

UNIVERSITY of  
MINNESOTA  
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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 for planning your course of study.

### CONTENTS

- Section I. Program Requirements
- Section II. Course Descriptions
- Section III. General Information
- Section IV. Departments and Faculty

### 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 from other collegiate units such as the College of Business Administration, College of Education, Institute of Technology, and School of Journalism and Mass Communication. These may be obtained by writing to the Office of Admissions and Records, 6 Morrill Hall, University of Minnesota, Minneapolis, Minnesota 55455.

The *Class Schedule*, published just before the registration period each quarter, gives the time and location of classes.

# 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 agriculturalists 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; 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 which form the fabric of modern agriculture.
2. to explore areas of study which record human experience and understanding so that students' personal lives will become enriched so 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.

Information on the college other than that contained in this bulletin may be obtained from the Office of the Dean, 277 Coffey Hall, University of Minnesota, St. Paul, Minnesota 55108, 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 has 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 which 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. 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 listed below.

1. Agricultural Business Administration  
Agricultural Business Administration
2. Agricultural Science and Industries  
Agricultural Economics  
Agricultural Education

## ***Program Requirements***

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- 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
  - Resource Economics
  - Recreation Resource Management
  - Soil and Water Resource Management
  - Landscape Architecture

## **Departments and Majors**

The six curricular areas represent academic divisions of the college; for administrative purposes, the college is divided into 12 departments which supervise actual courses in each curricular area. The 12 departments and corresponding majors offered through each are:

1. Agricultural and Applied Economics
  - Agricultural Business Administration
  - Agricultural Economics
  - 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:

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 page 110-113.)

**Graduate Degrees**—The departments in the College of Agriculture through the Graduate School 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 for a period of 12 weeks during fall, winter, and spring quarters of the academic year and during summer.

## Program Requirements

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A maximum of 6 credits, with grading on the S-N system, will be awarded to students satisfactorily completing the program. Generally students will be salaried by industries, producers, and agencies who are cooperating with the program. Registration for the program is through Continuing Education and Extension, and fees are assessed on a per credit basis. Departments offering the PEP option list it as course number 5000 in the Course Descriptions section of this bulletin. For additional information, students should consult their adviser or inquire at the Office of the Dean, 277 Coffey Hall.

## CURRICULA IN AGRICULTURE

### Agricultural Business Administration

This 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 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 upon receiving the 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 as they relate to agricultural businesses and industries involved in the manufacture and supply of materials for farm production (feed, seed, fertilizers, machinery, equipment, pharmaceuticals), and the assembly, processing, 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. Opportunity exists to elect a variety of courses at the junior-senior level to accommodate the varied interests and needs of students as suggested by the range in employment areas outlined above.

In the first 2 years, students register and pay fees in the College of Agriculture. In the last 2 years, they register 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

## *Agricultural Science and Industries*

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**B. Physical and Biological Sciences—20 credits**

Credits to be selected from the following: BioC 1301, 1302; Biol 1011; Biol 1103, Biol 1106; EBB 1104, Chem 1004, 1005; Geo 1001; MicB 3103; Phys 1031, 1032

**C. Man and Society—15 credits**

Sociology (4)

Soc 1001 or 1651

Psychology (5)

Psy 1001

Plus 6 credits in social science areas:

Anthropology, history, geography, political science, excluding economics or agricultural economics

**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

**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 nonmajors in that department or that 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**

BLaw 3058, Tran 3054, Mgmt 3001, IR 3002; plus 8 credits from among the following: Mktg 3000, Ins 3100, IR 3010, BFin 3000, Mgmt 3004, or AgEc 5290

**J. Free Electives—30 credits**

Recommended: PubH 3004; Rhet 3562, 3254, or 3266; selected courses from the CLE list of suggested courses (see 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 a professional curriculum 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. It is, in addition, designed to enable students to prepare themselves

## Program Requirements

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for graduate studies in a wide variety of disciplines in agricultural sciences and agricultural and applied economics. Specific career opportunities for each of the majors offered under this curriculum are described in the section on departmental course offerings in this bulletin.

Courses required in this curriculum have been selected to assist the student in obtaining the background in biological and physical sciences and the skills in oral and written communication that are essential to studies in scientific and professional agriculture. This background will permit 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 educational 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 once the degree is obtained.

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

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. The pattern of study developed to achieve this minimum requirement may be composed of courses selected from separate disciplines but must clearly form a coherent program contributory to a balanced training in the student's chosen area of interest. A random assortment of courses originating in several disciplines would not meet this requirement. Specific course requirements for each major are described in this section of the bulletin. Areas of specialization within the major permit greater concentration of study in specialized disciplines.

### 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 and Biological Sciences—41-45 credits

Courses required of all students (29-30 credits)

General Chemistry (10)

Chem 1004, 1005

Biology (9-10)

Biol 1011 (5) and either 1103 (5) or 1106 (4)

Organic Chemistry (5)

BioC 1301\*\*

\*\*Students majoring in agricultural economics may elect to substitute any course listed in the second section of additional (elective) courses for BioC 1301.

Physics (5)  
Phys 1031

In addition to the above courses, students must select at least three additional courses (12-15 credits) from among the following†:

Biochemistry (4)  
BioC 1302

Physics (5)  
Phys 1032

Microbiology (5)  
MicB 3103

Genetics (4)  
GCB 3022

Geology (5)  
Geo 1001

Ecology (4)  
EBB 3004

C. **Man and Society**—14 credits (not more than two courses in any one discipline; e.g., history, economics, etc.)

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. Information concerning career objectives and course requirements for each major follow in this section. Individual course descriptions can be found in Section II of this bulletin.

F. **Electives**

TOTAL CREDITS FOR PROGRAM—192

### **Agricultural Economics**

Students who plan to work in areas of agricultural production or processing where a rather extensive knowledge of the technical phases of the work is involved, but who expect to work in economic or business management aspects of the field, will find a concentration in agricultural economics to be useful. (Students who expect that the major part of their employment will involve business management and who desire less training in technical agriculture may find the curriculum in agricultural business administration more suitable. Either program will be suitable for students who plan to pursue graduate work in agricultural economics.)

No areas of emphasis are designated within the general area of agricultural economics; the varieties of interests and needs of different students can be met by changes in courses scheduled for the major. The requirements for the program will be developed largely for the individual student. In general, however, the program of work must include at least 9 credits in principles of economics (macro and

†Students majoring in agricultural economics are required to take at least two courses from among this list.

## Program Requirements

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micro), 18 credits in economics and/or agricultural economics beyond principles, 5 credits in accounting, 4 credits in statistics, and in addition, at least 27 credits in agricultural science to be 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 requirements for the major. In the Man and Society areas, a minimum of 15 credits in addition to economic principles is required.

### **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 schools, or junior colleges in Minnesota communities. 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, for other professional careers in the field, or for farming. It also offers the special training in education necessary for recommendation for certification as an instructor of agriculture or horticulture.

In the third quarter of the sophomore year, students should make application at the Office of Admissions and Records, Coffey Hall, St. Paul Campus, for joint registration in the College of Education in one of the combined curricula. They will 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 GPA of at least 2.00 for all courses taken at this University and at least a 2.30 GPA in technical agriculture courses as follows:

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

**For Agricultural Education Specialization:** 2.30 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 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 they 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; both require a total of 192 quarter credits for completion.

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

## COMMON REQUIREMENTS

**Professional Education Courses** (minimum 30 credits)

AgEd 1001—Introduction (1)

AgEd 1010—History and Philosophy of Vocational and Community Education (3)

AgEd 3010—Organization and Direction of Supervised Occupational Experience and FFA Activities (4)

- AgEd 3031—Student Teaching (8)
- 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**

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

**VOCATIONAL AGRICULTURE SPECIALIZATION**

In addition to the common requirements listed above, those choosing this option will complete:

**Major Courses (minimum 80 credits)**

- AgEc 1020—Principles of Macroeconomics (5)
- AgEc 1030—Principles of Microeconomics (4)
- AgEc 3820—Farm Management Economics (4)
- AgEc 5800—Farm Records and Business Analysis (4)
- Soil 1122—Introduction to Soil Science (4)
- Agro 1010—Principles of Agronomy (4)
- PlPa 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)
- Electives—24 credits in technical agriculture

**Professional Education Courses (minimum 33 credits)**

- AgEd 5049—Agricultural Education for Adults (5)

**VOCATIONAL HORTICULTURE SPECIALIZATION**

In addition to the common requirements previously listed, those choosing this option will complete:

**Major Courses (minimum 79 credits)**

- AgEc 1020—Principles of Macroeconomics (5)
- AgEc 1030—Principles of Microeconomics (4)
- Soil 1122—Introduction to Soil Science (4)
- PlPa 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)
- PlPh 3131—Survey of Plant Physiology (3)
- PlPh 3132—Laboratory (2)
- Electives—18 credits in horticulture and 19 credits in technical agriculture.

## Program Requirements

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### Professional Education Courses (minimum 31 credits)

AgEd 5049—Agricultural Education for Adults (5) (or) Educ 5104—Adult Education (3)

## SUPPORTING FIELDS

**Supporting Field in Agriculture for Agricultural Education Majors**—Students majoring in agricultural education may choose a concentration in an agriculture department. Such 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**—A supporting field in agricultural education is open to students majoring in the agricultural science and industries curriculum. This field, however, will not include requirements for teaching certification. 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 is a combination of both. A good background is developed in the biological sciences and in principles derived from the engineering sciences. Courses utilizing this background will 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 may choose a broad program of closely related subject matter from several disciplines.

Graduates will 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 for Agricultural Science and Industries (see pages 8-9) plus the following requirements:

- Math 1142—Introduction to Calculus
- Choose Physics 1032 in Group B
- Choose AgEc 1030 in Group C

## MAJOR COURSE REQUIREMENTS

- AgEn 1010—Technical Drawing\*\*
- AgEn 1030—Computer Programming
- AgEn 5021—Mechanics of Agricultural Systems
- AgEn 5022—Energy Systems in Agriculture
- AgEn 5023—Fluids and Electricity in Agriculture

16 additional credits from the following list of courses:

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

\*\*Waived for students already proficient in drawing.

### ADDITIONAL REQUIREMENTS

Minimum of 20 credits of supporting courses in other departments of the College of Agriculture

### ADDITIONAL ELECTIVES—approximately 48 credits

The additional electives are primarily courses 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 of the 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 should consider a major in agronomy. Agronomists, through research and extension on field crops, provide much of the world's food supplies and clothing 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 vocational objectives and life 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 and fieldmen for herbicide and seed companies, fieldmen for production of specialty 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 interested in farming will be able to secure an excellent background by making wise 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 necessary courses and background to enter graduate school in the specialization of their choice.

Students enrolling in agronomy will establish a background in biological and physical sciences by completing the course requirements in the agricultural science and industries curriculum. This training will permit them to adapt and apply biological, chemical, and physical principles to problems encountered in the production and improvement of crops. Technical courses required of all students in agronomy, in addition to the general curriculum requirements, include a course in genetics, soil science, plant physiology, statistics, plant pathology, and entomology. Students will select additional courses in agronomy and related areas, in consultation with their adviser, in order to meet their career goals.

## **Program Requirements**

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### **Animal Science**

Animal science is the study of the many factors that collectively result in the efficient production of farm animals and poultry. Students who are interested in the care, judging, housing, feeding, and breeding of beef and dairy cattle, chickens, horses, swine, or turkeys or who are interested in animal physiology or meat and meat byproducts should consider majoring in animal science. Any student with an interest in farm animals will find animal science an interesting and challenging area of study. Animal science majors find their contact with the campus herds and flocks and their classroom experiences valuable aids in increasing their knowledge of livestock production. Animal science graduates are employed as farmers, farm managers, county extension agents, livestock buyers, and in a variety of other jobs in the meat industry, with feed companies, breed associations, governmental agencies, and artificial insemination organizations.

Students majoring in animal science follow the requirements of the agricultural science and industries curriculum. The agricultural science and industries curriculum sets some general requirements that all students must follow but allows the student to develop an overall program that fits individual interests. Students who plan to continue their studies at the graduate level in preparation for college teaching and research or for consulting or research in industry are urged to take more biology, chemistry, physics, and mathematics than is required by this curriculum. In addition to the curriculum requirements, animal science majors are required to take AnSc 1100, 1300, 1401, 1500, 3220, 5703, one production course (AnSc 5601, 5602, 5603, 5604, or 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 each of these areas.

### **Entomology**

Entomology is a scientific discipline having its basic roots in biology. It is the study of insects and their relatives, their biology, ecology, and control in relation to their environment and to man. Two options for specializing in entomology are provided as 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, to supervise the application of control measures, and to participate in environmental impact reviews.

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

Stat 5021, 5022; Chem 1006; Biol 1103, 1106, and EBB 3004; Ent 1005, 1020, 3175, 5210, 5215; Soil 1122, Agro 1010, 1011, 5030; PIPa 1001 or 5050, AgEn 3215; elective 46 credits. Practical experience with persons in companies or agencies dealing with insect pest management 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 persons for positions as professional entomologists. Employment opportunities include college teaching, research (in universities, private industry, state, federal, and international agencies), and positions as extension entomologists. Employers may also be natural history museums and military services, or the individual may enter private practice as a consulting entomologist.

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

Math 1111, 1142; Stat 5021, 5022; Chem 1006, 3301, 3302; BioC 5001, 5002; Phys 1032; Biol 1103, 1106; Ent 1005, 3175, EBB 3004, GCB 3022, Zool 5071, and Soil 1122; either PIPh 3131, 3132 or AnSc 1300; electives 38 credits. Attendance at a field biology station recommended.

TOTAL CREDITS FOR PROGRAM—192

### **Horticultural Science**

There are seven areas of educational emphasis 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 are free to concentrate in one particular area or to select courses from several areas of interest. Those who plan to enter some 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 elect the bachelor of landscape architecture degree available through the resource and community development curriculum. Students planning on graduate work in horticulture should follow the curriculum in agricultural science and industries and, with the help of their adviser, enrich their program with additional mathematics and basic sciences course work.

### MAJOR IN HORTICULTURE

In addition to the course and program requirements of the agricultural science and industries curriculum, all students will complete 36 credits in horticulture or landscape architecture courses to include: Hort 1001, 1036, 3099, and a minimum of 18 credits in major courses number 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; BioC 1302, GCB 3022\*\* or Biol 1101; \*\* Stat 1051\*\* or 3081.\*\*

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

#### Horticultural Food Production

##### a. Vegetable Science

Hort 3031, 3032, 5006, 5033, 5040, 5041, 5044; Agro 5020; FS&N 1010, 5530; Soil 5430; PIPa 5702

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

## *Program Requirements*

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### **b. Fruit Science**

Hort 3031, 3032, 5006, 5033, 5040, 5041; FScN 5530; Soil 5430

## **Landscape Horticulture**

### **a. Nursery Management**

Hort 1016, 1021, 1022, 3074, 3076, 3079, 5040, 5042, 5045; LA 1024, 3071, 3075

### **b. Urban Park and Landscape Management**

Hort 1021, 1022, 3074, 3076, 5040, 5042; LA 1024, 3071, 3075, 5010; FRD 1201, 5232; AgEn 3205

### **c. Turf Management**

Hort 1021, 1022, 3074, 5042, 3097; Soil 5232, 5430; AgEn 3205; LA 3071

## **Floriculture**

Hort 1016, 1022, 1036, 3053, 3077, 3079, 5040, 5052, 5053, 5054

## **MAJOR IN LANDSCAPE ARCHITECTURE**

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

## ***Plant Health Technology***

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

Plant health is continually threatened by the activities of pests and man. Individuals majoring in plant health technology will receive training in the biological and physical sciences as they relate to plants in health and disease. Graduates will 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, in the proper use of pesticides to control disease, and in the application of integrated control in the treatment of disease.

Students will be provided with 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 will be emphasized. Practical experience in disease diagnosis and the prescription of treatment will be provided by requiring a 3-month internship in the Plant Disease Clinic. The internship will include 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—50 credits**

- PIPa 1001—Introductory Plant Pathology (5)
- PIPa 5215—Insects in Relation to Plant Disease (4)
- PIPa 5702—Principles of Plant Disease Control (3)
- PIPa 5600—Plant Disease Diagnosis (3)
- PIPa 5110—Air Pollution and Its Effects on Vegetation (4)
- 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)

**Option I—Take two of the following:**

- PIPa 5100—Fungus Diseases of Plants (4)
- PIPa 5300—Virus Diseases of Plants (3)
- PIPa 5400—Bacterial Diseases of Plants (3)
- PIPa 5500—Plant Nematology (4)

**Option II**

- PIPa 3100-3101—Pathogens in Plant Disease I and II (4 cr each; 8)

**ADDITIONAL REQUIRED COURSES—20 credits**

- GCB 3022—Genetics (4)
- PIPh 5141—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—70**

**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, natural flora) relationships, or research should consider majoring 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 Masters or Doctor's degree in preparation for teaching or research at the college level or for consulting in research or industry may choose either of the two curricula below but should consult their faculty adviser

## Program Requirements

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concerning additional 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 majoring in soil science may do so either in the agricultural science and industries curriculum or the soil and water resource management major in the resource and community development curriculum:

1. **Agricultural Science and Industries**—Students whose vocational goal is 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  
Soil 3220—Soil and Water Management and Conservation  
Soil 3412—Soil Fertility Evaluation  
Soil 5512—Soil Geography  
Geo 1001—Physical Geology  
Geog 1004—Physical Geography

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

AgEn 3410—Hydrology Water Control  
Agro 1010—Principles of Agronomy  
Ent 1005—Economic Entomology  
FW 3050—Principles of Fisheries, Wildlife Management  
Hort 1001—Fundamentals of Horticulture  
PIPa 1001—Introduction to Plant Pathology  
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 with conservation, planning, land appraisal, or in environmental-related fields should consider this curriculum. Courses taken in addition to those required in the curriculum will be decided on 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 in the material introductory to that program.

Agricultural journalism is offered by the Department of Information and Agricultural Journalism. Technical communication is offered by the Department of Rhetoric.

### **Agricultural Journalism**

The program in agricultural journalism is offered jointly by the College of Agriculture and by 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, such as staff positions on agricultural magazines, newspapers, trade papers, and house organs; editing and writing publications for state and federal departments of agriculture and for experiment stations; serving on public relations and promotional

staffs in industry and government; acting as farm service directors for radio and TV stations; and serving on advertising and marketing staffs of mass media agencies or industry.

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

Students majoring in agricultural journalism work toward a bachelor of arts degree. A bachelor of science degree is being developed and should be available to many students. Both degrees are or will be offered jointly by the College of Agriculture and the College of Liberal Arts. All students register initially in the College of Agriculture and may transfer to the College of Liberal Arts during their senior year. All must have their programs of agricultural subjects approved by their adviser in agricultural journalism for the College of Agriculture.

The curriculum requires 180 credits for graduation. Students can choose between four different sequences in journalism. They are: (1) news-editorial, (2) advertising, (3) broadcast journalism, and (4) photographic communications. Also, students may adapt their programs to specialize in science writing, public relations, and other special areas.

### Program Requirements for AGRICULTURAL JOURNALISM

#### A. Communication, Language, Symbolic Systems—18-19 credits

Rhet 1101—Communication I (4) and Rhet 1102—Communication II (4) 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

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

#### 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 proposed B.S. degree will require 24 credits in advanced courses.

Electives to meet College of Liberal Arts language requirements for B.A. degree

## Program Requirements

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### F. Major Course Requirements

#### General

Jour 1005—Visual Communication (3)

#### News-Editorial Sequence—39-45 credits

Jour 1101—Reporting (5)

Jour 1701—Mass Communications Law (2) or Jour 3776—Mass Communications Law (4)

Jour 3121—Public Affairs Reporting (4)

Jour 3155—Publications Editing (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 among:

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—15 credits

Jour 1201—Principles of Advertising (4)

5 credits in introductory psychology

Jour 3231—Advertising Graphics (4)

Jour 3241—Advertising Copywriting (4)

Jour 5251—Psychology of Advertising (4)

Jour 5501—Communication and Public Opinion I (4)

Jour 5261—Advertising: Media Analysis (4)

Jour 5274—Current Advertising Developments and Problems (4)

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

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—41-45 credits, plus 13 speech credits

Jour 1101—Reporting (5)

Jour 1701—Mass Communications Law (2) or Jour 3776—Mass Communications Law (4)

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

Jour 3121—Public Affairs Reporting (4)

Jour 3401—Basic Cinematography (4)

Jour 3451—Television and Radio News (5)

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)

4 additional upper division credits in agricultural journalism or journalism

Spch 3201—Introduction to Broadcasting Production (5)

Spch 3203—Radio Production (4) or Spch 3204—Television Production (4)

Spch 3211—Determinants of Broadcast Programming (4)

Jour 5402 or Jour 5444 may be taken to meet this requirement

Additional speech courses are recommended

*Photographic Communication Sequence* —41-43 credits

Jour 1101—Reporting (5)

Jour 1301—Beginning Photojournalism (4)

Jour 1701—Mass Communications Law (2) or 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 3121—Public Affairs Reporting (4) or Jour 3486—Radio and Television Script Writing (4)

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

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

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

Additional speech courses are recommended

Modifications in all sequences may be approved by the adviser.

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

## **Technical Communication**

Technical communication is defined as 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 run from the scientist and engineer to management and to the consumers of the products and services provided by technology.

To accomplish his or her 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 a specialist in 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 structure his or her education to fit personal career goals.

## Program Requirements

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Technical communicators with a Bachelor's degree are employed in government, in education, and in organizations in the fields of agriculture, aeronautics, communication, electronics, research and development, transportation, and others. Graduates of the program will be able to function as writer-editors, extension specialists, managers of research and development, and training and/or communication managers. The program also provides a broad base for those graduates who wish to specialize further in graduate communication programs.

### Program Requirements for TECHNICAL COMMUNICATION

#### A. Communication, Language, Symbolic Systems—21 credits

- Communication (8)
  - Rhet 1101, 1102
- Public Speaking (4)
  - Rhet 1222
- Technical and Scientific Writing (4)
  - Rhet 3562
- College Algebra and Analytic Geometry (5)
  - Math 1111

#### 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 1004; 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, 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 of courses available throughout 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 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 undergoes on-the-job training 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 in the major are expected to achieve enough competency in some 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, if properly thought out, interdisciplinary as well as intradisciplinary. Areas from which the student may choose include agriculture, computer science, forestry, health science, home economics, and the natural and physical sciences.

**G. Electives—25 credits**

**TOTAL CREDITS FOR PROGRAM—180**

## **Fisheries and Wildlife**

The fisheries and wildlife curricula are designed to offer students essential basic training in the biological and physical sciences and in related disciplines which 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, requiring additional graduate study, is desired, if not required, for many management or administrative and for most research positions. Further graduate study leading to the doctor of philosophy (Ph.D.) 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 his educational program.

### **PRE-FISHERIES AND WILDLIFE CURRICULUM 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

## Program Requirements

April 15 for those wishing entrance at the beginning of 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 not meeting requirements for entry into 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 (a) definite curriculum goals projected toward declaration of a major or (b) an early opportunity for seeking 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 into a declared 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; Biol 1011; 1103, 1106; Math 1142; Phys 1031, 1032; Chem 1004, 1005; VB 1120 and EBB 3004
2. A grade point average (GPA) of 2.75 or better in the above-listed specific core courses.

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

**Credit and Course Requirements**—These curricula require 198 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 year. A Graduate Study Preparation Option is available in fisheries (see page 27). 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**—Minimum of 14 credits in the social sciences, not more than two courses in any one discipline to be applied. Five credits each in economics (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**—Minimum of 8 credits in humanities, literature, and the arts. 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 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 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
- Pre-Calculus (5)  
Math 1142 or equivalent\*\*

**B. Physical and Biological Sciences—56 credits**

- Fisheries and Wildlife Orientation (0)  
FW 0001
- 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
- Anatomy (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 PROGRAM—92**

**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

**B. Physical and Biological Sciences—52-53 credits**

- Advanced Chemistry (9)  
Chem 1006; 3100, 3101

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

†Plus a minimum of 4 credits to meet general graduation requirements.

## Program Requirements

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- Algae (5)
  - Bot 5231 or 5811\*\*
- Limnology (4-5)
  - Geo 5601 or EBB 5813\*\*
- Entomology (5)
  - Ent 3175 or 5020\*\*
- Aquatic Invertebrates (5)
  - Zool 5814\*\* or 5071 or Ent 5130\*\*
- Ichthyology (4)
  - Zool 5121
- Microbiology (5)
  - MicB 3103
- Animal Physiology (6)
  - AnSc 1300
- Fisheries and Wildlife (9)
  - FW 5451, 5452, 5453

**C. Man and Society**—4-5 credits elected  
See CLE list of suggested courses in Section III of this bulletin.

**D. Artistic Expression**  
If requirement not yet fulfilled.

**E. Other Requirements**—7 credits  
Technical Drawing (3)

- AgEn 1010

Surveying (4)

- AgEn 1400

Summer Field Requirement (see Pre-Fisheries and Wildlife Curriculum Status section above)

**F. Electives**  
Recommended elective courses in fisheries: CICS 3101 (Computers); Bot 3131, 3132 (Plant Physiology); Bot 5805\*\* (Aquatic Plants); EBB 5814\*\* (Ecosystems); FW 5280 (Seminar); FRD 5233 (Recreation Design); FRD 5259 (Recreation Amenities); AgEn 3800 (Sanitation, Water Supply); AgEn 3410 (Hydrology, Water Control); AgEn 5000 (Radioisotope Measurements); Chem 3301, 3302, or BioC 1301, 1302 (Organic Chemistry, Biochemistry); Zool 5093 (Animal Parasitology) or 5843 (Animal Parasites)\*\*; Stat 5022 (Statistical Analysis II); Math 1421, 1431 (Calculus); Rhet 3257 (Scientific and Technical Speaking)

**TOTAL CREDITS FOR PROGRAM—198**

### 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

\*\*Course offered at Lake Itasca Forestry and Biological Station during Summer Session.

**B. Physical and Biological Sciences—56-60 credits**

- Advanced Chemistry (9-10)  
Chem 3301, 3302, or BioC 1301, 1302
- Plant Taxonomy (7-8)  
Bot 3201  
Bot 5205, 5805\*\* , 5801\*\*
- Animal Physiology (6)  
AnSc 1300
- Mammalogy (5)  
FW 5129
- Ornithology (5)  
Zool 5077 or 5834\*\*
- Plant Ecology (5)  
EBB 5014 or 5814\*\*
- Animal Ecology (3-5)  
Ent 5400 or EBB 5817\*\*
- Wildlife Parasites, Diseases (3)  
VB 5603, 5604
- Fisheries and Wildlife (13)  
FW 5561, 5562, 5563

**C. Man and Society—4-5 credits elected**

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

**D. Artistic Expression**

If requirement not yet fulfilled

**E. Other Requirements—4 credits**

- Air Photo Interpretation (4)  
FRD 5200
- Seminar: Wildlife (1)  
FW 5281
- Summer Field Requirement (see Pre-Fisheries and Wildlife Curriculum Status section above)

**F. Electives**

Recommended elective courses in wildlife: AnSc 1401 (Animal Nutrition); AnSc 5322 (Physiology of Reproduction); CICS 3101 (Computers); Bot 3131, 3132 (Plant Physiology); EBB 5813\*\* or Geo 5601 (Limnology); EBB 5015 (Ecosystems); EBB 5016 (Plant Geography); Ent 3175 or 5020\*\* (Entomology); FW 5451 (Fish Populations); FBio 1100 (Dendrology); Geog 3421 (Climatology); FRD 5230 (Forest Fire); FRD 5231 (Range Management); FRD 5233 (Recreation Design); FRD 5259 (Amenities Lands); Ger 1101, 1102++ (Beginning German); Math 1221, 1231++ (Analytical Geometry, Calculus); AgEn 1010 (Technical Drawing); AgEn 1400 (Surveying); VB 5103 (Embryology); Zool 5071 (Invertebrate); Zool 5121 (Ichthyology); Rhet 3257 (Scientific and Technical Speaking)

## 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

\*\*Courses offered at Lake Itasca Forestry and Biological Station during Summer Session.

++Recommended for students planning to continue with graduate study.

## Program Requirements

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and senior years of the fisheries major, intended as preparation for later graduate work leading to the M.S. or Ph.D. degree. In addition to the specific courses listed below will be a group of supporting courses, the selection of which will be dependent on the student's area of interest and will be determined 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 5890\*\*) will consist of: (a) introduction to the scientific method, (b) library literature research, (c) formulation of a hypothesis and experiment design, (d) field work 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

Microbiology (5)

MicB 3103

Animal Physiology (6)

AnSc 1300

Limnology (4-5)

EBB 5813\*\* or Geo 5601

Fisheries and Wildlife (10)

FW 5451, 5452, 5453

#### C. Man and Society—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 5890\*\*

Summer Field Requirement (see Pre-Fisheries and Wildlife Curriculum Status section above)

\*\*Courses offered at Lake Itasca Forestry and Biological Station during Summer Session.

## F. Supporting Courses

To be planned with the help of adviser. Supporting courses are selected to form an integrated program of course work that directly supports the major in fisheries. Courses may include such subjects as analytic chemistry, aquatic ecology, ichthyology, algae and aquatic plants, entomology, etc.

TOTAL CREDITS FOR PROGRAM—198

## Food Science and Nutrition

This curriculum includes 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 health and disease. These programs are open to students registered in either the College of Agriculture or the College of Home Economics. Faculty advisers will normally be 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 which follow.

### Consumer Food Science

It is the purpose of this program to prepare the student for professional work in areas relating to the promotion, product development, marketing, and consumption of food. A graduate may expect to be engaged in work of an educational, public relations, advertising, promotional, or developmental nature. His role in any of these positions may include several different aspects of food, such as developing new products as well as improving existing products, testing and developing new processing and packaging techniques, writing food releases for various communication media, etc.

Persons considering graduate study in the consumer food science area may acquire additional preparation in the physical and biological sciences or in the social sciences by the modifications suggested under these collateral areas. Persons 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

- Rhet 1101-1102—Communication (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

- Chem 1004-1005—General Principles of Chemistry (10)
- Chem 3301-3302—Elementary Organic Chemistry (10)

## Program Requirements

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- Biol 1011—General Biology (5)
- MicB 3103—General Microbiology (5)
- (or) MicB 5105—Biology of Microorganisms (4)
- Biol 3021—Biochemistry (4)
- BioC 5025—Lab: 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

- 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)
- (or) Soc 1505-1506—Principles of Sociology (10)

### D. Artistic Expression

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

### E. Major Requirements

Students majoring in consumer food science take the following courses:

- FScN 1272—Introduction to Food Decision Making (2)
- FScN 1602—Principles of Nutrition (4)
- FScN 3110—Food Chemistry (5)
- 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 (3)
- FScN 5362—Sensory Evaluation Laboratory Techniques (1)
- FScN 5403—Experimental Study of Foods (5)
- FScN 5412—Physicochemistry of Foods I (4)
- FScN 5413—Physicochemistry of Foods II (4)
- 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

In addition to the previously defined course requirements, each student must select one of the following fields as an area of emphasis. A minimum of 20 credits constitutes a collateral area.

## Food Chemistry and Product Development

Each student must select at least 20 credits from the following courses:

- Food Science and Nutrition—1500, 3102, 3730, 5102, 5111, 5120, 5122, 5135, 5321, 5350, 5380, 5404, 5406, 5623, 5643
- Family Social Science—1401
- Textiles and Clothing—3621
- Biochemistry—5002
- Chemistry—3100, 3101

Mathematics—1142, 1211  
Statistics—5601, 5201  
Psychology—3031

### **Consumer Services**

Each student must select at least 20 credits from the following courses:

Food Science and Nutrition—1600, 3400, 3642, 3720, 3730, 5102, 5404  
Design—1501, 1521, 1525, 1551 or 1552, 3558, 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, 3000  
Business Law—3058

### **Business**

Each student must select at least 20 credits from the following courses:

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  
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  
Family Social Science—5202  
Sociology—5201, 5355  
Psychology—5201, 5751  
Rhetoric—3254

## **Program Requirements**

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### **Social Science**

Each student must select at least 20 credits from the following courses:

Anthropology—1002, 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

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

### **Physical and Biological Sciences**

Each student must select at least 20 credits from the following courses:

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

Biol—3012

Bot—3131, 5141

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 Course Requirements upon consultation with advisers.

### **G. Free Electives**

Electives to make a total of 185 credits required for graduation

### **Food Science and Technology**

Food science and technology is defined as "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 which encompass the food chain from production of the raw material to the ultimate utilization of the product by the consumer. Therefore, a curricular program designed to educate individuals in this emerging discipline of food science balances fundamental principles and useful applications of theory within a flexible program that permits each student to tailor his or her education to fit personal career goals.

The basic objective of the program is to provide the student with a liberal and professional education which will lead to a satisfying career in one of the numerous and diverse career opportunities available in the food industry. Thus, in addition to a general education, this program provides the student with 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, superior students often continue on to graduate study. Food scientists and technologists have unlimited and challenging oppor-

tunities in rewarding and diversified positions. These opportunities lie mainly in food and allied industries, in government service, and in education. Some of the jobs available for graduates include 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 positions in international nutrition and food agencies.

Students educated in food science and technology will be able to 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 our 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 will acquire the ability 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 by supplementary areas of emphasis in business administration, chemistry, engineering, microbiology, and public health. Consequently, these food scientists will be prepared to meet challenges in one or more commodity areas such as cereals, dairy products, fruits and vegetables, meats 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 for FOOD SCIENCE AND TECHNOLOGY

#### A. Communication, Language, Symbolic Systems

Rhet 1101-1102—Communication (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)

(or) Math 1141—Algebra, Probability, and Pre-Calculus (5)

(or) Math 1142—Introduction to Calculus (5)

#### B. Physical and Biological Sciences

Chem 1004-1005—General Principles of Chemistry (10)

BioC 1301—Elementary Biochemistry I\*\* (5)

BioC 1302—Elementary Biochemistry II\*\* (4)

Phys 1031-1032—Introductory Physics: Measurement and Applications (10)

Biol 1011—General Biology (5)

MicB 3103—General Microbiology (5)

#### C. Man and Society

See CLE list of suggested courses

#### D. Artistic Expression

See CLE list of suggested courses

#### E. Major Requirements

Students majoring in food science and technology take the following courses:

FScN 1602—Principles of Nutrition (4)

FScN 3102—Technology of Food Processing (4)

\*\*Students interested in chemistry, microbiology, and nutrition areas of emphasis may substitute Chem 3301, 3302 and Biol 3021, BioC 5025.

## Program Requirements

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- FScN 3110—Food Chemistry (5)
- FScN 5100—General Seminar (1)
- (or) FScN 5102—Case Studies in Food Science and Nutrition (5)
- FScN 5120—Food Microbiology (5)
- FScN 5122—Sanitation, Process Microbiology (4)
- FScN 5135—Food Process Engineering (5)

In addition to the above required courses, a minimum of 20 credits to be chosen from among the following courses:

- FScN 1500—Meat Science (4)
- FScN 5000—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 5312—Chemical and Instrumental Analysis of Foods (5)
- 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 (3)
- FScN 5362—Sensory Evaluation Laboratory Techniques (1)
- FScN 5380—Food Packaging (3)
- 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 5555—Freezing and Dehydration of Foods (4)
- FScN 5581—International Food Technology (3-5)

### F. Areas of Emphasis

In addition to the previously defined course requirements, each student must select one of the following areas of emphasis as well as sufficient electives to meet the 186-credit requirement for graduation. The area must represent a high level of course work as illustrated in the chemistry area below, and must not be repetitious of the major requirements.

### 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. At least 20 additional credits of chemistry must be selected and usually include the following:

- Chem 3100-3101—Quantitative Analysis (3/2)
- Chem 1006—Solution Chemistry (4)
- Chem 3301-3302—Elementary Organic Chemistry (10)
- Chem 5520-5521—Elementary Physical Chemistry (6)
- Biol 3021—Biochemistry (4)
- BioC 5025—Lab: Biochemistry (2)
- BioC 5002—Biochemistry (4)

### Engineering Technology

This area of emphasis is 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 Math 1142 and 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:

Math 1142—Calculus (5)

ME 3900—Introduction to Engineering Statistics (4)

(or) Stat 3092—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 wishing training to meet the problems of the business and economic phases of the various food industries. The following courses are to be taken in addition to the previously listed requirements:

AgEc 1020-1030—Principles of Macroeconomics, Microeconomics (9)

(or) Econ 1001, 1002—Principles of Macroeconomics, Microeconomics (8)

Statistics (3-4)

At least 20 credits from course offerings in the Departments of Agricultural and Applied Economics, Economics, and Rhetoric, and in the College of Business Administration

### Microbiology

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

Chem 3301-3302—Elementary Organic Chemistry\*\* (10)

Biol 3021—Biochemistry\*\* (4)

BioC 5025—Lab: Biochemistry\*\* (2)

MicB 5321—Physiology of Bacteria (3)

### Nutrition

This area of emphasis is designed for students who desire courses specifically related to the nutritional aspects of the food processing industry. In addition to previously listed requirements, the following courses are to be taken:

Phsl 1002—Human Physiology (4)

About 20 credits of nutrition-oriented course offerings in food science and nutrition, biochemistry, animal science, and related departments

\*\*Recommended to replace BioC 1301, 1302.

## **Program Requirements**

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### **Public Health**

This area of emphasis provides the necessary background for the variety of activities of the sanitarian in either governmental or industrial employ 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 offerings of the School of Public Health.

### **Other Areas**

The courses presented for the six areas above 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.

### **G. Free Electives**

Electives to make a total of 186 credits required for graduation

## **Hospitality and Food Service Management**

The program in hospitality and food service management is designed to provide its majors with the basic principles and techniques essential to qualify them for employment in three general related areas: food service management, hospitality business management, and personnel training and development. The broad scope of the hospitality and food service industry and changing patterns of living make it possible for the student to concentrate his or her professional training in a wide variety of new and needed service-related fields.

The professionally trained person in this field is concerned with the useful application of theoretical principles; thus the program strives to provide a balance between theory and practical experience.

### **Program Requirements for FOOD SERVICE MANAGEMENT OPTION**

#### **A. Communication, Language, Symbolic Systems**

Rhet 1101-1102—Communication (8)  
(or) Equivalent courses  
Rhet 1222—Public Speaking (4)  
Rhet 3551—Professional Writing (4)  
Math 1111—College Algebra and Analytic Geometry (5)

#### **B. Physical and Biological Sciences**

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

#### **C. Man and Society**

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**

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

**E. Major Requirements**

Students majoring in hospitality and food service management take the following courses:

- FScN 1212—Scientific Principles of Food Preparation I (4)
- FScN 1213—Scientific Principles of Food Preparation II (3)
- FScN 1602—Principles of Nutrition (4)
- FScN 1700—Introduction to Hospitality and Food Service Management (2)
- FScN 3123—Microbiology of Foods (5)
- 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 5100—General Seminar (1)
- Acct 1050-1051—Principles of Accounting (8)
- Acct 3255—Managerial Cost Accounting (4)
- BLaw 3058—Introduction to Law, and the Law of Contracts and Agency (4)
- 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 5100—Computer Systems Design (4)
- Mktg 3000—Principles of Marketing (4)
- PubH 3004—Basic Concepts in Personal and Community Health (4)
- Arch 1001—Environmental Design: Man and Environment (4)
- Arch 1002—Environmental Design: Tools and Processes (4)
- Arch 1003—Environmental Design: Implementation and Evaluation (4)
- AgEc 3410—Economic Organization of the Hospitality Industry (4)

**F. Free Electives**

Electives to make a total of 185 credits required for graduation

***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 requirement of the American Dietetic Association for membership and for internship. Students who complete a program in dietetics or community nutrition will find employment opportunities in hospitals or community agencies upon completion of a 6 to 12 month hospital or public health internship. A nutrition science option is offered for those students who are interested in graduate study in nutrition science. Students in this option should maintain a grade point average of 2.80 or better and upon completion of an M.S. or Ph.D. program would find employment opportunities in college or university teaching or in university or industrial research.

Students must normally complete the sequence in organic chemistry by the end of the sophomore year or be delayed in the completion of the program. Students who transfer into the program and have completed organic chemistry or biochemistry courses more elementary than those listed below will be required to take additional course in those areas.

The American Dietetic Association has approved "under organization" status for a coordinated undergraduate program in dietetics at the University of Min-

## Program Requirements

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nesota. In this program, with the cooperation of Twin Cities area hospitals, the dietetic education of qualified students is facilitated by integration of the internship experience with the final 2 undergraduate years. Students completing the program are assured membership in the American Dietetic Association. Enrollment is limited, and interested students should apply to the director of the program early in the sophomore year.

### Program Requirements for NUTRITION AND DIETETICS

#### A. Communication, Language, Symbolic Systems

- Rhet 1101-1102—Communication (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

- Chem 1004-1005—General Principles of Chemistry (10)
- Chem 3301-3302—Elementary Organic Chemistry (10)
- Biol 1011—General Biology (5)
- MicB 3103—General Microbiology (5)
- (or) Biol 3013—General Microbiology (5)
- Phs1 3051—Human Physiology (5)
- (or) Phs1 1002—Human Physiology (4)
- Biol 3021—Biochemistry (4)
- BioC 5025—Lab: Biochemistry (2)

#### C. Man and Society

- 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

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

#### E. Major Requirements

Students majoring in nutrition and dietetics take the following courses:

- Mgmt 3001—Fundamentals (4)
- FScN 1600—Sociocultural Aspects of Nutrition (3)
- FScN 1602—Principles of Nutrition (4)
- FScN 3110—Food Chemistry (5)
- 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 (5)
- LaMP 5175—Pathology and Clinical Medicine for Allied Health Students I (3)
- LaMP 5176—Pathology and Clinical Medicine for Allied Health Students II (3)

- 4-5 credits in sociology or anthropology
- 3-5 credits in statistics or computer usage
- 3-4 credits in psychology of learning to be selected from:
  - Psy 3011—Introduction to Psychology of Learning (4)
  - PsyF 5141—Psychology of School Learning (3)

**F. Collateral Areas**

Select one of the following options:

**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**

3-5 credits in anatomy, genetics, physiology, or endocrinology

**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.

**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

**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.

- Math 1141-1142-1211-1222
- Chem 1006, 3100, 3303, 5520, 5523
- Biol 3021, BioC 5025, 5751, 5752
- 10-15 credits of college physics

**G. Free Electives**

Electives to make a total of 185 credits required for graduation

**Resource and Community Development**

The program in resource and community development prepares students for careers in resource development; community development; public land use; rural

## **Program Requirements**

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and urban zoning; conservation; recreation; resource economics and sociology; environmental design; landscape architecture; and related discipline areas.

Students completing majors in the program are equipped to function in positions with federal, state, county, and local planning, administrative, and management agencies. Private landscape architecture planning, banking, recreation, and research organizations also offer career opportunities for graduates. The preparation 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 discipline areas of agriculture and forestry on planning and administrative training. This 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 his or her 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 in which a coherent program in administration and/or planning may be developed on an individual basis.

### **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 on planning commissions, extension services, the Soil Conservation Service, and other public and private agencies involved with resource and community development activities. Program participants 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 (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—31-33 credits**  
Chemistry (10)  
Chem 1004, 1005  
Biology (13-14)  
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)

In agricultural economics, 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, and 5640; or Econ 3101, 3102, and 3851 and one other course.

Planning (4)

Arch 5137

**F. Techniques of Analysis—17-19 credits**

Statistics (8)

Stat 5021, 5022

Other (9-11)

Choose from among: Geog 3531, 3511, 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 are also suggested.

**TOTAL CREDITS FOR PROGRAM—192**

**Recreation Resource Management**

The general objectives of the program are:

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

## **Program Requirements**

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While this undergraduate program of study may be terminal for some, it is primarily designed to attract students motivated toward and capable of graduate work. This is an interdisciplinary program administered by the College of Forestry with the assistance of special college committees.

### **Program Requirements for RECREATION RESOURCE MANAGEMENT**

- A. Communication, Language, Symbolic Systems—34 credits**  
English (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 or FRD 3204
- 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)  
FRD 1201 (3)  
FBio 1100 (4)  
Soils (4)  
Soil 1122
- C. Man and Society—37 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 5130 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—13 credits**

Forestry (10)

FRD 5232, 5233 (7)

FRD 5257 or 5259 (3)

Fisheries and Wildlife (3)

FW 3050

**F. Technical Background—12 credits\*\***

Surveying (4)

AgEn 1400

Hydrology (4)

AgEn 3410 or FBio 5104

Aerial Photogrammetry (4)

FRD 5200

**G. Resource and Community Development—14 credits**

AgEc 3610 or FRD 5212 or AgEc 5620

RCD 5100, 5101 (10)

**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 of soil and water resources. Students are trained in the use of these physical resources. Employment possibilities exist for soil and water specialists in rural, urban, and recreational planning; in conservation; in land appraisal; and in other positions involving interpretation and use of soil and water information. Students in this program may be advised 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 (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

\*\*Students 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*

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### **B. Physical and Biological Sciences—42 credits**

- Chemistry (10)
  - Chem 1004, 1005
- Biology (10)
  - Biol 1011, 1103
- Ecology (3)
  - EBB 3004
- Microbiology (5)
  - MicB 3103
- 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—11 credits**

- AgEc 3610 (4)
- RCD 5100, 5101 (10)

### **F. Specialized Courses—46 credits**

- Drawing (3)
  - AgEn 1010
- Surveying (4)
  - AgEn 1400
- Agricultural Engineering (12)
  - AgEn 3410, 3800, 5400
- Civil Engineering (4)
  - CE 5420
- Soil Science (14)
  - Soil 3220, 5512, 5540, 5240
- Forestry (9)
  - FRD 1201, 5200, 5232

### **G. Electives—46 credits**

Soil 5232, 5310, 5520, 5550; Geo 5261, 5601; Geog 5441, 5443, 5743; AgEn 5810; Hort 3025; Ent 5400; EBB 5014; RCD 3010, 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 which results through the development of land for specific human use.

The landscape architect concentrates on a wide range of involvement: 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. Specifically, this range 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 planting 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 are studied carefully to assure sound recommendation.

**Bachelor of Landscape Architecture (BLA)**—This program is organized to provide the basic professional training for the practice of landscape architecture and to allow for specialization in one of the expanding areas of professional interest.

The program is offered jointly by the Institute of Technology and the Institute of Agriculture. Students may enroll in either institute.

There are 215 credits required for graduation: 179 credits in core area requirements, which include a sequential design-course program taking a minimum of 3 years, and 36 credits in specialized focus areas. Students, through consultation with their adviser during the second year, elect one of four areas of specialized focus options. They are:

**Site Planning and Design**—Students in this option will focus upon the art and science of developing small-size land areas for intense human usage. Studies are directed toward analyzing microscale environments as well as aspects of human interaction in detail environments by analyzing the potential subtleties of site organization. Projects will focus upon a range of intensely developed landscapes including those for housing, commercial, industrial, educational, and urban recreational development.

**Urban Landscape Design**—Students in this option will focus upon the organization of urban environments. Studies are directed toward exploring the potential input of a designer trained in the development of urban systems (such as open space, housing, commercial, industrial, transportation historic preservation, etc.)

**Regional Resource Planning and Design**—Students in this option will focus on large-scale land areas to analyze their development potential and to differentiate land uses such as those for agricultural, residential, commercial, industrial, recreational, and preservation purposes. Students will prepare analyses and develop other special skills related to the planning process for large-scale areas. Specialized emphasis in the areas of computer-assisted approach to regional land analysis and recreational planning issues are a major part of the option.

## Program Requirements

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**Recreational Planning and Design**—The recreational planning focus provides an area specialization in the broad field of recreation. Students interested in this area will develop special capabilities in park design, golf course design, ski areas, camping facilities, recreational streams and rivers, resort grounds planning, and county or large jurisdictional recreation areas from both the resource and design capability point of view.

It is strongly recommended that all students show evidence of completing 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.

### ADMISSION PROCEDURES

Application is required to enter the Landscape Architecture Program. The procedure is as follows:

1. Complete a minimum of 30 credit hours of acceptable college courses.
2. Complete Form LA 110b (available from the Department of Horticultural Science and Landscape Architecture, St. Paul; School of Architecture and Landscape Architecture, Minneapolis; or the Office of Admissions and Records).
3. Interview or correspond with a minimum of two members of the landscape architecture faculty prior to the May 1 application submission.
4. Submit the application form by May 1 of the year of desired entry.

Approval of admission will be based on consideration of the following: (a) the student's scholastic standing in high school and on previous college work; (b) his or her maturity and experience; (c) a letter of intent, stating why the student wishes to become a landscape architect.

Students may apply for admission to the Landscape Architecture Program at any point in their academic or professional career. However, past experience has indicated that application during the second year of college provides the best opportunity to be admitted. All students will be considered on an equal basis except those applying for advanced standing. It is strongly recommended that after two rejections students apply to another program.

Admission to Basic Design (LA 3081) is normally permitted only in the fall quarter. However, students who wish to apply for advanced standing within the program are requested to bring a portfolio of their work and a grade transcript to discussions with the advisers in landscape architecture.

Students are encouraged to visit the design studios and talk to students who are in the program, as well as to enroll in LA 1031 (Introduction to Landscape Architecture). Both of these experiences are intended to aid the students in their decision to select landscape architecture as a profession.

### Program Requirements for LANDSCAPE ARCHITECTURE

#### LOWER DIVISION (1T)

**Core Course Requirements**—36 credits

English Composition or Communications

Three courses in mathematics, statistics, and computer information

Chem 1004

Soc 1001

Econ 1001

**LOWER DIVISION (IAG)**

**Core Course Requirements—36 credits**

Rhet 1022, 1101, 1102

Math 1008, 1111

Chem 1004

Soc 1001

AgEc 1020

Following completion of the above, the student must apply for admission to the program before May 1 of the year entry to LA 3081 is sought.

**UPPER DIVISION (IT AND IAG)**

**Core Course Requirements—103 credits**

LA 1022

LA 1024

LA 1025

LA 3071-3072-3075

LA 3081-3082-3083

LA 3091, 3092

LA 3101

Studio arts courses (6 credits)

AgEn 1400 or CE 3100

Soil 1122

Biology courses (10 credits)

Hort 1021-1022

Hort 3074

Ecology courses (4 credits)

Geography courses (5 credits)

Rhet 3551 or 3562 (IA only)

**Electives—18 credits**

**Option Requirements—58 credits**

**OPTIONS**

**Site Planning and Design—58 credits**

Design Area (41)

Design

LA 3093 (6)

LA 5101 (6)

LA 5110 (6)

Design course (5)

Theory

LA 5115-5116 (2 each)

LA 5124 (1)

History

Arth 3001 (4)

Arch 1021 (4)

Arch 5056 (4)

Technology Area (8)

LA 3073 (4)

LA 5226 (4)

Special Option Requirements (9)

Design course electives as approved by adviser

## **Program Requirements**

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### **Urban Landscape Design—58 credits**

#### **Design Area (42)**

##### **Design**

LA 3093 (6)

LA 5103 (6)

LA 5110 (6)

Design course (6)

##### **Theory**

LA 5115 (2)

Arch 5137 (4)

Arch 5138 (4)

##### **History**

LA 1021 (4)

LA 1023 (4)

#### **Technology Area (8)**

LA 3073 (4)

LA 5226 (4)

#### **Special Option Requirements (8)**

Design course electives selected in consultation with adviser

### **Regional Resource Planning and Design—58 credits**

#### **Design Area (42)**

##### **Design**

RCD 5100 (3)

RCD 5101 (4)

LA 5107 (6)

LA 5110 (6)

Design course (6)

##### **Theory**

AgEc 3610 (4)

Soil 5540 (4)

Arch 5136 (4)

Arch 5137 (4)

Hort 3099 (1)

#### **Technology Area (4)**

Aerial Photographic Interpretation or Land Analysis (4)

#### **Special Option Requirements (12)**

Soc 5401 or 5651 (4)

Electives (8)

### **Recreational Planning and Design—58 credits**

#### **Design Area (38)**

##### **Design**

RCD 5100 (5)

RCD 5101 (5)

LA 5105 (6)

LA 5110 (6)

Design course (6)

##### **Theory**

AgEc 3610 (4)

Soil 5540 (4)

LA 5010 (4)

Hort 3099 (1)

## Enrichment Program in International Affairs

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Technology Area (4)

Aerial Photography or Land Analysis (4)

Ecology Area (7)

FW 3050 (3)

Forestry Pathology/Entomology/Arboriculture (4)

Special Option Requirements (9)

Soc 5401 or 5651 (4)

Electives (5)

## 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 for careers in developing and applying new and improved machines, structures and systems for expanding production of crops and livestock at home and abroad, for reducing the dependence on labor in agriculture, and for using our soil, water, and energy resources wisely.

Additional information may be obtained by writing or visiting the Department of Agricultural Engineering in 213 Agricultural Engineering Building on the St. Paul Campus.

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

### Enrichment Program in Journalism

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

### Enrichment Program in International Affairs

Many students now preparing themselves for professional careers in agriculture will find themselves employed in the worldwide battle against hunger. Such employment requires sound preparation in a professional field and an understanding of the world. A special curriculum enrichment program is available for students interested in expanding their intellectual horizons in preparation for their professional careers.

## **Program Requirements**

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A special certificate in international affairs may be earned through selection of appropriate elective courses so as to complete 18 credits in addition to the major and all-college requirements. A faculty adviser will help the student plan a program in order to qualify for the certificate. The student will select three areas, each of which requires completion of a minimum of 5 credits. One area should be a field in agriculture outside the major field and judged by the adviser to be useful in work abroad. Two other areas should be selected to give a broad understanding of international affairs. Courses used to fulfill CLE requirements may be used to satisfy international enrichment requirements if appropriate. The two areas other than agriculture should be selected from among the following: sociology, economics, history, geography, Latin-American studies, Asian studies, a foreign language, business administration, anthropology, and political science.

### **Extension Education**

Students interested in serving as extension agents and 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 give a background for careers in extension work.

### **Pre-Biological Sciences**

Freshman and sophomore students interested in obtaining a degree in biological sciences may choose the College of Agriculture for their prerequisite work since the College of Biological Sciences (CBS) accepts only those students classified as juniors. 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 Curriculum**

This program is available for students who wish to complete the minimum requirements prior to admission to the College of Veterinary Medicine. Freshman students will be assisted by an adviser from the College of Veterinary Medicine. After the freshman year, students must select an alternate major. An adviser from the alternate area will counsel students as they work toward completing entrance requirements for the College of Veterinary Medicine, while pursuing the alternate major. Students transferring from other colleges after 1 year of studies must select an alternate major.

A minimum of 90 quarter-credit hours of college-level course work is required of all students prior to entrance into the College of Veterinary Medicine. All course work applicable toward meeting the minimum pre-veterinary requirements should be evaluated with the A-N letter grading system except when a college does not offer a course under that grading system or when advanced placement (exemption) is given. The required areas of study for admission to the College of Veterinary Medicine with the suggested pre-veterinary courses for those enrolled in the College of Agriculture are as follows:

- A. **Communication, Language, Symbolic Systems—17-20 credits**
  - English, Communication (8)
  - Rhet 1101, 1102

Public Speaking (4)

Rhet 1222

Mathematics (5-8)

Trigonometry, College Algebra, Pre-Calculus or Calculus (number of credits will depend on high school math background)

Math 1008, 1111 or 1142 (or 1201 or 1211 or 1131)

**B. Physical and Biological Sciences—48 credits**

Chemistry: General Inorganic and Qualitative, Quantitative, and Organic (not terminal); all courses must include laboratory

General Inorganic (10)

Chem 1004, 1005

Solution (4)

Chem 1006

Quantitative Analysis (5)

Chem 3100, 3101

Organic (10)

Chem 3301, 3302

Physics (10)

Mechanics, Heat, Electricity, Sound, Light (with laboratory)

Phys 1031, 1032

Biology (10)

General Biology, Zoology or its equivalent (with laboratory)

Biol 1011, 1106

**C. Man and Society—8 credits**

An introductory course in agricultural economics or economics:

AgEc 1020 (5)

Additional courses may be selected from the following areas: agricultural economics or economics, anthropology, geography, history, political science, psychology, social science, or sociology

**D. Artistic Expression—8 credits**

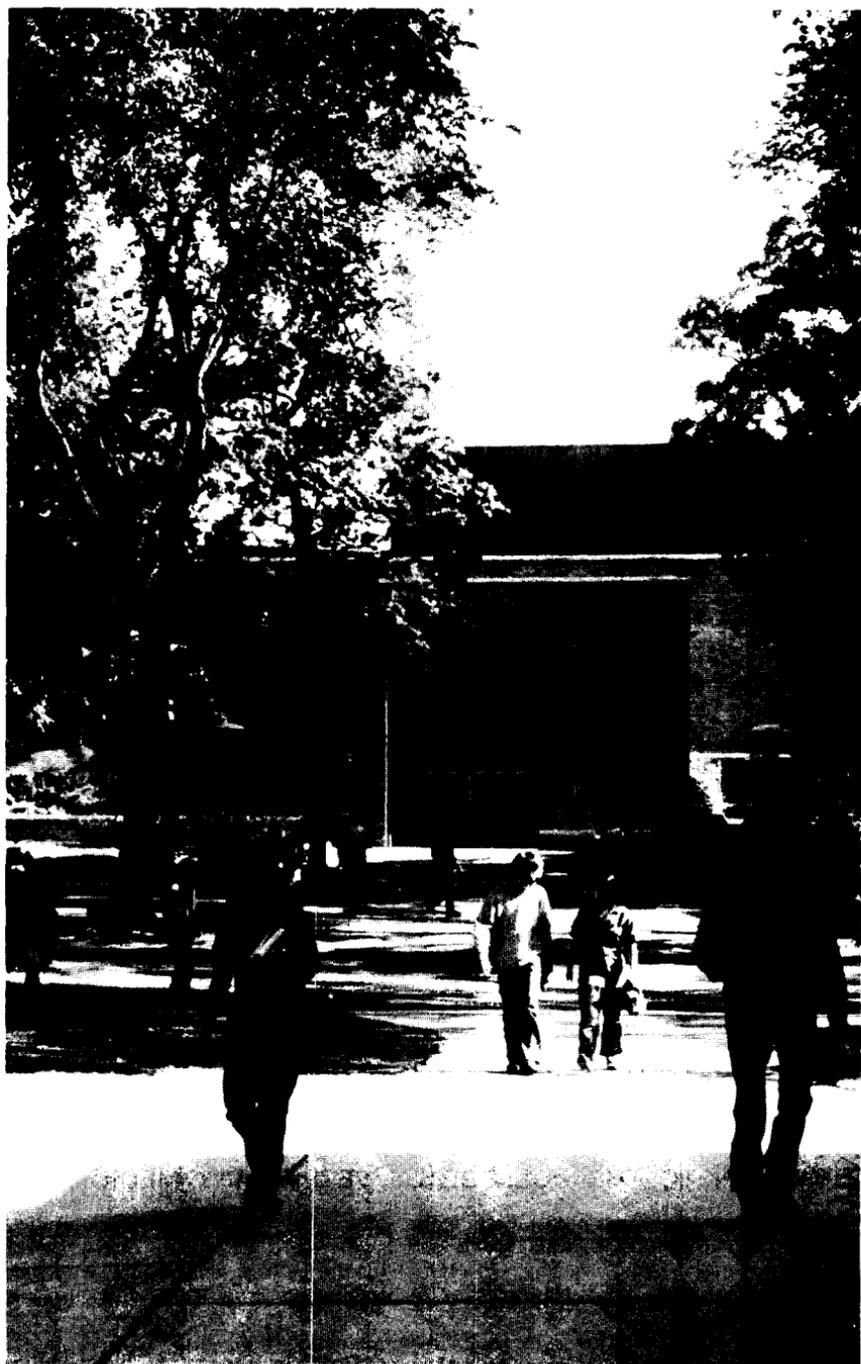
See CLE list of suggested courses in Section III of this bulletin

**E. Electives**

Electives may be selected on the basis of the student's interest in a broad educational program. Courses in literature, history, humanities, linguistics, and related areas would help students to strengthen their understanding of their fellowman and to broaden their enjoyment of literature and the arts. Courses in animal nutrition and business management would be useful for those planning to enter practice. Additional science and mathematics courses would help prepare students for academic or research careers. Those lacking experience and knowledge of food-producing animals may wish to elect courses in the animal sciences.

**ADMISSION TO THE COLLEGE OF VETERINARY MEDICINE**

For detailed information concerning procedures leading to admission to the professional curriculum, criteria for selection, the facilities of the College of Veterinary Medicine, and the degrees offered by the college, consult the *College of Veterinary Medicine Bulletin*, or write to the Office of Professional and Undergraduate Education, 301 Veterinary Science Building, College of Veterinary Medicine, University of Minnesota, St. Paul, Minnesota 55108.



## II. COURSE DESCRIPTIONS

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

- Courses in which it is possible for graduate students to prepare Plan B projects.
- † All the courses preceding the dagger must be completed before credit will be granted for any quarter of the sequence.
- § Credit will not be given if the equivalent course listed after the section mark has been taken for credit.
- ¶ Means "concurrent registration."
- ‡ Means "consent of instructor is required."
- △ Means "consent of division, department, or school offering course is required."
- x Means "course is offered more than one 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 (3142-3143-3144) indicates a sequence of courses which must be taken in the order listed.

A comma between course numbers (1234, 1235, 1236) indicates a series of courses which 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.
- 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.
- 1040. ECONOMIC DEVELOPMENT OF AMERICAN AGRICULTURE.** (4 cr; prereq 1030)  
Review of economic, political, social, and technical forces that have shaped the development of American agriculture; role of agricultural development in national economic development in the United States; implications for presently developing countries.
- 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, the demand for and supply of agricultural products, and the study of food and fiber market organization.
- 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 Descriptions

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- 3102. MACROECONOMIC THEORY.** (4 cr, \$Econ 3102; prereq 1020 and 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.
- 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. AGRICULTURAL FINANCE.** (5 cr; prereq 1030)  
Elements of money and banking with emphasis on financing the production and marketing of agricultural products; description and analysis of agricultural credit institutions and agencies.
- 3610. COMMUNITY RESOURCE DEVELOPMENT.** (4 cr; prereq 1030 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.
- 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)  
Use of cost and production theory in farm management; nature and process of management.
- 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.
- 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.
- 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.
- 5120. AGRIBUSINESS MANAGEMENT AND MARKETING.** (3 cr; not open to majors in AgEc Dept; prereq 1020-1030)  
Business management and marketing problems in the 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.
- 5290. AGRIBUSINESS MANAGEMENT.** (4 cr for undergrad, 3 cr for grad; prereq 1020, 1030 and Mgmt 3001 for agricultural business majors...3101 for others or §)  
Application of economic, other social science, and technical concepts to the decision-making process of firms supplying inputs to agriculture and/or processing and distributing agricultural products.
- 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. Study of unique market institutions as they 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. COMMODITY MARKETS AND FUTURES TRADING.** (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 capital accumulation in agriculture; finance and credit institutions; farm appraisal and agricultural credit policies.
- 5580. ECONOMIC ORGANIZATION OF THE HOUSEHOLD.** (4 cr for undergrad, 3 cr for grad; prereq 1030 or Econ 1002...3101 or Econ 3101 for grad)  
The family as an economic unit marshaling its resources of labor, capital goods, location, and accompanying public goods and purchased consumer goods and services to produce labor, capital, money and in-kind income, and satisfaction. Modern adaptations of consumer behavior and firm theory along with time series and cross-section data on families to explain and interpret changes in the organization of family production activities and resources consequent upon changes in wage rates, returns to capital, consumer goods and services prices, land prices, consumer and producer technology, the environment, the public sector, and family preferences.
- 5590. GOVERNMENT AND CONSUMERS.** (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101...3102 or Econ 3102 recommended)  
Demand and consumption relations for goods and services publicly supplied under governmental policies and actions, as they affect individuals as consumers but not as taxpayers or as purchasers of products of regulated industries. Markets for publicly supplied goods and services, with particular attention to demand and consumption relations and effects on consumers of governmental policies and behavior. Informational defects in public as well as private markets, along with alternative means of consumer redress.
- 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.
- 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.

## Course Descriptions

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- 5630. REGIONAL DEVELOPMENT SYSTEMS.** (4 cr for undergrad, 3 cr for grad; prereq 1030 or Econ 1002)  
Regional subsystems in resource productivity cycle. Public service delivery subsystems. Public intervention strategies in environmental management. Settlement planning and resource development.
- 5640. FINANCING PUBLIC SERVICES IN RURAL AREAS.** (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101)  
Public financing potentials in rural and urban areas. Flow of funds accounts. Public expenditure criteria. Implications of regional financing alternatives.
- 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.
- 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, §VCS 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 will be sought from the social and economic sciences, plant sciences, and the animal sciences for their application to food problems.
- 5800. FARM RECORDS AND BUSINESS ANALYSIS.** (4 cr; prereq 1030 or §)  
Analysis of farm records and their role in management of farm business; types of farm records; calculation of farm earnings by various measures.
- 5830. FARM PLANNING.** (3 cr; prereq 3820 or §)  
Special problems in farm planning.
- 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

- 8200-8201-8202. GENERAL SEMINAR: AGRICULTURAL ECONOMICS**
- 8205. RESEARCH METHODOLOGY IN AGRICULTURAL ECONOMICS**
- 8206. FOUNDATIONS OF APPLIED ECONOMICS**
- 8231. AGRICULTURAL PRICES**
- 8245. AGRICULTURAL MARKETING ECONOMICS**
- 8264. RESOURCE ECONOMICS**
- 8278. AGRICULTURAL AND ECONOMIC DEVELOPMENT**
- 8287. PRODUCTION ECONOMICS I**
- 8288. PRODUCTION ECONOMICS II**
- 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
- 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 SUPERVISED OCCUPATIONAL EXPERIENCE AND FFA ACTIVITIES.** (4 cr)  
Organization and direction of vocational agribusiness and natural resources education, supervised occupational experience and FFA (youth leadership organization) activities at the secondary level. Occupational analyses; course building; integration of classroom, supervised occupational experience, and FFA activities; and emphasis on development of abilities to organize, develop, and direct such experiences.
- 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 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 AGRICULTURAL PRODUCTION IN DEVELOPING COUNTRIES.** (2 cr)  
Extension methods to promote the 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 Descriptions

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- 5027. PRACTICUM: EXTENSION EXPERIENCES.** (2-6 cr [max 6 cr])  
Observation of the activities of county extension staff; familiarization with staff, program planning and development, county committee, youth activities and office activities, with opportunity to participate in the function of an extension educator.
- 5028. TEACHING METHODS IN AGRICULTURAL EDUCATION.** (5 cr; prereq SeEd 3155 or ¶SeEd 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 the farm business as a basis for identifying problems; planning learning experiences to improve farm management at the 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 a program of agricultural education in a community school, integration with total school program, administrative relationships, techniques and use of program evaluation in planning.
- 5065. EVALUATION OF LOCAL VOCATIONAL EDUCATION PROGRAMS.** (3 cr)  
Procedures and instruments for assessing effectiveness of programs for employment-bound youth and adults.
- 5066. POLICY AND PROGRAM DEVELOPMENT IN AGRICULTURAL EDUCATION.** (3 cr)  
Appraisal of the situation in local schools and development of plans for improving the program development process.
- 5070. SUPERVISED FARM PRACTICE IN VOCATIONAL AGRICULTURE.** (3 cr [may be repeated for max 9 cr]; prereq 10 cr education or #)  
Selecting, planning, supervising, and summarizing individual farming programs, adaptation to meet needs of high school FFA students, young farmers, adults.
- 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 [may be repeated for 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 may be 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 nonmajor in agricultural education 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...nonmajor in agricultural education 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

- 8001. RESEARCH IN AGRICULTURAL EDUCATION**
- 8010. CURRENT ISSUES IN AGRICULTURAL EDUCATION**
- 8020. SEMINAR: AGRICULTURAL EDUCATION**
- 8081. SUPERVISION OF VOCATIONAL AGRICULTURE**
- 8082. ORGANIZATION AND ADMINISTRATION OF EDUCATIONAL PROGRAMS IN AGRICULTURE**
- 8091. FIELD PROBLEMS**
- 8303. SEMINAR: GRADUATE STUDIES REVIEW**

## Agricultural Engineering (AgEn)

### COURSES IN AGRICULTURAL ENGINEERING TECHNOLOGY

- 1000. SLIDE RULE COMPUTATION.** (1 cr; prereq Math 1111 or §; 1 hr per wk)  
Basic operations: multiplication, division, square roots, and cube roots. Techniques of computations, powers of 10, and location of decimal points. Use of sine, tangent, and log scales.
- 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.

## Course Descriptions

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- 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.** (2 cr; prereq Math 1111; 1 lect and 2 lab 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.** (4 cr; prereq 1010, Math 1008)  
Use of steel tape, engineers' level, hand level, transit, and plane table for field measurements. Application to topographic surveying and mapping, area determination, and road layout.
- 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 1032, Soils 1122; 3 lect hrs, 1 hr rec per wk)  
The hydrologic cycle—precipitation, infiltration, evaporation, surface runoff. Water table variations, subsurface runoff. Flow in open channels, flow measurement. Watershed runoff, floods. Sediment sources, erosion, and sediment control. Water control on a watershed basis.
- 3411. SEMINAR: CURRENT TOPICS IN WATER RESOURCES.** (1 cr; 1 hr rec per wk)  
Group discussions of water resources problems and programs. Interrelationship of engineering, environmental, and regulatory aspects. Readings on discussion topics.
- 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 #AgEd 3031)  
Planning and designing high school vocational agriculture facilities, organizing equipment, tools, supplies, and storage as demanded 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 the implementation of instructional programs in agricultural mechanics. Selection, application, operation, service, and maintenance of equipment used in agricultural mechanics as pertaining to 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.

## Course Descriptions

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- 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 the 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 having the prerequisite courses. For descriptions of 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.** (4 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)  
**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)

### FOR GRADUATE STUDENTS ONLY

- 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.
- 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 communications 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 still photography, both color and black and white, production of photographs and slides of quality acceptable for teaching and for use in publications, press, television, exhibits, and group presentations.
- 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, introductory psychology and sociology or §)  
Mass media behavior in rural communities; theoretical approaches relevant to problems of rural mass media behavior; analysis of research concerning adult education efforts through mass media.
- 5535. COMMUNICATIONS IN INTERNATIONAL AGRICULTURAL DEVELOPMENT.** (3 cr; prereq 3530 or equiv in journalism or §)  
For American and foreign students. Analyzes U.S. and foreign rural communications as developing tools. Develops ability to plan and execute communication programs in developing nations.
- 5600. TRANSFER OF TECHNOLOGY.** (4 cr; prereq one of following courses: Rhet 3257, 3551, 3562, 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 AGRICULTURE COMMUNICATIONS.** (Cr ar; prereq §)  
Communications problems related to specific aspects of student's major field of study.

## **Agronomy and Plant Genetics (Agro)**

- 1001. SEMINAR: INTRODUCTION 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)  
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)  
Informal small group discussion of questions and problems identified in lectures in 1010, readings, or other sources and review of examinations and papers.

## Course Descriptions

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- 1020. SPECIAL PROBLEMS.** (1-3 cr; prereq #)  
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)  
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... Agro 3021 recommended)  
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)  
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)  
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 #)  
In-depth research or studies in agronomy. Intended for advanced 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. 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.

## Agronomy and Plant Genetics

- 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 integrating principles of agronomy, climatology, economics, soil fertility, and other related disciplines into decisions on crop selection, tillage and seedbed preparation, planting, cultural practices, pest control, harvesting, storage, and marketing of major field crops.
- 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 one course in biology, physics, and in organic chemistry or biochemistry)  
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 one course in biology and organic chemistry)  
Growth of higher plants including division and differentiation of cells, development of plant organs, the 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.
- PIPh 5702. GAS EXCHANGE BY PLANTS.** (2 cr; prereq ♯; offered 1974-75 and alt yrs)  
A laboratory course dealing with carbon dioxide and water vapor exchange by attached leaves. Methods of measurement of carbon dioxide and water vapor fluxes and effects of environment on rates of net photosynthesis, respiration, and transpiration.

### FOR GRADUATE STUDENTS ONLY

- 8010. RESEARCH IN FARM CROPS**
- 8020. SEMINAR: AGRONOMY**
- 8030. ADVANCED WEED SCIENCE**
- 8050. PHYSIOLOGY IN 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**

## Course Descriptions

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- 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.
- 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 1011, 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 FSaN 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 §)  
(Same as FSaN 1520) Relationships of production and management concepts to dairy farm planning and production and marketing of high-quality milk.
- 1600. **HORSE PRODUCTION.** (4 cr)  
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 offering designed for students interested in livestock selection and marketing; fall quarter for students interested in 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.
- 3220. PRINCIPLES OF ANIMAL BREEDING.** (5 cr; prereq 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.
- 3402. NONRUMINANT NUTRITION.** (4 cr; prereq 1401)  
Nutrient requirements of chickens, turkeys, and 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.
- 3403. RUMINANT NUTRITION.** (4 cr; 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 also considered.
- 5000. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq 90 college credits, 15 cr in animal science and 5; 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 5)  
The 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 5)  
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 5)  
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 5)  
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. 5VB 5314; prereq 1300 or 6 cr systemic physiology, Biol 5051 or 5; offered 1976-77 and alt yrs)  
(Same as VB 5314) 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)  
(Same as VB 5322) Principles of reproductive physiology with emphasis on endocrinological aspects.
- 5323. COMPARATIVE PATTERNS OF VERTEBRATE REPRODUCTION.** (4 cr; prereq 5322 or 5; offered winter 1975-76 and alt yrs)

## Course Descriptions

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- (Same as VB 5323) Comparative patterns, endogenous and exogenous rhythms, and control of estrous cycles.
- 5324. SEMEN PRESERVATION AND ARTIFICIAL INSEMINATION.** (4 cr; prereq 5322 or §; offered spring 1976 and alt yrs)  
(Same as VB 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 1976-77 and alt yrs)  
(Same as VB 5325) 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 1977 and alt yrs)  
(Same as VB 5326) Blood groups and polymorphic proteins affecting reproduction, immunoglobulin formation, antigens of semen, ova and genital secretions, immunopathology, maternal-fetal incompatibility, 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.
- 5402. NONRUMINANT NUTRITION.** (4 cr; prereq 1401)  
See AnSc 3402.
- 5403. RUMINANT NUTRITION.** (4 cr; prereq 1401)  
(See AnSc 3403) Term paper required.
- 5404. RUMINANT NUTRITION FOR VETERINARY MEDICINE STUDENTS.** (3 cr)  
Fundamentals of nutrition, nutrient requirements of ruminants, nutrient content of feed-stuffs, protein and nonprotein nitrogen utilization, energy utilization, formulation of adequate rations, and nutritional disorders and deficiencies in ruminants.
- 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; 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; 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; 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; 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.

- 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.
- 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. A written report of the research required. Open to students who have completed pertinent prerequisites.
- 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**

- 8200.° ADVANCED ANIMAL BREEDING**
- 8221.° QUANTITATIVE INHERITANCE**
- 8420.° ENERGY IN ANIMAL NUTRITION**
- 8421.° PROTEIN AND AMINO ACID NUTRITION**
- 8422.° VITAMIN 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.
- 1020. 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 ar; 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.

## Course Descriptions

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- 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  $\Delta$ )  
This course provides a special arrangement for the making up of certain deficiencies in biological background.
- 5020. FIELD ENTOMOLOGY.** (5 cr; limited to 15 students; prereq introductory Biol; offered SSI at Itasca)  
The 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. Includes some lectures by selected faculty and short field trips. For individuals interested in learning about insects.
- 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.<sup>o</sup> INSECT METABOLISM AND COORDINATION.** (5 cr; prereq  $\$$ ...BioC 5002 or MdBc 5101 recommended)  
Homeostasis, permeability, circulation, metabolic systems and products, properties of muscles and nerves, sensation, behavior.
- 5050.<sup>o</sup> 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 at Itasca)  
Identification and biology of aquatic and littoral insects in all stages.
- 5131. AQUATIC ENTOMOLOGY.** (2 cr; prereq 3175 or equiv or  $\$$ ; offered 1975-76 and alt yrs)  
Identification and biology of aquatic and littoral insects in all stages.
- 5133. INSECT TAXONOMY.** (4 cr; prereq 3175 or equiv)  
Identification of taxa within insect orders; use of taxonomic literature and catalogs; formation of an insect collection.
- 5150. PRINCIPLES OF SYSTEMATIC ENTOMOLOGY.** (2 cr; prereq 15 cr entomology or zoology; offered 1975-76 and alt yrs)  
Lectures on history of systematic entomology, the species concept and higher categories, systematic procedures, and zoological nomenclature.
- 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.<sup>o</sup> INTEGRATED CONTROL.** (4 cr; prereq 3175,  $\$$ )  
Suppression of insect, mite, and weed populations by integration of biotic agents; host plant resistance, artificial pest control measures, and cultural practices. Principles of ecological approach to pest control. Laboratory work or independent study required. Laboratory work concerned with identification of entomophagous insects, both those used in control programs and those naturally occurring.
- 5215.<sup>o</sup> 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.<sup>o</sup> PRINCIPLES OF ECONOMIC ENTOMOLOGY.** (4 cr; prereq 15 cr zoology and entomology incl 1005 or  $\$$ ; offered 1976-77 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.

## Entomology, Fisheries, and Wildlife

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- 5275. MEDICAL ENTOMOLOGY.** (4 cr; prereq 3175 or §)  
Principal arthropods noxious to man and animals. Emphasis on those that serve as vectors of pathogenic organisms of man 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 in special fields of entomological research given by a visiting professor.
- 5500. PROBLEMS IN MICROTECHNIQUE.** (Cr ar; prereq §)  
Guidance for independent study of material of student's choice with particular reference to insects.
- 5510. BIOLOGICAL MICROSCOPY.** (4 cr; prereq 15 cr biological sciences, §; offered when demand warrants)  
Necessary elements of optics, use and limitations of various types of microscopes, interpretation of microscopical data. Laboratory, demonstration, plus project in field of student's interest.
- 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. ADVANCED WORK IN ENTOMOLOGY.** (Cr ar; prereq §)  
Library and laboratory research in various lines of entomology.

### FOR GRADUATE STUDENTS ONLY (Entomology)

- 8200x. SEMINAR**
- 8210. CURRENT TOPICS IN FOREST ENTOMOLOGY**
- 8300.° EXPERIMENTAL ECOLOGY LABORATORY**
- 8305.° INSECT ECOLOGY**
- 8315. BIOLOGY OF IMMATURE INSECTS**
- 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.
- 3050. PRINCIPLES OF FISHERIES AND WILDLIFE MANAGEMENT.** (3 cr, \$5451, \$5561; prereq Biol 1106, EBB 3001 or 3004 or FBio 3101, non-FW major)  
Introduction to fishery and wildlife population ecology; relations between fish and wildlife and their environments; management of fish and game populations and habitats; management and research methods; administration of fish and wildlife agencies.
- 3051. PRINCIPLES OF FISHERIES AND WILDLIFE MANAGEMENT—LABORATORY.** (2 cr, \$5451, \$5552, \$5563, \$EBB 5817; prereq 3050 or §)  
Primarily field and, to some extent, laboratory experiences as demonstrations of principles of fisheries and wildlife management.
- 3167. TECHNIQUES OF FOREST WILDLIFE MANAGEMENT.** (2 cr; prereq 3050; 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 Δ)  
This course provides a special arrangement for the making up of certain deficiencies in biological background.

## Course Descriptions

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- 5106. BASIC WILDLIFE BIOLOGY.** (Cr ar; prereq §)  
This course provides a special arrangement for the making up of certain deficiencies in biological background.
- 5129. MAMMALOLOGY.** (5 cr, §Zool 5129; prereq Zool 5124 or VB 1120 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.
- 5451. ECOLOGY OF FISHERY POPULATIONS.** (3 cr; prereq EBB 3001 or equiv, EBB 5813 or Geo 5601, Zool 5121, 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.** (3 cr; prereq 5451 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.
- 5453. TECHNIQUES OF FISHERY BIOLOGY.** (3 cr; prereq 5452 or §)  
Basic methods used in fishery 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.
- 5454.° FISHERY ECOLOGY IN POLLUTED WATERS.** (3 cr; prereq 5451, Chem 1004, 1005, 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, §3050; prereq 5129, EBB 3004 or equiv and 5014, Zool 5077 or 5834 or §...courses in soils, plant and animal physiology, experimental or field vertebrate ecology recommended)  
Review of ecological background for wildlife management, of development of programs in the field, and of 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.** (5 cr; prereq 5562 or §)  
Principles and concepts pertaining to management of wildlife populations and their habitats, to land use and land management practices; field exercises involving collections and analyses of data for wildlife management; treatment of ethical and biopolitical aspects of wildlife management.
- 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)

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: BIG GAME

## Food Science and Nutrition (FScN)

1010. **MAN'S FOOD.** (4 cr)  
Man's nutritional needs; food composition, world food supply, consumption patterns, acceptance, quality programs and regulations, food preservation, commercial processes, packaging, marketing, national and international food programs.
1012. **FOOD FOR THOUGHT—FOR FOOD.** (4 cr)  
Nutritional requirements of man, 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-qtr 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)  
An understanding and appreciation of the 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.
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 will prepare various products in the laboratory. Methods covered will 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 the 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 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.
1600. **SOCIOCULTURAL ASPECTS OF NUTRITION.** (3 cr)  
Food habits of man 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.

## Course Descriptions

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- 1604. SEMINAR: EXPLORING NUTRITION.** (2 cr; S-N only; not open to jrs and srs)
- 1700. INTRODUCTION TO HOSPITALITY AND FOOD SERVICE MANAGEMENT.** (2 cr)  
Basic principles of the hospitality and food service industry, emphasizing its scope, current trends, and relationships with other areas such as dietetics, public health, recreation, food science, etc. Includes field trips and guest speakers.
- 3102. TECHNOLOGY OF FOOD PROCESSING.** (4 cr; prereq high school chemistry and biology)  
Introduction to the technology of food processing; handling and storage of fresh product (washing, butchering, refrigeration, controlled atmosphere storage, packaging), food preservation techniques (blanching, canning, freezing, dehydration, concentration, smoking, addition of salt or sugar), cereal and oil seed technology (milling, extraction, baking, oil processing), packaging, and governmental regulations and laws.
- 3110. FOOD CHEMISTRY.** (3 or 5 cr [3 cr for lect taken separately]; prereq BioC 1302 or §)  
Chemical properties of foods and food constituents as influenced by processing and storage.
- 3123. MICROBIOLOGY OF FOODS.** (5 cr. §MicB 3103, §VB 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 the 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.** (2 cr; prereq 1213 or 3403)  
Purposes and techniques of demonstrations for the general public and in business. Production techniques and performance for television and motion picture demonstrations.
- 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. The 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 the coordinated undergraduate program in dietetics)  
An 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, sr in hospitality and food service management or #)  
Planned management experience in a selected food service or hospitality business, including understanding of the operation, planning, purchasing, personnel management, financial management, supervision, and related functions.
- 3730. QUANTITY FOOD PURCHASING AND PRODUCTION.** (5 cr; prereq 3rd-4th soph, 1212 or 3110, 3472)  
Participation in management procedures used in the selection, storage, preparation, cost, 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.
- 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.
- 5000. PROFESSIONAL EXPERIENCE PROGRAM.** (1-6 cr; prereq 15 cr in food science and nutrition and #; not for grad cr)  
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 #; 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.
- 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 PROCESS MICROBIOLOGY.** (4 cr [3 cr for lect taken separately with #]; prereq 5120 or #)  
Factors that influence the control and destruction of microorganisms; chemical, physical, and microbiological principles in cleaning and sanitizing dairy and food processing equipment; inactivation of microorganisms and thermal process evaluation; microbiological fermentations and preservation methods; development of sanitation programs; microbiological standards for dairy and food products.
- 5135. FOOD PROCESS ENGINEERING.** (5 cr; prereq completion of 6 cr physics and math requirement)  
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.

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- 5312. CHEMICAL AND INSTRUMENTAL ANALYSIS OF FOODS.** (5 cr; prereq 3110, Chem 3101 or #)  
Application of quantitative physical, chemical, and instrumental methods of analysis to the 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 cheesemaking. 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 or #)  
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.** (3 cr; prereq 3110, Stat 3081 or 5021)  
Fundamentals of flavor perception, sensory methods used in measuring quality of food products.
- 5362. SENSORY EVALUATION LABORATORY TECHNIQUES.** (1 cr; prereq 5360 or #5360)  
Laboratory projects in sensory evaluation of food quality.
- 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 as it deals with nutrition, food additives, food safety, food fads, health foods, environmental contamination, the consumer movement, naturally occurring food toxicants, processed foods, synthetic foods, organically grown foods.
- 5406. CURRENT LITERATURE IN FOODS.** (2-4 cr [may be repeated for max 6 cr]; prereq 5413)  
Assigned readings, reports, and discussions of topics in the experimental study of foods.
- 5412. PHYSICO-CHEMISTRY OF FOODS I.** (4 cr; prereq 3110, Biol 3021 or #Biol 3021... one course in physical chemistry recommended)  
Food as a complex biochemical system. Functionality of various biological and chemical constituents of foodstuffs. Physical and chemical changes induced in food systems through preparation and preservation. Survey of current literature.
- 5413. PHYSICO-CHEMISTRY OF FOODS II.** (4 cr; prereq 5412)  
Continuation of 5412.
- 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 3110, 5120)  
An integration of chemical, microbiological, and physical principles involved in the processing of cheeses, buttermilk, yogurt, and sour cream.
- 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.
- 5555. FREEZING AND DEHYDRATION OF FOODS.** (4 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.
- 5581. INTERNATIONAL FOOD TECHNOLOGY.** (3-4 cr; prereq sr)  
Independent study of food processing problems and developments throughout the world. Relation of food technology to adequate feeding of peoples of the world emphasized.
- 5622. HUMAN NUTRITION.** (5 cr; prereq 1602, Biol 3021, Phsl 3051 or §)  
Physiological function and metabolic fate of nutrients and factors influencing the utilization of nutrients in the human.
- 5623. HUMAN NUTRITION RESEARCH METHODS.** (3 cr; prereq 5622, Biol 3021 or §Biol 3021)  
A theoretical consideration of techniques used in studying human metabolism and nutrient requirements. Includes metabolic and balance studies and surveys of nutritional status.
- 5642. FIELD EXPERIENCE IN COMMUNITY NUTRITION.** (3-18 cr; prereq course in human nutrition and §)  
Application and nutrition information to problems of health and welfare, involving assigned readings, discussions, plus experience in a community agency.
- 5643. WORLD FOOD SUPPLY PROBLEMS.** (4 cr, \$AgEc 5790, \$PIPa 5220, \$Soc 5675, \$VCS 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.** (5 cr; prereq 5622, Biol 3021 or §)  
Application of principles of normal nutrition to clinical problems, with description of altered nutrient requirements in human disease. Diet therapy as an applied aspect of clinical nutrition considered.
- 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.
- 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 upon the role of nutrition in total medical care.

## Course Descriptions

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- 5692. CURRENT DEVELOPMENTS IN NUTRITION.** (3 cr; prereq sr, 1602, 1212, BioC 1301, Phsl 3051 or §)  
Fundamental facts and techniques for solving current nutrition problems.
- 5693. SELECTED ASPECTS OF NUTRITION.** (2-4 cr [may be repeated for max 12 cr]; prereq sr, 1212, 1602 or §)  
Special attention to a single, preselected aspect of nutrition each quarter. Teaching procedure and approach determined by nature of topic and student needs, but such that both in-breadth and in-depth treatment of the subject obtained. 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.
- 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 study and seek solutions to problems related to quantity food service. Ample opportunity to integrate lectures, laboratory experiences, and independent study with instructional programs in occupational foods.

### FOR GRADUATE STUDENTS ONLY

- 8101. RESEARCH SEMINAR**
- 8205. GENERAL SEMINAR**
- 8310. ADVANCED FOOD CHEMISTRY**
- 8311. FLAVOR CHEMISTRY**
- 8312. REACTION KINETICS OF FOOD DETERIORATION**
- 8322. THERMAL PROCESSING OF FOOD**
- 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 which 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.
- 1016. GREENHOUSE MANAGEMENT.** (3 cr; prereq Biol 1103; offered 1976-77 and alt yrs)  
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 deal with principles while laboratories give student opportunity to practice various propagating techniques. Field trips.
- 3026. RESIDENTIAL LANDSCAPE DESIGN.** (4 cr; prereq 1021, LA 1025)  
Principles of landscape design with special 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 for man, 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; offered 1976-77 and alt yrs)  
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)  
Intended for beginning students in turf management and students in landscape horticulture, agronomy, soil science, and agricultural education who are interested in general landscape maintenance and turf culture. Students with objectives of working in areas of industrial grounds maintenance, park and recreation area maintenance, and general lawn care may elect this course. Students interested in advanced turfgrass science and fine turf management will also elect Hort 5042 after completing this course.
- 3074. LANDSCAPE MANAGEMENT AND HORTICULTURAL PRACTICES.** (4 cr; prereq 1001, Soil 1122)  
Application of basic biological principles to successful establishment and maintenance of horticultural plantings on commercial, private, utility, recreational, highway, and park lands. Techniques and equipment used in culture and transplanting, pruning, tree maintenance and repair, and weed control in landscape plantings.
- 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.

## Course Descriptions

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- 3077. FLORAL DESIGN.** (3 cr)  
Fundamental principles in floral arrangement. Analysis of basic design principles used in floral design. The decorative use of flowers, foliage, 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 modern business world. Lectures, discussion, 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 1975-76 and alt yrs)  
Systematic relationships of the world's resources of fruit and vegetable taxa. Lectures, literature review, and laboratory.
- 5011. MANAGEMENT OF ARTIFICIAL ENVIRONMENTS FOR PLANT GROWTH.** (3 cr,  $\$1016$ ; prereq 10 cr plant sciences; offered 1976-77 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.
- 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; offered 1975-76 and alt yrs)  
The physiology and agricultural technology of phytohormones and synthetic growth regulators in horticulture. Emphasis on practical uses of such substances in the control of fruit and leaf abscission, parthenocarpy, growth rate, growth habit, plant size, apical dominance, organ initiation, dormancy, germination flowering, callusing, and others.
- 5041. ENVIRONMENTAL REQUIREMENTS OF HORTICULTURAL PLANTS.** (4 cr; prereq 15 cr plant sciences incl 3 cr plant physiology)  
Lectures, assigned readings, and laboratory exercises on the relation of light, temperature, and water to the growth and culture 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.

## Horticultural Science and Landscape Architecture

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- 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, impact of environmental factors on varietal types and market grades.
- 5045. TOPICS IN NURSERY MANAGEMENT.** (1 cr; prereq 1036, PIPh 3131; offered 1975-76 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 1975-76 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 1975-76 and alt yrs)  
Physiological and cultural aspects of optimized production of principal florist crops of economic importance. Roses, bulbous plants, 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.
- 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 man's relationship to his 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.

## Course Descriptions

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- 3071. LANDSCAPE TECHNOLOGY: GROUND FORM DESIGN.** (4 cr; prereq CE 3100 and AgEn 1400 and LA 3083; 2 lect and 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, develop methods of presenting ideas verbally and visually. Design of small-scale site systems with simple variables.
- 3091-3092. 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.
- 5010. PRINCIPLES OF OUTDOOR RECREATION DESIGN AND PLANNING.** (4 cr; 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, 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; 2 lect and 12 lab hrs per wk)  
Advanced studies in area of student's option.
- 5115-5116. THEORY OF LANDSCAPE FORM AND STRUCTURE.** (2 cr per qtr; prereq 3091 or 5; 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.** (1 cr; prereq terminal yr of study)  
Analysis of design principles and design 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 5)  
2)
- 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 landscape created by man 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**

- 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 8061.° DISCUSSIONS IN INCOMPATIBILITY**
- Hort 8062.° DISCUSSIONS IN PLANT HARDINESS**
- Hort 8063.° DISCUSSIONS IN HORTICULTURAL PLANT BREEDING**
- Hort 8064.° DISUCSSIONS IN FLORICULTURAL SCIENCE**
- Hort 8065.° DISCUSSIONS IN POSTHARVEST PHYSIOLOGY**

**Plant Pathology (PIPa)**

- 1001. INTRODUCTORY PLANT PATHOLOGY.** (5 cr, \$3050, \$5050; prereq soph, 9 cr plant science incl at least 6 cr botany, or Biol 1011)  
Introductory course in plant diseases. Lectures, laboratory, and special problems.
- 3090. RESEARCH IN PLANT PATHOLOGY.** (Cr and hrs ar; prereq 1001 or equiv or 5)  
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 considered.

## Course Descriptions

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- 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)  
Up to 12 weeks of experience in a selected agricultural industry; open to advanced students in the plant health technology program; evaluative reports and consultations with faculty advisers and employers.
- 5002. INTRODUCTORY PLANT PATHOLOGY FOR ADVANCED STUDENTS.** (3 cr, §1001, §3050, §5050; prereq 14 cr plant science or §)
- 5013. DISEASES OF ECONOMIC PLANTS.** (2 cr; prereq 1001 or equiv... §5100 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 1976 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 1976 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 characters 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)  
Lectures and laboratory exercises on the taxonomy, identification, life histories, genetics, and ecology of the fungi.
- 5107. MYCOLOGY: BASIDIOMYCETES.** (3 cr; prereq 1001 or 5050 or MicB 3103)  
Lectures and laboratory exercises on the taxonomy, identification, life histories, genetics, and ecology of the fungi.
- 5109. BIOCHEMISTRY AND PHYSIOLOGY OF FUNGI.** (3 cr; prereq 8 cr biochemistry or §; offered 1976-77 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, case histories.
- 5132. BIOLOGY OF FUNGI.** (3 cr; prereq Biol 1011, Chem 3302 or BioC 1302 or §; offered 1975 and alt yrs)  
Survey of the fungi; their morphology, taxonomy, genetics, physiology, biochemistry, and ecology.
- 5133. BIOLOGY OF FUNGI LABORATORY.** (1 cr; prereq §5132)  
Exercises with fungi, their growth and ecology.
- 5200. POISONOUS PLANTS.** (2 cr; prereq §)  
Systematic study of important plants poisonous to animals. Lectures and field trips in identification.

- 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, \$VCS 5280, \$FScN 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 1975 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 1976 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 §; offered 1975 and alt yrs)  
 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, 8 cr plant pathology)  
 Laboratory and field 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 1976 and alt yrs)  
 Principles and practices relating to plant disease control, with emphasis on quarantine, eradication, cultural practices, and fungicides.

**FOR GRADUATE STUDENTS ONLY**

- 8090. RESEARCH IN PLANT PATHOLOGY**
- 8110. PROBLEMS IN MYCOLOGY**
- 8111. GENETICS OF PLANT PATHOGENS**
- 8112. ECOLOGY OF PLANT PATHOGENS**
- 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.
- 1102. COMMUNICATION II.** (4 cr)  
 Writing from research and from 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.

## Course Descriptions

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- 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 1101 and 1102)  
The dimensions of interpersonal communication. Designed to introduce theories, problems, and practical exercises of interpersonal communication 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 rhetoric 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 rhetoric 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 three central abilities. Readings, research, theory, and practice.
- 1301. HUMANITIES: THE ENLIGHTENMENT.** (5 cr)  
Introduction to the interdisciplinary humanistic study; the French Revolution, the Napoleonic era, the rise of rationalism, humanism, neoclassicism. Readings in Pope, Voltaire, Locke, Rousseau, Tolstoy, Burke, and others.
- 1302. HUMANITIES: THE INDUSTRIAL REVOLUTION.** (5 cr)  
The industrial transformation of Europe; the British Empire; liberalism and the romantic response; socialism. Readings in Smith, Bentham, Carlyle, Ruskin, and Marx; Zola, Ibsen, and Dostoyevsky.
- 1303. HUMANITIES: THE AGE OF DARWIN.** (5 cr)  
The impact of evolutionary thought; religion and morality in a changing society. Readings in Darwin and the evolutionists; Nietzsche, Shaw, Thomas Mann, and others.
- 1401. INTRODUCTION TO LITERATURE.** (4 cr)  
Analysis of literary structural forms and stylistic devices: poetry, drama, and prose fiction.
- 1424. WORLD LITERATURE I.** (5 cr)  
Examination and analysis of selected master works of continental and Middle Eastern literature from the ancients through the Renaissance.
- 1425. WORLD LITERATURE II.** (5 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 readings 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.

Includes a 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 such as the illustrated lecture, videotape, 35mm slides, etc.

- 3192. COMMUNICATION FOR INTERNATIONAL EXCHANGE GROUPS.** (3 cr; prereq intermediate knowledge of oral and written English)  
Communication and culture will be the focus of this lecture/discussion course for 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 studied.
- 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.
- 3257. SCIENTIFIC AND TECHNICAL SPEAKING.** (4 cr; prereq 1222)  
Training for specific speech situations related to technical or scientific topics. Emphasis on audience analysis and adaptation, techniques of support and visualization, organization for clarity and accuracy, and techniques of interpreting and answering questions. Students present and evaluate technical and scientific speeches.
- 3266. DISCUSSION METHODS.** (4 cr; prereq completion of rhetoric 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, evaluating group progress.
- 3270. SPEECH: SPECIAL PROBLEMS.** (1-5 cr; prereq 3)  
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 rhetoric 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.** (5 cr)  
The literature, philosophy, and arts of ancient Greece central to understanding contemporary Western society. Readings in Homer, the tragedians, Plato, Aristotle, Thucydides.
- 3322. HUMANITIES: THE ROMAN AND MEDIEVAL HERITAGE.** (5 cr)  
The continuing relevance of the literature, philosophy, theology, and arts of the Roman past and of the Middle Ages. Readings in Virgil, Lucretius, Augustine, the poetry of courtly love, medieval theology, Dante.
- 3323. HUMANITIES: THE RENAISSANCE AND REFORMATION.** (5 cr)  
The literature, philosophy, arts, and scientific advances of the early and high Renaissance; the Reformation and Counter-Reformation in the Church. Readings in Machiavelli, Copernicus, Galileo, Luther, Calvin, St. Ignatius, Pascal.
- 3324. HUMANITIES: ASIATIC CULTURE.** (5 cr)  
Asiatic religious and philosophical systems; introduction to the art, architecture, and music of Asia. Readings in classical and modern Asiatic literature; Buddhism, Taoism, Confucianism.
- 3371. HUMANITIES: AMERICAN INDIVIDUALISM.** (5 cr)  
Examination and evaluation of conflicts arising from the varied individualistic traditions in America. Readings in Emerson, Thoreau, Mark Twain, Whitman, Jack London.
- 3372. HUMANITIES: RELIGION IN AMERICAN THOUGHT AND EXPERIENCE.** (5 cr)  
The diverse values centered in American religious and philosophical thinking from the 17th century to the present. Readings in Edwards, Emerson, Hawthorne, James, Dewey, and Harold Frederic.
- 3373. HUMANITIES: NATIONALISM IN AMERICAN THOUGHT AND EXPERIENCE.** (5 cr)  
The growth of political and cultural nationalism in America. Black nationalism. Readings in Jefferson, Calhoun, Turner, Henry James, Dos Passos, Du Bois, and Malcolm X.
- 3374. HUMANITIES: SPECIAL PROBLEMS.** (1-5 cr; prereq 3)  
Primarily for supervised reading and research on topics not covered in regularly scheduled humanities offerings.

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- 3381. HUMANITIES: 20TH-CENTURY CULTURE.** (5 cr)  
The changing structure of 20th-century culture from World War I to the present. Freudianism, communism, fascism, modern movements in literature, the visual arts, and music; existentialism.
- 3471. AMERICAN LITERATURE.** (5 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 works from modern literature.
- 3551. PROFESSIONAL WRITING.** (4 cr; 3551 or 3562 is required of all students unless exempted through deptl exam; prereq jr)  
Projects and reports in professional communication: the résumé, application letter, 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 deptl exam; prereq jr)  
Methods of exposition in scientific and technical writing; types of reports; audience analysis; continuous practice in report writing.
- 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 of Minnesota 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 inpost and outpost 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 onsite 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)  
Systematic analysis of communication techniques and procedures for the manager. Emphasis on manager's ability to achieve vertical and horizontal understanding and acceptance. Class activities include 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.
- 5301. HUMANITIES SEMINAR: THE INDIVIDUAL AND SOCIETY.** (3 cr; prereq 1301, 1302, 1303 or §)  
Contemporary ethical and cultural values as manifested in such conflicts as: liberty and authority, freedom and organization, art and technology, science and religion.
- 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 for seniors anticipating graduate work. Organization of reports and theses; 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)  
The professional as communicator; analysis of markets: professional, trade, and general; information sources and topic selection; communicating environmental information; adaptation to the specialized and the general reader; writing and preparing manuscripts for publication; marketing techniques.
- 5600. TRANSFER OF TECHNOLOGY.** (4 cr; prereq one of the following courses: Rhet 3257, 3551, 3562, Jour 5133, Engl 3085, PubH 5070, 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.

### FOR GRADUATE STUDENTS ONLY

- 8251. SEMINAR: LISTENING COMPREHENSION**

## Soil Science (Soil)

- 1122. INTRODUCTORY SOIL SCIENCE.** (4 cr; prereq ¶Chem 1004 or equiv)  
Basic physical, chemical, and microbiological properties of soil. Soil genesis, classification, and principles of soil fertility. Lectures, laboratory.
- 1262. INTRODUCTION TO METEOROLOGY.** (4 cr)  
(Same as Geog 1425) Pre-calculus introduction to nature of the 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 1976-77 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 DRAINAGE AND IRRIGATION.** (1 cr; S-N only; offered winter 1975-76 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, laboratory.
- 3418. SEMINAR: REMOVAL OF PLANT NUTRIENTS FROM SOILS BY PERCOLATION, RUNOFF, AND EROSION.** (1 cr; S-N only; offered winter 1976-77 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.
- 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 1975-76 and alt yrs)  
Round table discussions of assigned readings in the subject matter.

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- 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.
- 5114. SPECIAL PROBLEMS IN SOILS.** (1-5 cr [may be repeated for max 10 cr]; prereq 1122 or #)  
Research, readings, instruction.
- 5232. SOIL PHYSICS.** (4 cr; prereq Math 1142 or equiv or #)  
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 #)  
The study of meteorology and climatology in relation to the soil-atmosphere interface, with particular emphasis on the microclimate, physical processes taking place within the microclimate, modification of the microclimate by man's activities including agricultural practices, description of meteorological instruments, and use of weather data.
- 5310. SOIL CHEMISTRY AND MINERALOGY.** (4 cr; prereq 1122 or #; offered 1975-76 and alt yrs)  
Basic structure of clay minerals 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 1976-77 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 which 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 essential to understanding distribution patterns of soils. Primary 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, 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 or #; 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, classification of soils according to soil taxonomy.
- 5612. ECOLOGY OF SOIL MICROORGANISMS.** (4 cr; prereq MicB 3103 or 3013; offered 1976-77 and alt yrs)

(Same as MicB 5612) Soil as a microhabitat; nature of the microbial population of soil; interactions among microorganisms in the soil ecosystem; and significant activities of soil microorganisms. Lectures and laboratory.

- 5632.° SOIL MICROBIOLOGY AND PLANT GROWTH.** (4 cr. \$5612; prereq 1122 and course in microbiology or ♯; offered 1975-76 and alt yrs)  
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.
- 5642. CONCEPTS OF MICROBIAL ECOLOGY AND DIVERSITY.** (5 cr; limited to 20 students; prereq introductory course in microbiology or ♯; offered at Itasca)  
Bacterial components of aquatic ecosystems. Both classical and contemporary approaches to measuring bacterial transformations, activities, and interaction stressed.

#### FOR GRADUATE STUDENTS ONLY

- 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)**

- 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 and/or other affairs of the academic community may earn credit for such activities. Proposal stating objectives of this experience, progress reports, and final written report required.
- 3100. AGRICULTURE OF S. EUROPE AND THE MEDITERRANEAN.** (4 cr)  
Agriculture of the region as a system studied from multidisciplinary perspective and contrasted with United States. Introduction to foreign agricultural systems; intended for any student traveling abroad. Prerequisite for summer study-travel program (Ag 3101).
- 3101. SUMMER STUDY-TRAVEL PROGRAM: FIELD STUDIES IN INTERNATIONAL AGRICULTURE.** (8 cr; prereq 3100)  
Organized on a rotating basis by CIC universities each summer to provide opportunity for individual and group study of problems related to agriculture and natural resources in foreign countries. The College of Agriculture is leading a study-travel program to the Mediterranean (Morocco, Tunisia, Spain, and Italy) in 1976.
- 5555. INTEGRATING PAPER FOR MASTER OF AGRICULTURE STUDENTS.** (1 cr)  
A paper of the quality of a professional trade journal article will be prepared. The paper should integrate 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 will be interested in the following listing of 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

## Course Descriptions

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when students have 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 who wish further advice and information on 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, §Bot 3131; prereq Biol 1103 or 3012, BioC 1301 or Chem 3301 or §)  
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.
- 5141. SURVEY OF PLANT PHYSIOLOGY.** (3 cr, §Bot 5141; prereq Biol 1103 or 3012, course in organic chemistry or biochemistry)  
Physiological processes in living plants with emphasis on higher plants. Growth and development, energy relations, mineral nutrition, water relations, respiration, photosynthesis, and nitrogen metabolism.
- 5142. PLANT PHYSIOLOGY LABORATORY.** (2 cr, §Bot 5142; prereq 5141 or ¶5141)  
A laboratory course to accompany PIPh 5141.
- 5167.\* PHYSIOLOGY OF THE PLANT CELL.** (3 cr; prereq plant anatomy, inorganic and organic chemistry or biochemistry; offered 1976-77 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 1975-76 and alt yrs)  
Physical and physicochemical properties of living protoplasm in plant cells, including viscosity, wall attachment, permeability, primary and secondary fluorescence, vital staining.
- 5182.\* PLANT METABOLISM.** (3 cr, §Bot 5182; prereq course in biochemistry)  
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 course in biology, physics, and organic chemistry or biochemistry)  
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 course in biology and organic chemistry)  
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 1976-77 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.
- 5702. GAS EXCHANGE BY PLANTS.** (2 cr; prereq §; offered 1976-77 and alt yrs)  
A laboratory course dealing with carbon dioxide and water vapor exchange by attached leaves. Methods of measurement of carbon dioxide and water vapor fluxes, and effects of environment on the rates of net photosynthesis, respiration, and transpiration.
- 5703. INTERNAL WATER BALANCE.** (3 cr; prereq §; offered 1975-76 and alt yrs)  
Laboratory course in which components of water balance in plants (turgor, osmotic, water potentials) are measured using various techniques. Discussion of matching method to experimental goals.

## Resource and Community Development

**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. Discrete and independent units in:

**5721. The Primary Plant Metabolites.** (Cr ar; offered 1976-77 and alt yrs)

**5723. Plant Hormones and Tissue Culture.** (Cr ar; offered every yr)

**5724. Photosynthesis and Photosynthetic Pigments.** (Cr ar; offered 1976-77 and alt yrs)

**5725. Plant Nucleic Acids.** (Cr ar; offered 1975-76 and alt yrs)

**5726. Analysis of Cell Structure.** (Cr ar; offered 1976-77 and alt yrs)

**5727. Phytochrome, Photomorphogenesis, and the Physiology of Flowering.** (Cr ar; offered 1976-77 and alt yrs)

**5970.° SPECIAL PROBLEMS IN PLANT PHYSIOLOGY.** (Cr ar)  
Research, readings, instruction.

### FOR GRADUATE STUDENTS ONLY

**8251. SEMINAR: PLANT PHYSIOLOGY**

**8281.° GROWTH AND DIFFERENTIATION OF PLANTS**

**8282.° ADVANCED TOPICS IN PLANT METABOLISM**

**8285. PHOTOSYNTHESIS**

**8286. RADIOISOTOPE TECHNIQUES APPLIED TO BIOLOGY**

Additional courses treating the area of plant physiology are offered by several departments within the College of Agriculture. Students are directed to such courses as Agro 5030, 8030, 8050; Hort 5040, 5041, 8045, 8052; PIPa 5109, 8610; Soil 5240, 5340, and 5632, as examples of such courses offered by departments in the College of Agriculture.

## Resource and Community Development (RCD)

**1010. ISSUES IN THE ENVIRONMENT.** (3 cr)

Interdisciplinary offerings designed to explore five areas of environmental concern: aspects of environmental design which provide maximum compatibility of man with his 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 television 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.

**5100. INTERDISCIPLINARY SEMINAR I.** (5 cr; prereq resource and community development sr)

Designed to help students develop the competence necessary for identifying and analyzing resource development problems. Discussions will reflect diverse disciplinary contributions. Students contribute as members of a team combining disciplinary skills. Invited speakers, student assignments.

**5101. INTERDISCIPLINARY SEMINAR II.** (5 cr; prereq 5100)

(Continuation of RCD 5100) Papers, presentations, and critiques on selected complex resource development problems related to 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.

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### 5120. ENVIRONMENTAL PROBLEMS. (3 cr, §1010)

Interdisciplinary offering designed to explore five areas of environmental concern: aspects of environmental design which provide maximum compatibility of man with his 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 television lectures and 10 discussion periods. In addition, students prepare a report on a specific environmental problem. This course offered in the Continuing Education and Extension program only.

### 5200. COMMUNITY DEVELOPMENT SIMULATION. (4 cr; prereq 9 cr social science and §)

Simulation of regional activity systems and their environmental impacts. Playing community development game for decision makers in economic, social, and political sectors of model urban community.

## 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, §5021; prereq college algebra or §)

Sampling, variability, description and analysis of data, tests and confidence intervals.

### 3091. INTRODUCTION TO PROBABILITY AND STATISTICS. (4 cr, §5121, §5131; prereq differential and integral calculus; one section designated primarily for IT majors)

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; basic nonparametric methods.

### 5061. COMPUTERS IN AGRICULTURAL AND BIOLOGICAL RESEARCH. (3 cr; open only to Institute of Agriculture students; prereq 5022)

Impact of computer on research, FORTRAN programming, use of current libraries in processing statistical data, simulation techniques.

### 5071. STATISTICAL APPLICATION OF MATRIX ALGEBRA. (3 cr; prereq 5021, ¶Math 3142, or §)

Specific matrix operations with vector realizations, presuming no prior knowledge. Uses in analysis of variance and multivariate methods. Correlation structures, characteristic vectors, 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, distribution-free methods.

### 5131-5132-5133. THEORY OF STATISTICS. (4 cr per qtr, §5121-5122; prereq ¶Math 3411 or 3211)

5131: Probability models, univariate and bivariate distributions, independence, basic limit theorems. 5132-5133: Statistical decision theory, sampling, estimation, testing hypotheses, parametric and nonparametric procedures for one-sample and two-sample problems, regression, 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.
- 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, 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. Multidimensional tables and log-linear models, maximum-likelihood estimation and tests of goodness-of-fit. 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 \*)  
Students whose needs are not met by current offering may obtain content of regular courses or special areas through directed study.
- 5911-5912-5913. TOPICS IN STATISTICS.** (3 cr per qtr; prereq 5122 or 5133 and \*)  
Topics vary according to student needs and available staff; may be repeated for credit with department approval.

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

**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.
- 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.
- 5120. COMPARATIVE VERTEBRATE MORPHOLOGY**  
Same as VB 1120.
- 5140. VERTEBRATE MICROANATOMY.** (5 cr; prereq 5120 or \*)  
Comparative studies of tissues and organs of representative examples of vertebrates.
- 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, central control of input and output; spontaneity, development, and learning.

## Course Descriptions

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- 5320 AVIAN PHYSIOLOGY.** (3 cr; prereq 1300 or 6 cr systemic physiology or equiv, ♀; offered winter 1976 and alt yrs)  
Physiology of various species of wild and domestic birds.
- 5321. ADVANCED AVIAN PHYSIOLOGY.** (1 cr; prereq 5320; offered spring 1976 and alt yrs)  
Survey of the physiology of some phenomena characteristic of nondomestic avian and mammalian species; such as physiology of 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.
- 5323. COMPARATIVE PATTERNS OF VERTEBRATE REPRODUCTION.** (4 cr; prereq 5322 or ♀; offered 1975-76 and alt yrs)  
(Same as AnSc 5323) Comparative patterns, endogenous and exogenous rhythms, and control of estrous cycles.
- 5324. SEMEN PRESERVATION AND ARTIFICIAL INSEMINATION.** (4 cr; prereq 5322 or ♀; offered 1976 and alt 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 1976-77 and alt yrs)  
(Same as AnSc 5325) 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 1977 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, antibodies to hormones.
- 5330. WILD BIRD MEDICINE.** (2 cr; prereq 4th yr or grad 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.
- 5603. PARASITES OF WILDLIFE.** (3 cr; prereq ♀; offered 1976-77 and alt yrs)  
Economic and biologic relationships of animal parasites and disease to regional wildlife.
- 5604. DISEASES OF WILDLIFE.** (3 cr; prereq ♀; offered 1976 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 1106, AnSc 1100, VB 3103 or equiv)  
General anatomy; physiology of digestion and reproduction; prevention and control of the more important diseases affecting poultry.

## Veterinary Clinical Sciences (VCS)

- 3502. ANIMAL HEALTH AND DISEASE.** (5 cr)  
Designed for non-veterinary medicine students to give a broad understanding of veterinary science as it applies to the health and disease of domestic animals. Emphasis on basic concepts of disease. Common animal diseases are studied which demonstrate 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 examines the 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.

### III. GENERAL INFORMATION

#### Admission

Listed below are requirements for admission to the programs in agriculture, as well as to the preparatory programs in biological sciences and veterinary medicine. Other requirements and procedures having to do with nonresident admission, admission with advanced standing, adult special admission, and admission by examination appear 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.

Students wishing to prepare for the College of Biological Sciences or the College of Veterinary Medicine may apply for admission to the College of Agriculture. (See pages 50-51).

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

**Admission With Advanced Standing**—Students with a minimum of 39 quarter credits of transferable work from other accredited colleges or universities or from another college of the University may be admitted with advanced standing in the College of Agriculture. The Office of Admissions and Records determines if transfer credit will be accepted as required or elective credit. When necessary, applications are referred to the Student Scholastic Standing Committee for a final decision (see page 98). Required credit is given when a transfer course is the equivalent of a specific course required in a curriculum here. The college usually does not consider agriculture courses taken elsewhere to be equivalent to courses offered in the junior and senior years in its programs (that is, courses numbered 3000 or over). Transfer students must complete all specific courses and area distribution requirements of the college, regardless of the number of elective credits they may have.

Thus, students who begin their degree work outside the College of Agriculture, intending to transfer here later, should carefully plan their pretransfer programs to 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, University of Minnesota, St. Paul, Minnesota 55108.

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

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Transfer of credit for courses in agriculture taken in non-land grant institutions is limited to introductory courses or those similar to the first courses offered by departments here. 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 Student 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 the Extension Division**—To transfer credits and grades for courses taken in the Extension Division of the University to their permanent record, students submit a petition requesting such a transfer to the Student Scholastic Standing Committee (see below).

**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. Normally, adult special students are not enrolled 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 of graduate caliber 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.

**Student Scholastic Standing Committee**—The Student Scholastic Standing Committee in the College of Agriculture is composed of eight faculty members and one student. The committee interprets and enforces faculty policy concerning academic regulations and requirements. It may exempt individual students from regulations that work to the student's educational disadvantage, provided 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 Office of the Dean, 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.

**Human Rights**—The Board of Regents has committed itself and the University of Minnesota to the policy that there shall be no discrimination in the treatment of persons because of race, creed, color, sex, or national origin. This is a guiding policy in the admission of students in all colleges and in their academic pursuits. It is also

to be a governing principle in University-owned and University-approved housing, in food services, student unions, extracurricular activities, and all other student and staff services. This policy must also be adhered to in the employment of students either by the University or by outsiders through the University and in the employment of faculty and civil service staff.

The University of Minnesota abides by the provisions of Title IX, federal legislation forbidding discrimination on the basis of sex, and abides by all other federal and state laws regarding equal opportunity.

## 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 promise to attend and pay fees for the classes they've chosen. Although occasionally errors appear in bulletin course listings, the responsibility for accurate, on-time registration and fee payment rests primarily with students. Copying errors, excess changes, failure to observe established procedures, and late registration and fee payment not only impose on University personnel, but are costly and timeconsuming for the individual student as well.

**Where To Go First**—Each quarter the registration process begins at the College Office, 277 Coffey Hall. Students pick up necessary materials there and receive instructions for completing them.

**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 Office of the Dean, 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 nor receive credit or a grade for the course. Auditors must enroll officially for a course and must pay the same fee charged for regular membership in the class. Both the student's adviser and the course instructor must approve a registration to audit a 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**—Often students prefer to study some courses on their own rather than in the usual instructor-classroom setting. Receiving 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.

Independent study means taking a course without attending class. Students on independent study 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 load for the quarter. The department offering the

## General Information

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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 slip 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 Student 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**—By registering for extra credit, students may, with the instructor's approval, 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.

During the first 6 weeks, a course may be canceled without grade with only the adviser's approval. After the sixth week, approval of the adviser and the instructor is required. Withdrawal from a course after the sixth week of the quarter is strongly discouraged, unless extenuating circumstances exist. From the last week of the quarter to the beginning of the final examination period, students must receive Student Scholastic Standing Committee approval to cancel a course. If their grade at that time is passing, the cancellation is permitted with a W on the transcript. If it is failing, an N (no credit) is recorded.

During the first 3 days of the quarter, a course may be added with the approval of the adviser only. After the first 3 days, approval of the adviser and the instructor is required.

**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. Tuition refunds are prorated according to the number of weeks that have elapsed in the quarter. No refunds are given after 6 weeks. Students are entitled to a full refund if they cancel their registration before the first day 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 move into 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 Office of the Dean.) 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 course work is chosen to meet the requirements of both majors.

## Credits and Class Attendance

**Course Load**—The typical courses 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 total grade point average of not less than 2.00) is required. To carry more than 21 credits, a B average in work of the previous quarter and permission from the Student Scholastic Standing Committee are required. Undergraduates must carry at least 12 credits each quarter to be considered a full-time student.

**Credit by Examination**—Students may earn credit for experience or instruction obtained outside the University through special examinations. These tests require permission of the department which would be accepting the credits thus acquired. If a test 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 the CLEP test. Inquire at the 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 good 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 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 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 Student Scholastic Standing Committee; and (d) participation in University-approved, cocurricular activities (the Office of Student Affairs certifies absences because of such activities).

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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 Student Scholastic Standing Committee intervenes only when special 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 may register for courses at the 5000 level. Students who have not attained junior classification and who are below a C average 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 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 is one which frees us from the limitations placed on our powers of judgment and choice by ignorance. More specifically, a liberal education asks of us that we seek control over the general intellectual instruments for acquiring and communicating knowledge, primarily the instruments of language and number; that we seek understanding of the ways in which scientists contribute to man's knowledge of himself and his environment; that we seek historical and philosophic perspective on the nature of our own lives and the world in which we live; and that we 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 persons 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 have 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 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 upon 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 some other 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**

This is but a *partial list* of courses that may be used. It is intended merely as a guide for the student. If in doubt about the use of a specific course, please call the Office of the Dean, 373-0921.

**I. Communication, Language, Symbolic Systems—18 credits**

- A. English and Foreign Language Communication Skills
  - Comm 1001-1002
  - Comp 1001-1002, 1027
  - Rhet 1101-1102, 1222, 1506, 3254, 3257, 3266, 3551, 3562
  - Spch 1101, 3605
- B. Linguistics, Logic, and Philosophic Analysis
  - Class 1048, 3048
  - Ling 1001, 3001
  - Phil 1001-1002, 5201
- C. Mathematics
  - Math—all courses through 1511
  - Stat 1051, 3091, 5021

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### II. The Physical and Biological Sciences—15 credits

#### A. The Physical Universe

Ast 1011, 3051  
BioC 1301-1302  
Chem 1004-1005, 1006  
Geo 1001, 1002, 1111  
NSci 1004, 1005, 1005  
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 1002

### 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  
AmIn 3061, 5121  
Anth 1002  
Econ 1001-1002, 1004-1005, 3001-3002  
FSoS 1001, 1025  
FRD 1201  
Geog 1301, 1311, 1401  
Jour 1003, 3021  
Pol 1001, 1025, 1026, 1027, 1031, 1051  
Psy 1001, 1004-1005, 3031  
Rhet 3250, 5165  
Soc 1001, 1002, 3101  
Spch 1103, 3401  
SSci 1111, 3111, 3205, 3304, 3402, 3507, 3601, 3981

#### B. Development of Civilization: Historical and Philosophical Studies

Afro 1015, 1025, 1036, 1441, 1442, 3081-3082  
AmIn 1101, 1102  
Clas 1001, 1002, 1003, 1004, 1005, 1006, 1042, 3071, 3072, 3073  
Hist—all courses through 1954  
Indc 1504, 1506  
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  
AmIn 5211, 5212  
Arch 1001, 1002, 1003  
ArtH 1001, 1008, 1015, 1016, 3009, 3011  
ArtS 1101, 1102, 1301, 1701, 1801  
Dsgn 1501, 1521, 5505  
Mus 1021—all courses above 1024  
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, providing 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 Student Scholastic Standing Committee (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**—Students may, with the approval of their adviser and the Student Scholastic Standing Committee, 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 the securing of 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 maximum 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 Mus 1430 or Concert Band.

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**Quality Credits**—The number of free elective credits required for graduation may be decreased by 1 for each 5 grade points in excess of those required to reach an average of 2.70. Free electives are those chosen without regard to curricular or all-college requirements. No more than one-twelfth of the total number of credits required for graduation may be gained through excess grade points. Questions regarding computation of quality credits should be directed to the Office of Admissions and Records.

## 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 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, N=0) 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 N stands for no credit.

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 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 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 the Office of the Dean (277 Coffey Hall) can answer questions concerning the use of the S-N system.

### OTHER SYMBOLS

- I— Assigned by an instructor to indicate "incomplete," 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

**Satisfactory Progress**—Satisfactory academic progress in the College of Agriculture is generally interpreted to mean the successful completion (grades of A, B, C, D, or S) of at least 12 credits per quarter with an overall average of C or better. Some curricula, however, require higher grade point averages. Check program descriptions for specifics.

## General Information

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**Unsatisfactory Progress**—Students who are not making satisfactory academic progress are contacted by their adviser to see what can be done to improve their performance. If a positive change does not occur within 1 quarter, a student may be requested to discuss his or her situation with a subcommittee of the Student Scholastic Standing Committee.

## 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 grade points per credit (i.e., the cumulative grade point average must be 2.00 or more)—for additional quality requirements, see statements of prescribed curricula; (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**—Undergraduate degrees may be awarded "with distinction" or "with high distinction." Students must meet in full the honors requirements stated below.

The degree is granted "with distinction" if a minimum grade point average of 3.00 for the entire curriculum is attained. Transfer students with less than 2 years of work in this college are not eligible for graduation with distinction. However, if one-half the number of credits required for graduation in a student's curriculum is completed in this college, the 2-year residence requirement is satisfied.

The degree is granted "with high distinction" if a minimum grade point average of 3.50 for the entire curriculum is attained. The same conditions for residence and recommendation apply as for degree honors with distinction.

When completing the curriculum in agricultural education, results of student teaching are reviewed as well as other requirements stated in the curriculum listing.

## Student Personnel Services

**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 Office of the Dean 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, or 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 Intramural-Extramural Office, 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 of 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/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. The instructor in consultation with the Honor System Commission will review the incident and will make a decision as to disposition of the matter. Details related to the operation of the honor system are published in a special brochure which is available in the Office of the Dean, 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. 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 Campus 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 Campus Student Center Board of Governors, made up of students representing the various academic units on the St. Paul Campus, formulates policy for operation of the Student Center and establishes its budget. Students wishing information about the Student Center, its operation, and opportunities to serve on the various planning and programming committees should inquire at the Information Desk, 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. (Non-residents of Minnesota must write directly to the Office of 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 forwarded to the Office of 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 they have the correct form prior to filling it out. These forms are also available from the high schools or by writing to the Financial Aid Office. (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 a United States citizen, 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 University Armory: Military Science, room 108; Naval Science, room 203; Aerospace Studies, room 3.

## Master of Agriculture Program

Agriculture is a technological science which has created a new cadre of professional agriculturalists who must 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 upon application and management. However, traditional graduate education has most often led to the research-oriented M.S. and Ph.D. degrees. Many persons 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 an opportunity 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. Examples are:

- A. Students, domestic 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 which 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 must obtain 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 shall consist of 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**—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 adult special courses taken.
  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 12 credits selected from among all courses earned off campus in Continuing Education and Extension may be applied toward this degree. However, no more

## General Information

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than 6 credits taken prior to admission to the master of agriculture degree program may be applied toward the 45 credits required for the 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 Wild  
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

*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. Five credits must be earned by completing Agri 5555 (1 cr) and Rhet 5561 (4 cr) in the preparation of an integrating paper for master of agriculture stu-

dents. 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:

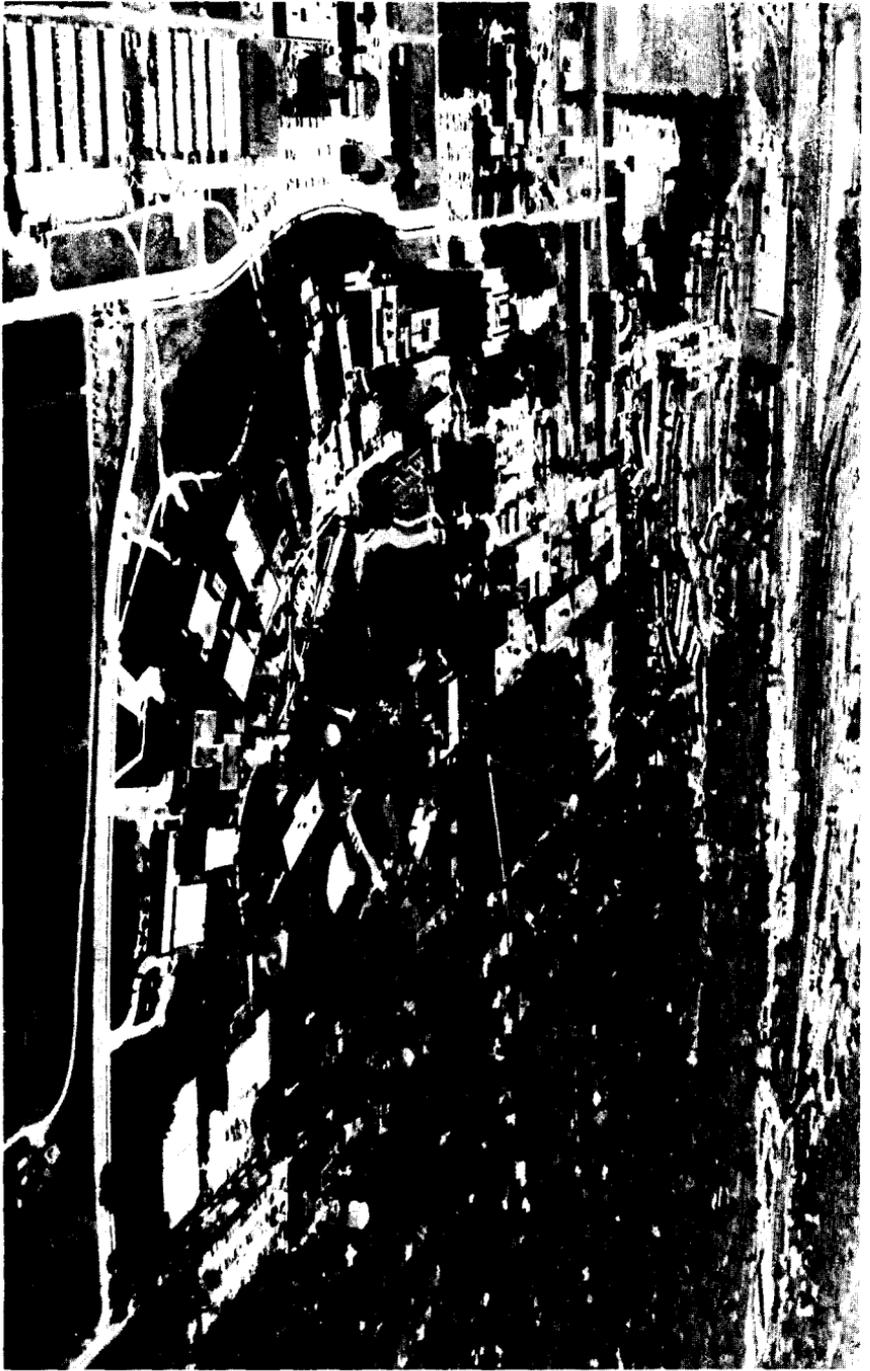
1. Presentation of the integrating paper to a seminar of faculty and the student's peers.
  2. Presentation of the paper at a recognized professional meeting or conference in the student's area of concentration.
  3. Acceptance of the paper for publication in a recognized professional trade journal, 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.
- D. 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 that which 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.
- 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 Office of the Dean, College of Agriculture, 277 Coffey Hall, University of Minnesota, St. Paul, Minnesota 55108. Completed applications should be returned to this address.



## IV. DEPARTMENTS AND FACULTY— COLLEGE OF AGRICULTURE

### Directory of Departments

#### Agricultural and Applied Economics

Wesley B. Sundquist, head, 231 Classroom Office Building, 373-1755

#### Agricultural Education

R. Paul Marvin, chairman, 130 Classroom Office Building, 373-1021

#### Agricultural Engineering

Arnold M. Flikke, head, 213 Agricultural Engineering Building, 373-1304

#### Agronomy and Plant Genetics

Herbert W. Johnson, head, 303 Agronomy Building, 373-0855

#### Animal Science

Robert W. Touchberry, head, 120 Peters Hall, 373-1485

#### Entomology, Fisheries, and Wildlife

Milton W. Weller, head, 219 Entomology, Fisheries, and Wildlife Building,  
373-1700

#### Food Science and Nutrition

Elwood F. Caldwell, head, 225 Food Science and Nutrition Building, 373-1071

#### Horticultural Science and Landscape Architecture

Robert E. Nylund, acting head, 305 Alderman Hall, 373-1026

#### Information and Agricultural Journalism

Eldon E. Fredericks, acting head, 433 Coffey Hall, 373-0710

#### Plant Pathology

Francis A. Wood, head, 304 Stakman Hall of Plant Pathology, 373-0852

#### Rhetoric

L. David Schuelke, head, 202 Haecker Hall, 373-0917

#### Soil Science

William P. Martin, head, 125 Soils Building, 373-1062

### Faculty Listing

#### AGRICULTURAL AND APPLIED ECONOMICS

##### Professor

Wesley B. Sundquist, Ph.D., head

Martin E. Abel, Ph.D.

O. Uel Blank, Ph.D.

Martin K. Christiansen, Ph.D.

Willard W. Cochrane, Ph.D.

Dale C. Dahl, Ph.D.

Reynold P. Dahl, Ph.D.

K. William Easter, Ph.D.

Kenneth E. Egertson, M.S.

Vernon R. Eidman, Ph.D.

Earl I. Fuller, Ph.D.

Jerome W. Hammond, Ph.D.

Paul R. Hasbargen, Ph.D.

John D. Helmberger, Ph.D.

Clifford G. Hildroth, Ph.D.

James P. Houck, Ph.D.

John S. Hoyt, Jr., Ph.D.

Harald R. Jensen, Ph.D.

Wilbur R. Maki, Ph.D.

Lee R. Martin, Ph.D.

Truman R. Nodland, Ph.D.

Willis L. Peterson, Ph.D.

Philip M. Raup, Ph.D.

Gordon D. Rose, Ph.D.

Frank J. Smith, Ph.D.

Kenneth H. Thomas, Ph.D.

Arley D. Waldo, Ph.D.

Delane E. Welsch, Ph.D.

*Associate Professor*

Willis E. Anthony, Ph.D.  
Fred J. Benson, Ph.D.  
Boyd M. Buxton, Ph.D.  
Richard O. Hawkins, M.S.  
Malcolm J. Purvis, Ph.D.  
Terry L. Roe, Ph.D.  
Mathew D. Shane, Ph.D.  
Robert W. Snyder, Ph.D.

John J. Waelti, Ph.D.  
Carole B. Yoho, M.S.

*Assistant Professor*

Mary E. Ryan, M.S.  
Benjamin H. Sexauer, Ph.D.

*Instructor*

Jerry Lee Thompson, B.S.

## AGRICULTURAL EDUCATION

*Professor*

R. Paul Marvin, Ph.D., *head*  
W. Forrest Bear, Ph.D.  
Milo J. Peterson, Ph.D.  
Gordon I. Swanson, Ph.D.

*Associate Professor*

George H. Copa, Ph.D.  
Gary W. Leske, Ph.D.  
Curtis D. Norenberg, Ph.D.  
Edgar A. Persons, Ph.D.  
Roland L. Peterson, Ed.D.

## AGRICULTURAL ENGINEERING

*Professor*

Arnold M. Flikke, Ph.D., *head*  
Evan R. Allred, M.S.  
W. Forrest Bear, Ph.D.  
Landis L. Boyd, Ph.D.  
Harold A. Cloud, Ph.D.  
Kenneth A. Jordan, Ph.D.  
Curtis L. Larson, Ph.D.  
Russell E. Larson, M.S.  
Roger E. Machmeier, Ph.D.  
Jesse H. Pomroy, M.S.  
Cletus E. Schertz, Ph.D.  
John Strait, M.S.

*Associate Professor*

Philip R. Goodrich, Ph.D.  
R. Vance Morey, Ph.D.  
David R. Thompson, Ph.D.

*Assistant Professor*

Robert J. Gustafson, Ph.D.  
James A. Moore, Ph.D.  
Charles A. Onstad, Ph.D.  
Donald C. Slack, Ph.D.  
Robert A. Young, Ph.D.

*Instructor*

Douglas A. Nordquist, B.S.

## INFORMATION AND AGRICULTURAL JOURNALISM

*Professor*

Harold B. Swanson, Ph.D.  
Raymond Wolf, B.S.

*Associate Professor*

Eldon E. Fredericks, M.S., *acting head*  
Norman Engle, M.S.  
Janet K. Macy, M.S.  
John M. Sperbeck, M.S.

*Assistant Professor*

Alden M. Balmer, M.B.A.  
Donald Breneman, M.A.

Wesley Grabow, Ph.D.  
Phillip E. Miller, M.A.  
Leona S. Nelson, M.A.  
Mary Kay O'Hearn, B.A.  
Kathleen K. Wolter, B.A.  
David Zarkin, M.A.

*Instructor*

Diane H. Grayden, B.A.  
Michael W. Harris, B.S.  
Dean A. Kruckeberg, M.A.  
Diedre M. Nagy, M.A.  
Gail M. Tischler, B.A.

## AGRONOMY AND PLANT GENETICS

*Professor*

Herbert W. Johnson, Ph.D., *head*  
Robert N. Andersen, Ph.D.  
Donald K. Barnes, Ph.D.  
Richard Behrens, Ph.D.  
William A. Brun, Ph.D.  
Laddie J. Elling, Ph.D.  
John A. Goodding, Ph.D.  
Arne W. Hovin, Ph.D.  
William F. Hueg, Jr., Ph.D.

Jean W. Lambert, Ph.D.  
Gordon C. Marten, Ph.D.  
Gerald R. Miller, Ph.D.  
Dale N. Moss, Ph.D.  
Harley J. Otto, Ph.D.  
Donald C. Rasmusson, Ph.D.  
Robert G. Robinson, Ph.D.  
Alois R. Schmid, Ph.D.  
Lawrence H. Smith, Ph.D.

*Associate Professor*

Vernon B. Cardwell, Ph.D.  
Robert E. Heiner, Ph.D.  
Dale R. Hicks, Ph.D.  
Ervin A. Oelke, Ph.D.  
Ronald L. Phillips, Ph.D.  
Oliver E. Strand, Ph.D.  
Robert E. Stucker, Ph.D.  
Deon D. Stuthman, Ph.D.  
Roy L. Thompson, Ph.D.

*Assistant Professor*

R. Kent Crookston, Ph.D.  
Anson Elliott, Ph.D.  
Jon L. Geadelmann, Ph.D.  
Burl C. Gengenbach, Ph.D.  
C. Edward Green, Ph.D.  
Neal P. Martin, Ph.D.  
Donald L. Wyse, Ph.D.

## ANIMAL SCIENCE

*Professor*

Robert W. Touchberry, Ph.D., *head*  
C. Eugene Allen, Ph.D.  
William J. Boylan, Ph.D.  
Charles J. Christians, Ph.D.  
Bo G. Crabo, Ph.D.  
John D. Donker, Ph.D.  
Richard D. Goodrich, Ph.D.  
Edmund F. Graham, Ph.D.  
Ralph S. Grant, M.S.  
Lester E. Hanson, Ph.D.  
Alan G. Hunter, Ph.D.  
Robert M. Jordan, Ph.D.  
Robert J. Meade, Ph.D.  
Jay C. Meiske, Ph.D.  
Donald E. Otterby, Ph.D.  
Richard E. Phillips, Ph.D.

William E. Rempel, Ph.D.  
Robert N. Shoffner, Ph.D.  
Paul E. Waibel, Ph.D.  
Jesse B. Williams, Ph.D.  
Charles W. Young, Ph.D.

*Associate Professor*

William H. Burke, Ph.D.  
Richard J. Epley, Ph.D.  
Jerry D. Hawton, Ph.D.  
Michael F. Hutjens, Ph.D.  
John D. Smith, Ph.D.

*Assistant Professor*

Neil K. Allen, Ph.D.  
William R. Dayton, Ph.D.  
Jonathan E. Wheaton, Ph.D.

## ENTOMOLOGY, FISHERIES, AND WILDLIFE

*Professor*

Milton W. Weller, Ph.D., *head*  
Marion Brooks-Wallace, Ph.D.  
Huai-chang Chiang, Ph.D.  
Edwin F. Cook, Ph.D.  
Laurence K. Cutkomp, Ph.D.  
L. Daniel Frenzel, Jr., Ph.D.  
Basil Furgala, Ph.D.  
Herbert M. Kulman, Ph.D.  
William H. Marshall, Ph.D.  
Allan G. Peterson, Ph.D.  
Roger D. Price, Ph.D.  
A. Glenn Richards, Ph.D.  
Lloyd L. Smith, Ph.D.  
Thomas F. Waters, Ph.D.

*Professor Emeritus*

A. A. Granovsky, Ph.D.  
Alexander C. Hodson, Ph.D.  
Clarence E. Mickel, Ph.D.

*Professor and Extension Entomologist*

Phillip K. Harvin, Ph.D.  
John A. Lofgren, M.S.

*Associate Professor*

Peter A. Jordan, Ph.D.  
Edward B. Radcliffe, Ph.D.

*Assistant Professor*

Ira A. Adelman, Ph.D.  
James A. Cooper, Ph.D.

*Instructor and Extension Entomologist*

David M. Noetzel, M.S.

## FOOD SCIENCE AND NUTRITION

*Professor*

Elwood F. Caldwell, Ph.D., *head*  
Samuel T. Coulter, Ph.D., *head emeritus*  
Harold Macy, *dean emeritus*  
Paul B. Addis, Ph.D.  
Francis F. Busta, Ph.D.  
Margaret D. Doyle, Ph.D.  
Joan Gordon, Ph.D.

Theodore P. Labuza, Ph.D.  
Howard A. Morris, Ph.D.  
Lura M. Morse, Ph.D.  
Vernal S. Packard, Jr., Ph.D.  
Irving J. Pflug, Ph.D.  
Patricia B. Swan, Ph.D.  
Elmer L. Thomas, Ph.D.  
Edmund A. Zottola, Ph.D.

*Associate Professor*

William M. Breene, Ph.D.  
Agnes S. Csallany, D.Sc.  
P. V. J. Hegarty, Ph.D.  
Larry L. McKay, Ph.D.  
Gary A. Reineccius, Ph.D.  
Eugene H. Sander, Ph.D.  
Oscar P. Snyder, Jr., Ph.D.  
Sita R. Tatini, Ph.D.  
Esther Y. Trammell, M.S.  
Dorothy G. Verstraete, M.S.

*Assistant Professor*

Margarita Billings, B.S.  
Muriel Brink, M.S.  
Betty Ruth Carruth, Ph.D.  
Mary E. Darling, M.P.H.

Eugenia A. Davis, Ph.D.  
Louise M. Mullan, Jr., M.S.  
Zata M. Vickers, Ph.D.  
Joseph J. Warthesen, Ph.D.

*Instructor*

Elaine Asp, M.S.  
Madge Hanson, M.S.  
Edith Johnson, M.P.H.  
Donna Meiske, M.S.  
Robert P. Olson, B.S.  
Isabel Wolf, M.S.

*Lecturer*

Alfred T. May, B.Ph.  
John E. Snow, Ph.D.

## HORTICULTURAL SCIENCE AND LANDSCAPE ARCHITECTURE

*Professor*

Robert E. Nylund, Ph.D., *acting head*  
David W. Davis, Ph.D.  
C. Gustav Hard, Ph.D.  
Arvo Kallio, Ph.D.  
Florian I. Lauer, Ph.D.  
Leon C. Snyder, Ph.D.  
Eduard J. Stadelmann, Ph.D.  
Cecil Stushnoff, Ph.D.  
Orrin C. Turnquist, Ph.D.  
Donald B. White, Ph.D.  
Richard E. Widmer, Ph.D.  
Harold F. Wilkins, Ph.D.

*Associate Professor*

Peter D. Ascher, Ph.D.  
Mark L. Brenner, Ph.D.  
Leonard B. Hertz, Ph.D.

Pen H. Li, Ph.D.  
Jane P. McKinnon, M.S.  
Robert Mullin, Ph.D.  
Harold M. Pellett, Ph.D.  
Paul E. Read, Ph.D.  
Harold W. Young, Ph.D.

*Assistant Professor*

Michael J. Burke, Ph.D.  
Sharon Desborough, Ph.D.  
Richard H. Forsyth, M.L.A.  
Shirley T. Munson, M.S.  
Peter Olin, M.L.A.  
Lawrence R. Parsons, Ph.D.  
David Sams, Ph.D.

*Instructor*

Marvin C. Eisel, B.S.

## PLANT PATHOLOGY

*Professor*

Francis A. Wood, Ph.D., *head*  
Neil A. Anderson, Ph.D.  
Ralph L. Anderson, Ph.D.  
Ernest E. Baantari, Ph.D.  
Howard L. Bissonnette, Ph.D.  
William R. Bushnell, Ph.D.  
David W. French, Ph.D.  
Fred I. Frosheiser, Ph.D.  
Herbert G. Johnson, Ph.D.  
Bill W. Kennedy, Ph.D.  
Milton F. Kernkamp, Ph.D.  
Thor Kommedahl, Ph.D.  
Chester J. Mirocha, Ph.D.  
John B. Rowell, Ph.D.  
Roy D. Wilcoxson, Ph.D.

*Professor Emeritus*

Clyde M. Christensen, Ph.D.  
Carl J. Eide, Ph.D.  
Matthew B. Moore, M.S.  
Elvin C. Stakman, Ph.D.

*Associate Professor*

David H. MacDonald, Ph.D.  
Darroll D. Skilling, Ph.D.  
Ward C. Stienstra, Ph.D.

*Assistant Professor*

Robert M. Brambl, Ph.D.  
James V. Groth, Ph.D.  
Sagar V. Krupa, Ph.D.  
Donald V. McVey, Ph.D.  
Richard J. Meronuck, Ph.D.  
Francis L. Pfleger, Ph.D.  
Alan P. Roelfs, Ph.D.  
Paul G. Rothman, Ph.D.  
Arthur L. Schipper, Ph.D.  
Robert D. Shrum, Ph.D.  
Elwin L. Stewart, Ph.D.  
Richard J. Zeyen, Ph.D.

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James E. Connolly, Ph.D.  
Francis E. Drake, Ph.D.  
William M. Marchand, Ph.D.  
Thomas E. Pearsall, Ph.D.  
Starling W. Price, Ph.D.  
Edward B. Savage, Ph.D.  
Eugene S. Wright, Ph.D.

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Richard O. Horberg, Ph.D.  
Sarah E. McBride, Ph.D.

### *Assistant Professor*

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Earl E. McDowell, Ph.D.  
Lyman K. Steil, M.A.

### *Instructor*

Richard W. Ferguson, M.A.

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Donald G. Baker, Ph.D.  
George R. Blake, Ph.D.  
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Rouse S. Farnham, Ph.D.  
Robert G. Gast, Ph.D.  
Janis Grava, Ph.D.  
Lowell D. Hanson, Ph.D.

Richard H. Rust, Ph.D.  
Edwin L. Schmidt, Ph.D.  
Charles A. Simkins, Ph.D.  
James B. Swan, Ph.D.

### *Associate Professor*

David F. Grigal, Ph.D.  
George E. Ham, Ph.D.

### *Assistant Professor*

Gary L. Malzer, Ph.D.  
Robert C. Munter, M.S.

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