- AnSc 1401—Principles of Animal Nutrition (5)
- AgEn 1020—Agricultural Shop-Metalwork (4)
- AgEn 5020—Program Planning and Instructional Methods in Agricultural Mechanics (4)
- AgEd 5072—Practicum: Agricultural Business and Industry (3)
- Electives—21 credits in technical agriculture

Professional Education Courses

- AgEd 5049—Agricultural Education for Adults (5)

Vocational Horticulture Specialization

In addition to the common requirements listed above, students choosing this option must complete:

Major Courses—80 credits minimum

- AgEc 1020—Principles of Macroeconomics (5)
- AgEc 1030—Principles of Microeconomics (4)
- Soil 1122—Introduction to Soil Science (4)
- PIPa 1001—Introduction to Plant Pathology (5)

Ent 1005—Economic Entomology (4) (or) Ent 5050—Forest Entomology (4)
Hort 1001—Fundamentals of Horticulture (4)
Hort 1016—Greenhouse Management (3)
Hort 1036—Plant Propagation (4)
AgEn 3205—Power and Power Use (4)
PIPh 3131—Survey of Plant Physiology (3)
AgEn 5020—Program Planning and Instructional Methods in Agricultural Mechanics (3)
AgEd 5072—Practicum: Agricultural Business and Industry (1-3 cr per qtr, max 9)
Electives—18 credits in horticulture and 16 credits in technical agriculture

Professional Education Courses

AgEd 5049—Agricultural Education for Adults (5)

Supporting Fields

Supporting Field in Agriculture for Agricultural Education Majors—Students majoring in agricultural education may choose a supporting field in an agriculture department. A supporting field consists of 18 credits exclusive of introductory courses. For details, consult the department or the *College of Education Bulletin*.

Supporting Field in Agricultural Education for College of Agriculture Students—Students majoring in the agricultural science and industries curriculum may choose a supporting field in agricultural education. This field, however, does not include requirements for teaching licensure. It is recommended that Psy 1001 be completed before entering the supporting sequence. A minimum of 18 credits may be selected from AgEd 1010, 5028, 5032, 5034, 5049, 5051, 5061, 5070, 5071.

AGRICULTURAL ENGINEERING TECHNOLOGY

Agricultural engineering technology is an undergraduate major offered by the Department of Agricultural Engineering. Within the major, students may choose a program emphasizing utilization and development of farm machines, equipment, structures, or processing as related to their interests in animals, plants, soils, water, or wastes. The program can stress either management or technology in the production and marketing of agricultural products but usually combines both. Good background is developed in the biological sciences and in principles derived from the engineering sciences. Courses utilizing this background can help students to develop useful solutions to agricultural and biological problems.

Students develop an individualized program in cooperation with their adviser. The program is built on a foundation of required and suggested courses. In addition, students may take courses in another discipline to give their program of study a secondary emphasis, or they may construct a broad program of composed closely related subject matter from several disciplines.

Graduates may find employment in the technical phases of agricultural production and related industries where they can apply the principles of engineering technology to solving problems.

Students in the agricultural engineering technology program must satisfy the general requirements detailed for the agricultural science and industries curriculum and the following additional requirements:

Math 1142—Introduction to Calculus
Phys 1032 in category B, Physical, Biological, and Analytical Sciences
AgEc 1030 in category C, Man and Society

Program Requirements

MAJOR COURSE REQUIREMENTS

AgEn 1010—Technical Drawing (4)¹

AgEn 1030—Computer Programming (3)

AgEn 5021—Mechanics of Agricultural Systems (4)

AgEn 5022—Energy Systems in Agriculture (4)

AgEn 5023—Fluids and Electricity in Agriculture (4)

16 additional credits from the following list of courses:

AgEn 1400, 3010, 3410, 3606, 3800, 5230, 5240, 5400, 5620, 5810, 3091, 5091, 5092

ADDITIONAL REQUIREMENTS

A minimum of 20 credits of supporting courses in other departments of the College of Agriculture.

ADDITIONAL ELECTIVES—approximately 48 credits

The additional electives are courses primarily in agricultural engineering technology and related areas that are selected by the student together with the adviser to meet the student's career goals.

Students interested in soil and water resource development (resource and community development curriculum) may request an agricultural engineering faculty adviser if they wish to emphasize engineering and technology.

A 4-year professional degree program in agricultural engineering is offered jointly with the Institute of Technology. Students interested in an engineering degree should consult the *Institute of Technology Bulletin* for information regarding the curriculum.

AGRONOMY AND PLANT GENETICS

Agronomists deal with the principles underlying the growth and improvement of field crops and with increasing crop productivity. Field crops are the high acreage crops of the world, and any improvement in their productivity adds significantly to the world's food supply. This is why the motto of many undergraduate agronomy clubs in the United States is "Agronomists Feed the World."

Students interested in the process of growth and development in plants; the influence of our environment upon crop growth, development, and adaptation; the role of herbicides and their mode of action in controlling plant competition and increasing crop productivity; and the development of crop varieties with increased resistance to disease and insects, greater yield potential and high nutritional quality are encouraged to consider a major in agronomy. Agronomists, through research and extension studies on field crops, provide new ways to improve the world's food and clothing supplies through the production of crops for human food, forage crops for livestock feed, and fiber crops for clothing and other uses.

Students considering a career in agronomy should consult an adviser in the department and develop a program of study to fit their specific interests and career goals. Upon completing a degree in agronomy, students are qualified for many positions relating to the production and improvement of field crops. Positions illustrative of these career opportunities include technical representatives for herbicide and seed companies, field agronomists for speciality crops such as sugar beets and dry beans, crop regulatory and control activities specialists, grain buyers and merchandisers, workers in agricultural extension, soil conservation service and other related areas, elevator operators, and numerous other occupations. Students inter-

¹Waived for students already proficient in drawing.

ested in farming can acquire a sound background through careful selection of electives and courses in the major.

Students desiring to continue their studies in graduate school should develop a program of study in conjunction with their adviser, to secure the courses and background necessary to enter graduate school in the area of specialization of their choice.

Students enrolling in agronomy will establish a background in the biological and physical sciences by completing the course requirements in the agricultural science and industries curriculum. This background will enable them to adapt and apply biological, chemical, and physical principles to problems encountered in the production and improvement of crops. Coursework required of all students majoring in agronomy includes 26 credits of supporting courses, economic entomology (ENT 1005), genetics (GCB 3022), plant pathology (PIPa 1001), plant physiology (PIPh 3131), soils (Soil 1122), and statistics (Stat 3081), or their equivalent; a minimum of 36 credits in professional courses including Agro 1100, 3010, 3020, 3030, 3200, 5020, 5030, and 5040, or their equivalent; and two additional courses from agronomy, soil science, or other fields. Students select additional courses in agronomy and related areas that are appropriate to their career goals in consultation with their adviser.

ANIMAL SCIENCE

Animal science is the study and evaluation of the physical, biological, chemical, economic, and social factors involved in the production of farm animals and poultry. Students interested in the production, management, feeding, breeding, care, and judging of beef and dairy cattle, chickens, horses, sheep, swine, or turkeys; or animal genetics, nutrition, or physiology; or meat science and meat and meat by-products are encouraged to consider a major in animal science. Students with an interest in farm animals will find animal science a challenging field of study. Animal science majors find that contact with campus herds and flocks and their classroom experiences are valuable aids in increasing their knowledge of livestock and poultry production.

Animal science graduates are employed in such occupations as farmers, farm managers, county extension agents, livestock buyers, and a variety of other positions in the meat packing industry, dairy industry, feed industry, farm supply industry, banks and other finance agencies, consulting organizations, breed associations, government agencies, and artificial insemination organizations.

Students majoring in animal science follow the requirements of the agricultural science and industries curriculum. About 40 percent of the credits required for program completion are elective, allowing students to develop individual interests. Students planning to pursue graduate studies in preparation for college teaching, research, or consulting are urged to take additional course work in biology, chemistry, physics, and mathematics. Animal science majors must also complete AnSc 1100, 1300, 1401, 1500, 3220, 5703, one production course (AnSc 5601, 5602, 5603, 5604, 5605), and GCB 3022.

In addition to the required courses, students majoring in animal science may select an area of emphasis in genetics, management, meats, nutrition, or physiology, or may elect courses from any of the areas. Animal science majors often use some of their elective courses to apply to a double major in agronomy, agricultural education, agricultural economics, food science and nutrition, soils, or other areas.

ENTOMOLOGY

Entomology is a scientific discipline whose basic roots are in biology. It involves the study of insects and their relatives, biology, ecology, and control in relation to

Program Requirements

their environment and to human beings. Two options for specializing in entomology are offered, insect population management and graduate study preparation. These are described below.

Insect Population Management

Although an advanced degree is essential for many positions, entomologists with a bachelor of science degree are employed by federal and state agencies, chemical companies, food processors, mosquito control agencies, pest control companies, and as biological science teachers. With the rapid development of the need for and interest in insect pest management, there is likely to be a demand for students trained in entomology and allied sciences to monitor pest insect populations, supervise the application of control measures, and participate in environmental impact reviews.

In addition to the basic courses outlined in the agricultural science and industries curriculum, students are expected to complete the following for the major:

Stat 5021, 5022; Chem 1006; Biol 1103, 1106, and EBB 3004; Ent 1005, 3020, 3175, 5210, 5215; Soil 1122, Agro 1010, 1011, 5030; PIPa 1001 or 5050, AgEn 3215; 46 elective credits. Practical experience in companies or agencies dealing with insect pest management is recommended.

Total Credits for Program—192

Graduate Study Preparation

This option is designed to provide a broad base in the physical and biological sciences as preparation for graduate study in entomology. Advanced degrees are essential to qualify for positions as professional entomologists. Employment opportunities include college teaching, research (in universities, natural history museums, military services, private industry, state, federal, and international agencies), extension work, or private practice as a consulting entomologist.

In addition to, or in place of, the courses required for the agricultural science and industries curriculum, students are expected to complete the following for the major:

Math 1111, 1142; Stat 5021, 5022; Chem 1006, 3301-3305, 3302-3306; BioC 5001, 5002; Phys 1032; Biol 1103, 1106; Ent 1005, 3175; EBB 3004, 5112; GCB 3022; and Soil 1122; either PIPh 3131, 3132 or AnSc 1300; 38 elective credits. Attendance at a field biology station is recommended.

Total Credits for Program—192

HORTICULTURAL SCIENCE

There are seven areas of emphasis available in the Department of Horticultural Science and Landscape Architecture: vegetable science, fruit science, floriculture, landscape nursery management, urban park and landscape management, turf management, and landscape architecture. Students may concentrate in one particular area or may select courses from several areas of interest. Those who plan to work in a horticultural industry such as fruit production, vegetable production, the nursery or floriculture industry, or turf, park, or landscape management should follow the curriculum in agricultural science and industries, majoring in horticulture. Students interested in landscape architecture should complete the bachelor of landscape architecture program available through the resource and community development curriculum. Students planning to pursue graduate work in horticulture should follow

the curriculum in agricultural science and industries and, with the help of their adviser, select courses to enrich their program with additional mathematics and basic sciences study.

An increasing number of students planning to major in horticulture attend a community college or state university for their freshman year. Students who do so should take courses that have been determined by their guidance counselor to be equivalent to the following University of Minnesota courses: Rhet 1101, 1102—Communications I, II; Rhet 1222—Public Speaking; Math 1111—College Algebra; Chem 1004, 1005—General Principles of Chemistry; Biol 1011—General Biology; Biol 1103—General Botany. Other students contemplating transferring to a horticulture major should have completed a majority of the biology, botany, chemistry, and mathematics courses listed for freshmen before transfer.

Horticulture Major

In addition to the course and program requirements for the agricultural science and industries curriculum, all students must complete 45 credits in horticulture or landscape architecture courses including: Hort 1001, 1016, 1036, 3099, and a minimum of 25 credits in major courses numbered 3000 and above. As supporting courses, all students are required to include in their program: Soil 1122; PIPa 1001 or 5050; Ent 1005; PIPh 3131; Chem 1004, 1005; BioC 1301, 1302; GCB 3022¹ or Biol 1101;¹ Stat 1051¹ or 3081.¹

The courses listed below are recommended for each of the indicated areas of emphasis.

Horticultural Food Production

Vegetable Science

Hort 3031, 3032, 5033, 5040, 5041, 5044; Agro 5020, 5030; FScN 3123, 5530; Soil 3420

Fruit Science

Hort 3031, 3032, 5006, 5033, 5040, 5041; FScN 3123, 5530; Soil 3420

Landscape Horticulture

Nursery Management

Hort 1021, 1022, 3072, 3076, 3079, 5040, 5045; LA 1024, 3071

Urban Park and Landscape Management

Hort 1021, 1022, 3072, 3076, 5040; LA 1024, 3071, 3075, 5010; FR 1201, 5232; AgEn 3205

Turf Management

Hort 1021, 1022, 3072, 5042, 3097; Soil 5232, 5430; AgEn 3205; LA 3071

Floriculture

Hort 1022, 1036, 3053, 3077, 3079, 5040, 5052, 5053, 5054

¹Students majoring in landscape horticulture with a strong design emphasis may substitute LA 1025 and LA 1024, 1031, or 1022.

Program Requirements

Landscape Architecture Major

See the bachelor of landscape architecture program in the resource and community development curriculum in this bulletin.

PLANT HEALTH TECHNOLOGY

The bachelor of science degree program with a major in plant health technology is offered by the Department of Plant Pathology. The plant health technologist is a practitioner knowledgeable in the diagnosis and treatment of plant disease and regulatory practices. In contrast, plant pathologists complete graduate degree programs and are educated in the areas of teaching, research, and extension relating to plant disease.

Plant health is continually threatened by the activities of pests and human beings. Students majoring in plant health technology will receive training in the biological and physical sciences as they relate to plants in conditions of health and disease. Graduates may find jobs in the federal, state, industrial, and private sectors where there is a need for personnel knowledgeable in the diagnosis and treatment of plant disease, the proper use of pesticides to control disease, and the application of integrated control procedures in the treatment of disease.

Studies provide background and training basic to the diagnosis and treatment of diseases of plants in urban, forest, and rural environments. Specifically, diseases caused by mycoplasma, viruses, bacteria, fungi, algae, parasitic seed plants, nematodes, insects, nutrient deficiencies or excesses, and air pollutants will be considered. Pertinent methods of diagnostic and treatment alternatives are emphasized. Practical experience in disease diagnosis and the prescription of treatment is provided through a required 3-month internship in the Plant Disease Clinic, which includes both laboratory and field experience.

There is sufficient flexibility in the program to allow a student to prepare for graduate studies in plant pathology.

CORE COURSES—45 credits

- PIPa 1001—Introductory Plant Pathology (5)
- PIPa 3100-3101—Pathogens in Plant Disease I and II (8)
- PIPa 5215—Insects in Relation to Plant Disease (4)
- PIPa 5702—Principles of Plant Disease Control (3)
- PIPa 5600—Plant Disease Diagnosis (3)
- PIPa 5650—Clinical Plant Pathology (6)
- Ent 1005—Economic Entomology (4)
- Ent 5210—Integrated Control (4)
- Agro 5030—Weed Control (5)
- Soil 5430—Chemistry of Plant Nutrient Elements in Soils (3)

ADDITIONAL REQUIRED COURSES—20 credits

- GCB 3022—Genetics (4)
- PIPh 3131—Plant Physiology (or any other beginning Plant Physiology) (3)
- Stat 3081—Experimental Techniques (5)
- Soil 1122—Introductory Soil Science (4)
- Soil 1262—Introduction to Meteorology (4)

ADDITIONAL RECOMMENDED COURSES

- Agro 3020—Growth, Development, and Culture of Field Crops (5)
- Hort 1001—Fundamentals of Horticulture (4)
- Hort 5021—Ornamental Plant Materials (5)

Soil 3220—Soil and Water Management and Conservation (3)
Soil 3420—Fertilizer Properties and Practices (3)
Soil 5540—Soil Resources and Environmental Relations (4)
EBB 3004—Fundamentals of Ecology (4)
FW 3050—Principles of Fishery and Wildlife Management (3)
Mathematics through calculus
Physics (5-10 additional credits)

Total Credits for Program—65

SOIL SCIENCE

Students interested in soil and water resource management, conservation, tillage, soil fertility, soil mapping, soil morphology, soil organic matter transformations, environmental quality, microclimatology, soil-plant (crop, and natural flora) relationships, or research are encouraged to consider a major in soil science. Soil science graduates are employed as farmers, soil and water specialists in rural, urban, and recreational planning, county agents, fertilizer and farm chemical company representatives, farm managers, land appraisers, environmentalists, and conservationists. Students who plan to continue studies for a master's or doctor's degree in preparation for teaching at the college level, research, or consulting work may choose either of the two curricula below. Prospective graduate students should consult their faculty adviser concerning suggested course work. This course work will usually include additional mathematics and physical and biological science courses beyond those required in the respective curricula.

Students may major in soil science either through the agricultural science and industries curriculum or through the soil and water resource management major in the resource and community development curriculum:

- 1. Agricultural Science and Industries**—Students whose vocational goal is employment in soil management, soil fertility, extension work, farming- or business-related enterprises usually follow this curriculum. In addition to the curriculum requirements, students are required to take the following courses:

Soil 1122—Introductory Soils (4)
Soil 3210—Soil Physical Properties (2)
Soil 3220—Soil and Water Management and Conservation (3)
Soil 3412—Soil Fertility Evaluation (4)
(or) Soil 3420—Fertilizer Properties and Practices (3)
Soil 5512—Soil Geography (4)
Geo 1001—Physical Geology (5)

Three additional courses from the following list are required along with sufficient additional courses to complete the major:

AgEn 3410—Hydrology Water Control (4)
Agro 1010—Principles of Agronomy (4)
Ent 1005—Economic Entomology (4)
Hort 1001—Fundamentals of Horticulture (4)
PIPa 1001—Introduction to Plant Pathology (5)
Stat 3081—Experimental Techniques and Statistical Inference

- 2. Soil and Water Resource Management**—Students whose vocational goal is employment in private or governmental agencies working in conservation, planning, land appraisal, or environmental-related areas should consider this curriculum. Courses taken in addition to those required for the curriculum will be selected by the student in consultation with his or her adviser.

Communication Science

Students interested in communication science may work toward either a B.A. or B.S. degree in agricultural journalism or a B.S. degree in technical communication. The programs leading to these degrees have much in common, but their content varies with the professional objectives of each. The rationale for each program is explained below.

The agricultural journalism program is offered by the Department of Information and Agricultural Journalism in conjunction with the School of Journalism and Mass Communication. The technical communication program is offered by the Department of Rhetoric.

AGRICULTURAL JOURNALISM

The program in agricultural journalism is offered jointly by the College of Agriculture and the School of Journalism and Mass Communication of the College of Liberal Arts. It is intended for those who wish to prepare for any branch of journalism that relates to agriculture or to industries closely related to agriculture. Employment possibilities include staff positions on agricultural magazines, newspapers, trade papers, and house organs; editing and writing publications for state and federal departments of agriculture and experiment stations; serving on public relations and promotional staffs in industry and government; working as farm service directors for radio and TV stations; and serving on advertising and marketing staffs of mass media agencies or industries.

Students take general courses in agricultural science, but the emphasis is on preparation for a career in professional journalism. Stress is also placed on the social and economic aspects of agriculture.

Students majoring in agricultural journalism work toward either a bachelor of arts degree or a bachelor of science degree. Both degrees are offered jointly by the College of Agriculture and the College of Liberal Arts. All students register initially in the College of Agriculture. Some may transfer to the College of Liberal Arts during their senior year. All students must have their programs of agriculture courses approved by their adviser in agricultural journalism for the College of Agriculture. Students meet the journalism requirements of the School of Journalism and Mass Communication and must be accepted by the school in addition to the College of Agriculture.

The curriculum requires 180 credits for graduation. Students can choose to complete one of four sequences in journalism: news-editorial, advertising, broadcast journalism, and photographic communications. Also, students may adapt their programs to specialize in science writing, public relations, or other special areas.

Program Requirements for AGRICULTURAL JOURNALISM

- A. Communication, Language, Symbolic Systems—18-19 credits**
Rhet 1101, 1102—Communication I, II (8) (or) equivalent courses
Rhet 1222—Public Speaking (4) (or) Spch 1101—Fundamentals of Speech (5) (or) equivalent courses
Jour 1001—Introduction to Mass Communications (2)
Rhet 3551—Professional Writing (4) (or) Rhet 3562—Scientific and Technical Writing (4) (or) Comp 1027—Intermediate Composition (4)
- B. Physical and Biological Sciences—12-18 credits (B.S. degree candidates must complete 18 credits)**
Credits to be selected from the following: BioC 1301, 1302; Biol 1011, 1103, 1106;

Chem 1004, 1005; Geo 1001; Phys 1031, 1032; NSci 1004, 1005, or comparable courses

C. Man and Society—22-26 credits

AgEc 1020—Principles of Macroeconomics (5) (and) AgEc 1030—Principles of Microeconomics (4) (Econ 1001 and 1002 may be substituted)
Soc 1651—Rural Sociology (4) (or) suitable substitute
4-8 credits in American history
5 credits in American government or politics

D. Artistic Expression—12 credits

See CLE list of suggested courses in section III of this bulletin.

E. Electives

15 credits in beginning courses in agriculture or forestry in addition to AgEc 1020 and 1030
18 credits in agricultural or forestry field of specialization or 9 credits in each of two fields. These credits must be in advanced courses. The B.S. degree requires 24 credits in advanced courses and the BA degree 18 credits.
Electives to meet College of Liberal Arts language requirements for B.A. degree

Students planning to earn a B.S. degree who meet CLA language requirements may consult with their adviser about taking fewer credits in categories B and E.

F. Major Requirements

General

Jour 1005—Visual Communication (3)

News-Editorial Sequence—41-45 credits

Jour 1101—Reporting (5)

Jour 3121—Public Affairs Reporting (4)

Jour 3155—Publications Editing (4) (or) AgJo 3155—Publications Editing (4)

Jour 3776—Mass Communications Law (4)

Jour 5131—Interpretive Reporting (4) (or) Jour 5133—Specialized Reporting: Social and Physical Sciences (4)

Jour 5501—Communication and Public Opinion I (4)

Jour 5601—History of Journalism (4)

AgJo 3530—Publicity (4)

One additional course whose major emphasis is writing, chosen from:

Jour 3173—Magazine Writing and Editing (4)

Jour 5141—Opinion Writing in America (4)

Jour 5143—Interpretation of Science and Technology (4)

4-8 additional elective upper division credits in agricultural journalism or journalism

Advertising Sequence—45 credits

Jour 1201—Principles of Advertising (4)

Jour 3231—Advertising Graphics (4)

Jour 3241—Advertising Copywriting (4)

Jour 5251—Psychology of Advertising (4)

Jour 5261—Advertising: Media Analysis (4)

Jour 5274—Current Advertising Developments and Problems (4)

Jour 5501—Communication and Public Opinion I (4)

Mktg 3000—Principles of Marketing or substitute courses in agricultural economics (4)

Program Requirements

5 credits in introductory psychology

For advertising management emphasis: Jour 5263—Advertising Campaign Planning and Media Strategy (4) plus 4 additional upper division credits in advertising

(or) For creative emphasis: Jour 5272—Advertising Copy-Graphics (4) plus 4 additional upper division credits in advertising

Other options allow for sequences in broadcast advertising and marketing (see adviser for details).

Broadcast Journalism Sequence—49-50 credits

Jour 1101—Reporting (5)

Jour 3121—Public Affairs Reporting (4)

Jour 3401—Basic Cinematography (4)

Jour 3451—Television and Radio News (5)

Jour 3776—Mass Communications Law (4)

Jour 5402—Film Production (5) (or) Jour 5444—Television and Radio Documentary (4)

Jour 5442—Advanced Television News (5)

Jour 5611—Development of American Broadcasting (4)

One of the following:

Jour 5501—Communication and Public Opinion I (4)

Jour 5615—Development of Photojournalism and Documentary Film (5)

Jour 5721—Mass Media in a Dynamic Society (4)

Spch 3201—Introduction to Broadcasting Production (5)

4 additional upper division credits in agricultural journalism or journalism

Additional speech courses recommended

Photographic Communication Sequence—43 credits

Jour 1101—Reporting (5)

Jour 1301—Beginning Photojournalism (4)

Jour 3121—Public Affairs Reporting (4) (or) Jour 3486—
Radio and Television Script Writing (4) (or) Jour 3173—
Magazine Writing (4) (or) Jour 3231—Advertising Graphics (4)
(or) Jour 3241—Advertising Copywriting (4)

Jour 3776—Mass Communications Law (4)

Jour 5353—Photographic Communication (4) (or) Jour 3401—Basic Cinematography (4)

Jour 5376—Advanced Photojournalism (5) (or) Jour 5402—Film Production (5)

Jour 5501—Communication and Public Opinion I (4) (or) Jour 5721—Mass Media in a Dynamic Society (4)

Jour 5615—Development of Photojournalism and Documentary Film (5)

8 elective upper division journalism or agricultural journalism credits including AgJo 3530—Publicity (4)

Additional speech courses recommended

Modifications in all sequences may be approved by the adviser.

Students must complete 75 3000- and 5000-level credits. For B.A. degree candidates, these credits must be acceptable to CLA. Thirty of the credits must be from course work outside of journalism, but they may include all work from advanced agriculture and forestry courses used to meet College of Agriculture and College of Forestry requirements.

TECHNICAL COMMUNICATION

Technical communication is the application of modern communication techniques to the dissemination of technical knowledge in industry, business, education, and government. The technical communicator develops the channels of communication that range from the scientist and engineer to management and to the consumers of the products and services provided by technology.

To accomplish her or his objectives, the technical communicator must be a generalist well acquainted with the basic principles of science, engineering, the social sciences, and management practices. The technical communicator must be knowledgeable about writing and editing, graphics, communication research and theory, and oral communication. The basic principles of all the media available to the communicator, including print, film, television, and radio, should be understood. The technical communication curriculum is designed to provide the necessary fundamental theory and its application in these areas, within a program flexible enough to allow each student to plan a program appropriate to his or her personal career goals.

Technical communicators with a bachelor's degree may be employed in government, education, and organizations in such fields as agriculture, aeronautics, communication, electronics, research and development, and transportation. Graduates of the program may pursue careers as writer-editors, extension specialists, research and development directors, and training and/or communication managers. The program also provides a broad base for those who plan to pursue a graduate communication program.

Program Requirements for TECHNICAL COMMUNICATION

A. Communication, Language, Symbolic Systems—23-24 credits

- Communication (8)
 - Rhet 1101, 1102
- Public Speaking (4)
 - Rhet 1222
- Scientific and Technical Writing (4)
 - Rhet 3562
- College Algebra and Analytic Geometry (5)
 - Math 1111
- Computer Science (2-3)
 - AgEn 1030 (or) CSci 1100

B. Physical and Biological Sciences—18 credits

Credits to be selected from the following: BioC 1301, 1302; Chem 1004-1005; Geo 1001, 1002, 1111; Phys 1031, 1032; Biol 1011, 1103, 1106; Bot 1009, 1012; EBB 3004; GCB 3022; MicB 3103; Phsl 1002

C. Man and Society—16 credits

See CLE list of suggested courses in section III of this bulletin. Students should have at least 3 credits in subcategory B. No more than 10 credits in any one discipline (e.g., history, economics, and psychology) may be counted toward the Man and Society requirements.

D. Artistic Expression—20 credits

See CLE list of suggested courses in section III of this bulletin.

E. Technical Communication—60 credits

Students must take a total of 60 credits in technical communication with a minimum of 7 credits in each of the competency areas listed below. A wide range

Program Requirements

of courses available through the colleges on the Twin Cities campus may be used to satisfy the requirements of each competency area. *Students may obtain a complete list of suggested courses at the main office of the Department of Rhetoric or from their adviser.* With the aid of their adviser, students may develop a flexible program that will provide the basic fundamentals of technical communication and yet allow a specialization of as much as 25 credits in one of the following six areas:

Writing-Editing

The development of skills in professional writing, writing for publication, publication editing, and science communication.

Media Communication

An introduction to media techniques to include courses in publicity, film production, broadcasting, and radio and television production.

Graphic Communication

The development of fundamental skills in photography, technical drawing, graphic arts processes, and design and typography.

Organizational, Managerial, and Training Communication

Theory and application gained through courses in community leadership, organizational communication, community resource development, managerial communication, and training in business and industry.

Communication Theory and Research

The development of skills in statistical methods, communication processes, language principles, and research methods. Included in this area is the internship in technical communication, a program in which the student participates in an on-the-job training experience under the supervision of his or her adviser.

Oral Communication

Practice and theory in effective listening, public speaking, oral technical communication, discussion, and parliamentary procedure.

F. Technical Electives—20 credits

Through the use of their technical electives, students are expected to achieve enough competency in a science, social science, or engineering discipline so that the goals and methods of science and technology are clear to them. Students may also use this portion of the program to prepare for employment in some specific area such as computers or foods. Technical electives will be chosen with the aid of the adviser and can be interdisciplinary as well as intradisciplinary. The student may choose from areas such as agriculture, computer science, forestry, health science, home economics, and the natural and physical sciences.

G. Electives—25 credits

Total Credits for Program—182 minimum

Fisheries and Wildlife

The fisheries and wildlife curricula are designed to offer students basic training in the biological and physical sciences and in related disciplines to provide the broad background necessary for competence in the respective professional fields. Students should recognize that these curricula satisfy only minimum requirements for professional career employment in fisheries and/or wildlife. The master's degree is

desired, if not required, for many management or administrative and for most research positions. Further graduate study leading to the doctor of philosophy degree may be required for some research positions and is essential for teaching at the college level. The qualified student is advised to include at least some graduate-level study in her or his educational program.

Pre-Fisheries and Wildlife Status

Admission Requirements—Admission of beginning freshmen and new students with advanced standing to the pre-fisheries and wildlife curriculum is on a limited and selective basis. Acceptance will be based on previous academic performance and other indicators of scholastic potential. Applications should be submitted before April 15 for those wishing to begin studies in the fall quarter of the following academic year, or 2 months prior to the beginning of winter and spring quarters or summer session.

All freshmen and other new students who do not meet requirements for entry to a major in either fisheries or wildlife enter the program at this level. The pre-fisheries and wildlife status enables freshmen and transfer students to establish definite curriculum goals projected toward declaration of a major or an early opportunity to seek another university curriculum if scholastic performance, interest, or both, are lacking. A faculty adviser works closely with the pre-fisheries and wildlife student.

Entry requirements for admission to a major in fisheries or wildlife are as follows:

1. Completion of 90 quarter credits, including the following specific core courses or their equivalents:

Rhet 1101, 1102; FW 0001, 3052; Biol 1011, 1103, 1106; Math 1142; Phys 1031, 1032; Chem 1004, 1005; VB 1120; and EBB 3004.

2. A grade point average of 2.75 or better in the specific above-listed core courses.

Advanced students are assigned a faculty adviser who is a fisheries or wildlife specialist, depending on the student's declared major.

Credit and Course Requirements—Both curricula require a minimum of 190 credits for graduation. Course requirements are identical for all students in the pre-fisheries and wildlife program but vary according to the desired fisheries or wildlife major in the junior and senior years. A graduate study preparation option is available in the fisheries major (see page 29). Courses should be taken as scheduled according to class year, as closely as possible. Departmental policy requires that fisheries and wildlife courses be taken on the A-N basis, except for FW 0001, 5280, and 5281, which may be taken on the S-N basis.

College Man and Society Requirement—A minimum of 14 credits in the social sciences is required, with no more than two courses in any one discipline to be applied. Five credits each in macroeconomics (i.e., AgEc 1020) and political science-government (i.e., Pol 1001) are required. Four or more credits in social science are to be elected (see Man and Society requirement).

College Artistic Expression Requirement—A minimum of 8 credits in humanities, literature, and the arts is required. The Rhet 1301 and 1302 or 1303 sequence, offered on the St. Paul campus, will satisfy this requirement; however, other courses may be taken (see Artistic Expression requirement).

Summer Field Requirement—A summer field activity or its equivalent is required, usually between the junior and senior years. This may consist of attendance at a field biology station (such as the Lake Itasca Forestry and Biological Station), a summer job with a conservation or fish and wildlife agency, or a similar field experience.

Program Requirements

Program Requirements for PRE-FISHERIES AND WILDLIFE

(Freshman and Sophomore Years)

A. Communication, Language, Symbolic Systems—17 credits

- English, Communication (8)
 - Rhet 1101, 1102
- Public Speaking (4)
 - Rhet 1222
- Calculus (5)
 - Math 1142 or equivalent¹

B. Physical and Biological Sciences—61 credits

- Fisheries and Wildlife Orientation (0)
 - FW 0001
- Fisheries and Wildlife (4)
 - FW 3052
- Biology (15)
 - Biol 1011, 1103, 1106
- General Chemistry (10)
 - Chem 1004, 1005
- Geology (5)
 - Geo 1001
- Physics (10)
 - Phys 1031, 1032
- Soils (4)
 - Soil 1122
- Genetics (4)
 - GCB 3022
- Ecology (4)
 - EBB 3004
- Comparative Vertebrate Morphology (5)
 - VB 1120

C. Man and Society—10 credits

- Economics (5)
 - AgEc 1020
- American Government, Politics (5)
 - Pol 1001

D. Artistic Expression—8 credits

See CLE list of suggested courses in section III of this bulletin.

Total Credits for Pre-Fisheries and Wildlife Program—96

Program Requirements for FISHERIES

(Junior and Senior Years)

A. Communication, Language, Symbolic Systems—8-9 credits

- Scientific and Technical Writing (4)
 - Rhet 3562
- Statistics (4-5)
 - Stat 3081 or 5021

¹Additional calculus is recommended but not required—a 3-quarter sequence in mathematics would provide an excellent background from selected courses.

B. Physical and Biological Sciences—56-57 credits

- Advanced Chemistry (9)
Chem 1006; 3100, 3101
- Algae (5)
Bot 5231 or 5811¹
- Limnology (4-5)
Geo 5601 or EBB 5812¹
- Entomology (5)
Ent 3175 or 5020¹
- Natural History of Invertebrates (5)
EBB 5831¹ or 5112 or Ent 5130¹
- Ichthyology (4)
EBB 5136
- Microbiology (5)
MicB 3103
- Animal Physiology (6)
AnSc 1300
- Fisheries and Wildlife (13)
FW 5450, 5451, 5452, 5454

C. Man and Society—4-5 credits

See CLE list of suggested courses in section III of this bulletin.

D. Artistic Expression

If requirement not yet fulfilled

E. Other Requirements—7-8 credits

- Technical Drawing (3-4)
AgEn 1010
- Surveying (3-4)
AgEn 1400
- Summer field requirement (see Pre-Fisheries and Wildlife Status section above)

F. Electives

Recommended elective courses in fisheries include: CSci 3101 (computers); Bot 3131, 5132 (plant physiology); Bot 5805¹ (aquatic plants); EBB 5116 (animal parasitology); EBB 5814¹ (community structure and functioning); FW 5280 (seminar); FR 5233 (recreation design); FR 5259 (recreation amenities); AgEn 3800 (sanitation, water supply); AgEn 3410 (hydrology, water control); AgEn 5000 (radioisotope measurements); Chem 3301, 3302, 3305, 3306, (or) BioC 1301, 1302 (organic chemistry, biochemistry); Stat 5022 (statistical analysis II); Math 1221, 1231 (calculus); Rhet 5257 (scientific technical presentations).

Total Credits for Program—190 minimum

**Program Requirements for
WILDLIFE**

(Junior and Senior Years)

A. Communication, Language, Symbolic Systems—9 credits

- Scientific and Technical Writing (4)
Rhet 3562
- Statistics (5)
Stat 3081 or 5021

¹Course offered at Lake Itasca Forestry and Biological Station during summer session.

Program Requirements

B. Physical and Biological Sciences—60-65 credits

- Advanced Chemistry (9-10)
 - Chem 3301, 3302, 3305, 3306, (or) BioC 1301, 1302
- Plant Taxonomy (7-8)
 - Bot 3201
 - Bot 5205, 5801¹, 5805¹
- Animal Physiology (6)
 - AnSc 1300
- Mammalogy (5)
 - FW 5129
- Ornithology (5)
 - EBB 5134 (or) 5834¹
- Plant Ecology (5)
 - EBB 5014 (or) 5814¹
- Animal Ecology (3-5)
 - Ent 5400 (or) EBB 5817¹
- Wildlife Parasites, Diseases (3)
 - VB 5603 (or) 5604
- Fisheries and Wildlife (13)
 - FW 5106, 5398, 5561, 5562, 5563

C. Man and Society—4-5 credits

See CLE list of suggested courses in section III of this bulletin.

D. Artistic Expression

If requirement not yet fulfilled

E. Other Requirements—3 credits

- Air Photo Interpretation (3)
 - FR 5200
- Seminar: Wildlife (1)
 - FW 5281
- Summer field requirement (see Pre-Fisheries and Wildlife section above)

F. Electives

Recommended elective courses in wildlife include: AnSc 1401 (animal nutrition); AnSc 5322 (physiology of reproduction); CSci 3101 (computers); Bot 3131, 5132 (plant physiology); EBB 5016 (plant geography); EBB 5112 (invertebrates); EBB 5136 (ichthyology); EBB 5812¹ or EBB/Geo 5601 (limnology); Ent 3175 or 5020¹ (entomology); FW 5450, 5451 (fish populations); FR 1100 (dendrology); FR 5230 (forest fire); FR 5231 (range management); FR 5233 (recreation design); FR 5259 (amenities lands); Geog 3421 (climatology); Ger 1101, 1102² (beginning german); Math 1221, 1231² (analytical geometry, calculus); AgEn 1015 (technical drawing); AgEn 1400 (surveying); VB 5103 (embryology); Rhet 5257 (scientific technical presentations).

Total Credits for Program—190 minimum

¹Courses offered at Lake Itasca Forestry and Biological Station during summer session.

²Recommended for students planning to continue with graduate study.

Graduate Study Preparation Option in Fisheries

Students with high competence and whose educational objective is directed toward research or university teaching may, after completing the pre-fisheries and wildlife requirements with a B average, elect the following option in the junior and senior years of the fisheries major. This option is intended as preparation for later graduate work leading to the M.S. or Ph.D. degree. In addition to the specific courses listed below, a group of supporting courses will be selected by the student depending on his or her area of interest. The supporting courses will be chosen in consultation with an adviser. The student must satisfy the requirements of either the regular curriculum or the following option, but not a combination of both.

The research problem (FW 5393, Biol 5890¹) will consist of: (a) introduction to the scientific method, (b) library literature research, (c) formulation of a hypothesis and experiment design, (d) fieldwork consisting of collection of biological materials and environmental measurements, (e) laboratory analysis of materials or experiment, (f) treatment and presentation of data, and (g) writing a report in a form suitable for publication. The report will be reviewed by a committee consisting of two members of the fisheries faculty and one from another area.

Program Requirements for FISHERIES GRADUATE STUDY PREPARATION OPTION

(Junior and Senior Years)

A. Communication, Language, Symbolic Systems—28-29 credits

Scientific and Technical Writing (4)

Rhet 3562

Statistics (4-5)

Stat 3081 or 5021

Language (10)

Ger 1101, 1102 (or) Russ 1101, 1102

Calculus (10)

Math 1221, 1231

B. Physical and Biological Sciences—35-36 credits

Organic Chemistry (10)

Chem 3301, 3302, 3305, 3306

Microbiology (5)

MicB 3103

Animal Physiology (6)

AnSc 1300

Limnology (4-5)

EBB 5812¹ (or) EBB/Geo 5601

Fisheries and Wildlife (13)

FW 5450, 5451, 5452, 5454

C. Man and Society—4-5 credits

D. Artistic Expression

If requirement not yet fulfilled

E. Other Requirements—11 credits

Seminar: Fisheries (1)

FW 5280

Research Project (10)

FW 5393; Biol 5890¹

Summer field requirement (see Pre-Fisheries and Wildlife section above)

¹Courses offered at Lake Itasca Forestry and Biological Station during summer session.

Program Requirements

F. Supporting Courses

These courses are selected, with the help of the adviser, to form an integrated program of course work that directly supports the major in fisheries. They may include such subjects as analytic chemistry, aquatic ecology, ichthyology, algae and aquatic plants, entomology, and similar topics.

Total Credits for Program—190 minimum

Food Science and Nutrition

This curriculum offers four separate programs spanning the broad range of career opportunities centering around the processing, manufacture, and distribution of food; its preparation and serving in the home and in hotels, restaurants, or institutions; and its nutritional properties as related to the requirements of people in conditions of health and disease. These programs are open to students registered in either the College of Agriculture or the College of Home Economics. Faculty advisers are normally from the Department of Food Science and Nutrition, which is jointly administered by both colleges. Areas of emphasis or options within each program are available. Details of these and of employment or graduate study opportunities are included in the descriptions of each major program that follow.

CONSUMER FOOD SCIENCE

This program is designed to prepare the student for professional work in areas relating to the promotion, product development, marketing, and consumption of food. A graduate may find employment in an educational, public relations, advertising, promotional, or developmental area of consumer food science. These positions may include several different aspects of food such as developing new products and improving existing products, testing and developing new processing and packaging techniques, and writing food releases for various communication media.

Students considering graduate study in the consumer food science area may acquire additional preparation in the physical and biological sciences or in the social sciences through the modifications suggested under these collateral areas. Those completing the advanced degree (M.S. or Ph.D.) may expect to enter research or college teaching positions. A student considering graduate study should maintain a GPA above 2.80 in order to meet graduate admission standards.

Program Requirements for CONSUMER FOOD SCIENCE

A. Communication, Language, Symbolic Systems—21 credits

Rhet 1101-1102—Communication I, II (8)
(or) Comp 1001-1002—Introductory Composition (8)
Rhet 1222—Public Speaking (4)
Rhet 3551—Professional Writing (4)
(or) Rhet 3562—Scientific and Technical Writing (4)
Math 1111—College Algebra and Analytical Geometry (5)

B. Physical and Biological Sciences—47-56 credits

Chem 1004-1005—General Principles of Chemistry (10)
Chem 3301-3302—Elementary Organic Chemistry (6)
Chem 3305-3306—Elementary Organic Chemistry Laboratory (4)
Biol 1011—General Biology (5)

MicB 3103—General Microbiology (5)
(or) MicB 5105—Biology of Microorganisms (4)
Biol 3021—Biochemistry (4)
BioC 5025—Laboratory in Biochemistry (2)
Phsl 3051—Human Physiology (5)
(or) Phsl 1002—Human Physiology (4)
Phys 1031-1032—Introductory Physics: Measurement and Applications (10)
(or) Phys 1014-1024—Introductory Physics: Concepts in Physics (8)
(or) Phys 1104-1105-1106—General Physics (15)

C. Man and Society—17-18 credits

AgEc 1020-1030—Principles of Macroeconomics, Microeconomics (9)
(or) Econ 1001, 1002—Principles of Macroeconomics, Microeconomics (8)
Psy 1001—General Psychology (5)
Soc 1001—Introduction to Sociology (4)

D. Artistic Expression—9 credits minimum

Minimum of 9 credits to be selected from CLE-approved courses

E. Major Requirements—44-53 credits

FScN 1272—Introduction to Food Decision Making (2)
FScN 1602—Principles of Nutrition (4)
FScN 3110—Food Chemistry (4)
FScN 3112—Food Chemistry Laboratory (2)
FScN 3403—Experimental Foods (4)
FScN 3472—Principles of Food Purchasing (4)
FScN 3622—Food and Nutrition in the Life Cycle (4)
(or) FScN 5622—Human Nutrition (5)
FScN 5100—General Seminar (1)
FScN 5360—Sensory Evaluation of Food Quality (4)
FScN 5403—Experimental Study of Foods (5)
FScN 5412—Physicochemistry of Foods (3)
FScN 5413—Structural-Functional Relations in Food Systems (3)
Stat 3081—Experimental Techniques and Statistical Inference (5)
(or) Stat 5021—Statistical Analysis I (4)
(or) Soc 3801-3802-3803—Sociological Methods (12)

F. Collateral Area—20 credits

In addition to the course requirements specified above, each student must select one of the six following fields as an area of emphasis. A minimum of 20 credits constitutes a collateral area. Courses are usually selected from those listed below, but others may be chosen in consultation with the adviser. More than one collateral area may be selected.

Food Chemistry and Product Development

Food Science and Nutrition—1102, 1500, 3730, 5000 (max of 4 cr), 5102, 5111, 5120, 5122, 5123, 5135, 5136, 5310, 5312, 5350, 5380, 5404, 5406, 5643
Family Social Science—1401
Textiles and Clothing—3621
Biochemistry—5002
Chemistry—3100, 3101
Mathematics—1142, 1211
Statistics—5201, 5601
Psychology—3031

Program Requirements

Consumer Services

Food Science and Nutrition—1600, 3400, 3642, 3720, 3730, 5000 (max of 4 cr),
5102, 5310, 5404
Design—1501, 1521, 1525, 1551 or 1552, 5505
Family Social Science—1401, 3260, 3500, 5200, 5201, 5202, 5220, 5404
Textiles and Clothing—3621, 5622
Agricultural Economics—1400, 5580, 5590
Journalism—1001, 1005, 1301, 5251
Sociology—5355, 5411, 5501
Psychology—5751
Industrial Relations—3010
Rhetoric—3254
Secondary Education—5105, 5107, 5108, 5109
Economics—1041 or 5041
Marketing—3098
Business Law—3508

Business

Agricultural Economics—1400, 5580, 5590
Agricultural Economics—3101, 3102, (or) Economics 3101, 3102
Marketing—3000, 3077, 3098
Journalism—1001, 1005, 1301, 5251
Psychology—3031, 5751
Sociology—3803, 5201, 5411, 5951
Statistics—5201
Industrial Relations—3010
Food Science and Nutrition—1600, 5000 (max of 4 cr)
Family Social Science—5202

Communications/Mass Media

Jour 1001—Introduction to Mass Communications (2)
Jour 1005—Visual Communications (3)
Jour 1101—Reporting (5)
Jour 1301—Beginning Photojournalism (4)
Jour 3121—Public Affairs Reporting (4)

Suggested electives:

Journalism—3155, 3173, 5221, 5251
Food Science and Nutrition—3400, 5000 (max of 4 cr)
Family Social Science—5202
Sociology—5201, 5355
Psychology—5201, 5751
Rhetoric—3254

Social Science

Anthropology—1101, 1102, 5141, 5151
Sociology—5201, 5305, 5355, 5405, 5411, 5501, 5505, 5951
Psychology—1004, 1005, 3031, 5201, 5751
Statistics—5201, 5601
Agricultural and Applied Economics—3101, 3102, (or) Economics 3101, 3102
Food Science and Nutrition—5000 (max of 4 cr)

Physical and Biological Sciences

Math—1142

(or) Math 1211, 1221, 1231

Chem—1006, 3100, 3101, 3303, 5365, 5501, 5502, 5503, 5520, 5521

BioC—5002, 5751, 5752, 5745, 5746, 5747

BioI—3012

Bot—3131, 5141

Food Science and Nutrition—5000 (max of 4 cr)

Students considering graduate study may substitute up to an additional 18-20 credits from courses listed above for an equivalent number of credits listed under Major Requirements, upon consultation with their adviser.

G. Free Electives

Electives to make a total of 185 credits required for graduation

FOOD SCIENCE AND TECHNOLOGY

Food science and technology is the application of modern science and engineering to the manufacture and distribution of food. To accomplish this objective, an understanding of the basic principles and techniques of many disciplines, including chemistry, physics, economics, engineering, microbiology, nutrition, management, public health, and agricultural production, must necessarily be coupled with the ability to apply this knowledge to food processing and preservation, and to marketing situations. The food scientist and food technologist are concerned with the theoretical and practical aspects of the food industry that encompass the food chain from production of the raw material to the ultimate utilization of the product by the consumer. This curriculum balances fundamental principles and useful applications of theory within a flexible program that permits each student to tailor her or his education to fit personal career goals.

The basic objective of the program is to provide the student with a liberal and professional education that will lead to a satisfying career in one of the numerous and diverse areas of the food industry. In addition to a general education, the program emphasizes the attitudes, knowledge, and skills essential for an understanding of the principles of food science. Many graduates of the program will accept employment after attaining the bachelor of science degree; however, qualified students often continue on to graduate study. Food scientists and technologists have diverse and challenging career opportunities in food and allied industries, government service, and education. Among the job areas available for graduates are production management, product and process research and development, public health and regulatory agency service, teaching, merchandising, advertising, technical service and sales, quality control supervision, and international nutrition and food agencies work.

Food scientists and technologists must assume a role of leadership in satisfying the needs of the future. Food scientists will face a challenge to search out and develop new and better ways to feed the expanding world population. They will be called upon to improve the quality of existing foods and to synthesize new foods from unconventional ingredients. The students educated in this program are taught to recognize and critically analyze problems of the food industry and to arrive at solutions through the application of principles of the biological and physical sciences, engineering, and business. Competence will be developed in a professional discipline related to the food industry through supplementary areas of emphasis in business administration, chemistry, engineering, microbiology, and public health. These food scientists and technologists should be prepared to meet challenges in one or more commodity areas such as cereals, dairy products, fruits and vegetables, meat and poultry products, or fabricated foods of the future.

Most of the courses under categories A and B, except Rhet 3551, should be taken during the freshman and sophomore years. Courses referred to under categories C and D should be distributed over all 4 years.

Program Requirements

Program Requirements for FOOD SCIENCE AND TECHNOLOGY

A. Communication, Language, Symbolic Systems—25 credits

- Rhet 1101-1102—Communication I, II (8)
- Rhet 1222—Public Speaking (4)
- Rhet 3551—Professional Writing (4)
- (or) Rhet 3562—Scientific and Technical Writing (4)
- Math 1142—Introduction to Calculus (5)
- Statistics (4)

B. Physical and Biological Sciences—46 credits

- Chem 1004-1005—General Principles of Chemistry (10)
- Chem 3301-3302—Elementary Organic Chemistry (6)
- Chem 3305-3306—Elementary Organic Chemistry Laboratory (4)
- Biol 3021—Biochemistry (4)
- BioC 5025—Biochemistry Laboratory (2)
- Phys 1031-1032—Introductory Physics: Measurement and Applications (10)
- Biol 1011—General Biology (5)
- MicB 3103—General Microbiology (5)

C. Man and Society—14 credits minimum

- Ag Ec 1020-1030—Principles of Macroeconomics, Microeconomics (9)
- (or) Econ 1001-1002—Principles of Macroeconomics, Microeconomics (8)
- Additional courses to be selected from CLE list to make a total of 14 credits minimum

D. Artistic Expression—9 credits minimum

See CLE list of suggested courses in section III of this bulletin.

E. Major Requirements—55-59 credits

- FScN 1102—Technology of Food Processing (4)
- FScN 1602—Principles of Nutrition (4)
- FScN 3110—Food Chemistry (4)
- FScN 3112—Food Chemistry Laboratory (2)
- FScN 5100—General Seminar (1)
- (or) FScN 5102—Case Studies in Food Science and Nutrition (5)
- FScN 5120—Food Microbiology (5)
- FScN 5122—Sanitation and Control of Microorganisms (2)
- FScN 5123—Microbiology of Food Fermentations (2)
- FScN 5135-5136—Food Process Engineering (6)
- FScN 5312—Chemical and Instrumental Analysis of Foods (5)

In addition to the above required courses, a minimum of 20 credits to be chosen from among the following courses; a minimum of 8 of the credits must be chosen from among FScN 5512, 5522, 5523, 5530, 5540, 5555:

- FScN 1500—Meat Science (4)
- FScN 5000¹—Professional Experience Program (1-6)
- FScN 5102—Case Studies in Food Science and Nutrition (5)
- FScN 5111—Independent Study in Food Science and Nutrition (1-5)
- FScN 5310—Advanced Food Chemistry (3)
- FScN 5320—Advanced Dairy and Food Microbiology (4)
- FScN 5321—Independent Study in Food Microbiology (1-5)
- FScN 5350—Food Formulation and Product Development (4)
- FScN 5360—Sensory Evaluation of Food Quality (4)
- FScN 5380—Food Packaging (3)

¹ A maximum of 4 credits of FScN 5000 may be included in the required 20 credits if they are completed on A-N grading.

- FScN 5510—Muscle Chemistry and Physiology (4)
- FScN 5512—Meat and Protein Technology (4)
- FScN 5522—Technology of Fluid and Concentrated Milk Products (4)
- FScN 5523—Technology of Fermented Dairy Products (4)
- FScN 5524—Sensory Evaluation of Dairy Products (1)
- FScN 5530—Industrial Processing of Fruits and Vegetables (4)
- FScN 5540—Fats and Oils Chemistry and Technology (4)
- FScN 5555—Freezing and Dehydration of Foods (5)

F. Areas of Emphasis

In addition to the course requirements specified above, each student must select one of the following seven areas of emphasis as well as sufficient electives to meet the 186-credit requirement for graduation. The area of emphasis is designed to support and complement the major field. Thus, courses in food per se are not acceptable as an area of emphasis while courses in a specialized area such as nutrition would be acceptable. It is assumed that a well-conceived area of emphasis will include some 3000- and 5000-level courses.

Chemistry

This area of emphasis is designed for the student seeking a more basic and fundamental approach to the chemistry of foods and food processes. FScN 5310 is required of all students selecting this area of emphasis. At least 20 additional credits of chemistry must be selected and usually include the following:

- Chem 1006—Solution Chemistry (4)
- Chem 3100-3101—Quantitative Analysis (3/2)
- Chem 5520-5521—Elementary Physical Chemistry (6)
- BioC 5002—Biochemistry (4)

Engineering Technology

This area of emphasis is designed for students interested primarily in the engineering technology aspects of food process development and production. At least 25 credits in a cohesive program are to be selected in consultation with an adviser. These should include AgEn 5021, 5022, 5023.

Students interested in a 4-year food engineering degree should consult the listings of the Department of Agricultural Engineering in the *Institute of Technology Bulletin*.

Industrial Engineering

This area of emphasis is designed for the student with competence and interest in the industrial engineering aspects of the food industry. The requirements include the following:

- ME 3900—Introduction to Engineering Statistics (4)
- (or) Stat 3091—Introduction: Probability, Statistics (4)

At least 20 credits from the industrial engineering courses described in the *Institute of Technology Bulletin*

Management

This area of emphasis is designed for the student interested in the problems of the business and economic phases of the various food industries. At least 30

Program Requirements

credits must be selected from course offerings in the Departments of Agricultural and Applied Economics, Economics, and Rhetoric, and in the College of Business Administration.

BioC 1301-1302-1303 (10) may be substituted for Chem 3301-3302-3305-3306 (10) and Biol 3021-BioC 5025 (6) in category B if desired.

Microbiology

This area of emphasis is designed for the student interested in courses related to the microbiological aspects of the food processing industry. About 20 credits of microbiology-oriented courses in biochemistry, microbiology, plant pathology, public health, and related departments must be selected. These usually include:

MicB 5321—Physiology of Bacteria (3).

Nutrition

This area of emphasis is designed for students interested in courses related to the nutritional aspects of the food processing industry. The following courses are required:

Phsl 1002—Human Physiology (4) (or) Phsl 3051—Human Physiology (5)
About 20 additional credits of nutrition-oriented courses in food science and nutrition, biochemistry, animal science, and related departments, including FScN 3622—Food and Nutrition in the Life Cycle (4) and FScN 5622—Human Nutrition (5)

Public Health

This area of emphasis is designed to provide the necessary background for the variety of activities performed by the sanitarian in either governmental or industrial work related to the regulatory and quality control of raw materials and finished products in the food field. At least 20 credits are to be selected from course offerings of the School of Public Health. See the *School of Public Health Bulletin* for details.

Other Areas

The courses presented for the above seven areas of emphasis may not satisfy the needs of every student. With the aid of an adviser, a student may set up a course of study designed to meet specific requirements in another area of emphasis or in a combination of suggested areas. Examples include advertising, journalism, sales, mechanical engineering, statistics, and experimental design. Some 3000- and 5000-level courses must be included.

G. Free Electives

Electives to make a total of 186 credits required for graduation.

Total Credits for Program—186

HOSPITALITY AND FOOD SERVICE MANAGEMENT

This program is intended for men and women interested in the field of hospitality management. The broad scope of the hospitality and food service industry and changes in life-styles among the American population have created a variety of service-related fields in which students may concentrate their professional preparation. Since work in the field involves the application of theoretical principles, course work strives to balance theory and practical experience.

Hospitality and food service management majors complete a common core of courses and may choose an area of emphasis in food production, food service management, or hospitality management.

**Program Requirements for
HOSPITALITY AND FOOD SERVICE MANAGEMENT**

A. Communication, Language, Symbolic Systems—21 credits

- Rhet 1101-1102—Communication I, II (8)
- (or) Comp 1001-1002—Introductory Composition (8)
- Rhet 1222—Public Speaking (4)
- Rhet 3551—Professional Writing (4)
- (or) Rhet 3562—Scientific and Technical Writing (4)
- Math 1111—College Algebra and Analytic Geometry (5)
- (or) Math 1131—Finite Math (5)
- (or) Math 1142—Introduction to Calculus (5)

B. Physical and Biological Sciences—15 credits

- Chem 1004-1005—General Principles of Chemistry (10)
- Biol 1011—General Biology (5)

C. Man and Society—17-18 credits

- AgEc 1020-1030—Principles of Macroeconomics, Microeconomics (9)
- (or) Econ 1001, 1002—Principles of Macroeconomics, Microeconomics (8)
- Psy 1001—General Psychology (5)
- Soc 1001—Introduction to Sociology (4)

D. Artistic Expression—9 credits minimum

Minimum of 9 credits to be selected from CLE-approved courses

E. Major Requirements—43-44 credits

- FScN 1212-1213—Scientific Principles of Food Preparation I-II (7) (or) FScN 3110-3112—Food Chemistry (6)
- FScN 1602—Principles of Nutrition (4)
- FScN 1700—Introduction to Hospitality and Food Service Management (2)
- FScN 3123—Microbiology of Foods (5)
- FScN 3760—Hospitality Cost Management (4)
- FScN 5100—General Seminar (1)
- Acct 1050-1051—Principles of Accounting (8)
- BFin 3000—Finance Fundamentals (4)
- IR 3002—Industrial Relations Systems: Labor Markets and the Management of Human Resources (4)
- Mgmt 3001—Fundamentals of Management (4)
- MIS 3099—Elementary FORTRAN (1)

F. Area of Emphasis

In addition to the course requirements, each student must select one of the three following areas of emphasis:

Food Production

This area of emphasis is designed to prepare graduates to respond to the needs of the food service industry for technical competence in such areas as operations, management, and food quality assurance. Food production majors should take FScN 3110-3112 rather than FScN 1212-1213.

- FScN 1500—Meat Science (4)

Program Requirements

- FScN 3403—Experimental Foods (4)
- FScN 3622—Food and Nutrition in the Life Cycle (4)
- (or) FScN 5622—Human Nutrition (5)
- FScN 3720—Administrative Experience: Hospitality or Food Service Enterprise (5)
- FScN 3730—Quantity Food Purchasing and Production (5)
- FScN 3740—Design and Layout of Food Services (4)
- FScN 3752—Food and Hospitality Operations: Application of Computer Systems to Smaller Units (4)
- (or) MIS 5100—Introduction to Computers and Computer Data Processing (4)
- (or) MIS 5101—Introduction to Management Information Systems (4)
- FScN 5135-5136—Food Process Engineering I-II (6)
- FScN 5360—Sensory Evaluation of Food Quality (4)
- Chem 3301-3302—Elementary Organic Chemistry (10)
- Biol 3021—Biochemistry (4)
- BioC 5025—Biochemistry Laboratory (2)
- Math 1142—Introduction to Calculus (5)
- (or) Math 1311-1321-1323—Computer Calculus I-II-III (15)
- Phsl 3051—Human Physiology (5)
- (or) Phsl 1002—Human Physiology (4)
- Phys 1031-1032—Introductory Physics: Measurement and Application (10)
- (or) Phys 1014-1024—Introductory Physics: Concepts in Physics (8)
- (or) Phys 1104-1105-1106—General Physics (15)
- Stat 3081—Experimental Techniques and Statistical Inference (5)
- (or) Stat 5021—Statistical Analysis I (4)
- (or) Soc 3801-3802-3803—Sociological Methods (12)

Food Service Management

This area of emphasis is designed to prepare graduates for employment as managers in institutional or commercial food services such as in hospitals, nursing homes, schools, colleges and universities, companies, airlines, vending, hotels, motels, restaurants, and fast food establishments.

- FScN 3472—Principles of Food Purchasing (4)
- FScN 3720—Administrative Experience: Hospitality or Food Service Enterprise (5)
- FScN 3730—Quantity Food Purchasing and Production (5)
- FScN 3740—Design and Layout of Food Services (4)
- FScN 3750—Management of Food Service and Hospitality Business Systems (3)
- FScN 3752—Food and Hospitality Operations: Application of Computer Systems to Smaller Units (4)
- AgEc 3410—Economic Organization of the Hospitality Industry (4)
- BLaw 3058—Introduction to Law, and the Law of Contracts and Agency (4)
- MIS 5100—Computer Systems Design (4)
- Mktg 3000—Principles of Marketing (4)

In consultation with the adviser, the student selects 20 credits from the following courses:

- Afro 1441—Afro-American History, Culture to 1865 (4)
- Afro 3061—Black Family (4)
- Amln 1771—Introduction to American Indian Studies (4)
- Arch 1001—Environmental Design: Man and Environment (4)

- BA 3002—Business and Society (4)
- Chic 1105—Introduction to Chicano Studies: The Beginnings (4)
- EBB 3101—Ecology: Engineers and Physical Scientists (4)
- FScN 1102—Technology of Food Processing (4)
- FScN 1500—Meat Science (4)
- FScN 3622—Food and Nutrition in the Life Cycle (4)
- FScN 3762—Hospitality Financial Management (4)
- FScN 5000—Professional Experience Program (1-6)
- FSoS 3001—Communication Skills and Interviewing Techniques: Introduction (3)
- Geog 3371—Urban Geography (4)
- Ins 3100—Risk Management and Insurance (4)
- IR 3007—Collective Bargaining Negotiations and Modern Labor Relations (4)
- Mktg 3077—Advertising and Sales Promotion (4)
- Phys 1014-1024—Introductory Physics: Concepts in Physics (8)
- Poi 1001—American Government and Politics (5)
- PubH 3004—Basic Concepts in Personal and Community Health (4)
- QA 1050—Elementary Managerial Statistics (4)
- Soc 1002—American Community (4)
- Soc 5201—Introduction to Social Psychology (4)
- (or) Psy 5201—Social Psychology (4)
- Soc 5951—Minority Group Relations (4)
- SSci 3981—Societies of the Future (4)

Hospitality Management

This area of emphasis is designed to prepare graduates to manage a wide range of facilities that provide services for the away-from-home public.

- FScN 3752—Food and Hospitality Operations: Application of Computer Systems to Smaller Units (4)
- (or) MIS 5100—Computers and Systems Design (4)
- (or) MIS 5101—Introduction to Management Information Systems (4)
- FScN 3762—Hospitality Financial Management (4)
- AgEc 3410—Economic Organization of the Hospitality Industry (4)
- BA 3002—Business and Society (4)
- BLaw 3058—Introduction to Law, and the Law of Contracts and Agency (4)
- AgEc 3101—Microeconomic Theory (4)
- Math 1131-1142—Finite Mathematics, Introduction to Calculus (10)
- (or) Math 1201-1211-1221—Analysis (15)
- Mktg 3000—Principles of Marketing (4)
- OAM 3055—Introduction to Management Sciences (4)
- QA 1050—Elementary Managerial Statistics (4)

In consultation with the adviser, the student selects 20 credits at the 3000 level and above in the areas of business and food science and nutrition.

G. Free Electives

Electives to make a total of 185 credits required for graduation.

Total Credits for Program—185

NUTRITION AND DIETETICS

This program is intended for men and women who are interested in the field of nutrition and its various applications in dietetics, public health, and nutrition science. The options in dietetics and community nutrition meet the requirements of the

Program Requirements

American Dietetic Association for membership and for internship. Students completing either option and/or a 6- to 12-month hospital or public health internship may seek employment in hospitals or community agencies.

The nutrition science option is planned for those interested in graduate study in this area. Students choosing this option should maintain a grade point average of 2.80. Employment possibilities for persons holding graduate degrees in nutrition science include college or university teaching or university or industrial research.

Students must normally complete the organic chemistry sequence by the end of their sophomore year, or will be delayed in completing the program. Transfer students who have completed organic chemistry or biochemistry courses that are not as extensive as those listed below are required to take additional courses in both fields.

The American Dietetic Association has accredited a coordinated undergraduate program in dietetics at the University. With the cooperation of Twin Cities area hospitals, this program enables qualified students to integrate an internship experience with the final 2 years of undergraduate study. Students completing the program are assured membership in the American Dietetic Association. Enrollment is limited, and interested students should apply to the director early in their sophomore year.

Program Requirements for NUTRITION AND DIETETICS

A. Communication, Language, Symbolic Systems—19 credits

- Rhet 1101-1102—Communication I, II (8)
- (or) equivalent course
- Rhet 3551—Professional Writing (4)
- (or) Rhet 3562—Scientific and Technical Writing (4)
- Math 1111—College Algebra and Analytic Geometry (5)
- Minimum of 2 additional credits selected from CLE-approved courses

B. Physical and Biological Sciences—40-41 credits

- Chem 1004-1005—General Principles of Chemistry (10)
- Chem 3301-3302—Elementary Organic Chemistry (6)
- Chem 3305-3306—Elementary Organic Chemistry Laboratory (4)
- Biol 1011—General Biology (5)
- Biol 3021—Biochemistry (4)
- BioC 5025—Laboratory in Biochemistry (2)
- MicB 3103—General Microbiology (5)
- (or) Biol 3013—General Microbiology (5)
- Phsl 3051—Human Physiology (5)
- (or) Phsl 1002—Human Physiology (4)

C. Man and Society—17-18 credits

- AgEc 1020-1030—Principles of Macroeconomics, Microeconomics (9)
- (or) Econ 1001, 1002—Principles of Macroeconomics, Microeconomics (8)
- Psy 1001—General Psychology (5)
- Soc 1001—Introduction to Sociology (4)

D. Artistic Expression—9 credits minimum

- Minimum of 9 credits to be selected from CLE-approved courses

E. Major Requirements—56-59 credits

- FScN 1600—Sociocultural Aspects of Nutrition (3)
- FScN 1602—Principles of Nutrition (4)
- FScN 3110—Food Chemistry (4)
- FScN 3112—Food Chemistry Laboratory (2)

- FScN 3403—Experimental Foods (4)
FScN 3472—Principles of Food Purchasing (4)
FScN 3622—Food and Nutrition in the Life Cycle (4)
FScN 5100—General Seminar (1)
FScN 5622—Human Nutrition (5)
FScN 5662—Clinical Nutrition (3)
FScN 5663—Clinical Nutrition Laboratory (2)
LaMP 5175, 5176—Pathology and Clinical Medicine for Allied Health Students I, II (6)
Mgmt 3001—Fundamentals (4)
4-5 additional credits in sociology or anthropology
3 credits in psychology of learning to be selected from:
 PsyF 5182—Learning and Educational Practice: The Child and Adolescent (3)
 PsyF 5183—Learning and Educational Practice: Adult Learner (3)
 HSU 5011—Instructional Skills for Health Professionals: The Teaching-Learning Process (3)
3-5 credits in statistics or computer usage to be selected from the following or in consultation with the adviser:
 Stat 1051—Introduction to Ideas of Statistics (4)
 Stat 3081—Experimental Techniques and Statistical Inference (5)
 Stat 5021—Statistical Analysis I (5)
 Soc 3801—Sociological Methods I: Descriptive Statistics (5)
 PsyF 5110—Introductory Statistical Methods (3)
 PubH 5404—Introduction to Biostatistics and Statistical Decision (4)

F. Areas of Emphasis

In addition to the course requirements specified above, each student must select one of the five following areas.

General Dietetics

- FScN 3730—Quantity Food Purchasing and Production (5)
FScN 3750—Management of Food Service and Hospitality Business Systems (3)

Therapeutic and Clinical Dietetics

The requirements for this option are met by the general program listed above. Additional courses in anatomy, genetics, and physiology are recommended.

Community Nutrition

- FScN 1700—Introduction to Hospitality and Food Service Management (2)
FScN 3642—Community Nutrition (3)
PubH 5380—Applied Human Nutrition (3)
One additional course in food service management to be selected by adviser and student

Coordinated Undergraduate Program in Dietetics

The basic curriculum is similar to that described in requirements A through E above. However, it also includes field experience courses in which didactic and clinical phases of instruction are coordinated. A detailed plan of the coordinated program may be obtained from the Department of Food Science and Nutrition.
FScN 5664—Field Experience in Clinical Nutrition (18)

Program Requirements

Nutrition Science

Students who want a nutrition science emphasis or who are considering graduate study may, after consultation with the adviser, substitute up to 20 credits from the courses listed below for an equivalent number of major course requirements. This option is intended primarily to provide preparation for graduate studies and does not meet the American Dietetic Association requirements for internship.

BioC 5751, 5752, with BioC 5745
Chem 1006, 3100, 3303, 5520, 5521
Math 1142 or 1201, 1211, 1221
10-15 credits of college physics

G. Free Electives

Electives to make a total of 185 credits required for graduation.

Total Credits for Program—185

Resource and Community Development

This program prepares students for careers in resource development: community development; public land use; rural and urban zoning; conservation; recreation; resource economics and sociology; environmental design; landscape architecture; and related areas.

Students completing majors in the program can seek positions with federal, state, county, and local planning, administrative, and management agencies as well as with private landscape architecture planning, banking, recreation, and research organizations. The training offered by the different majors also prepares students for continued study at the graduate level.

The program is offered at the institute level, relying on an interdisciplinary effort, in an endeavor to focus the complementary disciplines of agriculture and forestry on planning and administrative training. It relates the traditional specialties of applied resource development and management as well as the social and economic specialties to expanding contemporary needs. In addition to a selected specialty, students acquire a broad background in supporting areas.

In certain cases, the specific programs may not meet the needs of the student. In this event, the student, in consultation with her or his adviser, may develop a program of special interest in combination with supporting areas such as rural sociology, soil science, or agricultural engineering. Other circumstances may dictate an even broader program where no specialty is selected but a coherent individualized program in administration and/or planning is developed.

ECONOMICS OF PUBLIC SERVICES

This program is designed to prepare graduates for positions as economic policy analysts, planners, and administrators in regional, state, and local government and in private firms. The curriculum focuses on the economics of financing, providing and utilizing public goods and services, and the efficiency and distributive effects and organizational consequences of activities of the public sector. It offers the opportunity to develop specialized areas of emphasis in housing, municipal services, delivery of health services, education, transportation, regional and community development, or other areas of consumer interest in which important public concerns are asserted. The program is designed to provide technical competencies in applied economic analysis with supporting course work and experience in general fields such as public administration, political science, sociology, geography, and business administration as well as in technical fields of individual student interest such as health, education, transportation, housing, or others.

**Program Requirements for
ECONOMICS OF PUBLIC SERVICES**

A. Communication, Language, Symbolic Systems—29 credits

- English, Communication (8)
Rhet 1101, 1102
- Public Speaking (8)
Rhet 1222, 3254, or 3266
- Professional Writing (4)
Rhet 3551 or 3562
- Quantitative Analysis (9)
Math 1111
QA 1050
(or) Stat 1051
- Recommended:
Math 1142 or 1211-1221
Stat 5021-5022
Econ 3251
AgEc 5020

B. Physical and Biological Sciences—19 credits

- Chemistry (10)
Chem 1001-1002
- Biology (9)
Biol 1011
EBB 3004
- Recommended:
Biol 1103 or 1106
Geol 1001, 1007
Phys 1014, 1015, 1024, 1025
Soil 1122

C. Man and Society—29-35 credits

- Sociology (4)
Soc 1001 or 1651
- Other social sciences (9-13)
Psy 1001
Arch 5137 (or) Geog 5001-5002 or 5372-5373
- Plus four courses from the following (16-18):
Geog 3101, 3331
PA 5151
Pol 1001, 1027, 1031, 3561
Soc 3505

D. Artistic Expression—8 credits

See CLE list of suggested courses in section III of this bulletin

E. Economics and Accounting—22-25 credits

- AgEc 1020-1030
- AgEc 1250 (or) Acct 1050-1051
- AgEc 3101-3102 (or) Econ 3101-3102

F. Major—34-36 credits

- Economics and Planning of Public Services (22-24)
AgEc 3900, 3640, 3610

Program Requirements

- PA 3101
- RCD 5099, 5100, 5101
- Plus 12 credits from the following:
 - AgEc 3290 (or) Mgmt 3001
 - AgEc 5600 or 5610
 - AgEc 5620, 5630, 5640, 5650, 5660
 - RCD 3010, 5200

G. Electives—40-51 credits

Recommended are unused courses from item F above and Econ 3131, 3651, 3701, 3851, 5611, 5621, 5661; PA 3101, 5502, 5503, 5151; GC 3586; Geog 3371, 5375, 5376, 5383; and other courses in agricultural economics, business administration, economics, geography, mathematics, political science, psychology, public affairs, sociology, and statistics.

Special Areas of Emphasis

During the junior and senior years students take four to five courses in a specialized area of emphasis such as transportation, health policy and health care delivery, regional and community development, housing, or the economics of education. An example of courses in one possible area of emphasis, transportation, would be Tran 3054, 3084, 5195; Econ 5661; and Geog 5381.

Total Credits for Program—192

RESOURCE ECONOMICS

The objectives of this program are to provide a curriculum of basic natural and social sciences along with useful analytic techniques as preparation for employment in extension services, the Soil Conservation Service, planning commissions, and other public and private agencies involved with resource and community development activities. Students completing the program may also enter graduate programs in agricultural economics, resource economics, resource development, regional economics, or planning.

Program Requirements for RESOURCE ECONOMICS

A. Communication, Language, Symbolic Systems—30 credits

- English Communication (8)
 - Rhet 1101, 1102
- Public Speaking (8)
 - Rhet 1222 and 3254 or 3266
- Professional Writing (4)
 - Rhet 3551
- Mathematics (10)
 - Math 1111, 1142; or 1201, 1211, 1221 (preferred)

B. Physical and Biological Sciences—32-33 credits

- Chemistry (10)
 - Chem 1004, 1005
- Biology (14)
 - Biol 1011 and 1103 or 1106
 - EBB 3004
- Physics, or Geology and Soils (8-9)
 - Phys 1014, 1015, 1024, 1025, (or) Geo 1001 and Soil 1122

C. Man and Society—21 credits

Sociology (4)

Soc 1001 or 1002

Agricultural Economics (9)

AgEc 1020, 1030

Other social sciences (8)

Social science courses other than in sociology, agricultural economics, or economics

D. Artistic Expression—8 credits

See CLE list of suggested courses in section III of this bulletin.

E. Resource Economics—40 credits

Agricultural Economics (20)

AgEc 1250 may not count toward this requirement; no more than one marketing course beyond AgEc 1400 may count toward this requirement; AgEc 5600, 5620, 5630, 5640, and 5650 are strongly recommended for those who qualify.

Economics (16)

AgEc 3101, 3102 (or) Econ 3101, 3102; AgEc 3640 or 5640 (or) Econ 5821 and one other course

Planning (4)

Arch 5137

F. Techniques of Analysis—17-19 credits

Statistics (8)

Stat 5021, 5022

Other (9-11):

Courses chosen from among the following: Geog 3511, 3531, 5511; AgEc 1250, 1400; Law 5003; Stat 5201, 5302; Math 1231, 3211, 3221; Phil 1001; RCD 5200

G. Resource and Community Development—15 credits

AgEc 3610

Soc 5651

RCD 3010, 5100, 5101

H. Electives—26-30 credits

Recommended courses: Soc 5301, 5401, 5651, 5661; Pol 5315, 5327, 5328; Geog 3343, 5372, 5373, 5381, 5391; Law 5201, 5215, 5221; PubH 3151, 5002, 5151; FRD 1201, 5200, 5212, 5250; AgEn 3410; Geo 1001; RCD 5110, 5200; Soil 1122; EBB 3001; FW 3050; PA 5151, 5550; other courses in agricultural economics, mathematics, economics, and statistics.

Total Credits for Program—192

RECREATION RESOURCES MANAGEMENT

The general objectives of the program are:

1. To educate recreation resource specialists for recreation resource planning and management involving land and water areas.
2. To provide necessary background for participation in expanding state, regional, and federal resource-oriented recreation programs as well as for private planning consultant employment.

Program Requirements

3. To prepare students for graduate work in resource planning and management through forestry, agricultural economics, and other fields of study.

While some students may terminate their study with this undergraduate program, it is primarily designed to attract students motivated toward and capable of graduate work. To enter the recreation resource management program, students should apply to the College of Forestry for admission and advising.

Program Requirements for RECREATION RESOURCE MANAGEMENT

A. Communication, Language, Symbolic Systems—34 credits

- English, Communication (8)
 - Rhet 1101, 1102
- Public Speaking (4)
 - Rhet 1222
- Professional Writing or Scientific and Technical Writing (4)
 - Rhet 3551 or 3562
- Discussion Methods or Advanced Public Speaking (4)
 - Rhet 3254 or 3266
- Mathematics (10)
 - Math 1111 or 1131 or 1201 and 1142 or 1211
- Statistics (4)
 - Stat 5021 (or) Soc 3801

B. Physical and Biological Sciences—48 credits

- Chemistry (10)
 - Chem 1004, 1005
- Biology (5)
 - Biol 1011
- Botany (5)
 - Biol 1103
- Ecology (7)
 - EBB 3004, 5014 or 5016
- Physics (5)
 - Phys 1031
- Geology (5)
 - Geo 1001
- Forestry (7)
 - FR 1100 (4)
 - FR 1201 (3)
- Soils (4)
 - Soil 1122

C. Man and Society—36 credits

- Sociology (8)
 - Soc 1001
 - Soc 5401 or 5651 (or) Jour 5501
- Economics (9)
 - AgEc 1020, 1030
- Geography (5)
 - Geog 1401 or 1301
- Recreation (5)
 - Rec 3530 or 5150

Psychology (5)
 Psy 1001
Political Science (4)
 Pol 1027 or 1031 or 1041

D. Artistic Expression—8 credits

Horticulture (4)
 LA 1001 or 1024
See CLE list of suggested courses in section III of this bulletin.

E. Recreation Resource Management—14 credits

Forestry (10)
 FR 5232, 5233
 FR 5257 or 5259
Fisheries and Wildlife (4)
 FW 3052

F. Technical Background—12 credits¹

Surveying (4)
 AgEn 1400
Hydrology (4)
 AgEn 3410
Aerial Photogrammetry (4)
 FR 5200

G. Resource and Community Development—14 credits

AgEc 3610 or 5620
RCD 5099, 5100, 5101

H. Electives—26 credits

Total Credits for Program—192

SOIL AND WATER RESOURCE MANAGEMENT

The objective of this program is to prepare students for careers in the management and use of soil and water resources. Employment possibilities exist for soil and water specialists in rural, urban, and recreational planning; conservation; land appraisal; and other fields involving interpretation and use of soil and water information. Students in this program may have an adviser in either the Department of Soil Science or Department of Agricultural Engineering.

Program Requirements for SOIL AND WATER RESOURCE MANAGEMENT

A. Communication, Language, Symbolic Systems—21 credits

English, Communication (8)
 Rhet 1101, 1102
Professional Writing or Scientific and Technical Writing (4)
 Rhet 3551 or 3562
Public Speaking (4)
 Rhet 1222
Mathematics (5)
 Math 1111 or 1131

¹Students with a grade of C or better in high school mechanical drawing are exempt from AgEn 1010, Technical Drawing; others must take AgEn 1010. Students with a grade of C or better in high school trigonometry are exempt from Math 1008, Trigonometry; others must take Math 1008.

Program Requirements

B. Physical and Biological Sciences—37 credits

- Chemistry (10)
Chem 1004, 1005
- Biology (10)
Biol 1011, 1103
- Ecology (3)
EBB 3004
- Physics (5)
Phys 1031
- Geology (5)
Geo 1001
- Soils (4)
Soil 1122

C. Man and Society—18 credits

- Economics (9)
AgEc 1020, 1030
- Geography (5)
Geog 1401
- Social Science (4)
Soc 1001 or 1002

D. Artistic Expression—8 credits

See CLE list of suggested courses in section III of this bulletin.

E. Resource and Community Development—21 credits

- AgEc 3610 (4)
- RCD 1010, 3010, 5099, 5100, 5101 (17)

F. Specialized Courses—43 credits

- Drawing (3)
AgEn 1010
- Surveying (4)
AgEn 1400
- Agricultural Engineering (12)
AgEn 3410, 3800, 5400
- Civil Engineering (4)
CE 5420
- Soil Science (16)
Soil 3210, 3220 or 5232, 5512, 5540, 5240 or 1262
- Forestry (6)
FR 5200, 5232

G. Electives—44 credits

Soil 5232, 5310, 5520, 5550; Geo 5261, 5601; Geog 3344, 5444; AgEn 1030, 5810; Hort 1024, 3026; Ent 5400; EBB 5014; RCD 5110, 5200. Other courses with consent of instructor.

Total Credits for Program—192

LANDSCAPE ARCHITECTURE

Department of Horticultural Science and Landscape Architecture

Landscape architecture is concerned with the impact, disposition, and management of natural resources as well as the quality of experience that results from the development of land for specific human use.

The landscape architect is involved with a wide range of activities: large-scale regional landscape planning; design of exterior environments for working, living, and recreation; commercial, institutional, and industrial development; transportation systems; and multiple-use areas. These activities may vary in scale from single family residences to regional open space systems. Professional services include land use feasibility studies, site selection studies, site layout proposals, detail grading, and construction drawings and plantings plans.

Regional landscape planning and design, recreation planning and design, urban landscape design, and detail site planning projects involve interdisciplinary involvement between landscape architects, architects, planners, engineers, geographers, physical scientists, social scientists, and others in related professions. The relationship between regional or single site qualities of terrain, soil, climate, vegetation, orientation, visual quality, and the program for development must be studied carefully to assure sound recommendation.

Bachelor of Landscape Architecture (B.L.A.)—This 3-year program is offered jointly by the College of Agriculture and the Institute of Technology. The program focuses on understanding the design process and developing skill in its application. It provides basic professional training for the practice of landscape architecture and allows for exploration of one or more areas of professional interest. The professional degree bachelor of landscape architecture is awarded upon completion of the program.

A total of 230 credits is required for graduation. Of this total, 130 credits are in the upper division. The program includes a design course sequence taking a minimum of 3 years. During the second year, students, through consultation with their adviser, elect two of four areas of specialized focus options. These options are described below.

Site Planning and Design—This option focuses on developing small-scale land areas for intensive human use. Studies are directed toward analyzing microenvironmental determinants and human interactions in the detailed environment. From these analyses the potential subtleties of site organization are explored.

Urban Landscape Design—This option focuses on the organization of urban environments. Studies are directed toward exploring the potential input of a designer trained in the development or urban systems such as open space, housing, commercial and industrial, and transportation.

Regional Resource Planning and Design—This option focuses on the organization of large-scale land areas and analysis of their development potential in terms of land use. Students prepare analyses, explore interdisciplinary links, and develop other special skills related to regional planning. Computer-assisted approaches to regional analysis and design are explored.

Recreational Planning and Design—This option focuses on the broad aspects of recreation land use and site design in today's society. Students are urged to explore new concepts of recreation and to analyze these in terms of physical development for human use. Large-scale to small-scale design problems are explored.

It is recommended that all students complete a minimum of 800 hours of practical work experience outside of classwork. At least 400 of these hours should be spent in landscape construction or in a landscape nursery and 400 hours in an office of a professional landscape architect.

Bachelor of Environmental Design (B.E.D.)—This nonprofessional degree program is offered only through the Institute of Technology. The program allows the student to explore a broad range of environmental courses as well as complete 2

Program Requirements

years of professional courses in landscape architecture. Upon completion of the B.E.D. degree requirements, a student may continue on for the professional B.L.A. degree, enter a professional master's degree program, or transfer into another discipline such as city design, city and regional planning, or the social and natural sciences.

A total of 192 credits of course work is required for the B.E.D. degree. It is strongly recommended that the student also complete 400 hours of summer work in landscape architecture. Individual study programs that depart from the basic curriculum may be proposed to and accepted by the faculty.

In both degree programs, each course required in the curriculum must be passed with a minimum grade of C. Courses in the pre-landscape architecture and pre-environmental design programs are considered part of the respective curricula.

Admission Procedures

To enter the landscape architecture program, students must submit an application. Admission to the program is permitted only in the fall quarter, unless advanced standing is granted. The deadline for submitting an application is May 1 of the year of desired entry. The admission procedure and requirements are as follows:

1. Apply to the University of Minnesota if not already a University student. Forms may be obtained from the Office of Admissions and Records, 240 Williamson Hall, 231 Pillsbury Drive S.E., University of Minnesota, Minneapolis, Minnesota 55455; or the Office of Admission and Records, 130 Coffey Hall, 1420 Eckles Avenue, University of Minnesota, St. Paul, Minnesota 55108.
2. Before an application will be considered, a student must have completed a minimum of 75 credits, including the quarter of current enrollment. This total must include at least 8 credits in basic English or communications, 10 credits in physical and biological sciences, 6 credits in social sciences, 12 credits in studio arts or design, and 8 credits in landscape architectural, environmental, or design theory.
3. Complete the landscape architecture program application form (available from the Department of Horticultural Science and Landscape Architecture, 305 Alderman Hall, St. Paul campus; the School of Architecture and Landscape Architecture, 110 Architecture, Minneapolis campus; or either Office of Admissions and Records identified above).
4. Submit a letter of intent stating the reasons for selecting landscape architecture as a profession. This letter, generally consisting of one or two pages, should give an account of the student's reasons for becoming interested in the field, experience in landscape architecture or related fields (art, horticulture, architecture, engineering, construction, etc.), experience or participation in other interests (travel, hobbies, avocations, etc.), and perception of herself or himself in the role of a landscape architect.
5. Submit an official transcript of all college work completed to date at the University of Minnesota or other colleges. Generally, a student must have a 2.50 grade point average for admittance.
6. Submit a portfolio of art or design work, environmental or design reports, photographs of sculptural work, slides, or similar examples of creative work. It is suggested that the portfolio be a bound 8½-inch by 11-inch booklet. No portfolio will be accepted that is larger than 24 inches by 36 inches. Material not enclosed in a carrying case is unacceptable. Any slides must be in an 8½-inch by 11-inch transparent slide carrier. It is recommended that the student bring the portfolio to the interview with the faculty member also.

7. Interview or correspond with at least two landscape architecture faculty members prior to the May 1 application deadline. Specific times for interviews should be set up with the individual instructors. The interview or correspondence is used to judge the student's commitment to finish the landscape architecture design program and to determine the student's enthusiasm for landscape architecture and sensitivity to people and the environment. It allows the student to demonstrate his or her design, communication, and organizational skills. From the interview the faculty will judge the student's insight into landscape architecture, maturity, dedication and sincerity, self-confidence, demonstrated design abilities, and self-realization potential.

Applicants are encouraged to visit the design studios and talk to students who are in the program and to find out as much as they can about the profession.

The landscape architecture faculty votes on each applicant. The applicant is either admitted to the program, rejected, or assigned a pre-landscape architecture status. Approval for admission is based on consideration of the following:

1. The student's academic standing and GPA.
2. The student's maturity and experience.
3. The student's letter of intent.
4. The estimated design potential of the student.
5. The availability of staff and space.

Students admitted to the landscape architecture program will be notified by letter of their acceptance not later than June 1. Students who are accepted must notify the program chair of their intention to attend by July 1, or the place will be forfeited. Those not accepting the opportunity must reapply to gain entry into the program.

Program Requirements for PRE-LANDSCAPE ARCHITECTURE

(College of Agriculture and Institute of Technology)

BACHELOR OF LANDSCAPE ARCHITECTURE

Core Course Requirements—100 credits

Communications (16)

Basic Composition (8)¹

Speech (4)¹

Writing (4)¹

Mathematics (three courses or 12 credits in mathematics, statistics, or computer information)¹

Physical and Biological Science (18)¹

Social Sciences (12)¹

Humanities Areas (8)¹

Studio Arts (12)¹

Landscape Architecture Theory (12)

LA 1001—Environmental Design: Man and Environment (4)

LA 1002—Environmental Design: Tools and Progresses (4)

LA 1031—Introduction to Landscape Architecture (4)

¹Courses should be selected, in consultation with an adviser, to complete the Council on Liberal Education requirements as defined by each college.

Program Requirements

- Landscape Architecture Technology (10)
AgEn 1400—Surveying (3-4)
PO 1001—How to Study (2)
Soil 1122—Introduction: Soil Science (4)

Following substantial completion of the above requirements, the student must apply for admission to the program before May 1 of the year of desired entry.

Program Requirements for LANDSCAPE ARCHITECTURE

(College of Agriculture and Institute of Technology)

Core Course Requirements—90 credits

- Landscape Architecture (82)
LA 1022—History of Environmental Development: Landscape Architecture (4)
LA 1024—Landscape Theory (4)
LA 1025—Basic Visualization (4)
LA 3071—Landscape Technology: Ground Form Design (4)
LA 3072—Landscape Technology: Circulation and Utilities Design (4)
LA 3081—Basic Design (6)
LA 3082—Basic Design (6)
LA 3083—Basic Design (6)
LA 3091—Intermediate Design (6)
LA 3092—Intermediate Design (6)
LA 3093—Detail Site Design (6)
LA 3101—Communicating Landscape Quality (4)
LA 5110—Advanced Landscape Planning and Design (6)
LA 5115—Theory of Landscape Form and Structure (4)
LA 5116—Theory of Landscape Form and Structure (4)
LA 5124—Landscape Architecture Seminar (4)
LA 5226—Professional Practice (4)
- Horticulture (8)
Hort 1021—Plant Materials I (4)
Hort 1022—Plant Materials II (4)

Design Option and Option Support Requirement¹—28 credits

Elective Requirements¹—16 credits

Program Requirements for PRE-LANDSCAPE ARCHITECTURE (Institute of Technology Only)

BACHELOR OF ENVIRONMENTAL DESIGN

Core Course Requirements—84 credits

- Basic Composition (8)¹
Math 1211, 1221, 1231
Biology and Botany (10)¹
Physical Geology (5)¹
Physical Geography (5)¹
Art History 1001

¹Courses should be selected, in consultation with an adviser, to complete the Council on Liberal Education requirements as defined by each college.

Art, Studio 1107, 1108, 1109
Landscape Architecture 1001, 1002, 1003, 1021, 1022, 1023
Soil Science 1122
AgEn 1400 (or) CE 3100

Elective Requirements¹—12 credits

Following substantial completion of the above requirements, the student must apply for admission to the program before May 1 of the year of desired entry.

**Program Requirements for
LANDSCAPE ARCHITECTURE**
(Institute of Technology only)

Core Course Requirements—72 credits

Landscape Architecture (60)
LA 1025—Basic Visualization (4)
LA 3071—Landscape Technology: Ground Form Design (4)
LA 3072—Landscape Technology: Circulation and Utilities Design (4)
LA 3075—Landscape Technology: Materials and Construction Design (4)
LA 3081—Basic Design (6)
LA 3082—Basic Design (6)
LA 3083—Basic Design (6)
LA 3091—Intermediate Design (6)
LA 3092—Intermediate Design (6)
LA 3093—Detail Site Design (6)
LA 3101—Communicating Landscape Quality (4)
LA 5115—Theory of Landscape Form and Structure (4)
LA 5124—Landscape Architecture Seminar
Horticulture (8)
Hort 1021—Plant Materials I (4)
Hort 1022—Plant Materials II (4)
Ecology (4)¹

Elective Requirements¹—24 credits

CURRICULA RELATING TO AGRICULTURE

Agricultural Engineering

Professional 4-Year Curriculum—A professional 4-year curriculum leading to the degree of bachelor of agricultural engineering, B.Ag.E., is offered jointly with the Institute of Technology. Students register in the Institute of Technology. Emphasis in the curriculum is on physical sciences and engineering design, but economics, agricultural science, and other subjects are included. The objective is to prepare students for careers in developing and applying new and improved machines, structures, and systems for expanding production of crops and livestock in the US and abroad; for reducing the dependence of agriculture on labor, and for using soil, water, and energy resources wisely.

For additional information, write to the Department of Agricultural Engineering, 213 Agricultural Engineering, 1390 Eckles Avenue, University of Minnesota, St. Paul, Minnesota 55108.

Curriculum and course details are printed in the *Institute of Technology Bulletin*.

¹Courses should be selected, in consultation with an adviser, to complete the Council on Liberal Education requirements as defined by each college.

Program Requirements

Enrichment Program in Journalism

Students with a specialization in the College of Agriculture may select one of several enrichment programs in journalism. The program selected must be approved by an adviser in agricultural journalism in the College of Agriculture. Among the programs available are:

Advertising—Jour 1001 (2), 1201 (4), 3241 (4), 5251 (4), and AgJo 3530 (4). For those wanting further depth, Jour 5261 (4) is recommended.

News-Editorial—Jour 1011 (5) or AgJo 1011 (5), 3176 (4), or 3173 (4); AgJo 3530 (4); plus electives in journalism or agricultural journalism totaling at least 10 credits.

Other specialized enrichment programs are available in science writing, broadcasting, magazine journalism, photography, public relations, and other journalism-related fields.

Enrichment Program in International Agriculture

The University of Minnesota is deeply committed to an international dimension in its training, research, and extension programs. The problems of the world's agriculture and food supply are urgent and important. Increasing numbers of students are interested in careers in international agriculture or in opportunities to expand their knowledge of agriculture outside the United States. A special enrichment program in international agriculture is offered by the College of Agriculture. A certificate in international agriculture is awarded to students completing the program.

The certificate in international agriculture is awarded upon completion of 18 credits of course work specifically related to the international dimension of agriculture. These credits may not include courses used to meet all-college or major requirements. However, courses used to fulfill CLE requirements or other electives may be used. The courses selected for the enrichment program may include some taken outside of the College of Agriculture. The program of study is designed in collaboration with a faculty member. The program must be submitted for approval by the college Scholastic Standing Committee at least 1 full academic quarter prior to graduation. Forms for submitting the program, as well as a listing of courses that deal with international agriculture, are available in the college office.

Extension Education

Students interested in work as extension agents or extension specialists may consider this option. A major may be selected in any curriculum in the College of Agriculture. In addition, the extension sequence in agricultural education can be taken to help prepare for careers in this area.

Pre-Biological Sciences

Freshman and sophomore students interested in obtaining a degree in biological sciences may complete their prerequisite work in the College of Agriculture since the College of Biological Sciences (CBS) accepts upper division students only. Freshman and sophomore students will be assisted in their program planning by an adviser in CBS and can transfer to CBS when requirements for entry are met. Pre-CBS students may apply directly to the College of Agriculture.

Pre-Veterinary Medicine

Students may complete the minimum requirements for admission to the College of Veterinary Medicine within any of the majors in the College of Agriculture, provided that they meet the requirements for admission to the College of Agriculture and are accepted into the major of their choice. Pre-veterinary medicine students will be advised by a faculty adviser in their major department and will be expected to make satisfactory progress toward completion of the degree in that major.

For detailed information concerning procedures and requirements for admission to the College of Veterinary Medicine, criteria for selection, degree programs and courses offered by the college, and related information, consult the *College of Veterinary Medicine Bulletin*, or write to the Office of Professional and Undergraduate Education, College of Veterinary Medicine, 301 Veterinary Science Building, 1971 Commonwealth Avenue, University of Minnesota, St. Paul, Minnesota 55108.





II. COURSE LISTINGS

Symbols—The following symbols are used throughout the course descriptions in lieu of page footnotes:

- * Courses in which graduate students may prepare Plan B projects.
- † All courses preceding the dagger must be completed before credit will be granted for any quarter of the sequence.
- § Credit will not be granted if the equivalent course listed after the section mark has been taken for credit.
- ¶ Concurrent registration is allowed (or required) in the course listed after the paragraph mark.
- # Consent of the instructor is required prior to registration.
- △ Consent of the division, department, or school offering the course is required prior to registration.
- x Course is offered more than 1 quarter.

Courses primarily for freshmen and sophomores are numbered 1000 through 1998; for juniors and seniors, 3000 through 3998; for juniors, seniors, and graduate students, 5000 through 5998. Courses numbered 8000 and above are restricted to students registered in the Graduate School.

A hyphen between course numbers (e.g., 3142-3143-3144) indicates a sequence of courses that must be taken in the order listed.

A comma between course numbers (e.g., 1234, 1235, 1236) indicates a series of courses that may be entered any quarter.

When no abbreviated departmental prefix precedes a course number listed as a prerequisite, that prerequisite is in the same department as the course being described.

Courses in Agriculture

Agricultural and Applied Economics (AgEc)

- 1020. PRINCIPLES OF MACROECONOMICS.** (5 cr)
Determinants of national income and employment levels; prices and money; the banking system; monetary and fiscal policy; economic growth and development; role of government in the economy.
- 1020H. HONORS COURSE: PRINCIPLES OF MACROECONOMICS.** (5 cr; prereq 3rd-qttr freshman and B avg or #)
Determinants of national income and employment levels; prices and money; the banking system; monetary and fiscal policy; economic growth and development; the role of government in the economy.
- 1030. PRINCIPLES OF MICROECONOMICS.** (4 cr; prereq 1020)
Economics of the firm and household; factor and product price determination; theory of production, consumption, and distribution; supply and demand analysis; equilibrium analysis.
- 1250. PRINCIPLES OF ACCOUNTING.** (5 cr)
Fundamentals of business accounting; basic finance concepts; use of accounting data for income tax and managerial decision making.
- 1400. AGRICULTURAL MARKETS AND PRICES.** (4 cr; prereq 1030)
Economics of agricultural marketing; factors determining prices and price trends of agricultural commodities, demand for and supply of agricultural products, and food and fiber market organization.
- 3040. ECONOMIC DEVELOPMENT OF AMERICAN AGRICULTURE.** (4 cr; prereq 1030)
Economic, political, social, and technical forces that have shaped the development of American agriculture; the role of agricultural development in national economic development in the United States; implications for presently developing countries.
- 3070. AGRICULTURE AND ECONOMIC GROWTH IN DEVELOPING COUNTRIES.** (4 cr; prereq 1020, 1030)
Agricultural development problems; the contribution of economics to analyzing these problems; the use of economics in agricultural development policy and planning.
- 3101. MICROECONOMIC THEORY.** (4 cr; §Econ 3101; prereq 1030 or Econ 1002, Math 1111 or equiv or #)
Behavior of households, firms, and industries under competitive and monopolistic conditions; factors influencing production, price, and advertising decisions.

Course Listings

- 3102. MACROECONOMIC THEORY.** (4 cr; §Econ 3102; prereq 1020, 1030 or Econ 1001 and 1002 or #)
Determinants of national income, employment, and price level; aggregate consumption, investment, and government demand; the money market; the labor market.
- 3290. AGRIBUSINESS MANAGEMENT.** (4 cr; prereq 1020, 1030 and Mgmt 3001 for agricultural business majors...3101 or # for others)
Application of economic, other social science, and technical concepts to the decision-making process of firms supplying inputs to agriculture or processing and distributing agricultural products.
- 3410. ECONOMIC ORGANIZATION OF THE HOSPITALITY INDUSTRY.** (4 cr; prereq 1020, 1030, Mktg 3000 or #)
Principles of economics applied to markets and firms serving people away from home, including food, lodging, travel, recreation, health care, and related activities.
- 3420. GRAIN MARKETING ECONOMICS.** (3 cr; prereq 1400)
Economic relationships in the marketing of grain and grain products; analysis of supply and demand; grain grades, storage, and transportation; market structure, channels, pricing and competition; government programs and policies.
- 3430. DAIRY MARKETING ECONOMICS.** (3 cr; prereq 1400)
Economic relationships in the marketing of milk and milk products; analysis of supply and demand; market structure, channels, pricing and competition; federal milk market price regulations; dairy programs and policies.
- 3440. LIVESTOCK MARKETING ECONOMICS.** (3 cr; prereq 1400)
Economic relationships in the marketing of livestock and livestock products; analysis of supply and demand; livestock grades, inspection and transportation; market structure, channels, pricing and competition; government regulations and policies.
- 3500. FARM AND AGRIBUSINESS FINANCE.** (5 cr; prereq 1030, 1250 or Acct 1050 or equiv)
Financing and investment policies for farm and agribusiness firms with reference to effects on liquidity, solvency, and profitability. Introduction to financial intermediaries in agriculture.
- 3610. COMMUNITY RESOURCE DEVELOPMENT.** (4 cr; prereq 1020-1030 or Econ 1001-1002 or #)
Basic concepts of resource use including physical and economic classifications; physical and economic feasibility; benefits and costs; external effects; cost sharing; selected resource use problems. Economic areas and units for planning and development; generating alternative program elements and developing consequences; problems in choosing elements for an optimum resource development program.
- 3640. PUBLIC FINANCE: CONCEPTS AND PRACTICES.** (4 cr; prereq 1020, 1030 or Econ 1001, 1002)
Survey of government revenue systems, expenditures, taxation, and debt in the United States. Federal, state, and local fiscal institutions; intergovernmental fiscal relations; budget analysis; and policy issues.
- 3710. AGRICULTURAL AND MARKET POLICIES.** (4 cr; prereq 1400 or 3101, 3102 or Econ 3101, 3102 or #)
Analysis of public problems and issues concerning U.S. agriculture and the welfare of rural residents; economic problems of the food and fiber industry and of rural residents and communities; critical appraisal of past and present public programs; economic and social implications of alternative policies and programs; political decision making in policy formulation.
- 3820. FARM MANAGEMENT ECONOMICS.** (4 cr; prereq 1030)
Introduction to the use of farm accounts in planning; application of economic principles and budgeting procedures to the development of enterprise budgets and whole farm plans; development of projected cash flows; and evaluation of investment alternatives.
- 3830. ORGANIZING THE FARM BUSINESS FOR ENTRY, GROWTH, AND TRANSFER.** (4 cr; prereq 3820)
Evaluating opportunities to gain entry into farming; selecting methods to expand the ongoing business; transfer of the farm business between generations; financial management; evaluating alternative methods of acquiring land, labor, capital, and management resources; and use of alternative forms of (legal) business organization in entry, growth, and intergeneration transfer.
- 3840. ECONOMICS FOR VETERINARY MEDICINE.** (2 cr; for veterinary medicine majors only)
Economic principles important in dealing with health problems of animals or herds, in dealing with animal production on farms, and in understanding the economy as it affects livestock production.
- 3850. FARM BUSINESS AND ENTERPRISE ANALYSIS.** (4 cr; prereq 1030...3820 recommended)
Concepts to use in selecting a record system; data requirements and procedures of analysis to provide tax information, total business enterprise.
- 3860. FARM BUSINESS PLANNING.** (3 cr; prereq 3820, #...3830 recommended)
Development of a detailed production, marketing, and financial plan for either the student's home farm or another actual farm business.
- 3900. SPECIAL TOPICS IN THE ECONOMICS OF PUBLIC SERVICES.** (1-3 cr; prereq #)
Senior seminar on topics of current interest such as: economics of income maintenance, education, transportation, health services, housing, municipal services, and others.
- 3980. CURRENT ISSUES IN AGRICULTURAL ECONOMICS.** (1-3 cr; prereq #)
Discussion and analysis of important and timely problems in agricultural economics; primarily for undergraduate AFEA debate preparation.

Agricultural and Applied Economics

- 3990. PROBLEMS OR INDEPENDENT STUDY.** (cr ar; prereq #)
Independent study, supervised reading, or research on agricultural economic problems not covered in regularly offered courses.
- 5000. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq #: not for grad cr)
Professional experience in agribusiness firms or government agencies obtained through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.
- 5020. APPLIED LINEAR PROGRAMMING.** (4 cr for undergrad, 3 cr for grad; prereq 1030 and Math 1111 or 1131)
Application of linear programming to farm and agribusiness firms. Emphasizes economic concepts using minimal mathematics. Develops skills in computer use for decision making. Profit maximization, cost minimization, and transportation analysis.
- 5120. AGRIBUSINESS MANAGEMENT AND MARKETING.** (3 cr; not open to majors in AgEc Dept; prereq 1020-1030)
Business management and marketing problems in firms and industries serving agriculture; economic interrelationships among industries supplying agriculture and those processing and distributing farm products.
- 5130. LAND RESOURCE USE.** (3 cr; not open to majors in AgEc Dept; prereq 1020-1030)
Land as a factor of production; rural and urban utilization; rents and land values; land classification; taxation; exchange; public land management.
- 5140. AGRICULTURAL PRODUCTION.** (3 cr; not open to majors in AgEc Dept; prereq 1020-1030)
Application of managerial and economic analysis to the planning and evaluation of farm firms. Use of hand procedures and computerized decision aids in obtaining credit, budgeting, and evaluating farm plans.
- 5150. AGRICULTURAL POLICY.** (3 cr; not open to majors in AgEc Dept; prereq 1020, 1030)
Application of economic analysis to agricultural price and income policy issues; development of present-day price and income programs.
- 5271. BAYESIAN DECISION MAKING.** (4 cr, \$Econ 5271, \$Stat 5271; prereq Stat 5133)
Axioms for personal probability and utility. Elements of statistical decision theory. Bayesian analysis of linear models.
- 5272. BAYESIAN DECISION MAKING.** (4 cr, \$Econ 5272, \$Stat 5272; prereq 5271, 3101 or Econ 3101)
Expected utility models for economic decisions made under conditions of uncertainty. Applications to portfolio selection, forward and futures trading, betting, contingency markets, and business planning.
- 5400. INTERMEDIATE MARKET AND PRICE ANALYSIS.** (4 cr for undergrad, 3 cr for grad; prereq 1400 or 3101 or Econ 3101 or Econ 5151)
Development of analytical models and their application in various market situations. Unique market institutions that have developed in response to marketing problems and policies.
- 5440. COOPERATIVES AND AGRIBUSINESS ORGANIZATION.** (4 cr for undergrad, 3 cr for grad; prereq 1400)
Analysis of economic problems and issues facing agricultural cooperatives, including changing market organization, financing, taxation, antitrust regulations, and others.
- 5480. FUTURES, MARKETS, AND PRICES.** (4 cr for undergrad, 3 cr for grad; prereq 1400 or #)
Economics of cash and futures trading on organized markets; futures trading theory; hedging and speculation.
- 5500. ADVANCED AGRICULTURAL FINANCE.** (4 cr for undergrad, 3 cr for grad; prereq 3500)
Analysis of financial institutions and financial markets. Managerial policy issues confronting managers of financial intermediaries with reference to those operating in an agricultural setting. Current problem confronting financial intermediaries.
- 5560. ECONOMICS OF CONSUMER POLICIES.** (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101 or #)
Impact of legislative, regulatory, and judicial policies on consumers examined for their tendency to promote efficiency, equity, consumer sovereignty and freedom of choice. Policies for dealing with information, prices, consumer protection, consumer redress, public goods, and regulatory institutions.
- 5580. ECONOMIC ORGANIZATION OF THE HOUSEHOLD.** (4 cr for undergrad, 3 cr for grad; prereq 1030 or Econ 1002; not open to agricultural economics grads)
Economic concepts applied to the analysis of household production, market and nonmarket work, family formation and size, and household consumption activity.
- 5591. CONSUMPTION ECONOMICS.** (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101)
Analytical and empirical treatment of consumer behavior. Modern adaptations of theory to explain household consumption activities.
- 5600. LAND ECONOMICS.** (4 cr for undergrad, 3 cr for grad; prereq 3101, 3102 or Econ 3101, 3102 or #)
Land as a factor of production; land use, classification, and value; sale and rental markets for land; domestic and foreign land policies.
- 5610. INSTITUTIONAL FACTORS IN LAND USE.** (4 cr for undergrad, 3 cr for grad; prereq 1020, 1030)
Public laws and administrative rules, public and private contractual arrangements, monetary and tax policies, public spending, and legal procedures that affect land use and development.

Course Listings

- 5620. REGIONAL ECONOMIC ANALYSIS.** (4 cr for undergrad, 3 cr for grad; prereq 1030 or Econ 1002)
Basic concepts and theories used and problems encountered in economic study of sub-regions, including those applicable to space and planning, population and employment change, income estimation and social accounting, industrial location, identification of planning region, intraregional and interregional analyses, planning goals, and national and regional planning programs.
- 5630. REGIONAL DEVELOPMENT SYSTEMS.** (4 cr for undergrad, 3 cr for grad; prereq 1030 or Econ 1002)
Role of market economy and public sector activities in industry location and investment. Relation of interindustry structure and trade to community economic development. Computer simulation and forecasting of alternative economic futures for regional planning.
- 5640. FINANCING STATE AND LOCAL GOVERNMENTS.** (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101)
Problems and issues in financing state and local public services in the United States. State and local revenue systems, debt, and expenditures. Intergovernmental fiscal relations. Budget analysis.
- 5650. ECONOMICS OF NATURAL RESOURCE POLICY.** (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101 or Econ 5151 or #)
The application of economic analysis, including project evaluation, to current natural resource issues. Emphasis on conservation and resource scarcity, environmental quality, population growth, and resource use issues and their implications for public policy.
- 5660. ECONOMICS OF PUBLIC SERVICES.** (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101 or Econ 5151 or #)
Introduction to the issues of finance and supply and demand for public services; pricing, producing, and financing public goods; bureaucratic decision making; actualization and optimization of policy implementation.
- 5720. ECONOMICS OF WORLD AGRICULTURE.** (4 cr for undergrad, 3 cr for grad; prereq 1020, 1030 or #)
Distribution, quality, and utilization of agricultural resources, agricultural organization and structure; location of agricultural activity; national and international agricultural policies.
- 5750. AGRICULTURAL TRADE AND COMMERCIAL POLICIES.** (4 cr for undergrad, 3 cr for grad; prereq 3101, 3102 or Econ 3101, 3102)
Patterns of trade in agricultural products; trade policies and practices of export and import nations; commodity agreements; agricultural trade policies of common market areas; negotiations and potential trade developments.
- 5790. WORLD FOOD SUPPLY PROBLEMS.** (4 cr, §PIPa 5220, §Soc 5675, §LACS 5280, §FScN 5643; prereq ag, pre-veterinary medicine, home economics, or social science majors or #...agricultural economics grads with #)
A multidisciplinary approach will examine the social, economic, and technical problems of feeding the world's growing population. Principles sought from the social and economic sciences, plant sciences, and animal sciences for their application to food problems.
- 5840. MANAGEMENT OF THE FARM BUSINESS.** (4 cr for undergrad, 3 cr for grad; prereq 3830)
Decision-making procedures under conditions of uncertainty; development of an information system to monitor and control the ongoing operation; control of crop and livestock enterprises; labor management; and cash flow management.
- 5860. ECONOMICS OF AGRICULTURAL PRODUCTION.** (4 cr for undergrad, 3 cr for grad; primarily for grads; prereq 21 cr in economics or agricultural economics)
Production economics applied to agriculture; profitable combination of production factors; comparative advantage and location of production.

FOR GRADUATE STUDENTS ONLY

(For course descriptions, see the *Graduate School Bulletin*)

- 8200-8201-8202. GENERAL SEMINAR: AGRICULTURAL ECONOMICS**
- 8205. RESEARCH METHODOLOGY IN AGRICULTURAL ECONOMICS**
- 8206. FOUNDATIONS OF APPLIED ECONOMICS**
- 8220. APPLIED MATHEMATICAL PROGRAMMING**
- 8231. AGRICULTURAL PRICES**
- 8245. AGRICULTURAL MARKETING ECONOMICS**
- 8264. RESOURCE ECONOMICS**
- 8266. APPLIED REGIONAL ECONOMICS**
- 8278. AGRICULTURAL AND ECONOMIC DEVELOPMENT**
- 8287. PRODUCTION FUNCTIONS: THEORY AND ESTIMATIONS**

- 8288. DYNAMIC PRODUCTION ECONOMICS
- 8335. SEMINAR: PRICE ANALYSIS
- 8344. SEMINAR: COOPERATIVE MARKETING
- 8345. SEMINAR: AGRICULTURAL MARKETING
- 8346. SEMINAR: LAW AND AGRICULTURAL ECONOMICS
- 8356. SEMINAR: CONSUMPTION ECONOMICS
- 8360. SEMINAR: LAND ECONOMICS AND TENURE
- 8364. SEMINAR: RESOURCE ECONOMICS AND POLICY
- 8366. SEMINAR: APPLIED REGIONAL ECONOMICS
- 8373. SEMINAR: FOOD AND AGRICULTURAL POLICY IN THE UNITED STATES
- 8378. SEMINAR: AGRICULTURAL DEVELOPMENT
- 8382. SEMINAR: FARM MANAGEMENT AND PRODUCTION ECONOMICS

Agricultural Education (AgEd)

- 1001. **INTRODUCTION TO AGRICULTURAL EDUCATION.** (1 cr; prereq #)
Orientation to employment and service in agricultural education; qualifications of teachers, survey of preparatory offerings, the program in Minnesota.
- 1010. **HISTORY AND PHILOSOPHY OF VOCATIONAL AND COMMUNITY EDUCATION.** (3 cr)
Analysis and interpretation; alternative positions involving social, economic, and related community variables.
- 3010. **ORGANIZATION AND DIRECTION OF FFA ACTIVITIES.** (2 cr)
Development of FFA leadership: vocational agriculture/agribusiness and natural resources education, youth leadership organization; integration of classroom and supervised occupational experience.
- 3021. **EDUCATION THROUGH EXTENSION METHODS.** (3 cr; prereq soph)
Role of nonschool agencies in rural and agricultural education; methods and techniques of formal and informal instruction in school and nonschool educational programs.
- 3029. **DIRECTED EXPERIENCE IN AGRICULTURAL EDUCATION.** (1-3 cr)
Observation of activities of teachers of agriculture; familiarization with the staff, curriculum, and physical facilities and equipment in a department of vocational agriculture, with opportunity to participate in the functions of a teacher.
- 3031. **STUDENT TEACHING IN AGRICULTURE.** (8 cr; prereq jr, 5028, SeEd 3155, #)
Instruction in developing individual farming programs, contacting parents, program analysis of community needs, conducting classes, community activities, Future Farmers of America, and case studies.
- 3041. **PRACTICUM: AGRICULTURAL EDUCATION TECHNOLOGY.** (1-3 cr [may be repeated for max 5 cr])
Individualized study packages of 1 credit each of technology in agriculture, horticulture, off-farm agriculture, agricultural mechanics, adult and beginning farmer programs, youth organizations, program evaluation, and visual aids.
- 5010. **HISTORY AND PHILOSOPHY OF VOCATIONAL AND COMMUNITY EDUCATION.** (3 cr)
Analysis and interpretation; alternative value positions involving social, economic, and related community variables.
- 5021. **EDUCATION THROUGH EXTENSION METHODS.** (3 cr; prereq grad student or #)
Role of nonschool agencies in rural and agricultural education; methods and techniques of formal and informal instruction in school and nonschool educational programs.
- 5023. **EXTENSION METHODS FOR DEVELOPING COUNTRIES.** (3 cr)
Extension methods to promote rapid adoption of improved agricultural practices.
- 5024. **HISTORY AND PHILOSOPHY OF EXTENSION SERVICES.** (3 cr; prereq #)
Origin, philosophy, historical development, objectives, and organizational structure of the Cooperative Extension Service including agriculture, home economics, 4-H programs and community development work.
- 5025. **EXTENSION PROGRAM DEVELOPMENT.** (3 cr)
Planning, implementing, and evaluating the program development process.
- 5026. **EXTENSION ADMINISTRATION.** (3 cr; prereq #)
Administration of the Cooperative Extension Service organization at the county, area, and state levels.

Course Listings

- 5027. PRACTICUM: EXTENSION EXPERIENCES.** (2-6 cr [max 6 cr])
Observation of activities of county extension staff; familiarization with staff, program planning and development, county committee, youth activities and office activities, with opportunity to participate in function of an extension educator.
- 5028. TEACHING METHODS IN AGRICULTURAL EDUCATION.** (5 cr; prereq SeEd 3155 or fSeEd 3155)
Methods utilized in teaching agriculture in public schools; use of media, principles of learning, problem solving, test construction, classroom management, and specific practice in problem-solving teaching techniques; use of competency-based individualized instruction as a media for course presentation and a model for teaching methods.
- 5032. HIGH SCHOOL CURRICULUM IN AGRICULTURE.** (3 cr; prereq 10 cr education)
Philosophy, organization, and administration of instruction in agriculture departments in secondary schools.
- 5034. PROCEDURES IN TEACHING AGRICULTURE.** (3 cr; prereq #)
New developments in methodology; assessment of innovations and procedures; consideration of various levels of instruction.
- 5035. METHODS AND PRACTICES IN TEACHING POST-HIGH SCHOOL AGRICULTURE.** (3 cr)
Problems unique to area school and junior college teaching; improving ability to organize and present subject matter.
- 5041. WORKSHOP: AGRICULTURAL EDUCATION TECHNOLOGY.** (1-6 cr [max 6 cr])
New understandings, techniques and materials in animal science, plant science, horticulture, soil science, agricultural mechanics, forestry, natural resources, youth organization, visual aids, and occupational exploration.
- 5049. AGRICULTURAL EDUCATION FOR ADULTS.** (5 cr)
Methods, organization, and implementation of systematic education programs for beginning and established farmers; organization of local programs to meet needs of production agriculture in areas of enterprises, agricultural mechanics and management; developing a continuing program, observations.
- 5051. ENTERPRISE ANALYSIS.** (3 cr; prereq #)
Analyzing farm business as basis for identifying problems; planning learning experiences to improve farm management at high school, young farmer, and adult levels.
- 5052. FARM BUSINESS MANAGEMENT EDUCATION.** (3 cr; prereq 5049 or #)
Administration, organization, and operation of farm business management education programs for adults; development and utilization of curriculum materials based on farm business record data.
- 5061. PROGRAM PLANNING AND EVALUATION** (3 cr; prereq sr)
Developing program of agricultural education in community school, integration with total school program, administrative relationships, techniques and use of program evaluation in planning.
- 5071. SUPERVISED OCCUPATIONAL EXPERIENCES IN AGRICULTURE.** (3 cr)
Organization and administration of an occupational experience program in agriculture for high schools and area schools.
- 5072. PRACTICUM: AGRICULTURAL BUSINESS AND INDUSTRY.** (1-3 cr per qtr [max 9 cr])
Observation, study, and experience in agricultural business and industry; application to educational problems in agriculture.
- 5080. ORGANIZATION AND MANAGEMENT.** (3 cr; prereq #)
Administrative structure and function of subcollegiate programs.
- 5081. CURRENT ISSUES FOR THE BEGINNING AGRICULTURE TEACHER.** (1-3 cr [max 3 cr]; prereq #)
Teaching methods, organizing learning resource materials, managing classroom and laboratory learning activities, curriculum planning and organization, managing discipline situations, school and community relationships for the beginning teacher.
- 5084. CURRICULA FOR CAREER EXPLORATION IN AGRICULTURAL OCCUPATIONS.** (3 cr)
Analysis and evaluation of material; criteria for selection of material; content, organization, resource activities, and teaching techniques.
- 5085. CAREER DEVELOPMENT IN AGRICULTURAL EMPLOYMENT.** (3 cr)
Methods and materials in teaching career development for agricultural industries.
- 5090. INDEPENDENT STUDY.** (1-3 cr; prereq sr or #)
Topics chosen to permit study of areas within education or to supplement areas of inquiry not provided in the regular course structure.
- 5095. INDEPENDENT STUDY.** (3 cr; prereq MEd candidate in agricultural education)
Preparation of a paper dealing with studies in agricultural education applied to professional responsibilities.
- 5128. METHODS OF TEACHING.** (3 cr; prereq non-agricultural education major and/or #)
Methods of teaching agriculture or related subjects; developing competencies in planning, organizing, implementing, and evaluating instruction, with practice in instructional techniques.

- 5129. CURRICULUM PLANNING.** (3 cr; prereq 5128 or ¶5128...non-agricultural education major and/or #)
Methods and procedures in planning a curriculum to teach within a specific subject matter area; curriculum construction in the subject matter field for use in native country setting.
- 5130. EFFECTIVE TEACHING IN A COLLEGE OF AGRICULTURE.** (3 cr; prereq 1 yr grad study in agriculture or #)
Various approaches to effective teaching in a college of agriculture. Development of a personal philosophy of teaching; practice in employing several types of instructional improvement activities. Intended primarily for the graduate student who plans to teach in a college of agriculture.

FOR GRADUATE STUDENTS ONLY

(For course descriptions, see the *Graduate School Bulletin*)

- 8001.* RESEARCH IN AGRICULTURAL EDUCATION**
- 8010. CURRENT ISSUES IN AGRICULTURAL EDUCATION**
- 8020. SEMINAR: AGRICULTURAL EDUCATION**
- 8091. FIELD PROBLEMS**
- 8303. SEMINAR: GRADUATE STUDIES REVIEW**

Agricultural Engineering (AgEn)

COURSES IN AGRICULTURAL ENGINEERING TECHNOLOGY

- 1010. TECHNICAL DRAWING.** (4 cr; 2 lect, 4 lab hrs, 2 lab hrs ar per wk)
Drafting instruments and their uses. Lettering, scale reading, conventional symbols, tracings, and reproductions. Multiview drawings, pictorial drawings, plats of surveys, and contour maps.
- 1015. BASIC ARCHITECTURAL DRAWING.** (4 cr; 2 lect, 4 lab hrs, plus 2 lab hrs ar per wk)
Fundamental principles of architectural design for residences. Preparation of working drawings. Site selection, construction details, and overall planning as related to interior design.
- 1020. AGRICULTURAL SHOP—METALWORK.** (4 cr; prereq Chem 1004 or #; 2 lect and 6 lab hrs per wk)
Arc and oxyacetylene welding, soldering, use and conditioning of metalworking tools, and identification and characteristics of metals used in farm machinery.
- 1030. INTRODUCTION TO COMPUTER PROGRAMMING.** (3 cr; prereq Math 1111; 3 hrs per wk)
Elementary computer programming in BASIC. Use of teletype for input-output. Demonstrations and laboratory exercises in elementary problem solving. Elements of computer organization.
- 1090. DIRECTED STUDIES IN AGRICULTURAL ENGINEERING.** (Cr ar)
Independent study of topic(s) involving physical principles as applied to agricultural production and land resources.
- 1400. SURVEYING.** (3 cr [4 cr with #]; prereq Math 1008)
Basic principles of plane surveying; measurement of horizontal distances; leveling; measurement of angles and directions; traverse and stadia surveying; plane table surveys; contours; land descriptions; land surveying and legal aspects. Lectures and laboratory.
- 3010. ARCHITECTURAL DRAFTING.** (4 cr; 2 lect, 4 lab hrs, 2 lab hrs ar per wk)
Construction principles of architectural details for wood frame structures. Preparation of full set of working drawings of residence. Consideration of site selection, construction details and overall planning.
- 3091. SPECIAL PROBLEMS IN AGRICULTURAL ENGINEERING.** (2-5 cr; prereq #)
Individual study of topics in agricultural engineering. Application of physical principles to agricultural production.
- 3205. POWER AND POWER USE.** (4 cr; prereq Math 1111, Phys 1031; 3 lect and 3 lab hrs per wk)
Internal combustion engine. Principles including elementary thermodynamics of two- and four-cycle engines, ignition, and carburetion. Electric power principles for selection. Power transmission including direct drive, fluid couplers and hydraulic motors, belts and chain.
- 3215. MACHINERY AND EQUIPMENT.** (4 cr; prereq Math 1111, Phys 1031; 3 lect and 3 lab hrs per wk)
Mechanics of operation of field machines for tillage, planting, and harvesting and of structural equipment for materials handling. Utilization performance criteria, safety features, and selection processes.
- 3410. HYDROLOGY, WATER CONTROL.** (4 cr; prereq Math 1111, Phys 1031, Soils 1122; 3 lect hrs, 1 hr rec per wk)
The hydrologic cycle—precipitation, infiltration, evaporation, surface runoff. Water table variations, sub-surface runoff. Flow in open channels, flow measurement. Watershed runoff, floods. Sediment sources, erosion, and sediment control. Water control on a watershed basis.

Course Listings

- 3605. FRAME BUILDING CONSTRUCTION.** (4 cr; prereq Math 1111, Phys 1031; 3 lect and 3 lab hrs per wk)
Principles of light frame construction with emphasis on farm buildings. Design considerations for foundations, floors, walls, and roofs. Construction materials.
- 3606. FARM BUILDING DESIGN, LAYOUT, SYSTEMS.** (4 cr; prereq Math 1111, Phys 1031; 3 lect and 3 lab hrs per wk)
Farm building design based on functional and environmental requirements. Building and farmstead layouts to accommodate improved materials handling systems. Modified environment in warm or cold buildings.
- 3610. ELECTRICITY IN AGRICULTURE.** (3 cr; prereq Math 1111, Phys 1031; 2 lect hrs and 3 lab hrs per wk)
Basic theory and practical application of electricity in agriculture. Electric motors, heating, lighting, and controls. Selection and maintenance of electrical equipment. Electrical safety.
- 3800. RURAL SANITATION AND WATER SUPPLY.** (4 cr; prereq Phys 1031, Chem 1005; 3 lect and 3 lab hrs per wk)
Wells, pumps, water supply, and treatment. Water supply and waste disposal systems for homes, farmsteads, resorts, and recreational use.
- 5000. PRINCIPLES OF RADIOISOTOPE MEASUREMENTS.** (2 cr; prereq #: 2 lect and 2-3 lab hrs per wk; offered 1st 4 wks of qtr)
Theory and technique of radioisotope measurements including atomic and nuclear structure; properties of radiation; interactions of radiation with matter. Use of monitoring equipment.
- 5005. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq 12 cr in agricultural engineering technology and #: not for grad cr)
Up to 12 weeks of planned experience in a selected position in an industry or public agency; evaluative reports and consultations with faculty advisers and employers.
- 5016. COMPUTER PROGRAMMING IN STATISTICS.** (3 cr; prereq Stat 5022 or #)
FORTRAN programming; use of libraries of statistical routines.
- 5020. PROGRAM PLANNING AND INSTRUCTIONAL METHODS IN AGRICULTURAL MECHANICS.** (4 cr; prereq 10 cr agricultural engineering technology, AgEd 3031 or 1/2AgEd 3031)
Planning and designing high school vocational agriculture facilities, organizing equipment, tools, supplies, and storage required by the instructional program. Administering the agricultural mechanics program. Developing teaching techniques and program planning as related to student-supervised study programs in agricultural mechanics.
- 5021. MECHANICS OF AGRICULTURAL SYSTEMS.** (4 cr; prereq Math 1142, Phys 1032; 4 lect hrs per wk)
Analysis of forces in equilibrium as related to agricultural mechanics. Statics, equilibrium condition, loading, and deformation applied to engineering materials used in agriculture.
- 5022. ENERGY SYSTEMS IN AGRICULTURE.** (4 cr; prereq Math 1142, Phys 1032; 4 lect hrs per wk)
Application of principles of thermodynamics, heat utilization, and heat transfer methods to agricultural processes and systems.
- 5023. FLUIDS AND ELECTRICITY IN AGRICULTURE.** (4 cr; prereq Math 1142, Phys 1032; 4 lect hrs per wk)
Application of principles of fluids at rest and in motion to agricultural systems and equipment. Basic electrical systems, power, and control.
- 5030-5031-5032-5033-5034-5035. PROBLEMS AND FIELD STUDIES IN ADVANCED AGRICULTURE.** (1-3 cr; prereq 5020 or #)
Principles and practices pertaining to implementation of instructional programs in agricultural mechanics. Selection, application, operation, service, and maintenance of equipment used in agricultural mechanics for the specific instructional program.
- 5030. Agricultural Tractor and Engine Power**
 - 5031. Agricultural Machinery and Mechanization**
 - 5032. Electrical Power and Processing**
 - 5033. Farm Buildings and Environment Control**
 - 5034. Natural Resources Development and Management**
 - 5035. Metal Fabrication Materials and Techniques**
- 5040. ADVANCED METHODS FOR TEACHING AGRICULTURAL MECHANICS.** (3 cr; prereq #: 2 lect and 3 lab hrs per wk; off campus in fall and spring, on campus SSI)
Trends and role of agricultural mechanics in the mechanization of agriculture. Organization of instructional areas, selection of tools, supplies, reference materials, and facilities. Preparation of instructional materials and methods of effective teaching. Development of teaching demonstrations and procedures.
- 5091-5092. SPECIAL PROBLEMS IN AGRICULTURAL ENGINEERING.** (2-5 cr per qtr; prereq #)
Individual study project in agricultural engineering at advanced level. Application of engineering principles to a specific problem.

- 5230. MECHANISMS IN AGRICULTURAL MACHINERY.** (5 cr; prereq 1000, 1010, 5021; 3 lect and 3 lab hrs per wk)
Analysis of motion (position, velocity, and acceleration) forces, energy and power transmission, and control mechanisms in agricultural machinery.
- 5240. AGRICULTURAL POWER.** (4 cr; prereq 5021, 5022, 5023; 3 lect and 3 lab hrs per wk)
Tractor engines and chassis, chassis mechanics, accessory systems, fuels, and lubricants. Traction. Electrical power selection and utilization.
- 5400. DRAINAGE AND IRRIGATION.** (4 cr; prereq Soil 3210; 3 lect and 2 lab hrs per wk)
Soil moisture excesses and deficiencies. Theory and design of tile drainage, surface drainage, and sprinkler irrigation systems. Development of irrigation water supplies. Selection of pumps and power units for drainage and irrigation. Economic feasibility. Legal problems and procedures.
- 5620. FARMSTEAD ENGINEERING.** (4 cr; prereq 5021, 5022; 3 lect and 3 lab hrs per wk)
Basic structural, functional, and environmental requirements for crops and animals; materials of construction and construction details; materials handling systems, controlled environment systems, and design problems.
- 5810. AGRICULTURAL WASTE MANAGEMENT.** (4 cr; prereq Phys 1031, Chem 1005, Biol 1011; 3 lect hrs per wk)
Characteristics of various animal manures, plant materials, and processing wastes. Sanitary collection, storage, treatment, and utilization or disposal of liquid and solid agricultural waste.

COURSES IN AGRICULTURAL ENGINEERING IN IT

The following courses are offered by the Institute of Technology and are open to students in the 4-year engineering curriculum and to those who have completed the prerequisite courses. For descriptions of the courses, see the *Institute of Technology Bulletin*.

1031. COMPUTATIONS IN AGRICULTURAL ENGINEERING. (2 cr)
1060. AGRICULTURAL ENGINEERING ORIENTATION. (1 cr)
1071. INTRODUCTION TO AGRICULTURAL ENGINEERING. (2 cr)
3050. SOIL-PLANT RELATIONS IN AGRICULTURAL ENGINEERING. (3 cr)
3060. ANALYSIS IN AGRICULTURAL ENGINEERING. (4 cr)
3970. DIRECTED STUDIES IN AGRICULTURAL ENGINEERING. (Cr ar)
5050. INTERN REPORTS. (1 cr)
5060. PROCESSING. (4 cr)
5070. AUTOMATIC CONTROL AND INSTRUMENTATION. (4 cr)
5072. FINITE ELEMENT METHOD: FUNDAMENTALS AND APPLICATIONS. (4 cr)
- 5081, 5082, 5083, 5084. DESIGN. (4 cr)
- 5081. Power and Machinery
 - 5082. Soil and Water
 - 5083. Structures and Environment
 - 5084. Food Engineering
5130. FOOD ENGINEERING I. (4 cr)
5140. FOOD ENGINEERING II. (4 cr)
- 5191-5192. SPECIAL PROBLEMS IN AGRICULTURAL ENGINEERING. (2-5 cr)
5330. AGRICULTURAL MACHINERY. (4 cr)
5340. AGRICULTURAL TRACTORS. (4 cr)
5540. EROSION CONTROL, WATERSHED ENGINEERING. (4 cr)
5550. DRAINAGE AND IRRIGATION ENGINEERING. (4 cr)
5730. AGRICULTURAL STRUCTURES DESIGN. (4 cr)
5740. ENVIRONMENTAL CONTROL FOR AGRICULTURAL PRODUCTION. (4 cr)
5910. AGRICULTURAL WASTE MANAGEMENT ENGINEERING I. (4 cr)
5920. AGRICULTURAL WASTE MANAGEMENT ENGINEERING II. (4 cr)

Course Listings

FOR GRADUATE STUDENTS ONLY

(For course descriptions, see the *Graduate School Bulletin*)

8100. SEMINAR

8140. AGRICULTURAL ENGINEERING SIMILITUDE

8190, 8191, 8192. ADVANCED PROBLEMS AND RESEARCH

8500. HYDROLOGIC MODELING—SMALL WATERSHEDS

8700. MOISTURE AND HEAT TRANSFER

Agricultural Journalism (AgJo)

- 1011. JOURNALISTIC TECHNIQUES FOR NONMAJORS.** (5 cr; prereq completion of rhetoric communication requirement, English composition or equiv, C avg)
(Same as Jour 1011) General view of the printed mass media. Forms of news and feature stories; basics of mass communication law. Basics of publications editing, headlines, make-up for business publications. Lecture and laboratory.
- 3155. PUBLICATIONS EDITING.** (4 cr; prereq freshman composition plus advanced composition and 1011 or 3530 or equiv journalism course or #)
The publication process from copy selection, editing, and preparation to scheduling and supervising production of small publications and periodicals. Covers business, technical, educational, and general publications. Includes editing copy, writing headlines and outlines, marking and fitting copy, typesetting, proofreading, and keylining.
- 3230. BASIC TYPOGRAPHY.** (4 cr; prereq 1011 or 3530 or equiv in journalism or #)
Identification, selection, and design of typefaces. Use of typesetting machines, transfer lettering, and calligraphy. Legibility and design in layout. Preparation of type for publication including copyfitting and keylining for offset printing.
- 3530. PUBLICITY.** (4 cr; prereq completion of rhetoric communication requirement)
For students planning careers in agriculture, forestry, home economics, veterinary medicine, or some allied industry in which the cooperation of mass media will be needed. Covers mass media relationships, news and direct mail writing, radio and TV broadcasting, and preparation of visuals.
- 3936. SPECIAL PROBLEMS.** (Cr ar; prereq 3530 or #)
Communication problems in areas such as specialized analysis of media, specialized writing, publication or periodical planning, preparation of special audio and/or visual production, radio and TV programming, and other mass communication areas.
- 5000. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq 15 cr in communications and 15 cr in agricultural journalism or journalism and #: not for grad cr)
Up to 12 weeks of planned experience in a selected position in agricultural communications; evaluative reports and consultations with faculty advisers and employers.
- 5301. FUNCTIONAL PHOTOGRAPHY.** (3 cr; prereq #)
Use of photography in science and education. Includes the selection and use of equipment and film, close-up techniques, slide set production.
- 5500. RESEARCH IN COMMUNICATION STRATEGIES.** (4 cr; prereq #)
(Same as Rhet 5500) Introduction to basic research design and methodology in communication. Emphasis on application of various research methods to particular communication strategies or settings.
- 5534. RURAL COMMUNICATION MEDIA AND MEDIA BEHAVIOR.** (3 cr; prereq 3530 or equiv in journalism or #)
Behavior and characteristics of mass media reaching rural and agricultural audiences; analysis of research and examples of promotional, informational, and educational programs carried through rural media; theoretical approaches relevant to problems of rural mass media.
- 5535. COMMUNICATIONS IN INTERNATIONAL AGRICULTURAL DEVELOPMENT.** (3 cr; prereq 3530 or equiv in journalism or #)
For American and foreign students. U.S. and foreign rural communications as development tools. Development of ability to plan and execute communication programs in developing nations.
- 5600. TRANSFER OF TECHNOLOGY.** (4 cr; prereq one of following courses: Rhet 5257, Jour 5133, Engl 3085, PubH 5070, or #)
(Same as Rhet 5600) Methods of transferring scientific and technical knowledge. Review of research in diffusion and transfer methods.
- 5936.* SPECIAL PROBLEMS IN AGRICULTURAL COMMUNICATIONS.** (Cr ar; prereq #)
Communications problems related to specific aspects of student's major field of study.

Agronomy and Plant Genetics (Agro)

- 1001. SEMINAR: ORIENTATION TO AGRONOMY.** (1 cr; S-N only)
Introduction to agronomy—its programs and objectives in teaching, research, and extension through informal seminars with staff and students. Research and teaching facilities visited to acquaint students with personnel and facilities of the department.
- 1010. PRINCIPLES OF AGRONOMY.** (4 cr, §Agro 3010, 3020, 3030)
Principles and practices of plant and related sciences as they apply to increasing productivity and improvement of field crops. Emphasis on selection and improvement through breeding of crop varieties, seeds and seeding, crop growth and development, crop production hazards, and harvest and storage of field crops. Lecture and demonstration.
- 1011. PRINCIPLES OF AGRONOMY—DISCUSSION.** (1 cr; S-N only; prereq ¶Agro 1010)
Informal small group discussion of questions and problems identified in lectures in 1010, readings, or other sources and review of examinations and papers.
- 1020. SPECIAL PROBLEMS.** (1-3 cr; prereq 5 cr agronomy, #)
In-depth research or studies in agronomy. Intended for students who wish to pursue aspects of agronomy in greater depth than that offered in formal courses or who wish to investigate areas not presently offered in courses. Tutorial instruction under staff guidance.
- 1100. MORPHOLOGY AND IDENTIFICATION OF CROPS AND WEEDS.** (4 cr)
Developmental morphology of seeds, seedlings, and plants and utilization of morphological features of seeds and plants in keys to aid in identification of crops and weeds of major economic importance in the world. Lecture and laboratory.
- 1110. SEED ANALYSIS AND GRAIN GRADING.** (3 cr; prereq 1100 or #)
Principles and practice in evaluation of field crop seeds for purity and quality and in grading grain. Lecture and laboratory.
- 3010. ADAPTATION, DISTRIBUTION, AND PRODUCTION OF FIELD CROPS.** (3 cr; prereq Biol 1011)
Principles and concepts of origin, adaptation, distribution, and production of world crops as influenced by environmental, ecological, evolutionary, social, and political factors.
- 3011. ADAPTATION, DISTRIBUTION, AND PRODUCTION OF FIELD CROPS—DISCUSSION.** (1 cr; S-N only; prereq ¶Agro 3010)
Informal small group discussion of questions and problems identified in lectures in 3010, readings, or other sources and review of examinations and papers.
- 3020. GROWTH, DEVELOPMENT, AND CULTURE OF FIELD CROPS.** (5 cr; prereq Biol 1011, Chem 1005)
Principles of growth and development of field crops and their regulation to achieve maximum crop productivity. Emphasis on seeds, seeding; physiological basis of growth, development, and growth regulation; and effects of environment on crop growth, development, and culture. Lecture and laboratory.
- 3021. GROWTH, DEVELOPMENT, AND CULTURE OF FIELD CROPS—DISCUSSION.** (1 cr; S-N only; prereq ¶Agro 3020)
Informal small group discussion of questions and problems identified in lectures in 3020, readings, or other sources and review of examinations and papers.
- 3030. MATURATION, HARVEST, AND STORAGE OF FIELD CROPS.** (4 cr; prereq Biol 1011, Chem 1005)
Development and maturation of grains and forage crops, including the synthesis and accumulation of organic constituents and changes in these constituents as a result of the maturation process. Estimation of crop maturity and development of criteria for crop harvest, role of pre- and post-harvest treatments in preparation for storage, and losses associated with crop harvest. Principles of storage and preservation of crops in moist or dry state. Lecture and laboratory.
- 3031. MATURATION, HARVEST, AND STORAGE OF FIELD CROPS—DISCUSSION.** (1 cr; S-N only; prereq ¶Agro 3030)
Informal small group discussion of questions and problems identified in lectures in 3030, readings, or other sources and review of examinations and papers.
- 3150. ADVANCED SEED AND GRAIN EVALUATION.** (4 cr; prereq 1100 or #...1110 recommended)
Laboratory practice in identification of crops, weeds, and diseases and in grain grading and seed analysis. Members of the Intercollegiate Crops Team are selected from this class.
- 3200. SEMINAR.** (1 cr; prereq jr or sr, #)
Investigation through literature review and group discussion of selected topics in agronomy. Major emphasis on recent advances in agronomy.
- 5000. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq #; not for grad cr)
Supervised practical professional experience in agronomic industries and farm enterprise systems, together with studies of various aspects of the industry and related fields.
- 5001. PROBLEMS IN AGRONOMY FOR ADVANCED STUDENTS.** (1-5 cr; prereq 20 cr agronomy, #)
In-depth research or studies in agronomy. Intended for advanced students who wish to pursue aspects of

Course Listings

agronomy in greater depth than that offered in formal courses or who wish to investigate areas not presently offered in courses. Independent study and research under staff guidance.

- 5010. PASTURE AND GRASSLAND CROPS.** (4 cr)
Interrelationships between plants and animals as they relate to pasture and grassland crops. Nature and extent of grasslands, productivity measurements of natural grasslands, theory and concepts of range management, pasture renovation, systems of grazing management, and animal toxicities peculiar to forage crops. Lecture and laboratory.
- 5020. INTRODUCTION TO PLANT BREEDING.** (3 cr; prereq GCB 3022 or equiv)
Introductory course in application of genetic principles to improvement of crop plants.
- 5030. WEED CONTROL.** (5 cr; prereq 1010 or #)
Survey of the magnitude of the weed problem. Regulatory aspects of weed control and herbicide usage. Principles and methods of weed control. Lecture and discussion.
- 5040. MANAGEMENT OF CROPPING SYSTEMS.** (3 cr; prereq 3010, 3020, 3030, Soil 1122 or #)
A discussion and case-study approach using principles of agronomy in making decisions on crop selection, tillage and seedbed preparation, planting; cultural practices; pest control, harvesting, storage, and marketing of major field crops.
- 5050. HERBICIDES.** (3 cr; prereq Agro 5030, PIPa 3131, BioC 1302; offered 1978 and alt yrs)
Lectures and discussions on herbicides; their development, classification, mode of action, persistence, usage, ecological effects, and regulation.
- 5110. ADAPTATION, DISTRIBUTION, AND PRODUCTION OF FIELD CROPS.** (3 cr, §3010; prereq Biol 1011)
Principles and concepts of origin, adaptation, distribution, and production of world crops as influenced by environmental, ecological, evolutionary, social, and political factors. Lecture and discussion.
- 5120. GROWTH, DEVELOPMENT, AND CULTURE OF FIELD CROPS.** (5 cr, §3032; prereq Biol 1011, Chem 1005)
Principles of growth and development of field crops and their regulation to achieve maximum crop productivity. Emphasis on seeds, seeding; physiological basis of growth, development, and growth regulation; and effects of environment on crop growth, development, and culture. Lecture and laboratory.
- 5130. MATURATION, HARVEST, AND STORAGE OF FIELD CROPS** (4 cr, §3030; prereq Biol 1011, Chem 1005)
Development and maturation of grains and forage crops, including the synthesis and accumulation of organic constituents and changes in these constituents as a result of the maturation process. Estimation of crop maturity and development of criteria for crop harvest, role of pre- and post-harvest treatments in preparation for storage, and losses associated with crop harvest. Principles of storage and preservation of crops in moist or dry state. Lecture, laboratory, and discussion.
- PIPh 5183.* WATER, MINERALS, AND TRANSLOCATION.** (4 cr, §Bot 5183; prereq 5131 or equiv)
Membrane phenomena and osmotic properties of cells. Uptake, movement, and loss of water in plants, including the effects of external factors. The translocation of organic substances. The absorption, distribution, and function of inorganic elements.
- PIPh 5184.* PLANT GROWTH AND DEVELOPMENT.** (3 cr, §Bot 5184; prereq 5131 or equiv)
Growth of higher plants including division and differentiation of cells, development of plant organs, effects of external factors on plant growth, photosynthesis and respiration in relation to plant development, and the nature and action of plant growth substances.
- PIPh 5188.* RESEARCH PERSPECTIVES IN PLANT PHYSIOLOGY.** (Cr ar; prereq Chem 3100 and 3101, 8 cr in biochemistry and #)
A laboratory course in which the student undertakes a well-defined research problem of limited scope.

FOR GRADUATE STUDENTS ONLY

(For course descriptions, see the *Graduate School Bulletin*)

- 8010. RESEARCH IN AGRONOMY**
- 8020. SEMINAR: AGRONOMY**
- 8050. PHYSIOLOGY OF FIELD CROPS**
- 8100. PASTURE AND FORAGE RESEARCH TECHNIQUES**
- 8200. PRINCIPLES OF PLANT BREEDING I**
- 8210. PRINCIPLES OF PLANT BREEDING II**
- 8220. APPLICATION OF QUANTITATIVE GENETICS TO PLANT BREEDING**
- 8230. CYTOGENETICS**
- 8240. PLANT GENETICS IN RELATION TO PLANT IMPROVEMENT**
- 8270. SEMINAR: PLANT BREEDING**

- 8280. CURRENT TOPICS IN PLANT BREEDING
- 8310.* ORIENTATION TO FIELD CROP BREEDING
- 8330.* RESEARCH IN PLANT GENETICS
- 8380. APPLIED STATISTICS
- PIPh 8251. SEMINAR: PLANT PHYSIOLOGY

Animal Science (AnSc)

- 1100. **INTRODUCTORY ANIMAL SCIENCE.** (5 cr)
Introduction to animal science with emphasis on fundamental concepts of physiology, nutrition, animal breeding, and management as they apply to production of livestock and poultry.
- 1105. **ANIMAL CARE.** (1 cr)
Discussion and demonstration of elementary management practices and record keeping systems involved in the care, feeding, handling, training, and housing of livestock and poultry. For students without livestock or poultry experience.
- 1106. **CARE OF COMPANION ANIMALS.** (4 cr)
Introduction to the problems of pet ownership in society and biological processes of dogs and cats. Other species discussed.
- 1110. **DAIRY CATTLE EVALUATION.** (2 cr)
Evaluation of dairy animals on the basis of anatomy, production performance, and breeding. Visits to one or more herds in the area.
- 1120. **LIVESTOCK AND MEAT EVALUATION.** (4 cr)
Evaluation, grading, and pricing of live meat animals, followed by evaluation of the conformation, quality, and finish of carcasses and cuts. Principles of judging and grading of meat.
- 1300. **SYSTEMIC PHYSIOLOGY.** (6 cr; prereq Biol 1106, BioC 1301 or equiv)
(Same as VB 1300) Introduction to animal physiology, emphasizing the function of organ systems.
- 1401. **PRINCIPLES OF ANIMAL NUTRITION.** (5 cr; prereq soph)
Classification and functions of nutrients; nature of nutrient requirements and their expression; gross differences in anatomy and physiology of digestion of ruminants and non-ruminants; digestion, absorption, and utilization of nutrients; and sources of nutrients for livestock and poultry. Feeding standards and their uses.
- 1500. **MEAT SCIENCE.** (4 cr; prereq Biol 1011)
(Same as FScN 1500) Role of ante- and postmortem factors in altering the anatomy, function, and biochemical properties of muscle during its conversion to meat; importance of these changes to meat quality, and the manufacture, selection, preparation, and palatability characteristics of meat and meat products.
- 1520. **MILK PRODUCTION.** (3 cr; prereq 1100 or #)
Relationships of production and management concepts to dairy farm planning and production and marketing of high-quality milk.
- 1600. **HORSE PRODUCTION.** (4 cr, \$5501)
Breeds, selection, diseases, feeding, reproduction, management, and color inheritance of light horses. Demonstrations of equitation, tack, and farriery.
- 3111. **VERTEBRATE BEHAVIOR.** (4 cr; prereq Biol 1011, 3011 or #)
Introduction to the nature and variety, development, motivation, and evolution of animal behavior, emphasizing social interactions and communication.
- 3130. **LIVESTOCK EVALUATION.** (2 cr; prereq soph or #...1120 recommended)
Evaluation of beef cattle, horses, sheep, and swine on the basis of economic traits related to productivity and market value. Spring quarter—livestock selection and marketing; fall quarter—intercollegiate livestock judging competition.
- 3141. **ADVANCED DAIRY JUDGING.** (1 cr; prereq 1110)
Evaluation and selection of dairy cattle. Visits to local dairy herds. Training in presentation of oral and written reasons. Students selected from this course participate in intercollegiate judging contests.
- 3142. **ADVANCED LIVESTOCK JUDGING.** (1 cr; prereq 1120, 3130)
Live animal evaluation and selection of beef cattle, horses, sheep, and swine. Visits to local herds and flocks. Students selected from this course participate in intercollegiate judging contests.
- 3143. **ADVANCED MEATS JUDGING.** (1 cr; prereq 1120)
In-depth training in beef, pork, and lamb judging, writing reasons, and carcass grading. Field trips to packing plants. Students selected from this course participate in the International Intercollegiate Meats Judging Contest.

Course Listings

- 3220. PRINCIPLES OF ANIMAL BREEDING.** (5 cr; GCB 3022 recommended)
Application of qualitative genetic principles to animal breeding. Introduction to quantitative genetics. Concepts of livestock improvements through breeding and selection systems.
- 3305. REPRODUCTIVE PHYSIOLOGY, ARTIFICIAL INSEMINATION, AND LACTATION.** (5 cr; prereq 1300)
Functions of the reproductive organs, fertilization, the estrous cycle and its endocrine control, reproductive efficiency, and problems and principles of artificial insemination. Anatomy, physiology, and biochemistry of the mammary gland. Mammary growth, initiation and maintenance of lactation, milk synthesis, and factors influencing the lactation curve.
- 5000. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq 90 college credits, 15 cr in animal science and #; not for grad cr)
Up to 12 weeks of planned experience in a selected position in animal production and related industry; evaluative reports and consultations with faculty advisers and employers.
- 5100. PRINCIPLES AND PRACTICE OF LABORATORY ANIMAL USE.** (4 cr; prereq 1300, 1401 and 3220 or #)
Application of animal husbandry principles and knowledge to the use of laboratory animals in animal science research. Demonstration and practice of laboratory animal handling and sampling techniques.
- 5221. ANIMAL BREEDING FOR VOCATIONAL AGRICULTURE TEACHERS.** (3 cr; offered summer 1978)
Application of qualitative genetic principles to animal breeding. Introduction to quantitative genetics. Concepts of livestock improvement through breeding and selection systems.
- 5231. DAIRY CATTLE BREEDING.** (4 cr; prereq 3220 or #)
Application of quantitative genetic principles to the breeding of dairy cattle. Primary emphasis on evaluation of males, females, and systems of breeding. Rates of genetic improvement with and without artificial insemination.
- 5232. APPLIED MEAT ANIMAL BREEDING.** (3 cr; prereq 3220 or #)
Application of genetic principles to animal breeding; systems and methods of breeding related to beef cattle, sheep, swine, and poultry; improvement programs, industry-related problems. Genetics of horses also considered.
- 5240. ANIMAL CYTOGENETICS.** (4 cr; prereq GCB 3022 or #)
Application of cytogenetics to problems in animal biology. Emphasis on relationship of cytogenetic principles and practices to other fields such as animal breeding, pathology, cellular biology, and systematics.
- 5314. NEUROETHOLOGY.** (3 cr; prereq 1300 or 6 cr systemic physiology, Biol 5051 or #; offered 1979 and alt yrs)
Current concepts of neurological and neurochemical bases of animal behavior, including reception, coding, transmission, and storage of information; levels of integration, central control of input and output; spontaneity, development, and learning.
- 5315. REPRODUCTIVE PHYSIOLOGY AND LACTATION.** (3 cr; offered summer 1979)
Functions of the reproductive organs, fertilization, the estrous cycle and its endocrine control, reproductive efficiency, and problems and principles of artificial insemination. Anatomy, physiology, and biochemistry of the mammary gland. Mammary growth, initiation and maintenance of lactation, milk synthesis, and factors influencing the lactation curve.
- 5322. PHYSIOLOGY OF REPRODUCTION.** (5 cr; prereq 6 cr systemic physiology)
Principles of reproductive physiology with emphasis on endocrinological aspects.
- 5324. SEMEN PRESERVATION AND ARTIFICIAL INSEMINATION.** (4 cr; prereq 5322 or #; offered spring 1979 and alt yrs)
Chemistry of gametes and reproductive secretions; preservation of spermatozoa with emphasis on cryogenic methods; artificial insemination; and factors influencing reproductive performance.
- 5325. PHYSIOLOGY OF FERTILIZATION AND GESTATION.** (4 cr; prereq 5322 or #; offered winter 1979 and alt yrs)
Physiological events occurring during gametogenesis, capacitation, fertilization, the period of embryo, the period of fetus, and parturition.
- 5326. IMMUNOREPRODUCTION.** (4 cr; prereq 5322 or #; offered spring 1979 and alt yrs)
Blood groups and polymorphic proteins affecting reproduction, immunoglobulin formation, antigens of semen, ova and genital secretions, immunopathology, maternal-fetal incompatibility, and antibodies to hormones.
- 5327. GENERAL ENDOCRINE PHYSIOLOGY.** (3 cr; prereq 1300 or #)
Biological effects, biochemistry, methods of assay, and regulatory aspects of hormones.
- 5328. GENERAL ENDOCRINE PHYSIOLOGY LABORATORY.** (2 cr; prereq 5327 or #)
Demonstration of concepts in endocrinology using experimental approaches.
- 5329. BIOCHEMISTRY OF SPERMATOZOA, OVA, AND GENITAL SECRETIONS.** (4 cr; offered spring 1979 and alt yrs; prereq BioC 5002 or equiv)
Chemical composition of seminal fluid, spermatozoa, uterine fluids and ova, and their physiological function and metabolism with comparisons between species.

- 5401. SWINE NUTRITION.** (2 cr; offered 1st 5 wks of qtr; prereq 1401)
Nutrient requirements of swine; feed supplies, their composition and utilization in formulation of adequate diets. Role of feed additives, their use and limitations. Nutritional interrelationships and feeding systems.
- 5403. RUMINANT NUTRITION.** (4 cr, §5413; prereq 1401)
Nutrient requirements of ruminants (beef and dairy cattle, sheep); nutrient content of feedstuffs, primarily forages; protein and nonprotein nitrogen utilization; energy utilization; nutritional disorders; and formulation of adequate rations. Nutrition of horses considered also.
- 5404. RUMINANT NUTRITION FOR VETERINARY MEDICINE STUDENTS.** (3 cr)
Fundamentals of nutrition, nutrient requirements of ruminants, nutrient content of feedstuffs, protein and nonprotein nitrogen utilization, energy utilization, formulation of adequate rations, and nutritional disorders and deficiencies in ruminants.
- 5405. POULTRY NUTRITION.** (2 cr; offered 2nd 5 wks of qtr; prereq 1401)
Nutrient requirements of chickens and turkeys; feed supplies, their composition and utilization in formulation of adequate diets. Role of feed additives, their use and limitations. Least cost formulations, nutritional interrelationships, and feeding systems.
- 5406. COMPUTER FEED FORMULATION.** (2 cr; prereq 5401, 5403, 5405)
Use of computers to formulate least cost rations, interpretation of computer outputs of least cost rations, application to poultry, swine and ruminant rations; efficient use of common feedstuffs.
- 5413. RUMINANT NUTRITION.** (3 cr, §5403; prereq 1401; offered summer 1982)
Nutrient requirements of ruminants (beef and dairy cattle, sheep); nutrient content of feedstuffs, primarily forages; protein and nonprotein nitrogen utilization; energy utilization; nutritional disorders; and formulation of adequate rations. Nutrition of horses considered also.
- 5500. MEAT SCIENCE.** (3 cr; offered summer 1980)
Role of ante- and post-mortem factors in altering the anatomy, function, and biochemical properties of muscle during its conversion to meat; importance of these changes to meat quality and the manufacture, selection, preparation, and palatability characteristics of meat and meat products.
- 5501. HORSE PRODUCTION.** (3 cr, §1600; offered summer 1981)
Breeds, selection, diseases, feeding, reproduction, management, and color inheritance of light horses. Demonstrations of equitation, tack, and farriery.
- 5510. MUSCLE CHEMISTRY AND PHYSIOLOGY.** (4 cr; prereq BioC 1302 or #)
(Same as FScN 5510) Fundamental properties of muscle ultrastructure, chemistry and physiology as they relate to muscle proteins, growth, contraction, energy metabolism, adaptive responses, rigor mortis, and conversion of muscle to meat.
- 5512. MEAT AND PROTEIN TECHNOLOGY.** (4 cr; prereq BioC 1302 or #)
(Same as FScN 5512) Meat proteins: effects of pH, salt, and temperature on hydration and emulsification; methods of fractionation. Meat preservation: effects of heat, freezing, curing, and problems of product stability during storage. Sausage manufacture: chemistry, technology, least-cost analysis (graphical and computer methods), and chemical methods of quality control (rapid and classical methods of proximate analysis).
- 5601. SWINE PRODUCTION.** (4 cr, §5611; prereq 1401...3220 recommended)
Status and characteristics of the swine industry; application of principles of animal breeding, nutrition, physiology, and economics to swine production; considerations in development of a successful swine enterprise.
- 5602. SHEEP PRODUCTION.** (4 cr; prereq 1401...3220, 3403 recommended)
Status and characteristics of the sheep industry; application of principles of animal breeding, nutrition, physiology, and economics to management of sheep breeding flocks. Ration formulation, management, and marketing of feedlot lambs.
- 5603. BEEF CATTLE PRODUCTION.** (4 cr, §5613; prereq 1401...3220, 3403 recommended)
Status and characteristics of the beef cattle industry; application of principles of animal breeding, nutrition, physiology, and economics to management of beef cattle breeding herds. Ration formulation, management, and marketing of feedlot cattle.
- 5604. DAIRY FARM MANAGEMENT.** (4 cr, §5614; prereq 3403 or #...3220 recommended)
Application of principles of animal breeding, nutrition, physiology, and economics to planning and management of the dairy farm: genetic influences, housing requirements, health programs for large herds, feed budgets, and record analysis emphasized.
- 5605. COMMERCIAL POULTRY PRODUCTION.** (4 cr, §5615; prereq 1401...3402 recommended)
Current practices and production systems, with emphasis on managerial aspects of egg, broiler, and turkey production. Technical and practical phases of production and marketing considered in relation to their underlying principles. Visits to appropriate commercial production units.
- 5606. BEEF PRODUCTION FOR VETERINARY MEDICINE STUDENTS.** (3 cr)
Development and application of principles of animal breeding, nutrition, physiology, and economics for production of feedlot and beef breeding herds. Ration formulation, management, and marketing.

Course Listings

- 5607. DAIRY FARM MANAGEMENT FOR VETERINARY MEDICINE STUDENTS.** (3 cr; prereq 5404 or #)
Application of principles of animal breeding, nutrition, and economics to management of the dairy farm; genetic influences, breed differences, housing requirements, and record analysis emphasized.
- 5611. SWINE PRODUCTION.** (3 cr, §5601; prereq 1401; offered summer 1979)
Status and characteristics of the swine industry; application of the principles of animal breeding, nutrition, physiology, and economics to swine production; development of a successful swine enterprise.
- 5613. BEEF CATTLE PRODUCTION.** (3 cr, §5603; prereq 1401...3220, 3403 recommended; offered summer 1978)
Status and characteristics of the beef cattle industry; application of the principles of animal breeding, nutrition, physiology, and economics to management of beef cattle breeding herds. Ration formulation, management, and marketing of feedlot cattle.
- 5614. DAIRY FARM MANAGEMENT.** (3 cr, §5604; prereq 3403 or #...3220 recommended; offered summer 1982)
Application of the principles of animal breeding, nutrition, physiology, and economics to the planning and management of the dairy farm; genetic influences, housing requirements, health programs for large herds, feed budgets, and record analysis emphasized.
- 5615. POULTRY PRODUCTION.** (3 cr; offered summer 1980)
Current practices and production systems with emphasis on managerial aspects of egg, broiler, and turkey production. Principles underlying technical and practical phases of production and marketing.
- 5703. LITERATURE AND SEMINAR.** (2 or 3 cr [3rd cr for 2nd seminar report]; prereq jr)
Introduction to library resources concerned with animal science. Techniques of searching, abstracting, and constructing reviews for written and oral reports from library materials. Evaluation of seminar reports.
- 5710. SPECIAL PROBLEMS.** (Cr ar; prereq #)
Research in an area of animal science under supervision of a staff member. Written report on the research required.
- 5715. TUTORIAL.** (Cr ar; prereq #)
Informally structured course to encourage study in depth of a specific discipline in animal science. Pertinent readings, centered around fundamental propositions, suggested and preparation of written essays of high quality required. Tutorials available in cryobiology, cytogenetics, genetics, meats, nutrition, and physiology.

FOR GRADUATE STUDENTS ONLY

(For course descriptions, see the *Graduate School Bulletin*)

- 8220.* ADVANCED ANIMAL BREEDING**
- 8221.* QUANTITATIVE INHERITANCE**
- 8420.* ENERGY IN ANIMAL NUTRITION**
- 8421.* PROTEIN AND AMINO ACID NUTRITION**
- 8423.* MINERAL NUTRITION**
- 8440.* RUMINANT NUTRITION**
- 8740. CONCEPTS AND DEVELOPMENTS IN RUMINANT NUTRITION**
- 8741. CONCEPTS AND DEVELOPMENTS IN AVIAN NUTRITION**
- 8742. CONCEPTS AND DEVELOPMENTS IN SWINE NUTRITION**
- 8750x. CONCEPTS AND DEVELOPMENTS IN MEAT SCIENCE AND TECHNOLOGY**
- 8810x.* RESEARCH IN ANIMAL SCIENCE**
- 8820x.* RESEARCH IN ANIMAL GENETICS**
- 8830x. RESEARCH IN ANIMAL PHYSIOLOGY**
- 8840x.* RESEARCH IN ANIMAL NUTRITION**
- 8850x.* RESEARCH IN MUSCLE CHEMISTRY AND PHYSIOLOGY**

Entomology, Fisheries, and Wildlife

ENTOMOLOGY (Ent)

- 1005. ECONOMIC ENTOMOLOGY.** (4 cr; prereq Biol 1011 or #)
Brief introduction to structure and classification of insects; management of insect populations; life histories, habits, and recognition of insect pests of livestock, orchards, field crops, vegetables, and ornamentals.

Entomology, Fisheries, and Wildlife

- 3020. PRINCIPLES OF BEEKEEPING.** (4 cr; prereq Biol 1011 or #)
Lecture and laboratory demonstrations. History of beekeeping; life history and behavior of honey bees; colony and apiary management; pollination and hive products; honey bee diseases and their control.
- 3100. ENTOMOLOGICAL TECHNIQUES.** (Cr #: prereq 3175 or equiv or #)
Practical laboratory instruction in mounting, preservation of insect larvae; preparation of microscopic mounts of minute insects; labeling, identifying, and cataloging specimens of insects for scientific study.
- 3175. INTRODUCTORY ENTOMOLOGY.** (5 cr; prereq Biol 1011 or equiv)
General morphology, life histories, habits, and classification of insects.
- 5001. BASIC ENTOMOLOGY.** (Cr ar; prereq #)
Opportunity to make up certain deficiencies in biological background.
- 5020. FIELD ENTOMOLOGY.** (5 cr; limited to 15 students; prereq introductory biology; offered SSI at Itasca)
Insect fauna in various natural habitats of the park and surrounding areas. Includes field trips, collection and identification of insects, as well as studies of general morphology, life histories, and habitats of local species.
- 5022. HOUSE AND GARDEN INSECTS.** (3 cr; limited to 20 students; 3 lect and 6 lab hrs per week; offered SSI)
Identification and life history of commonly encountered Minnesota insects. Lectures by selected faculty and short field trips.
- 5025. INSECT MORPHOLOGY.** (5 cr; prereq 3175 or #)
Comparative studies of external and internal anatomy and histology of insects; phylogeny and function.
- 5026. EMBRYOLOGY AND DEVELOPMENT OF INSECTS.** (5 cr; prereq 5025, Chem 3302, #)
Reproductive behavior, embryology, and postembryonic development of insects.
- 5027.* INSECT PHYSIOLOGY.** (5 cr; prereq #. BioC 5001 and 5002 or MdBc 5100 recommended)
Insect integument, body fluid and circulation, digestion and nutrition, respiration, metabolic systems, muscles and nerves, sensory systems and behavior, and excretory system.
- 5050.* FOREST ENTOMOLOGY.** (4 cr; prereq forestry major or #)
Lectures and laboratory concerning ecology and population management of forest insects, with heavy emphasis on tree factors and biological control.
- 5130. AQUATIC ENTOMOLOGY.** (5 cr; prereq 3175 or 5020 or equiv or #; offered second summer term at Itasca)
Identification and biology of aquatic and littoral insects in all stages.
- 5131. AQUATIC ENTOMOLOGY.** (2 cr; prereq 3175 or equiv or #; offered 1978-79 and alt yrs)
Identification and biology of aquatic and littoral insects in all stages.
- 5133. INSECT TAXONOMY.** (5 cr; prereq 3175 or equiv)
Identification of adults and immatures of taxa within insect orders.
- 5134.* ADVANCED INSECT TAXONOMY.** (5 cr; prereq 3175 or equiv, 5133)
Procedures of systematic entomology, systematic literature, zoological nomenclature, use of and construction of keys, and presentation of results of systematic research.
- 5200. APICULTURE.** (4 cr; prereq 9 cr entomology or biology)
Characteristics and social behavior of honey bees; colony development and management; diseases and their control; hive products, pollination. Lectures and laboratory demonstrations.
- 5210. INTEGRATED PEST MANAGEMENT.** (4 cr; prereq 1005 or #, ¶5211, ¶5212)
Management of insect, mite, and weed populations through integration of various methods and techniques (including biotic agents, host plant resistance, artificial measures, and cultural practices) as harmonious systems that, in the context of the associated environment and population dynamics, maintain subeconomic pest densities.
- 5211.* CURRENT TOPICS: INTEGRATED PEST MANAGEMENT.** (1 cr; prereq 5210 or ¶5210, #)
Student recitations and group discussion of current topics relating to integrated pest management.
- 5212. ENTOMOPHAGOUS INSECTS.** (2 cr; prereq 1005 or 3175 or 5050; offered 1978-79 and alt yrs)
Identification and recognition of entomophagous insects concerned with natural and managed control of insect populations.
- 5215.* INSECTS IN RELATION TO PLANT DISEASES.** (4 cr; prereq 5 cr entomology and 5 cr plant pathology or equiv or #)
(Same as PIPa 5215) Insect transmission and dissemination of plant pathogens; development of plant-insect relationships, habits of principal insect vectors, with emphasis on practical methods of control.
- 5250.* PRINCIPLES OF ECONOMIC ENTOMOLOGY.** (4 cr; prereq 15 cr biological sciences and entomology incl 1005 or #; offered 1978-79 and alt yrs)
Methods and principles of insect control. Individual projects.
- 5252. STORED PRODUCT PEST MANAGEMENT.** (4 cr; prereq 1005 or 3175 or #)
Principles of management to protect stored food and fiber; pest identification, damage assessment, and prevention and control procedures based on interrelationships within storage ecosystems.

Course Listings

- 5275. MEDICAL ENTOMOLOGY.** (4 cr; prereq 3175 or #)
Principal arthropods noxious to human beings and animals. Emphasis on those that serve as vectors of pathogenic organisms of human beings and animals.
- 5400.* EXPERIMENTAL ECOLOGY.** (3 cr; prereq 9 cr biology or equiv, 3 cr animal or plant ecology or #)
Experimental approach to study of environmental factors affecting animal populations.
- 5425. SPECIAL LECTURES IN ENTOMOLOGY.** (Cr ar; offered when feasible)
Lectures and/or laboratories in special fields of entomological research given or supervised by a visiting scholar or regular staff member.
- 5500. PROBLEMS IN MICROTECHNIQUE.** (Cr ar; prereq #)
Guidance for independent study of material of student's choice with particular reference to insects.
- 5890. RESEARCH PROBLEMS AT ITASCA IN ENTOMOLOGY.** (Cr ar; prereq #)
Undergraduate students may develop a short-term research project during one or both terms.
- 5901. SPECIAL PROBLEMS IN ENTOMOLOGY.** (Cr ar; prereq #)
Individual laboratory or library studies in various aspects of entomology.

FOR GRADUATE STUDENTS ONLY (Entomology)

(For course descriptions, see the *Graduate School Bulletin*)

- 8200x. SEMINAR**
- 8210. CURRENT TOPICS IN FOREST ENTOMOLOGY**
- 8300.* EXPERIMENTAL ECOLOGY LABORATORY**
- 8305.* INSECT ECOLOGY**
- 8323.* TOPICS IN INSECT PHYSIOLOGY**
- 8350.* INSECT MICROBIOLOGY**
- 8400. INSECTICIDES AND THEIR ACTION**
- 8405. INSECTICIDES LABORATORY**
- 8500.* RESEARCH IN ENTOMOLOGY**

FISHERIES AND WILDLIFE (FW)

- 0001. ORIENTATION IN FISHERIES AND WILDLIFE.** (No cr)
Survey of technical requirements and training of fishery and wildlife technicians and scientists; introduction to fields of work, problems, and career outlets.
- 3052. INTRODUCTION TO FISHERIES AND WILDLIFE BIOLOGY AND MANAGEMENT.** (4 cr; prereq EBB 3004; 3 lect, 1 demonstration-discussion session per wk)
Introduction to fishery and wildlife population ecology; environmental relationships of fish and wildlife populations and habitats; management and research methods; fishery and wildlife agency administration.
- 3053. PRINCIPLES OF FISHERIES OR WILDLIFE MANAGEMENT, LABORATORY.** (Cr ar; prereq 3052 or #)
Primarily field and, to some extent, laboratory experiences to demonstrate principles of fisheries or wildlife ecology and management.
- 3167. TECHNIQUES OF FOREST WILDLIFE MANAGEMENT.** (1 cr; offered at Cloquet)
Biology and management of important forest wildlife species; methods of evaluating forest wildlife populations and habitats.
- 5103. BASIC FISHERY BIOLOGY.** (Cr ar; prereq #)
Opportunity to make up certain deficiencies in biological background.
- 5106. BASIC WILDLIFE BIOLOGY.** (Cr ar; prereq #)
Opportunity to make up certain deficiencies in biological background.
- 5129. MAMMALOLOGY.** (5 cr, \$EBB 5129; prereq Biol 1106 or 3011 or #)
Recent families and orders of mammals of the world and genera and species of mammals of North America, with emphasis on morphology, evolution, and zoogeographic history.
- 5278. SPECIAL LECTURES IN WILDLIFE.** (Cr ar; offered when feasible)
Lectures in special fields of research given by a visiting professor.
- 5279. SPECIAL LECTURES IN FISHERIES.** (Cr ar; offered when feasible)
Lectures in special fields of research given by a visiting professor.
- 5280. SENIOR SEMINAR: FISHERIES.** (1 cr)
Discussion and presentation of papers in fisheries and related subjects.

- 5281. SENIOR SEMINAR: WILDLIFE.** (1 cr)
Discussion and presentation of papers in wildlife and related subjects.
- 5393. ADVANCED WORK IN FISHERY BIOLOGY.** (Cr ar; prereq #)
Library and laboratory research in various lines of fishery biology.
- 5398. ADVANCED WORK IN WILDLIFE BIOLOGY.** (Cr ar; prereq #)
Library and laboratory research in various lines of wildlife biology.
- 5450. TECHNIQUES OF FISHERY BIOLOGY.** (4 cr; prereq 3052, EBB 5812 or EBB/Geo 5601, EBB 5136, or #)
Basic methods used in fisheries research and management; lake and stream survey methods, mapping, chemical and biological sampling; methods of fish collection, use of nets and traps, fish toxicants, electrofishing; tagging and marking; methods of creel census.
- 5451. ECOLOGY OF FISHERY POPULATIONS.** (3 cr; prereq EBB 3001 or equiv, EBB 5812 or EBB/Geo 5601, EBB 5136, Math 1142 or equiv or #)
Relationship of fishery populations to limnological conditions; factors influencing strength of year classes; influence of climatological factors on fish growth; species interactions as related to population structure; influence of natural and fishing mortality rates of structure and yield of exploited populations; fishery yield models.
- 5452. FISHERY MANAGEMENT.** (4 cr; prereq 3052, EBB 5812 or #)
Fundamentals of population control; use of fishing regulations, habitat development; water quality control; use of artificial stocks for population maintenance; relationship between sport and commercial fisheries, including economic aspects; fundamentals of hatchery practice; pond management.
- 5454.* FISHERY ECOLOGY IN POLLUTED WATERS.** (3 cr; prereq 5452, Chem 1006, #)
Description of degrading water quality factors and influence on fish production. Fishery bioassay, setting of standards, and determination of criteria for aquatic organisms; administrative problems of pollution abatement. Biological effect of various pollutants on fish.
- 5561. WILDLIFE ECOLOGY, MANAGEMENT I.** (4 cr; prereq 3052, 5129, EBB 3004, 5134 or 5834, #...courses in soils, plant and animal physiology, experimental or field vertebrate ecology and plant ecology recommended)
Review of ecological background for wildlife management, development of programs in the field, and organizations working with fisheries and wildlife programs.
- 5562. WILDLIFE ECOLOGY, MANAGEMENT II.** (4 cr; prereq 5561 or #)
Characteristics of wildlife population relevant to management, including natality, recruitment, and mortality rates, density and behavior.
- 5563. WILDLIFE ECOLOGY, MANAGEMENT III.** (3 cr; prereq sr standing or #)
Habitat relationships of bird and mammal populations and the ecological basis for habitat management. Lectures, readings, library projects, and local field trips.
- 5890. RESEARCH PROBLEMS AT ITASCA IN FISHERIES AND WILDLIFE.** (Cr ar; prereq #)
Undergraduate students may develop a short-term research project during one or both terms.

FOR GRADUATE STUDENTS ONLY (Fisheries and Wildlife)

(For course descriptions, see the *Graduate School Bulletin*)

8200x. SEMINAR

8364.* RESEARCH IN FISHERY BIOLOGY

8377.* RESEARCH IN WILDLIFE BIOLOGY

8448-8449.*† FISHERY BIOLOGY

8451.* PRODUCTION BIOLOGY OF FISHERY ENVIRONMENTS

8455. FISHERY ECOLOGY OF POLLUTED WATERS LABORATORY

8574.* WILDLIFE MANAGEMENT: UPLAND GAME

8575.* WILDLIFE MANAGEMENT: WATERFOWL

8576.* WILDLIFE MANAGEMENT: LARGE MAMMALS

Food Science and Nutrition (FScN)

1010. MAN'S FOOD. (4 cr, §1012)

Human nutritional needs; food composition, world food supply, consumption patterns, acceptance, quality programs and regulations, food preservation, commercial processes, packaging, marketing, and national and international food programs.

Course Listings

- 1012. FOOD FOR THOUGHT—FOR FOOD.** (4 cr, §1010)
Nutritional requirements of human beings, basis of a balanced diet, effect of processing and storage on food quality and nutritional value, chemical additives and food safety, FDA, food fads, dieting, future world food production problems and answers. Individual 1-week dietary survey conducted.
- 1020. INTRODUCTORY MICROBIOLOGY.** (4 cr; especially for home economics majors; prereq 3rd-qr fr, #)
Fundamental principles of microbiology, characteristics of bacteria, yeasts, molds, and other microorganisms, their importance in preparation and preservation of foods, relation to health and well-being of the individual and the family.
- 1030. UNDERSTANDING CHEESE.** (2 cr, intended for nonmajors)
Conversion of milk into cheese; cheese curing; optimum characteristics of many varieties of natural cheeses; fondue, process, and club cheeses; nutritional value and care of cheese in the home.
- 1102. TECHNOLOGY OF FOOD PROCESSING.** (4 cr; prereq high school chemistry and biology)
Introduction to the technology of processing and distributing foods with reference to the prevention of biological, physical, and chemical deterioration. Changes in food composition, microbiological safety, food laws and regulations, technologies of the major food processes such as canning, freezing, drying, and cereal and oilseed processing.
- 1212. SCIENTIFIC PRINCIPLES OF FOOD PREPARATION I.** (4 cr; prereq 2 qtrs inorganic chemistry)
Introduction to composition, nutritive value, and chemical and physical properties of foods; interaction and reaction of foods in food preparation procedures; evaluation of food products prepared in laboratory using quality standards; introduction to experimental study of foods.
- 1213. SCIENTIFIC PRINCIPLES OF FOOD PREPARATION II.** (3 cr; prereq 1212)
Continuation of FScN 1212 with the addition of individual and group projects to illustrate work area layouts and the sequence of tasks as related to food preparation.
- 1215. HOME PRESERVATION OF FOODS.** (2 cr; intended for nonmajors)
Description and demonstration of safe methods of home food preservation. Students prepare various products in the laboratory. Methods covered include: canning, freezing, fermenting, salting, drying, and others.
- 1272. INTRODUCTION TO FOOD DECISION MAKING.** (2 cr; prereq 1600 or 1602)
The decision-making process related to provision of nutritionally adequate food for a variety of eating patterns.
- 1500. MEAT SCIENCE.** (4 cr; prereq Biol 1011)
(Same as AnSc 1500) Role of ante- and post-mortem factors in altering the anatomy, function, and biochemical properties of muscle during its conversion to meat; importance of these changes to meat quality; and the manufacture, selection, preparation, and palatability characteristics of meat and meat products.
- 1600. SOCIOCULTURAL ASPECTS OF NUTRITION.** (3 cr)
Food habits of human beings in terms of historical, social, and cultural perspectives. Influence of different food patterns on nutritional status.
- 1602. PRINCIPLES OF NUTRITION.** (4 cr; prereq course in biology and course in chemistry or equiv in natural science sequence)
Fundamental principles of nutrition, including requirements for various nutrients and results of excess or deficient intakes of these nutrients.
- 1603. FAMILY NUTRITION.** (2 cr; intended for nonmajors)
Basic concepts in nutrition, emphasizing interrelationships between nutrients and the human requirement for specific nutrients. Current controversial topics in nutrition.
- 1700. INTRODUCTION TO HOSPITALITY AND FOOD SERVICE MANAGEMENT.** (2 cr)
Introduction to the hospitality and food service industry, emphasizing its scope, current trends, and growth and orientation as a business delivery system.
- 3110. FOOD CHEMISTRY.** (4 cr; prereq BioC 1302 or Biol 3021)
Structures, properties, reactions, and functions of basic chemical components of foods. Chemical properties of food systems, influence of processing, storage, and preparation.
- 3112. FOOD CHEMISTRY LABORATORY.** (2 cr; prereq 3110 or §3110)
Laboratory experiments to investigate chemical properties and reactions of selected food systems and food components.
- 3123. MICROBIOLOGY OF FOODS.** (5 cr, §MicB 3103, §VPB 3103; prereq Biol 1011 and 10 cr college chemistry, or 1020 or #; not for majors in food science and technology)
Incidence and sources of microorganisms in foods. Principles involved in control of microorganisms in foods for prevention of spoilage and public health hazards. Enhancement of keeping quality, nutritive value, and flavor attributes of food by the activities of microorganisms, as found in the manufacture of cheese or other fermented food products. Principles in sanitation and in destruction or inhibition of growth of microorganisms through use of physical and chemical agents.

- 3400. FOOD DEMONSTRATION TECHNIQUES.** (3 cr; prereq 1213 or 3403)
Purposes and techniques for food demonstrations for the general public and business. Production techniques and performance for TV and motion picture demonstrations. Effective use of media (films, slides, and other visuals) in the presentation of accurate food and nutrition information for designated audience situations. Opportunity to present one food demonstration prepared for class to an appropriate audience in the community.
- 3403. EXPERIMENTAL FOODS.** (4 cr; prereq 3110)
Principles and modern concepts of food systems and preparation; laboratory projects to illustrate effects of different procedures and ingredients.
- 3472. PRINCIPLES OF FOOD PURCHASING.** (4 cr; prereq 5 cr in food science and nutrition)
Principles of purchasing basic groups of foods. Relative cost of key nutrients from alternates within the food group. Food prices and indices of change. Laws and regulations pertinent to the labeling of food. Food standards and grades. Functional role of food additives.
- 3602. NUTRITION IN PROFESSIONAL HEALTH CARE.** (4 cr, \$1602; prereq chemistry, human physiology, regis in a professional health discipline, or #)
General principles of nutrition in professional health care. Nutrition as a factor in attaining and maintaining health. The role of the health practitioner in nutrition education.
- 3622. FOOD AND NUTRITION IN THE LIFE CYCLE.** (4 cr; prereq 1602, 3472, physiology or human biology, or #)
Application of the principles of nutrition to meeting the special requirements of growth, development, adult maintenance, and aging. The delivery of nutrients from foods as influenced by various life styles and stages.
- 3623. FOOD AND NUTRITION IN THE LIFE CYCLE.** (4 cr; prereq 1602, 3472, physiology or human biology, regis in coordinated undergraduate program in dietetics)
Application of the principles of nutrition to meeting the special requirements of growth, development, adult maintenance, and aging. The delivery of nutrients from foods as influenced by various life styles and stages. Emphasis on professional education for nutrition care of various age groups.
- 3642. COMMUNITY NUTRITION.** (3 cr; prereq jr, 1602 or equiv, 6 cr of psychology, sociology, anthropology or economics)
Nutrition and health practices of the family in the community; concepts and methodologies for nutrition education.
- 3643. COMMUNITY NUTRITION.** (4 cr; prereq 1602 or equiv, 6 cr of psychology, sociology, anthropology, or economics, regis in coordinated undergraduate program in dietetics)
Nutrition and health practices of the family in the community; concepts and methodologies for nutrition education. Development of competency in application of nutrition principles to problems in the community.
- 3662. INTRODUCTION TO THE CLINICAL PRACTICE OF DIETETICS.** (2 cr; prereq 12 cr in food science and nutrition, regis in coordinated undergraduate program in dietetics)
Introduction to the practice of dietetics in hospitals, outpatient clinics, public service agencies, and food services.
- 3702. PRINCIPLES OF FOOD SERVICE ORGANIZATION AND MANAGEMENT.** (4 cr; prereq sr, Mgmt 3001, regis in coordinated undergraduate program in dietetics)
Systems of food service management in the delivery of health care services; selection, supervision, and evaluation of personnel; effective planning and communication with food service management personnel.
- 3703. FIELD EXPERIENCE IN FOOD SERVICE MANAGEMENT.** (3 cr; prereq sr, #3702, Mgmt 3001, regis in coordinated undergraduate program in dietetics)
Supervised food service management experience in a health care facility.
- 3720. ADMINISTRATIVE EXPERIENCE: HOSPITALITY OR FOOD SERVICE ENTERPRISE.** (5 cr; prereq 3750 or 3760, sr in hospitality and food service management or #)
Planned management experience in a selected food service or hospitality business, including understanding the operation, planning, purchasing, personnel management, financial management, supervision, and related functions.
- 3730. QUANTITY FOOD PURCHASING AND PRODUCTION.** (5 cr; prereq 3rd-qtr soph, 1212 or 3110, 3472, preregistration with instructor)
Participation in management procedures used in selection, storage, preparation, pricing, and service of food in quantity. A quantity food service used as laboratory.
- 3740. DESIGN AND LAYOUT OF FOOD SERVICES.** (4 cr; prereq 3730)
Arrangement and layout of food production, service, and storage areas. Purchase, maintenance, construction, and operation of equipment related to quantity food service.
- 3742. HOSPITALITY FACILITY PLANNING AND DESIGN.** (5 cr; prereq 1700)
Hospitality managerial planning and design of space; mechanical, electrical, and structural requirements in hospitality facilities.

Course Listings

- 3750. MANAGEMENT OF FOOD SERVICE AND HOSPITALITY BUSINESS SYSTEMS.** (3 cr; prereq 3730 and Mgmt 3001)
Application of management principles in a food service or hospitality business. Consideration of business procedures, personnel management, cost control, advertising, and related administrative problems. Field trips may be required.
- 3752. FOOD AND HOSPITALITY OPERATIONS: APPLICATION OF COMPUTER SYSTEMS TO SMALLER UNITS.** (4 cr; prereq 3730, 3750, MIS 5100 or #)
Use of the computer in planning, operating, and controlling production and services, personnel, logistics, finances, and quality control in a small unit food and hospitality operation.
- 3760. HOSPITALITY COST MANAGEMENT.** (4 cr; prereq Acct 1050)
Cost accounting applied to the hospitality services industry.
- 3762. HOSPITALITY FINANCIAL MANAGEMENT.** (4 cr; prereq 3760, 4 cr statistics)
Financial management and forecasting applied to the hospitality industry.
- 3790. FOOD SERVICE MARKETING, ADVERTISING, AND PROMOTION.** (4 cr; prereq 1700, AgEc 1030 or Econ 1002, or #)
Theories and practices of market analysis, product planning, and consumer motivation as they relate to enterprises that provide hospitality to people away from home. Determining and satisfying the needs and interests of the consuming public in public dining places, clubs, hospitals, in-plant cafeterias, schools, and other institutions.
- 5000. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq 15 cr in food science and nutrition and #: not for grad cr; S-N grading...A-N where required)
Up to 12 weeks of planned experience in a selected position in the food industry; evaluative reports and consultations with faculty advisers and employers.
- 5100. GENERAL SEMINAR.** (1 cr; S-N only; prereq sr or #)
Literature review and presentation of papers in selected areas of food science and nutrition.
- 5102. CASE STUDIES IN FOOD SCIENCE AND NUTRITION.** (5 cr; prereq sr, #)
Experiences in problem solving; integration of various aspects of food science by means of team approach to solving a current problem.
- 5111. INDEPENDENT STUDY IN FOOD SCIENCE AND NUTRITION.** (1-5 cr [may be repeated for cr] prereq Δ; available to students in any college)
Individual laboratory or library research in some area related to food chemistry, food processing, nutrition, food service, or hospitality management. Open to students in any college who wish to gain experience in food science and nutrition area.
- 5120. FOOD MICROBIOLOGY.** (5 cr [3 cr for lect taken separately with #]; prereq MicB 3103)
Relationship of environment to occurrence, growth, and survival of microorganisms in foods; evaluation of microbiological quality of dairy and food products; characteristics and activities of bacteria, yeasts, and molds related to food spoilage; utilization of microorganisms in manufacture of dairy and food products; recognition and control of food-borne pathogens and food poisoning.
- 5122. SANITATION AND CONTROL OF MICROORGANISMS.** (2 cr; prereq 5120 or #...5123 advised, especially for food science and technology majors)
Factors that influence control and destruction of microorganisms; chemical, physical, and microbiological principles in cleaning and sanitizing food processing equipment; inactivation of microorganisms and thermal process evaluation; microbiological preservation methods; development of sanitation programs; microbiological criteria; hazard analysis and critical control point concept.
- 5123. MICROBIOLOGY OF FOOD FERMENTATIONS.** (2 cr; prereq 5120 or #...5122 advised, especially for food science and technology majors)
Characteristics of bacteria, yeasts, and molds involved in dairy and food fermentations; properties of lactic bacteriophages, methods of control in dairy fermentations; composition and factors that influence activity of dairy and food starter cultures; microbiology of natural and controlled fermentations; use of microorganisms in production of single-cell protein, of products consumed in food, and in waste utilization.
- 5135. FOOD PROCESS ENGINEERING I.** (3 cr; prereq 1102 or 11102, Math 1142, Phys 1031-1032)
Discussion and demonstration of fluid flow, heat transfer, sanitation design, refrigeration, mass transfer, process control, and waste treatment as used by the food processing industry.
- 5136. FOOD PROCESS ENGINEERING II.** (3 cr; prereq 5135)
Continuation of 5135.
- 5310. ADVANCED FOOD CHEMISTRY.** (3 cr; prereq 3110)
Changes in chemical structure and functional properties of foods as modified by processing. Additional topics in areas of flavor, color, safety, nutritive value, sweeteners, and irradiation of food.
- 5312. CHEMICAL AND INSTRUMENTAL ANALYSIS OF FOODS.** (5 cr; prereq 3112, BioC 5025 or #)
Application of quantitative physical, chemical, and instrumental methods of analysis to examination of food products; and evaluation of methods and interpretation of results.

- 5320. ADVANCED DAIRY AND FOOD MICROBIOLOGY.** (4 cr; prereq sr, 5122 or #)
Microbiology of food starter cultures; composition of starters, nutrition and metabolism, inhibitors in milk, strain association and compatibility, preservation and mass production, and bacteriophage in cheese-making. Influence and resistance. Natural and microbial toxicants in foods, occurrence, techniques (general and specific) for monitoring their presence, and control.
- 5321. INDEPENDENT STUDY IN FOOD MICROBIOLOGY.** (1-5 cr; prereq sr, Δ)
Laboratory or library research on problems related to the microbiology of dairy and food products.
- 5350. FOOD FORMULATION, PRODUCT DEVELOPMENT.** (4 cr; prereq course in statistics)
Application of concepts and techniques of experimental design to solution of food science problems. Case studies, computer programming, and use emphasized.
- 5360. SENSORY EVALUATION OF FOOD QUALITY.** (4 cr; prereq Stat 3081 or 5021 or equiv)
Fundamentals of sensory perception. Test designs and methods used in studying sensory qualities of foods.
- 5380. FOOD PACKAGING.** (3 cr; prereq Phys 1031, 1032 or equiv)
Lecture and demonstration of properties of various packaging materials and their uses in the food industry.
- 5402. MODERN FOOD PREPARATION PRINCIPLES AND PRACTICES.** (2-4 cr; prereq organic chemistry and 15 cr food science and nutrition)
Experimental bases of principles underlying present-day food preparation practices; development of experiences illustrative of such principles in high school teaching, dietetics, and foods in business.
- 5403. EXPERIMENTAL STUDY OF FOODS.** (5 cr; prereq 5360 or #)
Individual laboratory experimentation and comprehensive literature search on a problem in foods. Statistics and computers as a research tool. Data analysis and interpretation for a scientific paper.
- 5404. CURRENT ISSUES IN FOOD AND NUTRITION.** (2-4 cr; prereq 15 cr food science and nutrition or #)
Evaluation of popular and scientific literature dealing with nutrition, food additives, food safety, food fads, health foods, environmental contamination, the consumer movement, naturally occurring food toxicants, processed foods, synthetic foods, and organically grown foods.
- 5406. CURRENT LITERATURE IN FOODS.** (2-4 cr [may be repeated for max 6 cr]; prereq 5413, Δ)
Assigned readings, reports, and discussions of topics in the experimental study of foods.
- 5412. PHYSICO-CHEMISTRY OF FOODS.** (3 cr; prereq 3110)
Characterization of crystalline systems, gels, emulsions, foams, and rheological systems; functionality of food macromolecules in these systems.
- 5413. STRUCTURAL-FUNCTIONAL RELATIONS IN FOOD SYSTEMS.** (3 cr; prereq 3110)
Food as a complex biochemical system. Functionality of various biological entities and chemical constituents of food systems.
- 5462. ADVANCED TOPICS IN SENSORY EVALUATION OF FOOD.** (2-4 cr; prereq 5360)
Review of current literature pertinent to specific topics under active investigation.
- 5472. FOOD PURCHASING.** (4 cr; prereq principles of economics and 15 cr food science and nutrition)
Cost-quality relationships of diverse food products as affected by technological changes. Composition and nutritive value of processed and formulated food products. Functional role of food additives. Recent legislation pertinent to labeling and grading of food products.
- 5473. ADVANCES IN THE MANAGEMENT AND PREPARATION OF FOOD.** (2-4 cr; prereq 3403, 3472, or equiv)
Recent developments in food materials and methods of preparation; their implications in the management of time, money, and energy expenditures.
- 5510. MUSCLE CHEMISTRY AND PHYSIOLOGY.** (4 cr; prereq BioC 1302 or #)
(Same as AnSc 5510) Fundamental properties of muscle: ultrastructure, chemistry and physiology as they relate to muscle proteins, growth, contraction, energy metabolism, adaptive responses, rigor mortis, and conversion of muscle to meat.
- 5512. MEAT AND PROTEIN TECHNOLOGY.** (4 cr; prereq BioC 1302 or #)
(Same as AnSc 5512) Meat proteins: effects of pH, salt, and temperature on hydration and emulsification; methods of fractionation. Meat preservation: effects of heat, freezing, curing, and problems of product stability during storage. Sausage manufacture: chemistry, technology, least-cost analysis (graphical and computer methods), and chemical methods of quality control (rapid and classical methods of proximate analysis).
- 5522. TECHNOLOGY OF FLUID AND CONCENTRATED MILK PRODUCTS.** (4 cr; prereq 3110, 5135, 5120 or #)
Application of scientific principles to problems involved in processing fluid and dehydrated milk systems and their control. Demonstration of basic processing operations including heating, cooling, homogenization, evaporation, drying, crystallization, and freezing.
- 5523. TECHNOLOGY OF FERMENTED DAIRY PRODUCTS.** (4 cr; prereq 3112, 5123)
Integration of chemical, microbiological, and physical principles involved in the processing of cheeses, buttermilk, yogurt, and sour cream.

Course Listings

- 5524. SENSORY EVALUATION OF DAIRY PRODUCTS.** (1 cr; prereq 5360 or #)
Laboratory and commercial procedures for evaluating sensory properties and market quality of dairy products. Causes and identification of common defects in flavor, physical properties, and appearance.
- 5530. INDUSTRIAL PROCESSING OF FRUITS AND VEGETABLES.** (4 cr; prereq 3110, 5120, 5135 or #; 3 lect and 3 lab hrs per wk)
Relationship of chemical, physical, and microbiological principles to commercial processing of fruits and vegetables from procurement of raw products through preparation, preservation, packaging, storage, transportation, and merchandising. Emphasis on preservation methods involving heat, sterilization, and freezing.
- 5540. FATS AND OILS CHEMISTRY AND TECHNOLOGY.** (4 cr; prereq 3112 or #)
Nature of fats and oils; their structure, composition, and chemical and physical properties; raw materials for fat and oil products; extraction, refining, hydrogenization, and other industrial manipulations; handling, storage, and analysis and grading of raw materials and finished products.
- 5555. FREEZING AND DEHYDRATION OF FOODS.** (5 cr; prereq 5135, 3110, 5120 or #)
Principles involved in the processing, handling, and storage of frozen, dry, and intermediate moisture foods, with emphasis on physicochemical properties of water in foods.
- 5622. HUMAN NUTRITION.** (5 cr; prereq 1602, Biol 3021, Phsl 3051 or #)
Physiological function and metabolic role of nutrients and factors influencing the utilization of nutrients in human beings.
- 5642. FIELD EXPERIENCE IN COMMUNITY NUTRITION.** (3-18 cr; prereq course in human nutrition and #)
Application of nutrition information to problems of health and welfare, involving assigned readings, discussions, plus experience in a community agency.
- 5643. SEMINAR: WORLD FOOD SUPPLY PROBLEMS.** (4 cr, \$AgEc 5790, \$PIPa 5220, \$Soc 5675, \$LACS 5280; enrollment limited; prereq sr or grad student with #)
A multidisciplinary approach will examine social, economic, and technical problems of feeding the world's growing population.
- 5662. CLINICAL NUTRITION.** (3 cr; prereq 5622, Biol 3021 or #)
Application of principles of normal nutrition to clinical problems, with description of altered nutrient requirements under conditions of human disease. Nutritional therapy for common clinical conditions and effect of treatment on nutritional status of patient.
- 5663. CLINICAL NUTRITION LABORATORY.** (2 cr; prereq 5662 or 15662 or #)
Application of principles of normal and clinical nutrition to diet therapy. Techniques of therapeutic diet preparation, patient interviewing, and patient instruction in dietary management.
- 5664. FIELD EXPERIENCE IN CLINICAL NUTRITION.** (3-18 cr; prereq course in human nutrition and #)
Application of principles of nutrition to problems in health and disease, involving assigned readings, discussions, plus experience in a clinical facility.
- 5665. APPLIED CLINICAL NUTRITION I.** (2 cr; prereq sr in coordinated undergraduate program in dietetics)
Description of pathology of and diet therapy for diseases of the mouth, esophagus, stomach, intestine, liver, pancreas, and gallbladder.
- 5666. APPLIED CLINICAL NUTRITION II.** (2 cr; prereq 5665)
(Continuation of 5665) Pathology of and therapy for diseases of the kidney, urinary tract, anemia, allergy, hypertension, and parathyroid problems.
- 5667. APPLIED CLINICAL NUTRITION III.** (2 cr; prereq 5666)
(Continuation of 5666) Pathology of and therapy for diseases of the cardiovascular system and of metabolism.
- 5668. ADVANCED CLINICAL NUTRITION.** (2 cr; prereq 5662 or #; offered at Rochester and the Twin Cities)
An integrated approach to prevention and treatment of illness focusing on the role of nutrition in total medical care.
- 5693. SELECTED ASPECTS OF NUTRITION.** (2-4 cr [may be repeated for max 12 cr]; prereq sr, 1212, 1602 or #)
In-depth treatment of a single, preselected aspect of nutrition each quarter. Teaching procedure and approach determined by nature of topic and student needs. Specific topic announced in advance of course offering.
- 5694. METABOLIC BASIS FOR THERAPEUTIC NUTRITION.** (4 cr; prereq 5664 or #; offered at Rochester and the Twin Cities)
Physiological and biochemical bases for dietary treatment and exploration of dietary principles as related to adequate nutrition. Case study presentations and clinical experience included.
- 5702. SELECTED ASPECTS OF FOOD SERVICE MANAGEMENT IN HEALTH CARE FACILITIES.** (3 cr; prereq 3 cr elementary statistics, 6 cr economics, #)
Management techniques applied to food services for health care facilities. Methods of analysis and control.

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- 5730. VOLUME RECIPE FORMULATION, PRODUCTION, AND CONTROL.** (5 cr; prereq sr. 3110, 3740, 5360, or #)
The technology associated with the operation of food facilities producing 3,000 to 100,000 or more meals a day; analysis and selection of ingredients for industrial types of food processes, identification of optimum operating conditions, and institution of controls to insure products comply with specifications. Laboratory examination of ingredients and process control methodology.
- 5740. DESIGN AND LAYOUT OF FOOD SERVICES.** (4 cr; prereq 3740)
Problems related to the design and layout of new and remodeled food services.
- 5750. SELECTED ASPECTS OF FOOD SERVICE AND HOSPITALITY BUSINESS MANAGEMENT.** (4 cr; prereq 4 cr elementary statistics, 3750, MIS 5100, Acct 3255)
Management techniques applied to a food service or hospitality business. Methods of analysis and control.
- 5752. FOOD AND HOSPITALITY OPERATIONS: CORPORATE APPLICATION OF COMPUTER SYSTEMS.** (4 cr; prereq 3752, Acct 3255, or #)
Use of the computer in planning, operating, and controlling the integrated operations of production and services, personnel, logistics and finances, quality assurance, and quality control in a multiunit corporate food and/or hospitality operation.
- 5790. QUANTITY FOOD PREPARATION PRACTICES.** (3 cr; prereq baccalaureate degree and current or impending affiliation with occupational foods program in a secondary school)
Storage, preparation, service, and pricing of selected menu items. Students investigate and seek solutions to problems related to quantity food service. Opportunity to integrate lectures, laboratory experiences, and independent study with instructional programs in occupational foods.

FOR GRADUATE STUDENTS ONLY

(For course descriptions, see the *Graduate School Bulletin*)

- 8101. RESEARCH SEMINAR**
- 8120. PROCESS MICROBIOLOGY**
- 8205. GENERAL SEMINAR**
- 8310. ADVANCED FOOD CHEMISTRY**
- 8311. FLAVOR CHEMISTRY**
- 8312. REACTION KINETICS OF FOOD DETERIORATION**
- 8313. TOPICS IN LIPID CHEMISTRY**
- 8315. FOOD PROTEINS**
- 8322. THERMAL PROCESSING OF FOOD**
- 8323. MICROBIAL STARTER CULTURES**
- 8324. MICROBIAL TOXINS AND TOXIC MICROORGANISMS IN FOODS**
- 8401. INDEPENDENT STUDY: FOOD SCIENCE**
- 8403. ADVANCED TOPICS IN FOOD SCIENCE**
- 8412. INTERRELATIONSHIPS AND FUNCTIONS OF FOOD COMPONENTS**
- 8621. INDEPENDENT STUDY: NUTRITION**
- 8622. ADVANCED HUMAN NUTRITION I**
- 8623. ADVANCED HUMAN NUTRITION II**

Horticultural Science and Landscape Architecture

HORTICULTURAL SCIENCE (Hort)

- 1001. FUNDAMENTALS OF HORTICULTURE.** (4 cr)
Fruit, vegetable, and ornamental plants, including factors that influence their culture, value, and importance. Lectures, laboratory, and field trips.
- 1010. HOME LANDSCAPE GARDENING AND DESIGN.** (4 cr; not designed for landscape horticulture majors)
Working knowledge of propagation and culture of common house plants and landscape materials: turf, flowers, trees, and shrubs. Principles of home landscape design applied to a home property of the student's own choosing. Lectures, laboratory, and reference reading.

Course Listings

- 1016. GREENHOUSE MANAGEMENT.** (3 cr; prereq Biol 1103)
Fundamentals of greenhouse construction and management; thorough discussion of cultural and physiological principles.
- 1021. PLANT MATERIALS I.** (4 cr)
Taxonomy, ecology, and landscape uses of trees, vines, evergreens, and native deciduous shrubs. Lectures, laboratories, and field trips.
- 1022. PLANT MATERIALS II.** (4 cr)
Taxonomy, ecology, and landscape uses of perennial and annual flowers, tender and hardy bulbs, ground covers, and selected deciduous shrubs. Lectures, laboratory, and field trips.
- 1036. PLANT PROPAGATION.** (4 cr; prereq Biol 1103, Hort 1001 or #)
Principles and techniques of propagating plants by seeds, cuttings, grafts, buds, layers, and division. Lectures on principles; laboratories on practice of various propagating techniques; and field trips.
- 3026. RESIDENTIAL LANDSCAPE DESIGN.** (4 cr; prereq 1021, LA 1025)
Principles of landscape design with reference to their practical application in planning of residential landscapes. Relationships of landscape design, architectural design, and interior design. Landscape drafting techniques and methods of presentation. Lectures, drawings, and practical problems.
- 3031. FRUIT SCIENCE.** (4 cr; prereq 1001, Soil 1122)
Principles of fruit production. Fruits of the world with emphasis on temperate climate crops. Site selection, cultural and management practices, physiological and environmental control of plant development, dwarfing, growth regulating compounds, insecticides, and herbicides. Lectures and laboratory.
- 3032. VEGETABLE SCIENCE.** (4 cr; prereq 1001, Soil 1122)
Principles of vegetable agriculture including world food problems, geography of production, nature and scope of fresh vegetable and processing industries, physiological adaptation of species as food sources and such principles of production practice as stand establishment, irrigation, nutrition, seed production, and postharvest handling. Lectures, discussion, and laboratory practice in field and greenhouse.
- 3053. ORNAMENTALS FOR INTERIOR DESIGN.** (4 cr)
Identification, utilization, and culture primarily of foliage plants used in interior decoration. Lectures, reference reading, and field trips.
- 3072. TURF MANAGEMENT.** (4 cr; prereq 1001 and Soil 1122 or Agro 1010 or Biol 1103)
General landscape maintenance and turf culture. Working in areas of industrial grounds maintenance, park and recreation area maintenance, and general lawn care.
- 3076. ARBORICULTURE.** (3 cr; prereq 1021, Soil 1122 or FBio 1100)
Survey of environmental and design functions of shade trees. Application of specific cultural principles and techniques pertaining to the installation, maintenance, and preservation of shade and ornamental trees. Equipment selection and adaptability. Fundamental concepts used in organization and administration of community shade tree programs. Lectures, demonstrations, and field trips.
- 3077. FLORAL DESIGN.** (3 cr)
Fundamental principles in floral arrangement. Analysis of basic design principles used in floral design. Decorative use of flowers, foliages, and accessories.
- 3079. ORNAMENTAL HORTICULTURE BUSINESS PRACTICES.** (3 cr)
Business management principles and practices in operation of horticultural retail firms. Scope of the industry and its place in horticulture and the modern business world. Lectures, discussion, and field trips.
- 3097. HORTICULTURE PRACTICUM.** (4-6 cr; prereq upper division horticulture major)
Approved field, laboratory, or greenhouse experiences in application of horticultural information and practices.
- 3098. UNDERGRADUATE RESEARCH PROJECT.** (2-6 cr; prereq 8 cr upper division horticulture courses)
Undergraduate research projects associated with laboratory, field, or greenhouse studies.
- 3099. SEMINAR.** (1 cr [may be repeated for max 2 cr]; prereq jr)
Horticultural problems, research projects, work experience, and employment opportunities.
- 5000. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq 15 cr in horticulture and #; not for grad cr)
Up to 12 weeks of planned experience in a selected position in the horticulture industry; evaluative reports and consultations with faculty advisers and employers.
- 5006. SYSTEMATICS OF TEMPERATE AND TROPICAL HORTICULTURAL FOOD CROPS.** (4 cr; offered 1977-78 and alt yrs)
Systematic relationships of the world's resources of fruit and vegetable taxa with particular reference to development of improved types and varieties. Lectures, literature review, and laboratory.
- 5011. MANAGEMENT OF ARTIFICIAL ENVIRONMENTS FOR PLANT GROWTH.** (3 cr, §1016; prereq 10 cr plant sciences; offered 1978-79 and alt yrs)
Fundamentals of design, construction, and management of greenhouses and growth chambers with emphasis on cultural and physiological principles and the use of these environments for research purposes.

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- 5020. HORTICULTURAL TECHNIQUES FOR EDUCATION MAJORS.** (3 cr [no cr for horticulture majors]; prereq education major or #)
Horticultural and botanical concepts and their impact on the use of horticultural plants in the classroom. Development of specific single concept classroom demonstration and pupil-oriented activities relating to horticultural plants.
- 5021. ORNAMENTAL PLANT MATERIALS.** (5 cr, §1021, §1022)
Identification and use of wide range of ornamental plant materials including trees, shrubs, annuals, perennials, and plants for interior design. Application of information and personal observations to individual student's area of study.
- 5031. FRUIT SCIENCE FOR ADVANCED STUDENTS.** (2 cr, §3031; prereq 1001, Soil 1122)
See Hort 3031.
- 5033. TOPICS: OPTIMIZING HORTICULTURAL FOOD PRODUCTION.** (1 cr)
Analysis of current and futuristic concepts in fruit and vegetable production. Topics include mechanical harvesting, population density, new cultural concepts, and environmental modifications as they apply to maximizing yield and quality.
- 5038. RESEARCH METHODS IN PLANT PROPAGATION.** (3 cr; prereq 1036 or #)
Basic concepts, theory, and techniques involved in propagating plants studied through literature search and discussion. Students design and conduct experiments with plants or propagation techniques of special interest.
- 5040. PLANT GROWTH REGULATORS.** (3 cr; prereq 15 cr plant sciences incl 3 cr plant physiology)
The physiology and agricultural technology of plant hormones and synthetic growth regulators in horticulture. Emphasis on practical uses of such substances in the control of fruit and leaf abscission, parthenocarp, growth rate, growth habit, plant size, apical dominance, organ initiation, dormancy, germination, flowering, callusing, and others.
- 5041. ENVIRONMENTAL PHYSIOLOGY OF HORTICULTURAL PLANTS.** (3 cr; prereq 15 cr plant sciences, PIPh 5184; offered 1977-78 and alt yrs)
Lectures and assigned readings on the relation of water, temperature, and light to the growth and development of horticultural plants.
- 5042. TURF GRASS SCIENCE.** (5 cr; prereq 3072, PIPa 1001, PIPh 3131)
For advanced students in turf with career objectives in professional turf management. All phases of the turf industry considered, with emphasis on the ecology, physiology, and theory of turf population dynamics and on specialized management situations such as golf course, commercial sod production, and fine turf athletic situations.
- 5044. MARKET GRADES AND VARIETAL ADAPTATION OF FRUITS AND VEGETABLES.** (4 cr; prereq 3031, 3032)
Characteristics of leading varieties of fruits and vegetables, market grades, variety testing, and impact of environmental factors on varietal types and market grades.
- 5045. TOPICS IN NURSERY MANAGEMENT.** (1 cr; prereq 1036, PIPh 3131; offered 1977-78 and alt yrs)
Relationship of plant growth requirements to production, storage, and distribution of nursery crops. Discussion and field trips.
- 5052. COMMERCIAL FLORICULTURE, FALL CROPS.** (3 cr; prereq 1016; offered 1977-78 and alt yrs)
Physiological and cultural aspects of optimized production of principal florist crops of economic importance. Chrysanthemums, carnations, cut flowers, and potted plants especially adapted to Christmas sales. Lectures, reference reading, and field trips to greenhouses, wholesalers, and retail flower stores.
- 5053. COMMERCIAL FLORICULTURE, WINTER CROPS.** (3 cr; prereq Biol 1103, PIPh 3131 or #)
Physiological and cultural aspects of bulbous plants (tulips, narcissi, bulbous irises, hyacinths, crocuses, and lilies) and year-round production of azaleas. Emphasis on latest research in growth, developmental, and flowering physiology of these commercially important floricultural crops. Lectures, reference reading, laboratory experience, and field trips.
- 5054. COMMERCIAL FLORICULTURE, SPRING CROPS.** (3 cr; prereq 1016; offered 1977-78 and alt yrs)
Physiological and cultural aspects of optimized production of principal florist crops of economic importance. Roses, snapdragons, gloxinias, and materials adapted to spring sales. Lectures, reference reading, and field trips to greenhouses, wholesalers, and retail stores.
- 5090, 5091, 5092. SPECIAL PROBLEMS.** (1-4 cr per qtr; prereq #)
Written report based on library, laboratory, or field research.

LANDSCAPE ARCHITECTURE (LA)

- 1001. ENVIRONMENTAL DESIGN: MAN AND ENVIRONMENT.** (4 cr, §Arch 1001)
See Arch 1001 for description.
- 1002. ENVIRONMENTAL DESIGN: TOOLS AND PROCESSES.** (4 cr, §Arch 1002; prereq 1001)
See Arch 1002 for description.

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- 1003. ENVIRONMENTAL DESIGN: IMPLEMENTATION AND EVALUATION.** (4 cr, §Arch 1003; prereq 1002)
See Arch 1003 for description.
- 1021. HISTORY OF ENVIRONMENTAL DEVELOPMENT: ARCHITECTURE.** (4 cr, §Arch 1021; 4 lect hrs per wk)
See Arch 1021 for description.
- 1022. HISTORY OF ENVIRONMENTAL DEVELOPMENT: LANDSCAPE ARCHITECTURE.** (4 cr, §Arch 1022; prereq 1021; 4 lect hrs per wk)
See Arch 1022 for description.
- 1023. HISTORY OF ENVIRONMENTAL DEVELOPMENT: PLANNING.** (4 cr, §Arch 1023; prereq 1022; 4 lect hrs per wk)
See Arch 1023 for description.
- 1024. LANDSCAPE THEORY.** (4 cr; 3 lect and 3 lab hrs per wk)
Analysis of design elements and forms involving direction, shape, proportion, and color, with emphasis on their function in design; perception and our relationship to the environment; the social effects and psychological basis for design.
- 1025. BASIC VISUALIZATION.** (4 cr; 2 lect and 4 lab hrs per wk; prereq LA major or #)
Perspective drawing, landscape sketching, visual analysis of landscape materials, presentation techniques for plans, sections, elevations, and diagrams.
- 1031. INTRODUCTION TO LANDSCAPE ARCHITECTURE.** (4 cr; 4 lect hrs per wk)
Design potential of materials of the landscape; exercises in assessment of land developments and detail landscapes; the role of the landscape architect in shaping the natural and cultural environment; brief historical review of site developments.
- 3071. LANDSCAPE TECHNOLOGY: GROUND FORM DESIGN.** (4 cr; prereq 3083, CE 3100, and AgEn 1400; 2 lect, 6 lab hrs per wk)
Lectures, exercises, and projects in ground form manipulation, earthwork computation, and surface drainage techniques.
- 3072. LANDSCAPE TECHNOLOGY: CIRCULATION AND UTILITIES DESIGN.** (4 cr; prereq 3071 and 3091; 2 lect and 6 lab hrs per wk)
Lectures, exercises, and projects in layout of circulation and landscape utilities systems.
- 3073. LANDSCAPE TECHNOLOGY: LAND ANALYSIS TECHNIQUES.** (4 cr; prereq 3072; 2 lect and 6 lab hrs per wk)
Lectures, exercises, and projects in land analysis techniques for use in assessment of land development potential.
- 3075. LANDSCAPE TECHNOLOGY: MATERIALS AND CONSTRUCTION DESIGN.** (4 cr; prereq 3072 and 3092; 2 lect and 6 lab hrs per wk)
Lectures, exercises, and project in materials and construction techniques and working document preparation.
- 3081-3082-3083. BASIC DESIGN.** (6 cr per qtr; prereq LA student; 1 lect and 15 lab hrs per wk)
Lectures and projects to expand awareness of the design potential of environment, develop processes and graphic techniques for problem solving, and develop methods of presenting ideas verbally and visually. Design of small-scale site systems with simple variables.
- 3081-3092. INTERMEDIATE DESIGN.** (6 cr per qtr; prereq 3083; 2 lect and 12 lab hrs per wk)
Lectures and projects in the design potential of natural land materials, landscape survey and analysis techniques, elements of the environment as they condition design potential, methodologies for solving design problems, methods of expressing landscape form both geographically and through models; design of site systems with simple variations.
- 3093. DETAIL SITE DESIGN.** (6 cr; prereq 3092)
Design of small-scale site systems with complex variables.
- 3096. SPECIAL PROBLEMS IN LANDSCAPE ARCHITECTURAL HISTORY.** (1-6 cr; prereq #)
- 3097. SPECIAL PROBLEMS IN LANDSCAPE ARCHITECTURAL THEORY.** (1-6 cr; prereq #)
- 3098. SPECIAL PROBLEMS IN LANDSCAPE ARCHITECTURAL DESIGN.** (1-6 cr; prereq #)
- 3099. SPECIAL PROBLEMS IN LANDSCAPE ARCHITECTURAL TECHNOLOGY.** (1-6 cr; prereq #)
- 3101. COMMUNICATING LANDSCAPE QUALITY.** (4 cr; 2 lect and 6 lab hrs per wk; prereq 1025 and 3082)
Lectures and exercises in drawing techniques focused on developing graphic skills for designers working predominantly with exterior environments.
- 5000. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq 3092 and #; not for grad cr)
Up to 12 weeks of planned experience in a selected position in the landscape architecture profession; evaluative reports and consultations with faculty advisers and employers.

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- 5010. PRINCIPLES OF OUTDOOR RECREATION DESIGN AND PLANNING.** (4 cr, §FR 5233; 4 lect hrs per wk)
For advanced students associated with design, management, and planning of recreation facilities. Planning and design principles related to recreational land use and development; parks, campsites, water areas, highways, and summer and winter recreational facilities.
- 5101. SITE PLANNING AND DESIGN.** (6 cr; 2 lect and 12 lab hrs per wk; prereq 3093)
Case study analysis and design of site organizational systems.
- 5103. URBAN LANDSCAPE DESIGN.** (6 cr; 2 lect and 12 lab hrs per wk; prereq 3093)
Case study analysis and design of urban environments.
- 5105. RECREATIONAL PLANNING AND DESIGN.** (6 cr; prereq 5010; 2 lect and 12 lab hrs per wk)
Analysis development and presentation of landscape design solutions for diverse recreational land use.
- 5107. REGIONAL LANDSCAPE DESIGN.** (6 cr; prereq 3092; 3 lect and 12 lab hrs per wk)
Emphasis on large-scale land areas. Analyzing development potential and evolving solutions for integration of divergent land use patterns such as agricultural, residential, commercial, industrial, and recreational.
- 5110. ADVANCED LANDSCAPE PLANNING AND DESIGN.** (6 cr; prereq terminal qtr of study; 2 lect and 12 lab hrs per wk)
Advanced studies in area of student's option.
- 5115-5116. THEORY OF LANDSCAPE FORM AND STRUCTURE.** (4 cr per qtr; prereq 3091 or #; 4 discussion hrs per wk)
Studies in landscape perception; lectures, discussions, and exercises in application of abstract design principles to the assessment of land developments; psychological and social implications of land developments; design potential of landscape materials; contemporary problems in land development including all scales and types of land uses.
- 5124. LANDSCAPE ARCHITECTURAL SEMINAR.** (4 cr; prereq terminal yr of study)
Analysis of design principles and goals in modern society. Current site development projects. In-depth investigation of specific areas of land development.
- 5131-5132-5133. SELECTED PROBLEMS IN LANDSCAPE ARCHITECTURE.** (Cr ar; prereq #)
- 5224. CONTEMPORARY ISSUES IN LANDSCAPE ARCHITECTURE.** (4 cr; prereq terminal yr of study; 4 discussion hrs per wk)
Analysis of design principles and design goals in modern society. Review of current site development projects. In-depth investigation into specific areas of land development.
- 5226. PROFESSIONAL PRACTICE.** (4 cr; prereq terminal yr of study)
Professional ethics, responsibility, and relations in business. Office management, preparation of professional communications, estimates, specifications, and contracts. Lectures, written exercises, and office visits.
- 5262. HISTORY AND LITERATURE OF LANDSCAPE ARCHITECTURE.** (4 cr; 4 lect hrs per wk; prereq 1022)
Design principles as expressed in landscaping from ancient times to contemporary period. Analysis of the visual form of environments as outgrowths of geographical, cultural, and technological determinants.

FOR GRADUATE STUDENTS ONLY

(For course descriptions, see the *Graduate School Bulletin*)

Agro 8270.* SEMINAR: PLANT BREEDING

GCB 8900. SEMINAR: GENETICS

Hort 8021.* BREEDING OF SEXUALLY PROPAGATED HORTICULTURAL CROPS

Hort 8022. BREEDING ASEXUALLY PROPAGATED CROPS

Hort 8023. EVOLUTION OF CROP PLANTS

Hort 8041. DISCUSSIONS IN ADMINISTRATIVE ORGANIZATION

Hort 8042. HORTICULTURAL SEMINAR

Hort 8045.* PLANT HARDINESS

Hort 8051x.* ADVANCED PROBLEMS IN HORTICULTURAL CROP BREEDING

Hort 8052x.* ADVANCED PROBLEMS IN PHYSIOLOGY OF HORTICULTURAL CROPS

Hort 8060. DISCUSSION IN POTATO RESEARCH

Hort 8061.* DISCUSSIONS IN INCOMPATIBILITY

Hort 8062.* DISCUSSIONS IN PLANT HARDINESS

Hort 8063.* DISCUSSIONS IN HORTICULTURAL PLANT BREEDING

Course Listings

- Hort 8064.* **DISCUSSIONS IN FLORICULTURAL SCIENCE**
Hort 8065.* **DISCUSSIONS IN POSTHARVEST PHYSIOLOGY**
Hort 8066. **DISCUSSION IN HORTICULTURAL RESEARCH**

Plant Pathology (PIPa)

- 1001. INTRODUCTORY PLANT PATHOLOGY.** (5 cr, §5050; prereq soph, 9 cr plant science)
Introductory course in plant diseases. Lectures, laboratory, and special problems.
- 3090. RESEARCH IN PLANT PATHOLOGY.** (Cr and hrs ar; prereq 1001 or equiv or #)
Assignment of special problems to undergraduate students who desire opportunity for independent research in plant pathology.
- 3100. PATHOGENS IN PLANT DISEASE I.** (4 cr; prereq 1001)
General characteristics of mycoplasma, viruses, bacteria, and fungi, with emphasis on those pathogenic to plants. Methods of reproduction, dispersal, colonization, and survival.
- 3101. PATHOGENS IN PLANT DISEASE II.** (4 cr; prereq 1001)
General characteristics of algae, parasitic seed plants, nematodes, and abiotic pathogens such as nutrient deficiencies and pollutants, with emphasis on those pathogenic to plants.
- 5000. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq 15 cr in plant pathology and #; not for grad cr)
Open to advanced students in plant health technology program. Up to 12 weeks of experience in a selected agricultural industry; evaluative reports and consultations with faculty advisers and employers.
- 5002. INTRODUCTORY PLANT PATHOLOGY FOR ADVANCED STUDENTS.** (3 cr, §1001, §5050; prereq 14 cr plant science or #)
- 5013. DISEASES OF ECONOMIC PLANTS.** (2 cr; prereq 1001 or equiv...\$100 recommended; offered summer only)
Diseases of ornamental plants, trees, and field crops, fruit crops, and vegetable crops. Lectures and field trips.
- 5050. FOREST PATHOLOGY.** (4 cr, §1001; prereq Biol 1103 or equiv)
Diseases of forest and shade trees: wood decay. Symptoms, etiology, and control. Lectures, laboratory, and fieldwork.
- 5051. ADVANCED FOREST PATHOLOGY.** (3 cr; prereq 5050 or equiv; offered 1979 and alt yrs)
Basic concepts in the etiology, epidemiology, and pathogenesis of tree diseases and wood deterioration.
- 5100. FUNGUS DISEASES OF PLANTS.** (4 cr; prereq 1001 or equiv; offered 1978 and alt yrs)
Morphological and anatomical effects of infection, relationships of parts of the fungal life cycle to factors affecting infection and control measures.
- 5102. INTRODUCTORY MYCOLOGY.** (6 cr; prereq 9 cr botany or #; offered at Itasca)
General characteristics of fungi, especially those used in identification; cultural and taxonomic procedures and practices.
- 5103. AQUATIC FUNGI.** (5 cr; limited to 12 students; prereq 3 cr mycology or #; offered at Itasca)
Collection, culture, taxonomy, and morphology of freshwater fungi.
- 5105. INTRODUCTION TO THE STUDY OF FUNGI.** (3 cr; prereq 9 cr botany or Biol 1011 or #)
Structures, habits, classification, and identification of fungi.
- 5106. MYCOLOGY: ASCOMYCETES—FUNGI IMPERFECTI.** (3 cr; prereq 1001 or 5050 or MicB 3103; offered 1978 and alt yrs)
Lectures and laboratory exercises on taxonomy, identification, life histories, genetics, and ecology of fungi.
- 5107. MYCOLOGY: BASIDIOMYCETES.** (3 cr; prereq 1001 or 5050 or MicB 3103; offered 1978 and alt yrs)
Lectures and laboratory exercises on the taxonomy, identification, life histories, genetics, and ecology of fungi.
- 5108. ABIOTIC DISEASES OF PLANTS.** (4 cr; prereq 1001 or 5002, 5184, and Soil 1122, or #; offered 1978 and alt yrs)
(Same as Soil 5108) Diagnosis, etiology, and control of plant diseases caused by adverse physicochemical factors. Effects on plants of temperature, moisture, light, agrochemicals, nutritional disorders, and air pollutants.
- 5109.* BIOCHEMISTRY AND PHYSIOLOGY OF FUNGI.** (3 cr; prereq 8 cr biochemistry or #; offered 1979 and alt yrs)
Lectures, assigned readings, and discussions of the chemical structure and activities of the fungus cell, including growth, nutrition, regulation of intermediary metabolism and protein and nucleic acid syntheses, sporulation and spore germination, mitochondrial biogenesis, photobiology, mycoviruses, and natural products.

- 5110. AIR POLLUTION AND ITS EFFECTS ON VEGETATION.** (4 cr; prereq 10 cr biology or #)
Types of air pollutants, sources and dispersal, meteorology, pollutants in rain and aerosols, field investigation techniques, effects on vegetation including communities, control of injury to plants, air quality criteria, and case histories.
- 5200. POISONOUS PLANTS.** (2 cr; prereq Biol 1011, 3 cr botany)
Plants poisonous to animals and people; plant families and species, symptoms of poisoning, and toxic principles. Lectures and field trips.
- 5215.* INSECTS IN RELATION TO PLANT DISEASES.** (4 cr; prereq 5 cr entomology, 5 cr plant pathology or equiv or #)
(Same as Ent 5215) Insect transmission and dissemination of plant pathogens; development of plant-insect relationships; habits of principal insect vectors with emphasis on methods of control.
- 5220. WORLD FOOD SUPPLY PROBLEMS.** (4 cr, §AgEc 5790, §Soc 5675, §LACS 5280, §FS&N 5643; limited enrollment; prereq sr and grad students with Δ or #)
A multidisciplinary approach will examine problems of feeding the world's growing population. Principles from public health and from the socioeconomic sciences, plant sciences, and animal sciences applied in lectures and informal discussions.
- 5300. VIRUS DISEASES OF PLANTS.** (3 cr; prereq 1001 or 5050 or 5002; offered 1977 and alt yrs)
Nature of plant viruses and types of diseases they cause; emphasis on methods for studying virus diseases.
- 5400. BACTERIAL DISEASES OF PLANTS.** (3 cr; prereq 1001 or 5050 or 5002 and 3 cr bacteriology; offered 1978, and alt yrs)
Bacteria as plant pathogens; representative types with particular reference to techniques used in studying bacterial diseases of plants.
- 5500. PLANT NEMATOLOGY.** (4 cr; prereq 1001 or 5050 or 5002 and Biol 1011 or #)
Nematode taxonomy, morphology, life cycles, biology, and control; nematodes as plant pathogens and their effects on plants.
- 5600. PLANT DISEASE DIAGNOSIS.** (3 cr; prereq 3101)
Fundamentals of plant disease diagnosis including field techniques, symptomatology, methods of isolation, histological procedures, and chemical analyses.
- 5650. CLINICAL PLANT PATHOLOGY.** (6 cr; prereq 1001, 5600, and 8 cr plant pathology)
Clinical and laboratory experience in Plant Disease Clinic in diagnosis, treatment, and control of plant diseases of field crops, vegetable crops, turf, ornamentals, and trees.
- 5702. CONTROL AND PREVENTION OF PLANT DISEASES.** (3 cr; prereq 1001 or 5050 or #; offered in 1978 and alt yrs)
Principles and practices relating to plant disease control with emphasis on quarantine, eradication, cultural practices, and fungicides.

FOR GRADUATE STUDENTS ONLY

(For course descriptions, see the *Graduate School Bulletin*)

- 8090. RESEARCH IN PLANT PATHOLOGY**
- 8110. PROBLEMS IN MYCOLOGY**
- 8111. GENETICS OF PLANT PATHOGENS**
- 8112. ECOLOGY OF PLANT PATHOGENS**
- 8113. PLANT EPIDEMIOLOGY**
- 8301. RESEARCH IN PLANT VIROLOGY**
- 8401.* RESEARCH IN PLANT BACTERIOLOGY**
- 8501.* CURRENT TOPICS AND PROBLEMS IN PLANT NEMATOLOGY**
- 8600. SEMINAR: PLANT PATHOLOGY**
- 8610. PHYSIOLOGY OF HOST-PARASITE RELATIONSHIPS**
- 8620. PRINCIPLES OF PLANT PATHOLOGY**

Rhetoric (Rhet)

- 1101. COMMUNICATION I.** (4 cr)
Writing from observation and personal experience. Emphasis on expository and descriptive prose that is clear, vigorous, honest, and economical. Attention to effectively written sentences and sound paragraph construction.

Course Listings

- 1102. COMMUNICATION II.** (4 cr)
Writing from research and personal observation. Emphasis on the research paper including techniques of drawing hypotheses; examining indexes and guides; selecting, evaluating, and organizing evidence; constructing paraphrases; and assembling footnotes and bibliography. Attention to effective sentences and forceful style.
- 1147. EFFICIENT READING.** (3 cr)
Designed to increase reading rate, comprehension, and vocabulary. For persons of average or above-average reading ability who wish to achieve or maintain superior scholastic status. Not a remedial course.
- 1220. PRINCIPLES OF HUMAN COMMUNICATION.** (3 cr)
The dimensions of human communication. The origins and nature of language, the development of language in the individual, theories of intrapersonal, interpersonal and small group communication, the role of public speaking in America, and the impact and development of the mass media. Emphasis on the relationship between language and human values, attitudes, beliefs, and behaviors.
- 1221. AN INTRODUCTION TO INTERPERSONAL COMMUNICATION.** (3 cr; prereq completion of freshman communication requirement)
The dimensions of interpersonal communication. Theories, problems, and practical exercises of interpersonal communication. Designed to enable students to become better communicators in interpersonal situations. Principles and experiences of interpersonal communication including factors related to interpersonal perception, orientation, contents, models, choice, attraction, barriers, and breakdowns.
- 1222. PUBLIC SPEAKING.** (4 cr; prereq soph. completion of freshman communication requirement)
Practical course in fundamentals of speechmaking. Emphasis on organizing the speech and projecting it to the audience.
- 1226. PARLIAMENTARY PROCEDURE, LEADERSHIP, AND PARTICIPATION.** (3 cr; prereq completion of freshman communication requirement)
Individual participation in the creation and development of a functioning organization using rules of parliamentary procedure as its basis for doing business. The history, theories, and processes of democratically oriented organizations.
- 1251. EFFECTIVE LISTENING.** (3 cr)
Designed to increase listening comprehension by developing four central abilities. Readings, research, theory, and practice.
- 1301. HUMANITIES: THE ENLIGHTENMENT.** (4 cr)
Introduction to interdisciplinary humanistic study; the French Revolution, the Napoleonic era, the rise of rationalism in religion, humanism, neoclassicism, and the rise of science.
- 1302. HUMANITIES: THE INDUSTRIAL REVOLUTION.** (4 cr)
The industrial transformation of Europe; laissez-faire capitalism and liberalism; the romantic response; socialism.
- 1303. HUMANITIES: THE AGE OF DARWIN.** (4 cr)
The impact of evolutionary thought; philosophy, religion, and morality in a changing society.
- 1376. HUMANITIES: TOPICS IN HUMANITIES AND LITERATURE.** (4 cr)
Topics vary from quarter to quarter and are listed in the *Class Schedule*. For full details, inquire at the departmental office prior to registration.
- 1401. INTRODUCTION TO LITERATURE.** (4 cr)
Analysis of literary structural forms and stylistic devices: poetry, drama, and prose fiction.
- 1424. WORLD LITERATURE I.** (4 cr)
Examination and analysis of selected master works of continental and Middle Eastern literature from the ancients through the Renaissance.
- 1425. WORLD LITERATURE II.** (4 cr)
Examination and analysis of selected master works of continental literature from the neoclassical period to the present.
- 1442. NOVEL AND SHORT STORY.** (4 cr)
Analysis of selected European and American fiction. Emphasis on literary style in relation to themes of prose fiction.
- 1451. INTRODUCTION TO DRAMATIC LITERATURE.** (4 cr)
Selected plays from Greek literature to the present. Emphasis on the development of dramatic art form.
- 1506. ORIGINAL WRITING.** (3 cr)
Systematic analysis of short story techniques. Through reading and writing short stories, the student is acquainted with basic constants of the art. Emphasis is on writing, but the course also provides a different way of reading and appreciating short stories.
- 3166. SCIENTIFIC AND TECHNICAL GRAPHICS.** (4 cr; prereq #)
A survey of graphic methods of transferring scientific and technical knowledge. Designed to acquaint students with types and methods of using graphics in technical communication. Contemporary and

historical overview of the use of graphics in scientific and technical disciplines. As many types of graphics as possible will be used in class; e.g., the illustrated lecture, videotape, 35mm slides, and others.

- 3192. COMMUNICATION FOR INTERNATIONAL EXCHANGE GROUPS.** (3 cr; prereq intermediate knowledge of oral and written English)
Communication and culture among members of international exchange groups of similar national origins. Communication processes and skill areas; factors such as animal, interpersonal, nonverbal, and intercultural communication. Facets of American literature, painting, and architecture.
- 3254. ADVANCED PUBLIC SPEAKING.** (4 cr; prereq 1222)
Training for specific speech situations most likely to be encountered professionally, soon after graduation. Psychology of communication, especially as related to use of visual aids, demonstration, performance methods, and radio.
- 3266. DISCUSSION METHODS.** (4 cr; prereq completion of freshman communication requirement)
Study of and practice in structured and unstructured discussion. Emphasis on group dynamics and the psychology of leadership. Practice in leading meetings, debating, planning radio programs, organizing in-service training programs, and evaluating group progress.
- 3270. SPEECH: SPECIAL PROBLEMS.** (1-5 cr; prereq #)
Supervised reading and research on advanced speech-communication topics not covered in regularly scheduled speech offerings.
- 3280. AMERICAN WOMEN COMMUNICATORS.** (3-5 cr; prereq completion of freshman communication requirement)
Effective communication by American women traced historically and original texts of speeches by women (both in print and on tape) analyzed. Students examine the rhetoric used in available speeches and, where possible, evaluate the vocal delivery used. In a few cases, influential written communications will be considered where speech texts are unavailable. Individual research into special areas of American culture to discover influential women speakers or analyze the most important speeches of individual women allows students to follow their particular interests.
- 3321. HUMANITIES: THE GREEK HERITAGE.** (4 cr)
The literature, philosophy, and arts of ancient Greece central to understanding contemporary Western society.
- 3322. HUMANITIES: THE ROMAN AND MEDIEVAL HERITAGE.** (4 cr)
The continuing relevance of the literature, philosophy, theology, and arts of the Roman past and of the Middle Ages.
- 3323. HUMANITIES: THE RENAISSANCE AND REFORMATION.** (4 cr)
The literature, philosophy, arts, and scientific advances of the early and high Renaissance; the Reformation and Counter-Reformation in the Church.
- 3371. HUMANITIES: AMERICAN INDIVIDUALISM.** (4 cr)
Examination and evaluation of conflicts arising from the varied individualistic traditions in America.
- 3372. HUMANITIES: RELIGION IN AMERICAN THOUGHT AND EXPERIENCE.** (4 cr)
The diverse values centered in American religious and philosophical thinking from the 17th century to the present.
- 3373. HUMANITIES: NATIONALISM IN AMERICAN THOUGHT AND EXPERIENCE.** (4 cr)
The growth of political and cultural nationalism in America from the 17th century to the present.
- 3374. HUMANITIES: SPECIAL PROBLEMS.** (1-5 cr; prereq #)
Primarily for supervised reading and research on topics not covered in regularly scheduled humanities offerings.
- 3381. HUMANITIES: 20TH-CENTURY CULTURE.** (4 cr)
The changing structure of 20th-century culture from World War I to the present. Communism, fascism, and democracy. Modern movements in literature, the visual arts, and architecture.
- 3471. AMERICAN LITERATURE.** (4 cr)
Analysis of philosophical and social concepts that have shaped American culture, as reflected in literature.
- 3473. CONTEMPORARY LITERATURE.** (4 cr)
Reading and analysis of significant modern literary works.
- 3551. PROFESSIONAL WRITING.** (4 cr; 3551 or 3562 is required of all students unless exempted through dept exam; prereq jr)
Projects and reports in professional communication: the résumé, application letter, and interview; professional journals; the review of literature; specialized bibliographic tools; the feature article.
- 3562. SCIENTIFIC AND TECHNICAL WRITING.** (4 cr; 3562 or 3551 is required of all students unless exempted through dept exam; prereq jr)
Methods of exposition in scientific and technical writing; types of reports; audience analysis; continuous practice in report writing.

Course Listings

- 3700. RHETORICAL THEORY: PERSUASION AND THE LITERATURE OF SCIENCE.** (4 cr; prereq completion of freshman communication requirement)
Introduction to principles of rhetorical analysis. Emphasis on Aristotelian theory. Practice in rhetorical criticism of contemporary communication.
- 5000. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq #; not for grad cr)
Internship in technical communication designed to give majors practical on-the-job experience with communication problems. Students intern as writers or editors either at the University or in industry.
- 5100. TECHNICAL COMMUNICATION: SPECIAL PROBLEMS.** (Cr ar; prereq #)
Designed for supervised reading, research, and work on advanced technical communication projects not covered in regularly scheduled courses.
- 5147. ADULT READING PROGRAMS.** (2 cr)
Problems, methods, and research in this field. Survey and evaluation of program designs including those suitable for TV.
- 5150. DIRECTION OF TRAINING IN BUSINESS AND SERVICE ORGANIZATIONS.** (4 cr; prereq freshman communication or equiv)
Business, industrial, and service organizations and their in-post and out-post training programs. The scope and sequence of specialized training and development programs, the job of the typical director of training and development, and skills required for entry into the field. Students make an on-site visitation of a training and development office in a selected business and/or service organization and conduct descriptive research concerning effectiveness of program involved.
- 5165. STUDIES IN ORGANIZATIONAL COMMUNICATION, CONFLICT AND CHANGE.** (4 cr; prereq freshman communication or equiv)
The roles of internal and external organizational communication, conflict-problem identification, and change processes. Contemporary theory and research in organizational development. Methods of problem identification and diagnosis. Change processes and applications to actual organizational settings.
- 5170. MANAGERIAL COMMUNICATIONS.** (4 cr; prereq freshman communication or equiv)
Systematic analysis of communication techniques and procedures for the manager. Emphasis on manager's ability to achieve vertical and horizontal understanding and acceptance. Readings, guest speakers, and a term project.
- 5175. PRINCIPLES OF LANGUAGE DEVELOPMENT.** (4 cr)
Analysis through history and semantics of principles of the English language. The course is based on the premise that an understanding of how English has evolved will generate a more enlightened attitude in its use.
- 5180. INTERNSHIP IN TECHNICAL COMMUNICATION.** (Cr ar)
Designed to give technical communication majors on-the-job experience at the University or in industry or government.
- 5257. SCIENTIFIC AND TECHNICAL PRESENTATIONS.** (4 cr; prereq 1222, 3562 or 3551 or #)
Presentations for specific situations related to technical or scientific topics. Audience analysis and adaptation, techniques of support and visualization, organization for clarity and accuracy, and techniques of interpreting and answering questions. Students will make and evaluate technical and scientific presentations. Emphasis on seminar reports and professional conference papers.
- 5375. HUMANITIES: SEMINAR IN AMERICAN AGRARIANISM.** (3 cr; prereq #)
Interdisciplinary seminar in humanities. The roots of the agrarian ideal in European thought and in early America. Individual research into and evaluations of the agrarian tradition in American social and political philosophy, and in history of imaginative literature, fine arts, and popular culture.
- 5400. DISSEMINATION AND UTILIZATION OF INFORMATION.** (4 cr; prereq jr, sr, or grad standing)
Methods and processes of using specialized information. Study of cases and development of materials for application in professional fields. Emphasis on channels for dissemination and utilization.
- 5500. RESEARCH IN COMMUNICATION STRATEGIES.** (4 cr; prereq #)
(Same as AgJo 5500) Introduction to basic research design and methodology in communication. Emphasis on application of various research methods to particular communication strategies or settings.
- 5551. REPORT AND THESIS WRITING.** (3 cr; prereq 3551 or 3562 or #)
For graduate students and seniors actually working on reports or theses. Organization of reports and thesis; library investigation; presentation of data; methods of documentation. Emphasis on revision of manuscripts and improvement in style of writing.
- 5561. WRITING FOR PUBLICATION.** (4 cr; prereq 3551 or 3562 or bachelor's degree)
The professional as communicator; analysis of markets: professional, trade, and general; information sources and topic selection; adaptation to the specialized and general reader; writing and preparing manuscripts for publication; marketing techniques.
- 5600. TRANSFER OF TECHNOLOGY.** (4 cr; prereq one of the following courses: 5257, 5400, Jour 5133 or #)
(Same as AgJo 5600) Methods of transferring scientific and technical knowledge and practice from those individuals and organizations who possess it to those who need it. Review of research in diffusion and

transfer methods at different technical levels. Tools, methodologies, and assessment procedures for an actual program of technical or scientific subject matter. Planning state-of-the-art or frontier technology seminars and impact analyses for scientists, engineers, and/or segments of the public required.

5700. COMMUNICATION IN TECHNOLOGICAL AND ENVIRONMENTAL IMPACT ASSESSMENT. (4 cr; prereq sr or grad standing, one course in statistics, #)

Theories and processes involved in technological assessment and environmental impact statement preparation. Case studies of technology assessments, forecasts, and environmental impact statements. Term project on planning of process and project management in an actual impact assessment.

Soil Science (Soil)

1122. INTRODUCTORY SOIL SCIENCE. (4 cr; prereq Chem 1001 or 1004)

Basic physical, chemical, and microbiological properties of soil. Soil genesis, classification, and principles of soil fertility. Lectures and laboratory.

1262. INTRODUCTION TO METEOROLOGY. (4 cr)

(Same as Geog 1425) Pre-calculus introduction to nature of atmosphere and its behavior. Atmospheric composition, structure, stability, and motion; precipitation processes, air masses, fronts, cyclones and anticyclones; general weather patterns; meteorological instruments and observations; plotting and analysis of maps; forecasting.

3049. SOIL PHYSICS SURVEY. (1 cr; prereq AEM 3016, #AgEn 3050 or #)

Soil physical concepts and calculations most essential for agricultural engineering students in the IT curriculum. Lectures and laboratory.

3118. SEMINAR: SOIL POLLUTION AND PUBLIC POLICY. (1 cr; S-N only; offered fall 1978-79 and alt yrs)

Round table discussions of assigned readings in the subject matter.

3210. SOIL PHYSICAL PROPERTIES. (2 cr; prereq 1122, Math 1111, Phys 1031 or #)

Physical characteristics of soil important in controlling plant growth and development. Seedbed preparation and tillage. Water storage and availability, soil heat and aeration and their enhancement for greater crop yields. Lectures and demonstrations.

3218. SEMINAR: SOIL WATER, IRRIGATION, AND TILLAGE. (1 cr; S-N only; offered winter 1978 and alt yrs)

Round table discussions of assigned readings in the subject matter.

3220. SOIL, WATER MANAGEMENT, AND CONSERVATION. (3 cr; prereq 3210 or #)

Factors affecting soil and water losses. Effect of soil tillage methods and cropping systems on structure maintenance, erosion control, water storage, and infiltration. Techniques and organizations in soil and water conservation.

3412. SOIL FERTILITY EVALUATION. (4 cr; prereq 1122)

Methods of soil fertility evaluation; soil tests and tissue tests and their use in fertilizers and lime recommendations; fertility demonstration techniques. Lectures and laboratory.

3418. SEMINAR: REMOVAL OF PLANT NUTRIENTS FROM SOILS BY PERCOLATION, RUNOFF, AND EROSION. (1 cr; S-N only; offered winter 1978-79 and alt yrs)

Round table discussions of assigned readings in the subject matter.

3420. FERTILIZER PROPERTIES AND PRACTICES. (3 cr; prereq 1122)

Chemical and physical properties of commercial fertilizer materials; reactions of fertilizers in soils; fertilizer use on crops—kinds, amounts, application methods, and effects on yield and quality.

3428. SEMINAR: SOIL FERTILITY AND SOIL AMENDMENTS. (1 cr; S-N only; offered winter 1979 and alt yrs)

Round table discussions and assigned readings.

3518. SEMINAR: SOIL JUDGING. (1 cr; S-N only)

Discussions of and use of the high school and FFA soil judging scorecard.

3528. SEMINAR: USE AND INTERPRETATION OF SOIL SURVEYS. (1 cr; S-N only; offered fall 1977-78 and alt yrs)

Round table discussions of assigned readings in the subject matter.

3538. SEMINAR: FOREST SOIL MANAGEMENT. (1 cr; S-N only; offered fall 1978 and alt yrs)

Round table discussions and assigned readings.

3548. SEMINAR: USE AND MANAGEMENT OF ORGANIC SOILS. (1 cr; S-N only; offered fall 1977 and alt yrs)

Round table discussions and assigned readings.

3558. SEMINAR: WORLD SOILS AND FOOD PRODUCTION. (1 cr; S-N only; offered Spring 1978 and alt yrs)

Round table discussions and assigned readings.

3618. SEMINAR: BIOLOGICAL NITROGEN FIXATION. (1 cr; S-N only; offered winter 1978 and alt yrs)

Round table discussions and assigned readings.

Course Listings

- 5000. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq 12 cr in soils and #; not for grad cr)
Up to 12 weeks of planned experience in a selected position related to soil science. Evaluation of work experience by employer and faculty adviser in consultation with student and employer.
- 5108. ABIOTIC DISEASES OF PLANTS.** (4 cr; prereq PIPa 1001 or 5002 and PIPh 5184, Soil 1122 or #)
(Same as PIPa 5108) Diagnosis, etiology, and control of plant diseases caused by adverse physicochemical factors. Effects on plants of temperature, moisture, light, agrochemicals, nutritional disorders, and air pollutants.
- 5114. SPECIAL PROBLEMS IN SOILS.** (1-5 cr [may be repeated for max 10 cr]; prereq 1122 or #)
Research, readings, and instruction.
- 5232. SOIL PHYSICS.** (4 cr; prereq Math 1142, 2 qtrs physics or f)
Basic physical laws governing processes occurring in soils and their quantification. Physical basis for water, air, and heat transport processes. Lectures, laboratory demonstrations, and problem-solving help sessions.
- 5240. MICROCLIMATOLOGY (SOILS).** (5 cr; prereq Math 1111, 10 cr physics or #)
Meteorology and climatology in relation to the soil-atmosphere interface, with emphasis on the microclimate, physical processes taking place within the microclimate, modification of the microclimate by human activities including agricultural practices, description of meteorological instruments, and use of weather data.
- 5310. SOIL CHEMISTRY AND MINERALOGY.** (4 cr; prereq 1122 or #; offered 1977-78 and alt yrs)
Basic physical laws governing processes occurring in soils. Chemical composition of mineral and organic matter, ionic exchange and factors affecting ionic movement. Acid, alkaline, calcareous, and alkali soils.
- 5333. SOIL ANALYTICAL CHEMISTRY TECHNIQUES.** (3 cr; limited to 10 students; prereq 1122, 5 cr physics, one course in analytical chemistry or #; offered 1978-79 and alt yrs)
Instrumental methods of inorganic and organic chemical analyses in soils. Lectures and laboratory.
- 5340. ORGANIC AND PESTICIDAL RESIDUES.** (5 cr; prereq 1122, sr or #)
The fate of crop residues, animal wastes, sewage materials, petroleum hydrocarbons, detergents, and pesticides in soils with emphasis on the chemical, physical, and biological factors of the soil that influence decomposition or persistence.
- 5430. CHEMISTRY OF PLANT NUTRIENT ELEMENTS IN SOILS.** (3 cr; prereq 1122)
Amounts, kinds, and reactions of plant nutrient elements in soils and effects on plants. Fertilizer nutrient reactions, persistence and loss in soils.
- 5512. SOIL GEOGRAPHY.** (4 cr; prereq 1122)
Introduction to soil morphology and classification as related to distribution patterns of soils. Emphasis on soil geography of the state, region, United States, and world. Interpretation of this geography with the use of soil maps and aerial photographs in various types of resource development. Lecture, laboratory, and field trips.
- 5520. SOIL DEVELOPMENT AND CLASSIFICATION.** (3 cr; prereq 5512 or #)
Soil profile characteristics; influence of parent material, climate, topography, vegetation, and time on soil development; system of soil classification; and world distribution of major soil groups.
- 5532. SOILS AND THE ECOSYSTEM.** (5 cr; limited to 20 students; may be taken in place of EBB 5819; prereq course in ecology; offered at Itasca SSI)
Functional and structural aspects of soils as a component of the ecosystem. Interrelationships of soil and vegetation on the landscape.
- 5540. SOIL RESOURCES AND ENVIRONMENTAL RELATIONSHIPS.** (4 cr; prereq 1122 or #)
Current types of soil resource concepts, land use as related to soils, and interactions of technology on the soil environment. Possible short- and long-term effects of fertilizers, soil amendments, and other substances on the soil-water ecosystem.
- 5550. ORGANIC SOILS.** (3 cr; prereq 1122)
Formation, classification, and properties of organic soils; their use and management. Lectures and laboratory.
- 5565. FIELD COURSE—SOIL SURVEY.** (10 cr; prereq 5512 and #; offered SSI only)
Principles of soil survey including description of soils in acceptable terms, mapping soils on airphoto base, interpretive groupings of soils, development of descriptive legend, and classification of soils according to soil taxonomy.
- 5632.* SOIL MICROBIOLOGY AND PLANT GROWTH.** (4 cr, \$5612; prereq 1122 and course in microbiology or #)
The soil environment. Microbiological population of the soil. Role of microorganisms in the soil-plant environment and cyclic transformations of agronomic interest (C, N, and mineral substances). Effect of soil microflora on soil fertility and plant nutrition. Lectures and laboratory.
- 5710. ADVANCED FOREST SOILS.** (3 cr [4 cr with paper]; prereq 1122, FR 5114)
Factors affecting tree growth; estimation, modification, and management effects on site productivity; regeneration.

FOR GRADUATE STUDENTS ONLY

(For course descriptions, see the *Graduate School Bulletin*)

- 8111. COLLOQUIA IN SOIL SCIENCE
- 8122. ADVANCED SOIL SCIENCE
- 8124. RESEARCH PROBLEMS IN SOILS
- 8128. SEMINAR
- 8322. SELECTED METHODS OF CLAY MINERAL ANALYSIS
- 8330. SOIL PHYSICAL CHEMISTRY

**Courses in Programs Serving All Departments
in the College of Agriculture**

Agriculture (Agri)

- 1000. **ACADEMIC ENRICHMENT AND HONORS PROGRAM: SPECIAL PROJECTS.** (1-15 cr; S-N only; prereq application and acceptance for Special Opportunity Grant, agriculture major only)
Pursuit of a special interest in depth as an alternative to regular classroom activities. Requires submission of a proposal describing the project, including estimation of its duration and a tentative expense budget (funds of up to \$100 are available for approved projects). For further information, check with the college office.
- 1001. **LEADERSHIP DEVELOPMENT: INDEPENDENT STUDY.** (1-3 cr [may be repeated for max 6 cr]; S-N only; prereq agriculture major, #)
Agriculture students who plan to actively participate in positions of leadership in student organizations, student activities, or programs of the academic community may earn credit for such activities. Proposal stating objectives of this experience, progress reports, and final written report required.
- 5555. **INTEGRATING PAPER FOR MASTER OF AGRICULTURE STUDENTS.** (1 cr)
Preparation of a paper of the quality of a professional trade journal article, integrating the student's studies with application to an agricultural problem or the student's major area of concentration. The paper will be reviewed and graded by the student's advisory committee.

Plant Physiology (PIPh)

Students majoring in the College of Agriculture may be interested in the following courses in plant physiology. With the approval of the adviser, the introductory courses in plant physiology may be used in partial fulfillment of the science requirement. Upper division courses in plant physiology may also be taken when students have completed the necessary prerequisites. These courses will serve to introduce undergraduates to the field of plant physiology and will illustrate how knowledge in this special area of plant science may be utilized in private or governmental research and in college and university teaching and research. Undergraduates interested in information about plant physiology as a professional career should contact any of the faculty members listed in this area in the *Graduate School Bulletin*.

- 3131. **SURVEY OF PLANT PHYSIOLOGY.** (4 cr, §5131, §Bot 3131, §5131; prereq Biol 1103 or 3012, BioC 1302 or ¶BioC 1302, or Biol 3021 or BioC 5001)
Physiological principles underlying processes that occur in living plants with emphasis on higher plants. Growth and development, mineral nutrition, water relations and solute metabolism, respiration, and photosynthesis.
- 3132. **PLANT PHYSIOLOGY LABORATORY.** (2 cr, §Bot 3132; prereq 3131 or ¶3131)
A laboratory course to accompany PIPh 3131.
- 5131. **SURVEY OF PLANT PHYSIOLOGY.** (4 cr, 3131, §Bot 3131, §Bot 5131; prereq Biol 1103 or 3012, BioC 1302 or ¶BioC 1302, or Biol 3021 or BioC 5001)
Same as PIPh 3131 with the addition of a weekly discussion and advanced reading session.
- 5132. **PLANT PHYSIOLOGY LABORATORY.** (2 cr, §Bot 5132; prereq 5131 or ¶5131)
Laboratory course to accompany PIPh 5131.

Course Listings

- 5167.* PHYSIOLOGY OF THE PLANT CELL.** (3 cr; prereq plant anatomy, inorganic and organic chemistry or biochemistry; offered 1978-79 and alt yrs)
Characteristics of the living state, general aspects of cell metabolism, development of the cell, polarity, differentiation, and irritability of the cell and cellular movements.
- 5168.* EXPERIMENTAL PROTOPLASMATOLOGY.** (3 cr; prereq #: offered 1977-78 and alt yrs)
Physical and physicochemical properties of living protoplasm in plant cells including viscosity, wall attachment, permeability, primary and secondary fluorescence, and vital staining.
- 5182.* PLANT METABOLISM.** (3 cr, §Bot 5182; prereq 5131, a course in biochemistry or equiv)
Plant metabolism including photosynthesis, respiration, and synthesis of macromolecules by plants. Structure-function relations at the plant, cell, and subcellular level. Energy flow in the plant system and regulation of plant metabolism.
- 5183.* WATER, MINERALS, AND TRANSLOCATION.** (4 cr, §Bot 5183; prereq 5131 or equiv)
Membrane phenomena and osmotic properties of cells. Uptake, movement, and loss of water in plants including effects of external factors. Translocation of organic substances. The absorption, distribution, and function of inorganic elements.
- 5184.* PLANT GROWTH AND DEVELOPMENT.** (3 cr, §Bot 5184; prereq 5131 or equiv)
Growth of higher plants including division and differentiation of cells, development of plant organs, effects of external factors on plant growth, photosynthesis, and respiration in relation to plant development, and the nature and action of plant growth substances.
- 5185.* PHYSIOLOGY OF PHOTOSYNTHETIC MICROORGANISMS.** (3-5 cr; prereq #: offered 1978-79 and alt yrs)
Primarily a lecture course. Applications of spectrophotometry, manometry, and other techniques toward elucidation of physiological behavior, chemical makeup, and intermediary metabolism of algae and photosynthetic bacteria.
- 5188.* RESEARCH PERSPECTIVES IN PLANT PHYSIOLOGY.** (Cr ar; prereq Chem 3100, 3101, 8 cr biochemistry, #)
A laboratory course in which the student undertakes a well-defined research problem of limited scope.
- 5703. INTERNAL WATER BALANCE.** (3 cr; prereq #: offered 1977-78 and alt yrs)
Laboratory course in which components of water balance in plants (turgor, osmotic, water potentials) are measured using various techniques. Matching method to experimental goals.
- 5721, 5723, 5724, 5725, 5726, 5727. METHODS OF PLANT ANALYSIS.** (Cr ar; enrollment limited; prereq Chem 3100, 3101, 8 cr biochemistry, #)
In-depth experimental laboratory approach to microscopic analysis, sample preparation, fractionation, isolation, and measurement of plant compounds employing modern methods of plant physiology. Independent units in:
- 5721. The Primary Plant Metabolites.** (Cr ar; offered 1978-79 and alt yrs)
 - 5723. Plant Hormones and Tissue Culture.** (Cr ar; offered every yr)
 - 5724. Photosynthesis and Photosynthetic Pigments.** (Cr ar; offered 1977-78 and alt yrs)
 - 5725. Plant Nucleic Acids.** (Cr ar; offered 1977-78 and alt yrs)
 - 5726. Analysis of Cell Structure.** (Cr ar; offered 1978-79 and alt yrs)
 - 5727. Phytochrome, Photomorphogenesis, and the Physiology of Flowering.** (Cr ar; offered 1978-79 and alt yrs)
- 5970.* SPECIAL PROBLEMS IN PLANT PHYSIOLOGY.** (Cr ar)
Research, readings, instruction.

FOR GRADUATE STUDENTS ONLY

(For course descriptions, see the *Graduate School Bulletin*)

- 8251. SEMINAR: PLANT PHYSIOLOGY**
- 8281.* GROWTH AND DIFFERENTIATION OF PLANTS**
- 8282.* ADVANCED TOPICS IN PLANT METABOLISM**
- 8285. PHOTOSYNTHESIS**
- 8286. RADIOISOTOPE TECHNIQUES IN PLANT SCIENCE**
- 8310. METHODS IN PLANT PHYSIOLOGY**

Additional courses treating the area of plant physiology that are offered by several departments within the College of Agriculture include Agro 5030, 8030, 8050; BioC 5950; FR 8101; Hort 5040, 5041, 8045, 8052; MicB 5321, 8121; PIPa 5109, 8610; Soil 5240, 5340, and 5632.

Resource and Community Development (RCD)

- 1010. ISSUES IN THE ENVIRONMENT.** (3 cr)
Interdisciplinary offerings exploring five areas of environmental concern: aspects of environmental design that provide maximum compatibility of human beings with their environment, sources of water pollution and their control, disposal and control of solid wastes from agriculture, minimization of pesticide pollution of the environment, and managed use of forest resources to maintain environmental quality. This is a televised course involving 20 taped lectures and 10 discussion periods.
- 3010. THE MINNESOTA COMMUNITY: ANALYSIS OF ITS ORGANIZATION, CHANGE, AND DEVELOPMENT.** (4 cr; prereq one social science course and #)
Community problem solving and decision making. How local problems are defined, what communities can do in dealing with their problems, and how information (primarily scientific knowledge) may be applied to local problems. Conceptual analysis of communities and their problems. Secondary data analysis as a research technique for use in analysis of community problems in Minnesota.
- 5099. INTERDISCIPLINARY SEMINAR I.** (2 cr; prereq resource and community development major or #)
Selected speakers, readings, and discussion topics dealing with resource and community development analysis and implications for resource allocation. Discussions reflect diverse disciplinary contributions.
- 5100. INTERDISCIPLINARY SEMINAR II.** (4 cr, 5100-5101†; prereq 5099 and resource and community development sr or #)
Designed to help students develop the competency necessary for identifying and analyzing resource development problems. Discussions reflect diverse disciplinary contributions. Students participate as members of a team combining disciplinary skills. Guest speakers and student assignments.
- 5101. INTERDISCIPLINARY SEMINAR III.** (4 cr, 5100-5101†; prereq 5100)
(Continuation of RCD 5100) Papers, presentations, and critiques on selected complex resource development problems related to resource analysis and discussion programs in Seminars I and II.
- 5110. SPECIAL PROBLEMS.** (1-4 cr [may be repeated for max 12 cr]; prereq resource and community development sr, #)
Projects, plans, and written reports related to RCD 5100, 5101; resource and environmental inventory and analysis.
- 5120. ENVIRONMENTAL PROBLEMS.** (3 cr, §1010)
Interdisciplinary offering exploring five areas of environmental concern: aspects of environmental design that provide maximum compatibility of human beings with their environment, sources of water pollution and their control, disposal and control of solid wastes from agriculture, minimization of pesticide pollution of the environment, and managed use of forest resources to maintain environmental quality. This is a televised course involving 22 taped lectures and 10 discussion periods. Report on a specific environmental problem also required. This course offered in Continuing Education and Extension only.
- 5200. COMMUNITY DEVELOPMENT SIMULATION.** (4 cr for undergrad, 3 cr for grad; prereq #)
Participation in making and using water and land resource use decisions in a community development simulation. Preparation and use of a small-area data base for monitoring community well-being and forecasting fiscal and ecological impacts of market, and public sector activities and local decision making.

Statistics (Stat)

- 1051. INTRODUCTION TO IDEAS OF STATISTICS.** (4 cr; prereq high school higher algebra)
Presentation and analysis of data. Probabilistic models for inference. Types of inference and decision procedures. Emphasis on concepts rather than computation.
- 3081. EXPERIMENTAL TECHNIQUES AND STATISTICAL INFERENCE.** (5 cr; prereq college algebra; open only to agriculture students)
Sampling, variability, description and analysis of data, tests and confidence intervals, multiple comparisons; choosing experimental design, material, and design. Introduction to correlation and regression.
- 3091. INTRODUCTION TO PROBABILITY AND STATISTICS.** (4 cr, §5121, §5131; prereq differential and integral calculus)
Elementary probability and probability distributions, sampling and elements of statistical inference. Treatment more mathematical than that in 1051.
- 5021. STATISTICAL ANALYSIS I.** (5 cr; prereq college algebra or #)
Frequency distributions; descriptive statistics; elementary probability; binomial, Poisson, and normal distribution; estimation and testing; analysis of variance; multiple comparisons; linear regression.
- 5022. STATISTICAL ANALYSIS II.** (5 cr; prereq 5021 or #)
(Continuation of 5021) Multiple regression and correlation; multiway analysis of variance, variance components, covariance; elementary principles of design; basic nonparametric methods.

Course Listings

- 5071. STATISTICAL APPLICATION OF MATRIX ALGEBRA.** (3 cr; prereq 5021, ¶Math 3142, or #)
Introduction to specific matrix operations with vector realizations, presuming no prior knowledge. Uses in analysis of variance and multivariate methods. Correlation structures, characteristic vectors, and quadratic forms.
- 5101. INTRODUCTION TO DECISION THEORY.** (4 cr, §5132; prereq Econ 5111 or Math 1142 or 1211 or #)
Elements of probability; basic concepts in statistical decision theory; relationship to game theory and other types of decision problems; prediction and inference.
- 5121-5122. THEORY OF STATISTICS.** (4 cr per qtr, §5131-5132-5133; prereq Math 1231 or 1331 or 1621)
Univariate and multivariate distributions, law of large numbers, sampling, likelihood methods, estimation and hypothesis testing, regression and analysis of variance and covariance, confidence intervals, and distribution-free methods.
- 5131-5132-5133. THEORY OF STATISTICS.** (4 cr per qtr, §5121-5122; prereq ¶Math 3211 or 3411)
5131: Probability models, univariate and bivariate distributions, independence, and basic limit theorems. 5132-5133: Statistical decision theory, sampling, estimation, testing hypotheses, parametric and nonparametric procedures for one-sample and two-sample problems, regression, and analysis of variance. Treatment more mathematical than that of 5121-5122.
- 5201. SAMPLING METHODOLOGY IN FINITE POPULATIONS.** (4 cr; prereq 5021 or 5121 or 3091)
Simple random, systematic, stratified, and unequal probability sampling. Ratio and regression estimation. Multistage and cluster sampling.
- 5211. THEORY OF SAMPLE SURVEYS.** (4 cr; prereq 5122 or 5133)
Mathematical treatment of survey sampling including stratified and multistage sampling, models for nonsampling errors.
- 5271-5272. BAYESIAN DECISION MAKING.** (4 cr, §Econ 5271-5272; prereq 5133 for 5271...5271 and Econ 3101 for 5272)
5271: Axioms for personal probability and utility. Elements of statistical decision theory. Bayesian analysis of linear models. 5272: Expected utility models for economic decisions made under conditions of uncertainty. Application to portfolio selection, forward and futures trading, betting, contingency markets, and business planning.
- 5301. DESIGNING EXPERIMENTS.** (4 cr; prereq 5022 or 5122 or 5133)
Control of variation, construction and analysis of complete and incomplete block, split plot, factorial, and groups of similar experiments. Confounding, crossover, and optimum seeking designs.
- 5302. APPLIED REGRESSION ANALYSIS.** (4 cr; prereq 5022 or 5071 or 5122 or #)
Simple, multiple, and polynomial regression. Estimation, testing, and prediction. Stepwise and other numerical methods; examination of residuals; weighted least squares; nonlinear models; response surface. Experimental research and economic applications.
- 5401. INTRODUCTION TO MULTIVARIATE METHODS.** (4 cr; prereq 5071, 5022 or 5122)
Bivariate and multivariate distributions. Inference on multivariate normal distributions. Discrimination and classification. Multivariate analysis of variance. Partial, canonical correlation and independence. Principal component analysis, factor analysis, analysis of repeated measurements, cluster analysis, and profile analysis.
- 5421. ANALYSIS OF CATEGORICAL DATA.** (4 cr; prereq 5022 or 5122, or 5133)
Varieties of categorical data, cross-classifications and contingency tables, tests for independence. Multi-dimensional tables and log-linear models, maximum-likelihood estimation and tests of goodness-of-fit. Logit models and analogies with regression. Analysis of incomplete tables. Marginal homogeneity and symmetry in square tables. Analysis of Markov chain data. Smoothing counts.
- 5601. NONPARAMETRIC METHODS.** (4 cr; prereq 5022 or 5122 or #)
Survey of necessary discrete and continuous probability distributions. Goodness-of-fit, sign tests, order statistics, rank tests for location and for scale, two-sample and k-sample comparisons, association. Emphasis on methods and applications.
- 5900. TUTORIAL COURSE.** (Cr ar; prereq #)
Directed study in areas not covered by regular offerings
- 5911-512-5913. TOPICS IN STATISTICS.** (3 cr per qtr; prereq 5122 or 5133 and #)
Topics vary; may be repeated for credit with department approval.

Courses in the College of Veterinary Medicine Available to College of Agriculture Students

Large Animal Clinical Sciences (LACS)

- 3502. ANIMAL HEALTH AND DISEASE.** (5 cr)
Designed for non-veterinary medicine student to give a broad understanding of veterinary science as it applies to health and disease of domestic animals. Emphasis on basic concepts of disease. Common animal diseases studied demonstrating these concepts. How stress and management practices aggravate and create new disease conditions.
- 5280. SEMINAR: WORLD FOOD SUPPLY PROBLEMS.** (4 cr. \$AgEc 5790, \$FScN 5643, \$PIPa 5220, \$Soc 5675; limited enrollment; prereq major in agriculture, veterinary medicine, nutritional sciences, social science field or #...grad students by Δ only)
A multidisciplinary approach will examine social, economic, and technical problems of feeding the world's growing population. Principles sought from the social and economic sciences, plant sciences, animal sciences, and nutritional sciences for their application to food problems.
- 5650. VETERINARY EPIDEMIOLOGY.** (4 cr; prereq 10 cr biology, 12 cr chemistry or #)
Principles of epidemiology, ecology, and veterinary public health. Biostatistics applied to the measurement of health and disease in populations.

Veterinary Biology (VB)

- 1120. COMPARATIVE VERTEBRATE MORPHOLOGY.** (5 cr; recommended for pre-veterinary medicine students; prereq Biol 1106 or #)
The interpretation of vertebrate morphology, morphogenesis, and function with emphasis on phylogeny and adaptive significance.
- 1300. SYSTEMIC PHYSIOLOGY.** (6 cr; not open to veterinary medicine students; prereq Biol 1106, BioC 1301 or equiv)
(Same as AnSc 1300) Introduction to animal physiology emphasizing the function of organs.
- 5120. COMPARATIVE VERTEBRATE MORPHOLOGY**
Same as VB 1120.
- 5140. VERTEBRATE MICROANATOMY.** (1-6 cr; prereq 5120 or #)
Microscopic structure, cytochemical and functional aspects of cells, tissues, and organs of representative examples of vertebrates. Consists of four units: basic tissues (2 cr); G-I tract (1 cr); respiratory integumentary systems (1 cr); excretory, reproductive, and endocrine systems (2 cr). Depending on background and interests, students may elect to register for any or all units.
- 5314. BEHAVIORAL PHYSIOLOGY.** (3 cr; prereq 1300 or 6 cr systemic physiology, Biol 5051 or #)
(Same as AnSc 5314) Current concepts of neurological and neurochemical bases of animal behavior including reception, coding, transmission, and storage of information; levels of integration and central control of input and output; spontaneity, development, and learning.
- 5320. AVIAN PHYSIOLOGY.** (4 cr; prereq 1300 or 6 cr systemic physiology or equiv, #; offered winter 1978 and all yrs)
Circulatory, respiratory, digestive, metabolic, renal, endocrine, and reproductive physiology of various species of wild and domestic birds.
- 5321. ADVANCED AVIAN PHYSIOLOGY.** (1 cr; prereq 5320; offered spring 1978 and all yrs)
Survey of the physiology of some phenomena characteristic of nondomestic avian and mammalian species such as flying, diving, migration, annual reproductive cycles, circadian rhythms, hibernation, and torpidity.
- 5322. PHYSIOLOGY OF REPRODUCTION.** (5 cr; prereq 6 cr systemic physiology)
(Same as AnSc 5322) Principles of reproductive physiology with emphasis on endocrinological aspects.
- 5324. SEMEN PRESERVATION AND ARTIFICIAL INSEMINATION.** (4 cr; prereq 5322 or #; offered 1978 and all yrs)
(Same as AnSc 5324) Chemistry of gametes and reproductive secretions; preservation of spermatozoa with emphasis on cryogenic methods; artificial insemination; and factors influencing reproductive performance.
- 5325. PHYSIOLOGY OF FERTILIZATION AND GESTATION.** (4 cr; prereq 5322 or #; offered winter 1979 and all yrs)
(Same as AnSc 5325) Physiological events occurring during gametogenesis, capacitation, fertilization, the period of embryo, the period of fetus, and parturition.

Course Listings

- 5326. IMMUNOREPRODUCTION.** (4 cr; prereq 5322 or #; offered 1979 and alt yrs)
(Same as AnSc 5326) Blood groups and polymorphic proteins affecting reproduction, immunoglobulin formation, antigens of semen, ova and genital secretions, immunopathology, maternal-fetal incompatibility and antibodies to hormones.
- 5330. WILD BIRD MEDICINE.** (2 cr; prereq 4th yr or grad student or #)
Brief summary of important aspects of avian anatomy and physiology. Survey of diseases common to wild birds and surgical repair of common injuries and fractures.

Veterinary Pathobiology (VPB)

- 3103. GENERAL MICROBIOLOGY.** (5 cr; not open to veterinary medicine students; prereq 10 cr chemistry, 4 cr biological sciences)
Lectures and laboratory exercises concerning the morphology, taxonomy, genetics, physiology, and ecology of microorganisms. Practical application of fundamental principles of microbiology to other phases of science and industry.
- 5603. PARASITES OF WILDLIFE.** (3 cr; prereq #; offered 1979 and alt yrs)
Economic and biologic relationships of animal parasites and disease to regional wildlife.
- 5604. DISEASES OF WILDLIFE.** (3 cr; prereq #; offered 1978 and alt yrs)
Economic and biologic relationships of infectious and noninfectious diseases of wildlife.
- 5707. POULTRY DISEASE CONTROL.** (3 cr; not open to veterinary medicine students; prereq Biol 1002, AnSc 1100, MicB 3103 or equiv)
General anatomy; physiology of digestion and reproduction; prevention and control of the more important diseases affecting poultry.



III. GENERAL INFORMATION

Equal Opportunity Statement

The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, creed, color, sex, national origin, or handicap. In adhering to this policy, the University abides by the requirements of Title IX of the Education Amendments of 1972, by Section 504 of the Rehabilitation Act of 1973, and by other applicable statutes and regulations relating to equality of opportunity.

Inquiries regarding compliance may be directed to Lillian H. Williams, Director, Office of Equal Opportunity and Affirmative Action, 419 Morrill Hall, 100 Church Street S.E., University of Minnesota, Minneapolis, Minnesota 55455, (612) 373-7969, or to the Director of the Office of Civil Rights, Department of Health, Education, and Welfare, 330 Independence Avenue S.W., Washington, D.C. 20201.

Admission

Requirements for admission to the College of Agriculture are listed below. Other requirements and procedures including nonresident admission, admission with advanced standing, adult special admission, and admission by examination are explained in the *General Information Bulletin*.

High School Graduates—High school graduates in the upper 60 percent of their classes may enter if they have completed 12 units in grades 10-12. Nine of these should be chosen from high school offerings in English, social studies and history, mathematics, natural science, and foreign languages. At least 1 unit must be in natural science or agriculture.

Applicants must also have completed 3 units in mathematics, including 1 unit in elementary algebra, 1 unit in plane geometry, and 1 unit in higher algebra or its equivalent.

Participation in high school vocational agriculture is recognized as excellent preparation for the study of agriculture at the collegiate level. However, rural background and experience are not required for admission.

Exceptions to the specific requirements listed above may be made when additional information presented by the applicant indicates promise of academic success.

Transfer Students—Students who apply for admission to the College of Agriculture from other colleges or universities or from other colleges in the University (including Continuing Education and Extension) may be accepted if they meet the entrance requirements of the college and of the program they wish to enter. The general requirements for entrance to the college include a minimum cumulative grade point average of 2.00 (where A=4, B=3, C=2, D=1, no credit or failure=0) and a mathematics background equal to or exceeding that required of entering freshmen.

Exceptions to these requirements may be made when additional information presented by the applicant indicates promise of academic success.

The Office of Admissions and Records will evaluate all previous college work according to the transfer policies of the College of Agriculture and provide the student with a record of all courses that have been accepted. Questions concerning transfer of credit will be referred to the scholastic standing committee for a decision.

Transfer students must complete all specific courses and area distribution requirements of the college, regardless of the number of credits they have earned. Thus, students who begin their degree work outside the College of Agriculture, intending to transfer here later, should carefully plan their pretransfer programs to

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meet as many eventual requirements as possible. Courses required for each curriculum are listed in section I of this bulletin. Transfer students should note especially the requirements for the freshman and sophomore years. For more information, students should write to the Office of Admissions and Records, 130 Coffey Hall, 1420 Eckles Avenue, University of Minnesota, St. Paul, Minnesota 55108.

Transfer of Credit in Agricultural Courses Taken at Minnesota Non-Land Grant Institutions—Blanket approval is not given for transfer of credit in agriculture courses at Minnesota non-land grant institutions. Each course is individually reviewed.

Transfer of credit for courses in agriculture taken at Minnesota non-land grant institutions is limited to introductory courses or those similar to the first courses offered by departments at the University. Students seeking credit for advanced courses in agriculture should take examinations for credit in those courses.

Appropriate University departments review transcripts of transfer applicants and make recommendations about transfer of credit to the Scholastic Standing Committee (see below). Decisions about transfer credits are based on information about the course, including course outline and objectives provided by the offering institution, personal contact with the applicant, and a review of the course examinations written by the student. When the department, because of inadequate information, cannot determine the level and quality of preparation of the student, validating examinations may be required.

Transfer of Credit From Continuing Education and Extension—Students who wish to transfer credits and grades for courses taken in Continuing Education and Extension of the University should submit a transcript of these courses to Admissions and Records for evaluation and inclusion on their record in the College of Agriculture.

Adult Special Students—Persons who wish to register for particular courses to meet individual needs, but who are not interested in working toward a degree, may enter the college as adult special students if both department and college approval is granted. Normally, adult special students are not enrolled for a long time, but only as long as necessary to acquire the specific training they desire.

Students who enter the College of Agriculture with the intention of transferring later to the Graduate School should be aware that students admitted to the Graduate School may petition to transfer to their graduate record only the credits earned in their first academic quarter or summer term as an adult or summer special student. Such work must be graduate-level and must be taught by a member of the graduate faculty. If the petition is approved, students are granted both residence and credit on their graduate record.

Change of College Within the University—University students wishing to transfer to another collegiate unit within the University must meet the entrance requirements of the program they plan to enter. Application for transfer should be made at the Office of Admissions and Records on the campus where the student is currently registered or last attended classes. The transfer bureau of that office facilitates such changes by securing clearances, reevaluating credits, and forwarding documents.

Scholastic Standing Committee—The Scholastic Standing Committee in the College of Agriculture is composed of eight faculty members and one student. The committee assists in the development, interpretation, and enforcement of the faculty policy concerning academic regulations and requirements. It may exempt individual students from regulations that work to the student's educational disadvantage if the basic spirit of the regulation is maintained. Considering the aims of the college and the requirements of the various curricula, this committee also makes final decisions in evaluating transfer credits. Students with questions about the application of

faculty regulations may discuss them with their adviser or at the College Office, 277 Coffey Hall. When a departure from normal procedures seems valid, students may petition this committee to request an adjustment in their program. Petition forms are available at either the College Office, 277 Coffey Hall, or the Office of Admissions and Records, 130 Coffey Hall.

Registration

The University and enrolled students complete a contract each quarter through the registration and fee payment process: the University agrees to provide instruction and facilities, and students agree to attend and pay fees for the classes they have chosen. Although errors occasionally appear in bulletin course listings, the responsibility for accurate, on-time registration and fee payment rests primarily with students. Copying errors, excessive changes, failure to observe established procedures, and late registration and fee payment not only impose on University personnel, but are costly and time-consuming for the individual student.

Steps in Registration—Students registering in the College of Agriculture follow the procedure described below.

1. Pick up registration materials in the College Office, 277 Coffey Hall.
2. Meet with a faculty adviser to plan a program and select courses.
3. Obtain class cards and a fee statement at the Office of Admissions and Records, 130 Coffey Hall. (Students registering for upper division (3000- and 5000-level) courses from the College of Business Administration will receive special instructions regarding registration for such courses.)
4. Pay fees at the Cashier's Office, first floor, Coffey Hall.

Faculty Advisers—Students are assigned a faculty adviser in the area in which they plan to major. The adviser acts as a guide in helping to plan a program that meets the student's individual interests as well as baccalaureate degree requirements, and is concerned with the student's general progress. For student problems requiring other or more specialized assistance, advisers may refer students to other faculty members, to the College Office, or to other student personnel agencies.

Auditors—Auditors attend and complete all work required for a course, but they do not take the final examination or receive credit or a grade for the course. Auditors must enroll officially for a course and must pay the same fee charged for regular enrollment in the class. Both the student's adviser and the course instructor must approve the student's registering as an auditor for any course. A course being audited is entered on the registration card with a V after the course number (e.g., Agro 1010V).

Independent Study Registration—Students often prefer to study some courses on their own rather than in the usual instructor/classroom setting. Credit for independent study has long been available to College of Agriculture students through the credit by examination procedure, under which students request an examination (or other method of evaluation) in almost any course in the college, after preparing for the test in whatever way they choose. Because this option has not been widely used, the faculty has initiated additional approaches to independent study in the hope of attracting more students to this valuable way of learning.

Through independent study, students may take a course without attending class. They pay the usual fee for the course, meet all deadlines for required work, and take the final examination at the regular time. The usual regulations concerning grades, incompletes, and cancellations that apply to the course also apply to independent study students. A course taken on independent study counts as part of the total credit

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load for the quarter. The department offering the course gives permission to students who want to take it on independent study. Sometimes students must also have the approval of the course instructor. Students pick up independent study permission slips in the departmental office and return the completed slips to the Office of Admissions and Records, 130 Coffey Hall. A course taken on independent study is entered on the registration card with a Y after the course number (e.g., Agro 1010Y).

Reading Courses—Students may register for a course as a reading course (individual work) during the quarter in which the course is regularly offered, with the approval of their adviser, the course instructor, and the Scholastic Standing Committee, under the following conditions:

1. When the course normally offered is canceled because of inadequate registration.
2. When, because of conflicts, students cannot take the course at the time it is scheduled.

Students must complete the work of a reading course during the quarter in which they are registered for it and must take the final examination at the regularly scheduled time.

Extra Credit Registration—With the instructor's approval for registering for extra credit, students may earn 1 to 3 additional credits for a course they are taking, or have taken. Students do the extra work on their own, according to standards the instructor sets. With this option, students may explore the course topic intensively or may extend it to a related topic. Registering for extra credit should not be used when the department offers a regular course with the same objectives.

Students obtain a permission slip for extra credit registration at the departmental office and, after it is signed by the instructor, take it to the Office of Admissions and Records, 130 Coffey Hall. The usual regulations concerning fees, grades, and cancellations apply. A course taken for extra credit is entered on the registration card with an X after the course number (e.g., Agro 1010X).

Changes in Registration—A cancel-add form, available from the Office of Admissions and Records, is used to change registration. Changes should be made as early as possible in the quarter.

Students cancelling courses are subject to the following procedures and requirements.

1. Cancellations during the first 6 weeks of classes in the quarter require the adviser's signature; a grade of W is assigned.
2. Withdrawal from a course after the sixth week of the quarter is strongly discouraged unless there are extenuating circumstances.¹ Cancellations from the seventh week of the quarter to the beginning of the last week of the quarter prior to the beginning of the examination period require the adviser's and the instructor's signatures. The instructor must indicate whether the student is passing or failing the course. If passing, a grade of W is assigned. If failing, a grade of N is assigned.
3. Cancellations during the last week of the quarter prior to the beginning of the final examination period and during the final examination period are seldom approved by the Scholastic Standing Committee.¹ The adviser's, instructor's, and scholastic committee representative's signatures are required. If the cancellation is approved, a grade of W or N is assigned as stated in item 2 above.

¹See Scholastic Requirements section (page 109) for information concerning the honor point deficiency incurred with cancellation.

Students adding courses during the first 3 days of classes in the quarter must have their adviser's signature. After the first 3 days of classes, the adviser's and instructor's signatures are required.

Students changing from the S-N to the A-N grading system, or from A-N to S-N, must do so during the first 2 weeks of the quarter. Adviser's and instructor's signatures are required. Requests for changes after the first 2 weeks of the quarter must be referred to the Scholastic Standing Committee.

Cancellation of Entire Registration—If students leave the University before the end of the quarter, they should cancel their registration when they stop attending classes by submitting a cancellation form (not a cancel-add form) to the Office of Admissions and Records, 130 Coffey Hall. Tuition refunds are prorated according to the number of weeks that have elapsed in the quarter. Students are entitled to a full refund if they cancel their registration before the first day of classes. No refunds are given after 6 weeks of classes.

Mathematics Placement—Initial registration for courses in mathematics is based on high school courses, grades received, and scores on appropriate standardized tests. Students whose background in elementary and higher algebra proves insufficient to permit them to enroll in an advanced course are required to take a mathematics refresher course.

In curricula requiring trigonometry, students with acceptable performance in high school trigonometry do not need to take Math 1008—Trigonometry.

Double Majors—Students interested in pursuing a second major should discuss this possibility with their current adviser. If this is an appropriate goal, the first adviser helps students contact a faculty member in the area of the proposed second major. (If the original adviser cannot recommend a faculty member in the second area, the adviser will call the College Office.) Students then plan a second major program with the adviser in the second area. Those with double majors must have their program card signed first by the second adviser and then by the first adviser, and must submit the form to the Office of Admissions and Records, 130 Coffey Hall. The original adviser remains the primary contact person for students with a double major, and sees that the student chooses course work to meet the requirements of both majors.

Credits and Class Attendance

Course Load—The typical course load per quarter is 14 to 18 credit hours. A credit hour requires, on the average, 3 hours of work each week. Quarterly programs may vary in total credits according to the student's ability or circumstances. To carry more than 18 credits, a C average (that is, a cumulative grade point average of not less than 2.00) is required. To carry more than 21 credits, a B average (3.00 GPA) in work of the previous quarter and permission from the Scholastic Standing Committee are required. Undergraduates must carry at least 12 credits each quarter to be considered full-time students.

Credit by Examination—Students may earn credit through special examinations for experience or instruction obtained outside the University. These tests require permission of the department that would be accepting the credits thus acquired. If an examination is taken during the first quarter in residence there is no fee; after that time a \$20 fee is charged. Students receive both credit and a grade for a course if they earn a grade of C or better on the examination for credit.

College Level Examination Program—Another alternative method of earning credit is through the College Level Examination Program (CLEP). Inquire at the

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College Office, 277 Coffey Hall, or the Office of Admissions and Records, 130 Coffey Hall, for details.

Class Attendance—Attendance for certain classes is compulsory in the College of Agriculture because of the nature of such classes. If a class is missed for a valid reason, students may request the instructor's assistance in making up the work missed. Instructors are under no obligation, however, to give assistance if the absence is deliberate, although there are situations in which they may wish to do so.

The following four situations are accepted by instructors as justifiable reasons for absence from class and for a request for assistance in making up work: (a) illness certified by the Boynton Health Service or by the family physician; (b) emergencies caused by a death or serious illness in the immediate family; (c) absences approved by the Scholastic Standing Committee; and (d) participation in University-approved, cocurricular activities (the Office of Student Affairs certifies absences for such activities).

To make up work, students should confer directly with instructors concerning the reason for their absence and the possibility and ways of completing missed classwork. The Scholastic Standing Committee intervenes only when emergencies (items b and c above) are involved and as an appeal agency.

Classification of Students

Sophomore—Students lacking no more than 18 credits of the total number of credits usually earned in the curriculum for the first year and who have completed 3 quarters of college work are classified as sophomores. The 3 quarters may include time spent at another institution of collegiate rank. Sophomores lacking no more than 12 credits of being classified as juniors and who have a B average (3.00 GPA) may register for courses at the 5000 level. Students who have not attained junior classification and who are below a C average (2.00 GPA) are not permitted to register for courses numbered 5000 or above for which graduate credit is given.

Junior—A total of 90 credits with a grade point average of at least 2.00 and completion of the freshman rhetoric communication requirement is required for junior classification.

Senior—To be classified as a senior, students must be no more than 9 credits short of the number of credits required for the first 3 years of the curriculum.

Requirements for All Students

In addition to the specific requirements of each curriculum, the University of Minnesota believes that all of its students, whatever their area of specialization or vocational goals, should hold in common the search for a liberal education. In the broadest sense, a liberal education frees individuals from the limitations placed on their powers of judgment and choice by ignorance. More specifically, a liberal education asks individuals to seek control over the general intellectual instruments for acquiring and communicating knowledge, primarily the instruments of language and number; to seek understanding of the ways in which scientists contribute to the individual's knowledge of self and the environment; to seek historical and philosophic perspective on the nature of individuals' lives and the world; and to seek appreciation of the creative insights into life and nature provided by literature and the arts.

Rapid and dynamic changes and innovations are constantly occurring in all professions. Only those with wide horizons and with sensitivity and perspective will

be able to make the wise value judgments and adjustments required to meet these changes. By encouraging a liberal education, the college hopes to prepare a student to be poised, articulate, and able to communicate his or her ideas and to acquire an appreciation of the value of interpersonal relationships. The college believes that these goals can be encouraged and pursued concurrently with the development of technical professional competence in the student's specialty.

To help students achieve the goals of a liberal education, the College of Agriculture expects all students to distribute a part of their course work in each of the four categories listed below.

- I. Communication, Language, Symbolic Systems—18 credits**
 - A. English and Foreign Language Communication Skills
 - B. Linguistics, Rhetoric, Logic, and Philosophic Analysis
 - C. Mathematics
- II. The Physical and Biological Sciences—15 credits**
 - A. The Physical Universe
 - B. The Biological Universe
- III. Man and Society—14 credits**
 - A. Analysis of Human Behavior and Institutions
 - B. Development of Civilization: Historical and Philosophical Studies
- IV. Artistic Expression—8 credits**
 - A. Literature
 - B. The Arts

In category I, students are expected to take a minimum of 8 credits of freshman communication. Transfer students from other colleges with less than 8 credits in freshman communication or the equivalent are placed in Communication I or II, depending on their needs as revealed by the diagnostic testing program.

Public Speaking (4 credits) and Professional Writing or Scientific and Technical Writing (4 credits) must also be taken by all students. Most students register for Rhet 1222—Public Speaking during their sophomore year and for Rhet 3551—Professional Writing or Rhet 3562—Scientific and Technical Writing during their junior or senior year. An exemption examination for Rhet 3551 or Rhet 3562 is available to students of above-average competence in communication skills. This examination is given once each quarter at a time specified by the Department of Rhetoric. A course in advanced composition taken at another college cannot be used to satisfy the Rhet 3551 or Rhet 3562 requirement.

In category III, students should have at least one course in subcategory B. A maximum of 10 credits in any one discipline (e.g., history, economics, psychology) may be counted toward the category III requirement.

COUNCIL ON LIBERAL EDUCATION COURSE LIST— SUGGESTED COURSES TO MEET CLE REQUIREMENTS

The following is only a *partial list* of courses that may be used to fulfill the Council on Liberal Education (CLE) requirements. It is intended merely as a guide for the student. If in doubt about the use of a specific course, contact the College Office, 277 Coffey Hall, telephone 373-0921.

- I. Communication, Language, Symbolic Systems—18 credits**
 - A. English and Foreign Language Communication Skills
Comm 1001-1002

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Comp 1001-1002, 1027
Rhet 1101-1102, 1222, 1506, 3254, 3266, 3551, 3562
Spch 1101, 3605

B. Linguistics, Rhetoric, Logic, and Philosophic Analysis

Class 1048, 3048
Ling 1001, 3001
Phil 1001-1002, 3201

C. Mathematics

Math—all courses through 1511
Stat 1051, 3091, 5021

II. The Physical and Biological Sciences—15 credits

A. The Physical Universe

Ast 1011, 3051
BioC 1301-1302
Chem 1001-1002, 1004-1005, 1006
Geo 1001, 1002, 1111
Phys 1031, 1032
Soil 1122, 1262

B. The Biological Universe

Biol 1011, 1103, 1104, 1106
Bot 1009, 1012
EBB 3004
Ent 1005
GCB 3022
MicB 3103 (or) VB 3103
Phsl 1001

III. Man and Society— 14 credits

A. Analysis of Human Behavior and Institutions

Afro 1025, 3055, 3061-3062, 3072, 3075-3076, 3091-3092, 3098, 5401
AgEc 1020, 1030
Anth 1002
Econ 1001-1002, 1004-1005, 3001-3002
FSoS 1001 or 1002, 1025
FR 1201
Geog 1301, 1401
Jour 3021
Pol 1001, 1025, 1026, 1027, 1031, 1051
Psy 1001, 1004-1005
Rhet 5165
Soc 1001, 1002
Spch 1103, 3401
SSci 3402

B. Development of Civilization: Historical and Philosophical Studies

Afro 1015, 1025, 1036, 1441, 1442, 3081-3082
Clas 1001, 1002, 1003, 1004, 1005, 1006, 1042, 3071, 3072, 3073
Hist—all courses through 1954
Jour 5601
Languages (Civilization and Culture)—Fren 3501-3502, Ital 3501-3502,
Span 3501-3502, Russ 3501-3502-3503
Phil 1002, 3001, 3002, 3003, 3004
Pol 1041

IV. Artistic Expression—8 credits

A. Literature

- AmSt 1101, 1102, 1103
- Engl—all *literature* courses
- Foreign languages—all *literature* courses
- Hum—all courses
- Rhet—all *literature* courses
- Rhet—all *humanities* courses

B. The Arts

- Afro 1301, 3105, 3301
- Arch 1001, 1002, 1003
- ArtH 1001, 1008, 1015, 1016, 3009, 3011
- ArtS 1101, 1102, 1301, 1401, 1701, 1801
- Dsgn 1501, 1521, 5505
- Mus 1021 and all courses above
- Th 1101, 1321, 1326, 1504

Use in the Graduate School of Credits Earned While an Undergraduate

Credits for advanced courses earned while an undergraduate, even though in excess of those required for the baccalaureate degree, can be transferred to the Graduate School only under the following conditions:

1. If lacking no more than 9 credits for graduation, taking into account required and sequence courses, students may carry a limited amount of graduate work (approved courses numbered 5000 or above) for graduate credit if such courses are not to be applied toward an undergraduate degree. The conditions as stated apply to the beginning of the quarter in which the courses are taken for graduate credit. In order to hold these credits available for use at the graduate level, students must submit a petition to the Scholastic Standing Committee of the College of Agriculture, 277 Coffey Hall, at the time of registration for their final quarter, requesting that these specified credits be withheld from the undergraduate transcript. Transfer of credit is arranged later by petition to the Graduate School.
2. If lacking no more than 9 credits for graduation, students may register in the Graduate School.

Use of Elective Credits

Withholding Elective Credit From Courses Offered for Graduation—With the approval of their adviser and the Scholastic Standing Committee, students may request that some elective courses be omitted from the list of courses counted toward their degree. A maximum of 10 credits of elective courses may be withheld to raise the grade point average, but only in instances relating to securing junior classification or to satisfying the graduation requirement of a 2.00 grade point average. When a course is withheld from the undergraduate record as authorized above, it can be reinstated only by an examination for credit or by repeating the course.

Limitations on Use of Elective Credit in Physical Education and Music—Students in agriculture are not required to take courses in physical education. A maxi-

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mum of 9 credits in physical education may be counted toward graduation.

A maximum of 9 credits in music may be used as elective credits toward graduation, with not more than 6 of these in chorus or concert band.

Grading System

Academic progress in the College of Agriculture is evaluated by one of two grading systems: the letter grade system (A-N) or the satisfactory-no credit (S-N) system.

A-N SYSTEM

Under the A-N system (A-B-C-D-N), each letter grade carries the following meaning:

- A—Representing achievement that is outstanding relative to the level necessary to meet course requirements.
- B—Representing achievement that is significantly above the level necessary to meet course requirements.
- C—Representing achievement that meets the basic course requirements in every respect.
- D—Representing achievement that is worthy of credit even though it does not fully meet the basic course requirements in every respect.
- N—Assigned when the student does not earn a D or higher. It stands for no credit.

The grade point average is determined by dividing the sum of the grade points (A=4, B=3, C=2, D=1) by the sum of the credits completed. (Credits of F received prior to fall quarter 1972 are included in the sum of the credits.) A cumulative average of 2.00 (C) is required for graduation. Additional requirements related to the grade point average may be found under specific curricular listings in section I of this bulletin.

S-N SYSTEM

The S-N system is an alternative to the traditional grading system designed to encourage students to seek greater breadth in the educational experience.

Under the S-N system, the grade S stands for satisfactory and N for no credit. The S represents achievement that is satisfactory to the instructor, for the program in which the student is registered. This definition is intended to imply that the standards for S may vary from one program to another. The instructor is obligated to define to a class in its early meetings, as explicitly as possible, the performance that is necessary to earn the S. The grade N is assigned when the student does not earn an S.

The following principles have been adopted as a guide for use of the S-N grading system by College of Agriculture students:

1. All courses available to undergraduate students (those numbered under 8000) are available on the S-N and the A-N basis, except where specifically restricted by the department offering the course. Consult course listings in section III of this bulletin.
2. Candidates for the baccalaureate degree from the college may present a maximum of 25 percent of the residence course credits offered for graduation in courses in which they received a grade of S.

3. The S-N system is available to students of the college regardless of their academic standing.
4. S-N registration must be declared at the time of registration and may not be changed after the opening day of the third week of classes.
5. Courses identified by title and number as being required must be taken under the A-N system. Prerequisites for required courses and courses in the major must also be taken under the A-N system, unless exceptions are established.

A student's adviser or college office staff members at 277 Coffey Hall can answer questions concerning the use of the S-N system.

OTHER SYMBOLS

- I— Assigned by an instructor to indicate incomplete work, in accordance with provisions announced in class at the beginning of the quarter, when in the instructor's opinion there is a reasonable expectation that the student can complete successfully the work of the course. An I that is not made up by the end of the next quarter of residence becomes an N; instructors may set dates within the quarter for makeup examinations or work. When an I is changed to a grade, the I is removed from the record.
- W—Indicates official cancellation from a course without grade. The W is assigned in all cases of official cancellation during the first 6 weeks of classes. After the sixth calendar week, the approvals of the instructor and adviser are required. However, withdrawal from a course after the sixth calendar week of the quarter is strongly discouraged unless extenuating circumstances exist. Cancellations within the last week prior to the beginning of the quarterly final examination period are seldom approved.
- V— Indicates registration as an auditor or visitor, a noncredit, nongrade registration.
- T— Posted as a preceding supplement to the original grade to indicate credits transferred from another institution or from one college or campus to another within the University when reevaluation is required.
- X— Reported in a 2- or 3-quarter continuing course in which a grade cannot be determined until the full sequence of quarters is completed. The instructor submits a grade for each X when the student has completed the sequence.

Scholastic Requirements

Honor Point System—College of Agriculture students are expected to maintain an academic standing that will enable them to meet the minimum requirements for graduation upon completion of the required number of credits in the major that they have selected. To aid in the early identification of students who are not making satisfactory progress so that appropriate assistance can be provided, the following system has been developed.

An honor point total (HPT) is calculated for each student at the end of each quarter with points assigned according to letter grades (A=2 honor points per credit, B=1, C or S=0, D=-1, N=-2, W [after sixth week of quarter]=-2).

Students whose HPT for a given quarter is negative are referred to an adviser or a departmental scholastic standing committee for action. If the honor point deficiency is less than 10, the matter is handled by the adviser; if 10 or greater, by a committee. In

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either case, the purpose of the meeting is to determine the causes for the poor performance and to establish reasonable goals, which the student will be expected to meet during the next quarter in residence. Students who do not meet these quarterly goals are referred to the college Scholastic Standing Committee for appropriate action, which may include suspension from the college.

Students whose cumulative honor point deficiencies at the end of spring quarter are 15 or greater will not be permitted to register in the college until they have received permission to do so from the college Scholastic Standing Committee. If this approval is granted, specific goals will be established and the student will be expected to meet them. Students who do not meet these goals may be suspended from the college.

Students who enter the College of Agriculture for the first time in or after fall quarter 1977 will not be permitted to graduate with a negative honor point total.

Appeal System—Decisions by the adviser, the departmental scholastic standing committee, and the subcommittees of the college Scholastic Standing Committee may be appealed to the college Scholastic Standing Committee, and decisions by this committee may be appealed to the dean of the College of Agriculture.

Repeating Courses—Students may repeat, for credit, courses in which they have received grades of N or D, and only the credit and grade in the last attempt will be counted toward graduation. Students who want to repeat courses in which they received a grade of C or S must petition the Scholastic Standing Committee for approval to do so. Repetition for credit of courses in which grades of A or B have been received is not permitted.

Requirements for Graduation

For Bachelor's Degrees—Candidates are recommended for graduation after they: (a) complete the prescribed curriculum, including required and elective credits to meet the total number of credits required; (b) satisfy the Council on Liberal Education (CLE) distribution requirements; (c) maintain an average of 2.00 grade points per credit (i.e., the cumulative grade point average must be 2.00 or more)—for additional quality requirements, see the statements of prescribed curricula and the section on Scholastic Requirements; (d) meet residence and other general University requirements for graduation as noted in the *General Information Bulletin*.

Application for graduation should be made during the third quarter of the junior year in the Office of Admissions and Records, 130 Coffey Hall.

Graduation With Honors—Recommendations for revising the college policy concerning graduation with honors were under consideration by the faculty during spring quarter 1977. The new policy (if changes are made) will be available as soon as it is approved by the College Assembly.

Student Personnel Services

Advising Services—Every agriculture student is assigned a specific adviser, a staff or faculty member who helps the student plan a course of study and answers questions concerning college regulations and requirements.

Student Counseling Services—The Office of Student Affairs is located in 190 Coffey Hall. Counselors in this office help students with problems ranging from housing to career planning, and provide assistance in handling academic and personal problems.

Placement Service—To help students secure employment after graduation, the College Office through the Placement Service, 272 Coffey Hall, announces job opportunities and assists in arranging interviews with employer representatives. Representatives of over 100 firms and agencies annually visit the campus to interview degree candidates. While the Placement Service concentrates on full-time jobs for graduates, staff members frequently arrange summer jobs for students with companies offering internships or other types of summer employment.

Student Activities—Consult the student activities handbook, *Connect*, or inquire at Oasis, 190 Coffey Hall; the Student Activities Center, 317 17th Avenue S.E.; or the Orientation Office, 315 Coffman Memorial Union.

Intramurals-Extramurals—Consult the handbook or contact the Office of Recreational Sports, 107 Cooke Hall.

Student Government

St. Paul Campus Board of Colleges—The St. Paul Campus Board of Colleges directs and coordinates student activities and encourages student leadership throughout the St. Paul campus. Its membership is drawn from the Colleges of Agriculture, Forestry, Home Economics, Veterinary Medicine, and Biological Sciences.

The council cooperates with the Twin Cities Student Association (TCSA) and the Senate Committee on Student Affairs. It brings questions from the student body to the administration of the colleges and discusses problems and reaches decisions on matters of general interest.

College of Agriculture Student Board—The College of Agriculture Student Board promotes student involvement in issues related to the quality and content of education both in and out of the classroom. This purpose is achieved through the board's creation of permanent channels of communication between the students, faculty, and administration of the College of Agriculture. Through the board, students participate in such matters as consideration of proposed curricula, questions related to instruction, improvement of educational facilities, development of administrative policy, and the establishment of the goals at the College of Agriculture. Further information related to the board and its operation may be obtained in 277 Coffey Hall.

Honor System—Under the provisions of the Student Self-Government Honor System, the students in the College of Agriculture, rather than the faculty, conduct examinations and quizzes. The honor system is operated on the assumption that honesty prevails among a large majority of students. Students place themselves on their honor not to give or receive aid during examinations. The responsibility of honesty is between student and student; the faculty does not place the student on his or her honor.

A student who observes dishonesty during an examination period may take some appropriate step at the time to halt the dishonest act or may report the incident later to the classroom instructor or to a member of the College of Agriculture Honor System Commission. In consultation with the Honor System Commission, the instructor will review the incident and will make a decision as to the disposition of the matter. Details related to the operation of the honor system are published in a special brochure that is available in the College Office, 277 Coffey Hall.

The honor system is a preventive rather than a punitive system and provides for greater freedom of action on the part of students in this college. New students are urged to discuss the honor system with students previously registered in the college.

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The membership of the College of Agriculture Honor System Commission is posted in the first floor hallway in Coffey Hall together with a notice as to how members may be contacted for information or assistance.

Student Center Board of Governors—The St. Paul Student Center provides a varied program of social, cultural, and recreational activities and contributes in many ways to the educational objectives of the campus. Student participation in these activities is encouraged. An elected board, the St. Paul Student Center Board of Governors, is composed of students representing the various academic units on the St. Paul campus. It formulates policy for operation of the Student Center and establishes its budget. For information about the Student Center, its operation, and opportunities to serve on the various planning and programming committees, students should inquire at the Information Desk on the first floor of the Student Center.

Procedures To Obtain Financial Aid

Freshmen—Entering freshmen interested in loans, scholarships, or grants should contact their high school guidance office for application forms. (Nonresidents of Minnesota must write directly to the Office of Student Financial Aid.) One application ensures consideration for all types of financial assistance that the University has to offer—scholarships, loans, educational opportunity grants, and college work-study. These applications must be made through high school counselors or principals and mailed to the Office of Student Financial Aid, 107 Armory, Minneapolis campus, by February 15. In addition to this application, students must have their parents or guardian submit a financial statement of family resources. Forms are revised annually, so students should be sure that they have the most recent form prior to filling it out. These forms are also available from the high school counselor's office or from the Office of Student Financial Aid, 107 Armory, 15 Church Street S.E., University of Minnesota, Minneapolis, Minnesota 55455. Late applications receive lower priority for financial assistance.

Presently Enrolled Students, Transfer Students—Undergraduate and graduate students may obtain application forms and information by contacting the appropriate financial aid office. Applications should be completed by March 1.

Reserve Officers' Training Corps

The ROTC, through its three services—Army, Navy, and Air Force—gives college students an opportunity to combine military or naval training with their academic work. Students are eligible for ROTC enrollment if they are registered in an academic program leading toward a degree, if they are United States citizens, and if they meet physical and other qualifications. The general requirements of the three services and their special characteristics are described in the *Army, Navy, Air Force ROTC Bulletin*. Inquiries may also be made in person or by letter at the following offices in the Armory, 15 Church Street S.E., University of Minnesota, Minneapolis, Minnesota 55455: Military Science, room 108; Naval Science, room 203; Aerospace Studies, room 3.

Senior Citizens

Senior citizens, defined as Minnesota residents 62 years or older, are admitted to all University of Minnesota classes on a space-available basis, tuition free, provided they have completed specified prerequisites. If a course is taken for credit, there is a

fee of \$2 per credit. Eligible persons should check with the College Office, 277 Coffey Hall, for information.

Master of Agriculture Program

Agriculture is a technological science that has created a new cadre of professional agriculturalists who apply the principles of science and management to the technical practices of modern agriculture. There is a critical need for postbaccalaureate education in agriculture with an emphasis on application and management. However, traditional graduate education has most often led to the research-oriented M.S. and Ph.D. degrees. Many graduates are now seeking to build professional competence, but not research capabilities, through a sequence of study leading toward a postbaccalaureate degree.

Professional agriculturalists include county agricultural extension agents; Soil Conservation Service workers; technical specialists in the production; processing and marketing of agricultural products; credit managers; specialists in food processing; and others in a host of similar professional tasks. They have a need for in-service and continuing postbaccalaureate education, a need best defined by the rather specific parameters of their professional duties.

Objectives of the Program—This program is designed to provide postbaccalaureate education in professional agriculture to students seeking to update, supplement, and complement their present training and experience in technical agriculture. Advanced professional competence in the principles and applications of scientific technology and management to agriculture will be developed through an individualized program of study in a field or combination of fields in agricultural and related sciences.

The program is intended for professional workers in agriculture and related fields who are seeking a postbaccalaureate degree. This may include:

- A. Students, American or foreign, who have completed the baccalaureate degree in agriculture and who have a career interest in professional agriculture.
- B. Other students, with a baccalaureate degree not in a field of agriculture, who have exhibited an interest and demonstrated competence in professional agriculture by obtaining substantive background or experience in agriculture.

Admission to the Program—Students seeking admission to this program should apply to the dean of the College of Agriculture. Any student with a baccalaureate degree or its equivalent from a recognized college or university may apply for admission to the program. Students are encouraged to submit their objectives and a proposed plan of study that they wish to pursue in this program at the time of application for admission.

A student will be admitted to this program if the criteria in A or B, and C are met:

- A. The student has earned a baccalaureate degree or its equivalent and has at least 2 years' experience in a professional field of agriculture.
- B. The student has earned a baccalaureate degree in agriculture or a related field with a grade point average of at least 2.80.
- C. The student has obtained the approval of an adviser and department in one of the five areas of concentration listed for this program.

PROGRAM REQUIREMENTS FOR THE MASTER OF AGRICULTURE DEGREE

- A. Program Credit Requirements**—The program requires a minimum of 45 quarter hour credits in courses numbered 5000 or above. A minimum of 36 credits must be taken in residence. Courses transferred from universities other than the University of Minnesota and courses taken in Continuing Education and Extension prior to admission to the degree program are not considered as resident credits. Approval for exceptions to the stated requirements may be granted through the petition procedure.
- B. Transfer Credits**—A total of 9 transfer credits will be accepted in partial fulfillment of a student's program requirement under the following conditions:
1. **Adult Special Credits**—A maximum of 9 credits of work taken as an adult special prior to admission to this program may be applied toward the degree. These 9 credits may be selected from among all of the courses taken as an adult special.
 2. **Credits From Other Institutions**—A maximum of 9 credits, selected from among all credits earned after the baccalaureate degree in graduate-level courses at another institution, may be applied toward this degree.
 3. **Courses in Continuing Education and Extension**—A maximum of 9 credits selected from among all courses earned off campus in Continuing Education and Extension may be applied toward this degree. Only courses taken after admission to the degree program may be used to satisfy the 36 resident-credit requirement.
- C. Time Limitations**—The student must complete all requirements for the degree within 7 years starting from the date of enrollment in the first course included in the program of study.

DISTRIBUTION OF COURSES AND CREDITS IN THE PROGRAM

- A. The program of study must meet the following distribution requirements:
1. At least 27 credit hours of instruction must be taken in graduate-level courses offered in the College of Agriculture. Of these credits, at least 18 must be taken in one of the following areas of concentration.

Plant and Soil Technology

Including courses from the departments of:
Agronomy and Plant Genetics
Entomology, Fisheries, and Wildlife
Horticultural Science and
Landscape Architecture
Soil Science
Plant Pathology
Agricultural Engineering
Animal Science

Animal Technology

Including courses from the departments of:
Animal Science
Entomology, Fisheries, and
Wildlife
Agricultural Engineering
Agronomy and Plant Genetics

Master of Agriculture Program

Applied Social Science

Including courses from the departments of:
Agricultural and Applied Economics
Agricultural Education
Agricultural Journalism
Resource and Community Development
Rhetoric
Rural Sociology

Agricultural Engineering Technology

Including courses from the department of:
Agricultural Engineering

Food Technology

Including courses from the departments of:
Food Science and Nutrition
Entomology, Fisheries, and Wildlife
Plant Pathology
Horticultural Science and Landscape Architecture
Animal Science

2. No more than 3 of the 18 credits taken in one of the five areas of concentration may be earned in problems or independent study courses.

B. Of the remaining credits beyond the minimum of 18 required in the area of concentration, at least 9 must be taken in a single department or field of study outside the area of concentration. The other credits may be earned in any recognized graduate-level course as long as the course directly contributes to the student's career goal as indicated in his or her program of study.

C. Courses that may be used to fulfill the 4-credit Rhetoric requirement are Rhet 5551, 5561, 5500, and 5400. For most students, 5400 is recommended.

D. Agri 5555 (1 cr) is the required course for the preparation of the integrating paper. This paper should be of the quality of a professional trade journal article and should integrate the student's studies with an application to a problem(s) or area of work in the student's field. The paper will be critically reviewed and approved by the student's advisory committee. The paper must also be examined publicly through one of the following methods:

1. Presentation of the integrating paper to a seminar of faculty and the student's peers.
2. Presentation of the paper at a recognized professional meeting or conference in the student's area of concentration.
3. Acceptance of the paper for publication in a recognized professional trade journal, as a pamphlet or bulletin, or in some other organ designed for distribution to lay or professional persons within the student's area of concentration.

E. At least 1 credit must be earned in a graduate seminar in the student's area of concentration. This seminar must be in addition to the one that may be presented on the integrating paper.

CERTIFICATION FOR DEGREE

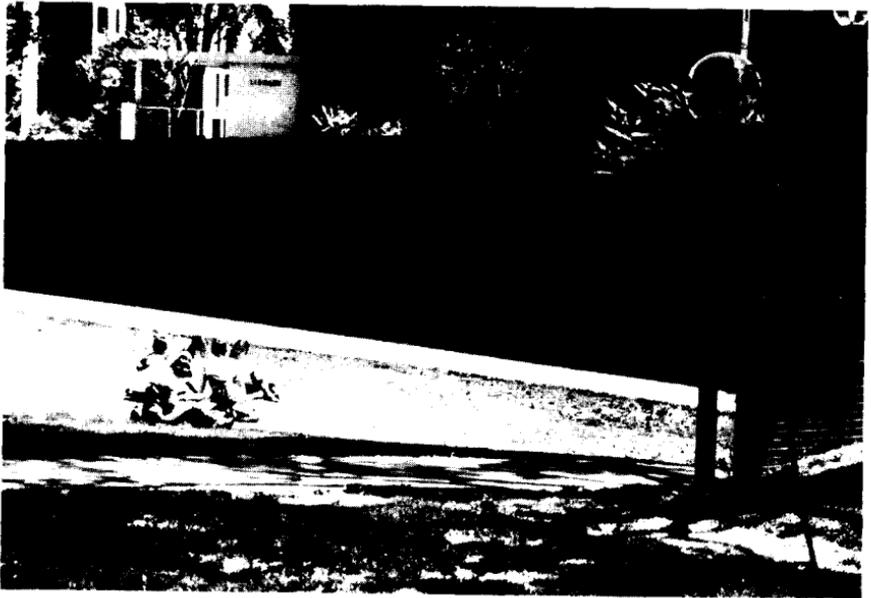
The student will be judged to have completed the program for the master of agriculture degree when the following criteria are met:

- A. All courses included in the student's program have been satisfactorily completed.
- B. The student has achieved a grade point average of at least 2.80 in all course work.

General Information

- C. The student's integrating paper has been accepted by his or her advisory committee.
- D. The adviser has certified to the Master of Agriculture Admissions and Policy Committee that the student has met the requirements for public examination of the integrating paper.

Application forms and additional information concerning the master of agriculture degree may be obtained from the College Office, College of Agriculture, 277 Coffey Hall, 1420 Eckles Avenue, University of Minnesota, St. Paul, Minnesota 55108. Completed applications should be returned to this address.



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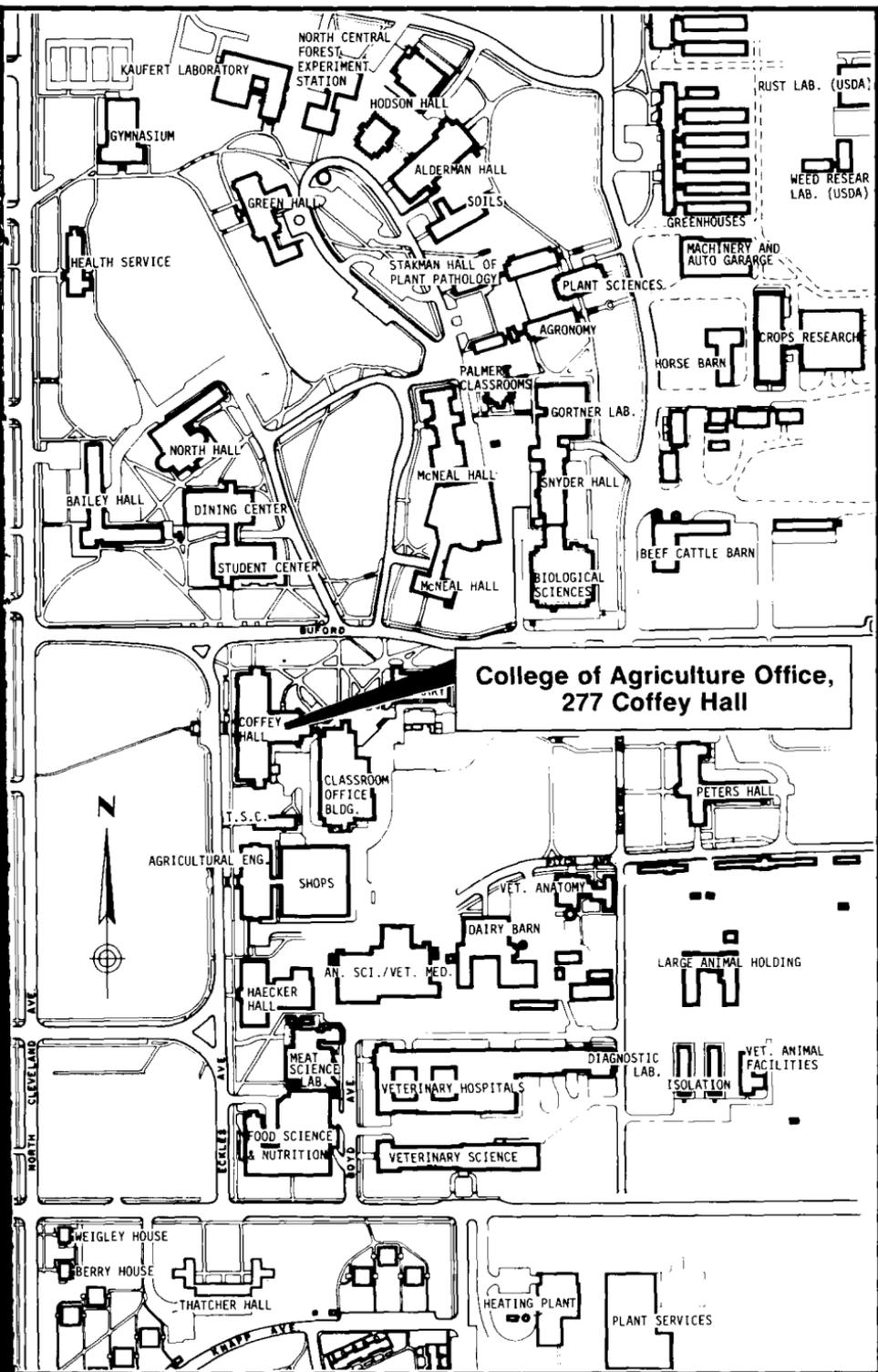
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