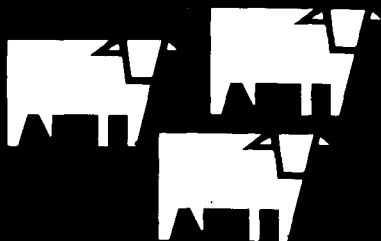


University of Minnesota

1115
Bulletin

JULY 29, 1971

college of agriculture



How to Use This Bulletin

This bulletin is the basic source of information about the offerings in agriculture in the College of Agriculture. You should keep it at hand for ready reference. The Index in the back of the bulletin will refer you to information on specific points.

- Page 3 Section I contains general information describing objectives of the programs in agriculture, admission requirements, scholarships and other financial aids, the registration process and regulations pertaining to class attendance, etc., degrees offered, requirements for all students, use of elective credits, and use in the Graduate School of credits earned while an undergraduate.
- Page 14 Section II contains descriptions of the curricula in agriculture.
- Page 53 Section III presents descriptions of course offerings in agriculture.
- Page 93 Section IV contains special information pertaining to scholarship requirements, classification, student personnel services, student government, and ROTC programs
- Page 99 Section V—List of faculty.

In addition to this bulletin and any other you may need for program planning, you will be supplied at the time of registration with a copy of the *Class Schedule*. This is published just prior to each quarter and lists courses offered during the quarter, with time and place of class meetings.

Explanation of Symbols and Course Numbers

Courses primarily for freshmen and sophomores are numbered 1-000 through 1-998; for juniors and seniors, 3-000 through 3-998; for juniors, seniors, and graduate students, 5-000 through 5-998. Courses numbered 8-000 and above are restricted to students registered in the Graduate School.

The following symbols are used throughout this bulletin:

- Graduate students may prepare Plan B papers.
- † To receive credit, all courses listed before the single dagger must be completed.
- ‡ Students may enter sequence course in any quarter which precedes the double dagger.
- § No credit is granted if credit was received for equivalent course listed after section mark.
- ¶ Concurrent registration is allowed with the course listed after paragraph mark.
- ‡ Consent of instructor is required.
- △ Consent of department or school offering course is required.
- x After a course number indicates course is offered more than 1 quarter.

When no abbreviated departmental prefix precedes the course number listed as a prerequisite, that prerequisite is in the same department as the course being described. A prerequisite reading "6 cr" means 6 credits in courses offered by the "same" department.

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220 Haecker Hall
- Agricultural Education**—R. Paul Marvin, Ph.D., *chairman*
208 Horticulture Building
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213 Agricultural Engineering Building
- Agronomy and Plant Genetics**—Herbert W. Johnson, Ph.D., *head*
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- Information and Agricultural Journalism**—Harold B. Swanson, Ph.D., *head*
433 Coffey Hall
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- Rhetoric**—Ralph G. Nichols, Ph.D., *head*
230 Agricultural Engineering Building
- Soil Science**—William P. Martin, Ph.D., *head*
120 Soils Building

College of Agriculture

SECTION I

GENERAL INFORMATION

Objectives of the Programs in the College of Agriculture

The College of Agriculture is a professional college with focused interests. Undergraduate instruction in agriculture is considered important in assuring agriculture's maximum contribution to the development of the nation's economy, in improving the diets, health, and well-being of people, in aiding rural populations in adjusting to change, in providing ideas and information needed to develop sound public policy relating to agriculture and natural resources, and in helping meet educational needs in world affairs and international relations as they relate to agriculture.

The faculty through the curricula in agriculture seeks to serve the student in several ways:

1. To enable the student to develop an understanding of the fundamentals of the biological, physical, and social sciences which are a part of the fabric of modern agriculture.
2. To assure the student an opportunity to explore those areas of human experience and understanding that will enable him to enjoy a rich personal life and to contribute in an effective manner to the welfare of the greater community.
3. To bring the student to a level of competence in one of the specialized areas of the college that will support responsible professional activity in the agricultural or business community.
4. To provide a foundation for highly specialized studies in the departmental disciplines at the graduate level.

Information on the college other than that contained in this bulletin may be obtained from the Office of the Dean, College of Agriculture, 277 Coffey Hall, University of Minnesota, St. Paul, Minnesota 55101.

Admission to Programs in Agriculture

How Application Is Made

To be admitted to a program in the College of Agriculture you must make application to the Office of Admissions and Records on the St. Paul Campus. Listed below are requirements for admission to the programs in agriculture, pre-biology, and pre-veterinary medicine. Other requirements and procedures

General Information

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.

Prior to admission applicants must 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 is not required for admission.

Students wishing to prepare for the College of Biological Sciences or the College of Veterinary Medicine should apply for admission to the College of Agriculture.

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

Graduates of the Schools of Agriculture—If you are a graduate in the upper 60 percent of one of the University of Minnesota Schools of Agriculture and meet the distribution requirements noted above, you will be admitted to a program in agriculture in the College of Agriculture.

Adult Special Students—You may be admitted as a special student if you are a mature person (24 years of age or older) and wish to register for particular courses to meet special needs. Normally, an adult special student will not be in residence for an extended period of time, but only so long as it is necessary to secure the information that is specifically desired.

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

Non-High School Graduates—Write the Office of Admissions and Records for information about entering the University by examination. Also, see the *General Information Bulletin*.

Admission with Advanced Standing—Credits from other accredited colleges and universities and from other colleges of the University of Minnesota which are appropriate for a student's course of study can be transferred to the College of Agriculture. These will be evaluated by the Office of Admissions and Records and will be designated as either required or elective credit. A course that is applied toward required credit is considered the equivalent of a specific course required in a curriculum here. Experience has shown that transfer credits for courses taken in agriculture are frequently not applicable to courses offered in the junior and senior years, i.e., to courses numbered 3-000 or over, in the Col-

lege of Agriculture. You will be expected to complete all required courses here and all area requirements regardless of the number of excess elective credits you may have.

Therefore it is important, in transferring to the College of Agriculture, to have planned your earlier programs carefully in order that your credits may apply with the greatest efficiency to the particular curriculum you desire to enter. If you are beginning your work in an institution other than the College of Agriculture and plan to transfer at a later date, refer to the appropriate program section of this bulletin. There you will find descriptions of the curricula and a listing of the required courses for each. You should note especially the requirements for the freshman and sophomore years. Your college adviser will help you select courses that will meet specific curricular requirements, and if you need further help you may write directly to the Office of Admissions and Records on the St. Paul Campus.

Transfer of Credit in Agricultural Courses Taken at Minnesota Non-Land Grant Colleges—Blanket approval will not be given for transfer of credit in agricultural courses from non-land grant institutions. Rather, transfer of credit will be considered on an individual basis.

Recommendation on transfer of credit will be made by the appropriate department of the University of Minnesota to the Student Scholastic Standing Committee of the College of Agriculture.

Appraisal of the accomplishment of the student shall be based upon information concerning the course, including course outline and objectives, to be secured from the offering institution, personal contact with the student, and a review of the course examinations written by the student. When the information at hand does not permit the department to make a judgment with respect to the level and quality of preparation of the student, validating examinations may be administered.

Transfer of credit in courses in agriculture taken in non-land grant institutions shall be limited to introductory courses, or those representative of the first courses in a departmental offering. The special examination for credit will be utilized by students seeking credit in areas covered by advanced courses in agriculture.

Transfer of Credit from General Extension Division—Transfer of credits and grades for courses taken through the programs of the General Extension Division of the University of Minnesota to your permanent record may be accomplished through submission of a petition requesting such action to the College of Agriculture Student Scholastic Standing Committee.

Examination upon Entrance—If you are a new student you are expected to have completed the American College Testing program and the Minnesota High School Statewide Testing program. These may be taken at the time of registration if not completed previously. Other examinations given at entrance will test your aptitude and achievement in English. Your admission to the College of Agriculture will not depend upon the results of these examinations if you are otherwise qualified.

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

General Information

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.

Scholarships and Other Financial Aids

Students entering as freshmen in the College of Agriculture may apply for all-University freshman scholarships, and also for scholarships specific to the college or to certain curricula in the college. All applications are submitted on an application for financial aid to be sent to the Office of Student Financial Aid, 107 Armory, University of Minnesota, Minneapolis, Minnesota 55455. The University of Minnesota scholarship program is coordinated through the College Scholarship Service with headquarters in Princeton, New Jersey; consequently the parents of each applicant must submit the Parents' Confidential Statement. The forms referred to are available at the high school principal's or counselor's office. Scholarship information is sent to all Minnesota high schools in early October of each year, and prospective students should consult with their high school principals concerning them, or correspond directly with the Office of Student Financial Aid (Minneapolis Campus), or with the Office of the Dean, College of Agriculture, 277 Coffey Hall, University of Minnesota, St. Paul, Minnesota 55101. Applicants should note the need for early submission of applications and conform to the established deadline date. (Generally the deadline is December 15 for scholarships that will be available the following fall.)

Additional scholarships or awards are distributed periodically to students in residence on the basis of specified criteria.

Selection of recipients for most scholarships is based upon academic aptitude, vocational promise, personal attributes, leadership, and, for most but not all of the scholarships, upon financial need.

The Registration Process

Working with Your Faculty Adviser—Upon entry into the college you will be assigned a faculty adviser on the basis of the curriculum you choose from among the several offered in agriculture. He will interpret the curriculum to you, will guide you in planning your program each quarter, and will be concerned about your general progress. Before you see your adviser at registration time, you should study curriculum requirements, course listings, and descriptions, and develop a tentative program with the aid of the *Class Schedule*.

Curriculum and Departmental Relationships—The curricula in agricultural science and industries, biological and physical sciences in agriculture, and resource and community development are interdepartmental offerings. In each of these curricula you may select one of several majors and areas of emphasis at the time you qualify for junior classification.

Registration and Class Attendance

Attention to Curriculum Requirements—It is your responsibility to know and meet all requirements prescribed for graduation in the curriculum you select. This includes the all-college major, and, where applicable, the area of emphasis requirements. If you have questions relative to any requirements, consult your faculty adviser.

Declaring the Major and Specialization or Area of Emphasis—In your sophomore year, after you have completed the equivalent of 5 quarters of residence, you are required to submit to the Office of Admissions and Records a specialization form (available from your adviser or the Office of Admissions and Records) which has been approved and signed by your adviser. On this form you will indicate your choice of a major and specialization or area of emphasis where applicable, or one of the outlined curricula. If this specialization form is not filed at the designated time, your registration may be withheld.

The major and specialization or area of emphasis sequence or the outlined curriculum, as indicated on your specialization form, becomes your curriculum required for graduation. Copies of the approved curriculum are sent to you, to your adviser, and to the Student Scholastic Standing Committee. Should the major be changed to a different field of work, a new adviser must be selected and your specialization form resubmitted, after obtaining approval of your adviser.

Registration and Class Attendance

Fees—For information about fees, see the *General Information Bulletin*.

Quantity of Work—The normal load of work for each quarter is 14 to 18 credit hours. A credit hour requires on the average 3 hours each week. These may be distributed as follows: 1 hour of lecture or recitation requiring 2 hours of preparation; 2 laboratory periods requiring 1 hour of preparation; or 3 laboratory periods requiring no outside preparation. Student programs in the College of Agriculture may vary in load according to the student's ability or circumstance. To carry more than 18 hours of credit, you must have a C average (that is, a total grade point average of not less than 2.00). To carry more than 21 hours, you must have a B average in work of the previous quarter and must secure permission from the Student Scholastic Standing Committee (277 Coffey Hall). An undergraduate must carry at least 12 credits each quarter in order to be considered a full-time student.

Auditors—The approval of the Student Scholastic Standing Committee (277 Coffey Hall), your adviser, and the instructor is necessary if you wish to register for a course as an auditor. An auditor must enroll officially for a course and must pay the same fee that is charged in regular membership in the class. He does not take the final examination and is not given a grade or credit for the course.

Changes in Registration—To change your registration you must obtain change of registration forms from the Office of Admissions and Records. Changes should be made only when necessary or highly desirable and they should be made as early as possible in a quarter.

General Information

During the first 6 weeks you may cancel a course without grade and with only your adviser's approval. After the sixth calendar week you are required to have the approval of your adviser, the instructor, and the Student Scholastic Standing Committee. However, withdrawal from a course after the sixth calendar week of the quarter is strongly discouraged unless extenuating circumstances exist. *Cancellations within the last 2 weeks prior to the beginning of the quarterly final examination period will seldom be approved.* The instructor must indicate your grade at the time of cancellation. If the grade is passing, you will be permitted to cancel with W on your report, or without grade. If it is failing, an I (incomplete) will be recorded. (See discussion of incomplete grades in back of bulletin.)

During the first 3 days of the quarter you may add a course with the approval of your adviser only. After the first 3 days you must have the approval of your adviser, the instructor, and the Student Scholastic Standing Committee (277 Coffey Hall).

Cancellation of Entire Registration—If you leave college before the end of the quarter, you should cancel your registration at the time you discontinue attending class. Cancellation within the first 6 weeks entitles you to a refund proportional to the amount of time you attended class. If you do not attend classes at all, you are entitled to a full refund.

Credit by Special Examination or Through Reading Courses—If you wish to secure full credit for a course for which you have adequate training and preparation, you may apply for permission to take a special examination. It may be taken during the first quarter in residence without fee; after that time a fee of \$20 is required. Special examinations in which a grade of C or better is earned are recorded with credit and grade, as part of the student's college record.

You 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 your adviser, the instructor in the course, and the Student Scholastic Standing Committee (277 Coffey Hall), under the following conditions:

1. When a course normally offered is canceled because of inadequate registration.
2. When, because of conflicts, the student finds it impossible to schedule the course at the time it is offered.

It is assumed that you will complete the work of the course during the quarter in which you are registered for it and take the final examination at the regularly scheduled time.

Independent Study and Extra Credit Registration—Often students prefer to study some courses on their own rather than through usual class participation and regular instructor direction. Opportunity to study in this way has long been available to College of Agriculture students through the credit-by-examination procedure, under which a student can apply for an examination (or other method of evaluation) in almost any course in the college, after studying the material in whatever way he wishes. Because the procedure 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 Registration—Departments have identified certain courses for which students may register for independent study, which means to

Registration and Class Attendance

take the course without attending class. (List of courses is available from the Office of the Dean, 277 Coffey Hall.) In some cases, instructions have been duplicated and filed in departmental offices; in others, direct consultation with the instructor is necessary to obtain directions. Further discussions with or assistance from instructors is not expected.

Registration for independent study counts as part of the regular credit load and regular fees are charged. The student must take the final at the regular time (or at a time directed by the instructor) and meet prescribed deadlines for any other work required. The usual regulations about grades, incompletes, and cancellations apply.

Permission to register for independent study is obtained from the department office. In some cases, the student will be referred to the instructor. In order to maintain proper records on this out-of-the-ordinary registration, the student should bring his permission slip to the Office of Admissions and Records, 130 Coffey Hall, so that his registration can be checked.

The registration card should show the course number followed by a capital "Y" (example: Agro 1-010Y).

Extra Credit Registration—Registration for extra credit (1 to 3) in conjunction with a course a student is taking or has taken requires approval of the instructor. The student does the work independently, meeting such evaluative standards as the instructor sets. This provides the opportunity for more intensive study of a topic in the regular course or extension beyond the course to a closely related topic. Such registrations should not be used when the department offers a regular course which has the same objective.

The student should bring his special permission slip, approved by the instructor, to the Office of Admissions and Records. The usual regulations concerning fees, grades, and cancellations apply. On the registration card he enters the course number followed by a capital "X" (example: Agro 1-010X). Such registrations are not reserved.

Credit and Grade Arrangements for Courses Repeated—College of Agriculture students may repeat courses in which they have received passing grades. The student who has a grade point deficiency may find that repeating courses in which he has received D grades advantageous, in that the grade and credit for the previous experience are deleted and the grade and credit received upon completion of the course the second time become the record for that course.

Class Attendance—Attendance is compulsory in the College of Agriculture for certain classes only, because of the nature of such classes. If you miss class for good reasons beyond your control, you have the privilege of requesting the instructor's assistance in making up the class work you miss. The instructor is under no obligation, however, to give assistance if you willfully absent yourself from class, although there are situations in which he may properly wish to do so.

The following situations will be accepted by instructors as reasons that would justify absence from class and 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 (certification that a student was absent from class because he was engaged in such activities will be made by the Office of Student Affairs).

General Information

If you wish to make up work, you should confer directly with the instructor in regard to the justification for your absence and the possibility and ways of making up the class work. The Student Scholastic Standing Committee will enter into the situation only when special emergencies (items b and c above) are involved and as an appeal agency.

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 you may choose without regard to curricular or all-college requirements. Not more than one-twelfth of the total number of credits required for graduation may be gained through excess grade points.

Mathematics Placement—Initial registration for courses in mathematics will be based on courses taken in high school, the quality of this work, and results on the mathematics section of the American College Test (ACT). A refresher course at extra cost will be required of those students whose background in elementary and higher algebra proves insufficient to permit them to move into advanced courses.

In those programs requiring trigonometry, students with acceptable performance in high school trigonometry will not need to take Math 1-008, Trigonometry, at the college level.

Degrees Offered and Their Requirements

Degrees—The college offers curricula leading to degrees as follows: (a) 4-year programs in agriculture leading to the degree of bachelor of science, (b) 4-year bachelor of science degree programs offered jointly with the College of Education (Agricultural Education) and the Institute of Technology (Agricultural Engineering), (c) a 4-year bachelor of landscape architecture degree offered jointly with the Institute of Technology, (d) a 4-year bachelor of agriculture/business administration degree program offered jointly with the School of Business Administration, and (e) a fifth-year program leading to the master of education degree in agricultural education.

Requirements for Graduation

For Bachelor's Degrees—Candidates will be recommended for graduation after completing the following requirements: (a) the prescribed curriculum, including required and elective credits to make the total number of credits required; (b) the Council on Liberal Education (C.L.E.) requirements; (c) an average of 2 grade points per credit—i.e., the cumulative grade point average must be 2.00 or more ($2.00=C$); for additional quality requirements, see statements of prescribed curricula; (d) requirements for all students as noted (see below); (e) residence and other general University requirements for graduation (see *General Information Bulletin*).

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

Requirements for All Students

Graduation with Honors—Undergraduate degrees may be awarded “with distinction” or “with high distinction.” If you should fail to meet in full the requirements stated below, your case will be referred to the Student Scholastic Standing Committee for individual consideration.

The degree is granted “with distinction” if you attain a minimum grade point average of 3.00 for the entire curriculum. If you are a transfer student with less than 2 years of work in this college you will not be eligible for graduation with distinction. However, if you complete in this college one-half the number of credits required for graduation in your curriculum, you will satisfy the 2-year residence requirements. Recommendations to the faculty for the degree “with distinction” are made through the Student Scholastic Standing Committee on the basis of scholarship and other evidence of satisfactory achievement and advancement in the course pursued.

Your degree will be granted “with high distinction” if you attain a minimum grade point average of 3.50 for the entire curriculum. The same conditions for residence and recommendation apply as for the degree “with distinction.”

If you are completing the curriculum in agricultural education you will be checked for your standing in student teaching as well as for the requirements stated in the curriculum listing.

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 their 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 by ignorance on our powers of judgment and choice. 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 by these changes. By encouraging a liberal education the college hopes to prepare a student to be poised, articulate, and able to communicate his ideas, and to have an appreciation of the value of interpersonal relationships. The college believes that these goals can be encouraged and sought concurrently with the development of technical professional competence in depth in the student's specialty.

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

General Information

- 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 will be 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 will be 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 (3 credits) will also be taken by all students. Most students register for Rhet 1-222 (Public Speaking) as sophomores, and for Rhet 3-551 (Professional Writing) or Rhet 3-562 (Scientific and Technical Writing) during their junior or senior year. An exemption examination for Rhet 3-551 or Rhet 3-562 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 3-551 or Rhet 3-562 requirement.

In category III students should have at least one course in subcategory B. Not more than 10 credits in any one discipline (i.e., history, economics, psychology) may be counted toward the category III requirement.

Council on Liberal Education Course List—Because of the numerous course revisions associated with the change in the major course credit module and the unavailability of the new listings at the time the bulletin was printed, the C.L.E. course list has been omitted. Advisers may be guided by the revised list in the *Adviser's Handbook*. An up-to-date list may be obtained by writing to the Office of the Dean, College of Agriculture, University of Minnesota, St. Paul, Minnesota 55101.

Use of Elective Credits

Withholding Elective Credit from Courses Offered for Graduation—You should consult with your adviser as to your choice of electives. Electives taken by students registered in the College of Agriculture may, upon approval of adviser and the Student Scholastic Standing Committee, be omitted from the courses offered for graduation. These electives, in amounts not to exceed 10 credits, may be withheld (from the list of courses counted toward a degree) to raise the grade point average only in instances relating to the securing of

Undergraduate Credit Used in Graduate School

junior classification or in meeting the graduation requirement of 2.00. After a course has been withheld from the undergraduate record as authorized above, it shall not be reinstated other than by special examination or through 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. Not more than 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 1-430 or Concert Band.

Use in the Graduate School of Credits Earned While an Undergraduate

Credits for advanced courses earned while you are 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 you lack not more than 9 credits of undergraduate work, taking into account required and sequence courses, you may carry a limited amount of graduate work (approved courses numbered 5-000 or above) for graduate credit, such courses not to be applied toward an undergraduate degree. The conditions as stated apply to the beginning of the quarter in which you are taking the courses for graduate credit. In order to hold these credits available for use at the graduate level, a petition must be submitted to the College of Agriculture Student Scholastic Standing Committee (277 Coffey Hall) at the time of registration for the last quarter, requesting that these specified credits be withheld from the undergraduate transcript. Transfer of credit must be arranged by petition to the Graduate School.
2. If you lack not more than 9 credits for graduation, you may register in the Graduate School.

SECTION II

CURRICULAR PROGRAMS

Students in agriculture in the College of Agriculture possess a wide variety of personal and professional goals. The curricular programs that follow are designed to provide routes toward these different objectives. Each program has identifying characteristics, yet each has much in common with the others. The present all-College requirements in the social sciences and the humanities are included in each curriculum outline, in form appropriate to that recommended by the All-University Council on Liberal Education. Professional content varies with program objectives, and the considerations upon which each program is organized are noted in the material introductory to that program.

The curricula which lead to the bachelor of science degree and the minimum credit requirements are:

1. Agricultural Business Administration—192 credits
2. Agricultural Science and Industries—192 credits

With majors in:

- Agricultural Economics
- Agricultural Education
- Agricultural Engineering Technology
- Animal Science
- Plant and Animal Protection
- Plant and Soil Science

3. Biological and Physical Sciences in Agriculture—186 credits

With majors in:

- Animal Science
- Entomology
- Food Science
- Plant and Soil Science

4. Fisheries and Wildlife—198 credits
5. Food Science and Industries—186 credits

With areas of emphasis in:

- Chemistry
- Industrial Engineering
- Management
- Microbiology
- Nutrition
- Public Health

6. Resource and Community Development—192 credits (215 credits for Landscape Architecture)

With majors in:

- Resource Economics
- Recreation Resource Management

Agricultural Business Administration

Soil and Water Resource Management
Landscape Architecture—215 credits

7. Technical Communication—180 credits

“Major” designations are listed for Agricultural Science and Industries, Biological and Physical Sciences in Agriculture, and Resource and Community Development Programs. In addition “specialization” designations are listed for Agricultural Science and Industries, The Biological and Physical Sciences in Agriculture, Resource and Community Development, and the Food Science and Industries curricula list “area of emphasis” designations. Since these terms may carry several meanings, the following definitions are provided:

Major—That subject matter grouping at the junior-senior level which, within a program, denotes the general interest area of the student. The major may be developed from courses drawn from one or several departments, with criteria for course selection mainly that the courses utilized in the major relate to each other in meaningful ways and contribute to the achievement of the program objectives.

Specialization or Area of Emphasis—Used to designate that department or area most closely identified with the core interest of the student. The major adviser at the junior-senior level will usually be working in the specialization or area of emphasis. This designation aids in describing the nature of the student's program formulation and will be useful to placement contacts. Certain of the majors at the junior-senior level are not subdivided into specializations or areas of emphasis, while others are.

A. PROGRAMS IN AGRICULTURE

1. Agricultural Business Administration

This program is offered jointly with the School of Business Administration. It is designed to prepare students for employment as managers, administrators, or managerial-related positions in agri-business. 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 the business organization and management principles as they relate to agricultural businesses and industries involved in the manufacturing and supplying of inputs to farm production (feed, seed, fertilizers, machinery, equipment, pharmaceuticals), and the assembling, processing, and distribution of food and fiber products. The program includes a professional balance between agricultural 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 accommo-

Curricular Programs

date 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 School 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 and Suggested Courses for AGRICULTURAL BUSINESS ADMINISTRATION

A. Communication, Language, Symbolic Systems—28 credits

English, Communication (8)

Rhet 1-101, 1-102

Public Speaking (4)

Rhet 1-222

Professional Writing or Scientific and Technical Writing (3)

Rhet 3-551 or 3-562 plus 3 credits to be chosen from among 3-254, 3-256, or 5-561

Mathematics (10)

College Algebra and Analytic Geometry (5)

Math 1-141 or Math 1-441

Introduction to Calculus (5)

Math 1-142 or Math 1-442, 1-443

B. Physical and Biological Sciences—20 credits

Credits to be selected from the following: BioC 1-301, 1-302; Biol 1-011; Bot 1-001; Zool 1-013; Ecol 1-004; Chem 1-004, 1-005; Geo 1-001; MicB 3-103; Phys 1-031, 1-032

C. Man and Society—15 credits

Sociology (4)

Soc 1-001 or 1-651

Psychology (5)

Psy 1-001

Plus 6 credits in social science areas:

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

D. Artistic Expression—8 credits

Rhet 1-301, 1-302 or courses from complete CLE list of suggested courses

E. Economic and Accounting Principles—18 credits

AgEc 1-020, 1-030 (9)

Acct 1-024, 1-025, 1-026 (9)

F. Quantitative Analysis—5 credits

QA 3-050

Agricultural Science and Industries

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—12 credits

Econ 3-101, 3-102 plus 4 credits to be chosen from among Econ 3-851, 3-651, 5-331, 5-431 (3-751 may be taken by finance-oriented students)

I. Agricultural Economics—21 credits

AgEc 1-400, 3-500, 3-710, plus 8 credits in other agricultural economics

J. Business Administration—21 credits

BLaw 3-058, Tran 3-054, Mgmt 3-001, IR 3-002 plus 9 credits from among the following: Mktg 3-000, Ins 3-100, IR 3-010, BFin 3-000, Prod 3-050, Mgmt 3-004 (Mgmt 3-004 may be chosen as an elective only if students have taken BFin 3-000 and Prod 3-050)

K. Free Electives—24 credits

Recommended: PubH 1-001 or 3-001, Rhet 3-562, 3-254, or 3-256, selected courses from the CLE general education list of courses, other courses from agricultural economics, economics, and School of Business Administration.

TOTAL CREDITS—192

2. Agricultural Science and Industries

This curriculum includes agricultural and related sciences which serve as preparation for careers in the production, processing, marketing, and distribution of agricultural and horticultural commodities. Most graduates of this program enter some type of commercial employment in agricultural production and related phases of business upon receipt of the bachelor of science degree. The program provides an excellent background for farm operation or farm management.

Some positions illustrative of career opportunities available to graduates of this program include those of field men for agricultural production concerns, landscape and nurserymen, florists, technical sales representatives, information specialists in power machinery and farm structures, agricultural extension, vocational agriculture instruction, regulatory and control activities, various U.S. government services, marketing and distribution specialists, farm managers, and positions in the agricultural credit and finance fields.

Students enrolling in this program will establish a foundation in the biological and physical sciences. This training will permit them to adapt and apply biological, physical, and economic principles to problems encountered in agricultural production and the management of allied industries. Graduates of the Agricultural Science and Industries program can move into graduate study if a wise selection of their electives is made. However, students following this program and deciding late in their undergraduate careers to continue in ad-

Curricular Programs

vanced study may need to take additional course work in selected areas before being admitted to a full graduate program.

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 professional agriculture. The additional requirements in *Man and Society* and *Artistic Expression* serve to broaden the educational background of the student in the areas of the social sciences and literature and the arts to better equip the student to make his contribution to society and to his personal well-being once the degree is obtained.

The breadth of course work possible in this curriculum (one third of credits are elective) provide the student with an opportunity to evaluate the resources of the College of Agriculture with a view to selecting a major and an area of specialization in a subject matter discipline of interest to the student. Considerable flexibility in programming is provided in order to accommodate levels of preparation, aptitudes, and interests of incoming students. Each student should work out a program of study within this curriculum in consultation with an adviser in the major field of study selected.

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.

Program Requirements and Suggested Courses for AGRICULTURAL SCIENCE AND INDUSTRIES

A. Communication, Language, Symbolic Systems—20 credits

- English, Communication (8)
Rhet 1-101, 1-102
- Public Speaking (4)
Rhet 1-222
- Professional Writing or Scientific and Technical Writing (3)
Rhet 3-551 or 3-562
- Mathematics (5)
Math 1-111 (College Algebra)

B. Physical and Biological Sciences—38 credits

- General Chemistry (10)
Chem 1-004, 1-005
- Organic Chemistry (5)
BioC 1-301
- Biochemistry (4)
BioC 1-302
- Biology (9-10)
Biol 1-011 (5) and one of the following:
Bot 1-001 (5), Ecol 1-004 (4), or Zool 1-013 (4)
- Microbiology (5)
MicB 3-103
- Physics (5)
Phys 1-031

Agricultural Science and Industries

C. Man and Society—15 credits (not more than two courses in any one discipline, e.g., history, economics, etc.)

The Analysis of Human Behavior and Institutions

AgEc 1-020 (5)

The Development of Civilization: Historical and Philosophic Studies

D. Artistic Expression—8 credits

Literature

Arts

E. Requirements in the Major

See major

F. Electives

TOTAL CREDITS—192

THE MAJOR

In addition to the general and specific requirements previously listed in this curriculum a student must complete a major in an academic discipline from among the following: agricultural economics, agricultural education, agricultural engineering technology, animal science, plant and animal protection, or plant and soil science. A minimum of 36 credits is required for a major. The pattern of study developed to achieve this minimum requirement may be made up 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. Course requirements for each major are described below. Areas of specialization within the major permit greater contribution of study in specialized disciplines.

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 on economic or business management aspects 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 variations in 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 micro), 18 credits in economics and/or agricultural economics beyond principles, 4 credits in accounting, 3 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 11 credits from one of these

Curricular Programs

three agricultural science areas can be used as an area of emphasis within the agricultural economics major to fulfill the 36-credit requirement for the major. In the Man and Society areas, a minimum of 15 credits in addition to economic principles are required.

Agricultural Education

The agricultural education major, offered jointly with the College of Education, is designed for students who plan to teach agriculture or horticulture in public schools, area vocational technical schools, and junior colleges in the communities of Minnesota. Agricultural extension workers and others preparing for professional careers in agriculture or for farming may find the agricultural education major appropriate to their needs. Agricultural education provides comprehensive training in technical agriculture and permits emphasis in such fields as animal science, agronomy, agricultural economics, horticulture, soils, and agricultural engineering technology. In addition, it offers the special training in education needed to qualify students for certification as agriculture or horticulture instructors.

In the third quarter of the sophomore year, students should make application for joint registration in the combined curricula of the College of Education and the College of Agriculture. To be eligible for joint registration a student must have a GPA in technical agriculture courses of 2.30 and an overall GPA of 2.00. In addition to grade requirements, speech, health, and psychological clearances must be obtained and a satisfactory recommendation received from the student's adviser and others.

Students wishing to major in agricultural education must:

1. Have satisfactory agricultural or horticultural background.
2. Complete the student teaching requirement.
3. Earn a minimum of 204 credits for graduation (200 credits for the horticulture specialization). A minimum of 80 credits must be in technical agriculture.
4. Complete the following courses (students may wish to take exemption examinations or special examinations for credit in certain of the listed required courses) in addition to the minimum CLE requirements listed for the Agricultural Science and Industries curriculum.

COMMON REQUIREMENTS FOR ALL AGRICULTURAL EDUCATION SPECIALIZATIONS

Education and Related Courses

Psy 1-001, 1-002—General Psychology
Educ 3-155—Introduction to Secondary School Teaching
PubH 1-001 (or 3-001)—Individual, Public Health
AgEd 1-001—Introduction to Agricultural Education
AgEd 1-010—Rural Education, Community Leadership
AgEd 3-020—Rural Education Through Extension Methods
AgEd 3-030—Teaching Agriculture in Public Schools
AgEd 3-031—Student Teaching
AgEd 5-060—Planning Programs
AgEd 5-050—Adult Education in Agriculture

Agricultural Science and Industries

Technical Agriculture Courses

- Soil 1-122—Introductory Soils
- PIPa 1-001—Introductory Plant Pathology
(or) PIPa 3-050—Forest Pathology
- Hort 1-001—Fundamentals of Horticulture
- Ent 1-005—Economic Entomology

SPECIAL REQUIREMENTS FOR AGRICULTURAL EDUCATION SPECIALIZATION

Education and Related Courses

- AgEd 5-040—Young Farmer Education in Agriculture

Technical Agriculture Courses

- AnSc 1-100—Introduction to Animal Science
 - AnSc 1-520—Milk Production
 - AnSc 1-401—Principles of Animal Nutrition
 - Agro 1-010—Principles of Agronomy
 - AgEc 1-030—Principles of Micro-Economics
 - AgEc 5-800—Farm Records and Business Analysis
 - AgEc 3-820—Farm Management Economics
 - Hort 3-032—Vegetable Science (may substitute for Hort 1-001)
 - AgEn 1-020—Agricultural Shop—Metalwork
 - AgEn 5-020—Program Planning and Instructional Methods in Agricultural Mechanics
- 9 credits selected from:

- AgEn 3-605—Structures and Environmental Processes
- AgEn 3-215—Machinery and Equipment
- AgEn 3-205—Power and Power Use
- AgEn 3-800—Rural Sanitation and Water Supply
- AgEn 3-410—Hydrology, Water Control
- AgEn 3-405—Soil and Water Management
- AgEn 3-606—Layout and Management of Animal Enterprise Systems
- AgEn 1-010—Technical Drawing
- AgEn 1-400—Surveying
- AgEn 5-810—Ag Waste Management

Recommended electives from the areas of soils, agronomy, horticultural science, animal science, veterinary medicine, agricultural economics, food science, forestry, agricultural journalism, entomology, agricultural engineering technology, plant pathology.

To be admitted to the College of Education the student must achieve a GPA of at least 2.30 in technical agriculture courses in the following areas: agricultural economics, agronomy, animal science, entomology, food science, forestry, horticulture, agricultural journalism, agricultural engineering technology, plant pathology, soils, and veterinary medicine.

SPECIFIC REQUIREMENTS FOR HORTICULTURAL EDUCATION SPECIALIZATION

Education and Related Courses

- Ed 5-104 may be substituted for AgEd 5-050—Adult Education
- Student teaching may be arranged (6-10 credits)

Technical Agriculture Courses

- PIPh 3-131—Survey of Plant Physiology
- PIPh 3-132—Survey of Plant Physiology Laboratory
- Ent 5-050—Forest Entomology
- AgEn 3-205—Power and Power Use
- Hort 1-016—Greenhouse Management
- Hort 1-036—Plant Propagation
- 18 additional credits in horticulture

Curricular Programs

For admission to the College of Education the student must have an overall GPA of at least 2.00 and 2.30 GPA in technical agriculture courses in the following areas: entomology, forestry, horticulture, agricultural engineering technology, plant pathology, agricultural economics, soils, agronomy, food science, and agricultural journalism.

Students must have had adequate experience in horticulture prior to enrollment or they must be employed the equivalent of 3 months full time in an appropriate occupation before receiving the B.S. degree.

Other Specific Requirements—As a requirement for student teaching and as a minimum qualification for graduation a student must achieve a GPA of 2.30 in courses taken in the areas identified as technical agriculture for purposes of admission to the College of Education.

Students in agricultural education specialization must have 204 credits to graduate; those in horticultural education specialization must have at least 200. A minimum overall GPA of 2.00 is required for graduation.

Supporting Fields in Agricultural Education Majors—Students majoring in agricultural education may choose to concentrate in supporting courses in an agriculture department. Such a supporting field consists of 18 credits exclusive of introductory courses. For courses approved as supporting fields in agriculture, consult the various agriculture departments. For minors in high school teaching subjects, see the *College of Education Bulletin*.

A 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. Students selecting a supporting field in agricultural education will not obtain a pattern of courses that will permit their being recommended for a teaching certificate.

It is recommended that Psy 1-001 and 1-002 be completed before entering the supporting sequence. A minimum of 18 credits may be selected from the following: AgEd 1-010, 3-020, 3-030, 5-040, 5-050, 5-060, 5-051, 5-070, 5-071, 5-032, 5-034. Other courses may be supported and approved by the adviser in agricultural education.

Agricultural Engineering Technology

The Agricultural Engineering Technology major provides areas of emphasis in the utilization and development of machines, equipment, structures, and processes for the management of soils, plants, animals, water, and wastes. The program can emphasize either the management or the technology of production, storage, processing, and marketing of agricultural products, but usually is a desirable combination of both. A good background is developed in the physical sciences and in principles derived from engineering sciences. Courses utilizing this important background and knowledge from agricultural, biological, and social sciences help students learn to develop useful solutions to problems facing society today.

Each student develops his own program in cooperation with his faculty adviser. The program requirements and suggested courses (page 59) comprise the foundation upon which the program is built. The student may take a number of courses in another discipline to give it secondary emphasis or he

Agricultural Science and Industries

may take courses in several other disciplines. Example programs are available from the department. Students interested in an engineering degree can enter either in the Physical and Biological Sciences in Agriculture program or directly into the Agricultural Engineering program through the Institute of Technology. Students interested in Soil and Water Resource Management may request an agricultural engineering faculty adviser if they wish to emphasize engineering and technology.

The Agricultural Engineering Department is developing an intern program with industry and public agencies in which the student can have the opportunity to use his educational experience to solve real problems.

Animal Science

Courses are offered that pertain to the production of beef and dairy cattle, chickens, horses, swine, turkeys, and various animal products. Students majoring in animal science may choose a broad program or a program closely related to one subject matter area (nutrition, breeding, physiology, or management). Courses that are required of all animal science majors are AnSc 1-100, 1-300, 1-401, 1-500, 3-220, 5-703, one 4-credit production course (5-601, 5-602, 5-603, 5-604, or 5-605) and GCB 3-022.

This program allows a minimum number of elective courses; thus a student has the opportunity to develop a program that conforms to his interests and aptitudes. Elective courses from agronomy, soils, agricultural engineering technology, agricultural economics, food science, and other areas help to provide a broad education for the student.

Plant and Animal Protection

Students interested in studies emphasizing problems relating to insects, weeds, and diseases in plant and animal production may elect plant and animal protection as their major. No areas of specialization will be designated within this major. Changes in courses scheduled for the major will be made to accommodate student needs and interests. Courses required of all students in this major include: plant pathology (6 credits); entomology (17 credits); veterinary medicine (5 credits); agronomy (3 credits); and soil science (3 credits).

Plant and Soil Science

Students whose major interests lie in the production, management, and improvement of field and horticultural crops and/or in the area of soil and water management, conservation, fertility, or morphology and mapping should elect plant and soil science as their major. Required courses in this area are designed to give students a broad basic understanding of plant and soil science. A course in genetics, soil science, plant physiology, biometrics, and plant pathology is required of all students in this major. Students should select an area of specialization from among the following in which to pursue their studies: agronomy and plant genetics, horticultural science, soil science.

3. Biological and Physical Sciences in Agriculture

This program is designed to provide a thorough preparation in biological and physical sciences for professional opportunities that are available at the Bachelor's degree level, to provide a broad and fundamental scientific base, to prepare a student for graduate studies, and to provide a sound base for appreciation of cultural, socio-economic, and international problems involving science in agriculture.

A student in this program will have opportunity to explore the several specialized disciplines in agricultural biology and physical science. He will acquire a scientific base sufficiently sound as to permit him to adjust to many professional pursuits if he chooses to terminate his education with a Bachelor's degree. This program will enable the graduate to perform as a laboratory or field technician and junior scientist. It will also orient him to the technical aspects of products should he choose, for example, technical sales or development work with agricultural chemicals, feeds, fertilizers, and/or other products.

This program has a central objective of preparing a student for graduate work. Its emphasis upon the biological and physical sciences will permit the student to move immediately from the B.S. degree into a graduate program in plant science, soil science, animal science, food technology, biochemistry, biometrics, genetics, microbiology, nutrition, and other areas. The undergraduate program does, therefore, give emphasis to mathematics, physics, chemistry, botany, zoology, microbiology, and genetics.

The program desires to provide the graduate with an awareness of the impact of agriculture on human activities. Hence the general education aspects of the curriculum are considered to be of basic importance in achieving curriculum objectives.

Program Requirements and Suggested Courses for BIOLOGICAL AND PHYSICAL SCIENCES IN AGRICULTURE

A. Communication, Language, Symbolic Systems—33 credits

English, Communication (8)
Rhet 1-101, 1-102

Scientific and Technical Writing (3)
Rhet 3-562

Public Speaking (4)
Rhet 1-222

Mathematics

College Algebra (5)
Math 1-141 or 1-441

Introduction to Calculus (5)
Math 1-142

One of the following sequences:

Math 1-443, 1-444¹ (calculus—10 cr)
Stat 5-021, 5-022 (statistics—8 cr)

¹ Students planning to enter the Graduate School should take Math 1-443, 1-444.

B. Physical and Biological Sciences—80 credits

- General Chemistry (14)
Chem 1-004, 1-005, 1-006
- Organic Chemistry (10)
Chem 3-301, 3-302
- Biology (9-10)
Biol 1-011 and Bot 1-001 or Zool 1-013
- Physiology (select one of the following):
 - Plant Physiology (5)
PIPh 3-031, 3-032
 - Systemic Physiology (6)
AnSc (VPP) 1-300
- Physics (15)
Phys 1-040, 1-050, 1-060
- General Microbiology (5)
MicB 3-103
- Genetics (4)
GCB 3-022
- Biochemistry (8)
BioC 5-001, 5-002²
- Introduction to Soil Science (4)
Soil 1-122

C. Man and Society—15 credits

- Economics (5)
AgEc 1-020
- Plus at least 10 credits in social science areas (anthropology, history, geography, political science, etc.—see CLE list of suggested courses)

D. Artistic Expression—10 credits

- Humanities (10)
Rhet 1-301 and 1-302 or 1-303

E. Technical Electives—40 credits

The technical electives must be used to satisfy the requirements of the major and areas of emphasis (animal science, plant and soil science, or food science) as developed in consultation with department adviser.

F. Electives—8 credits

TOTAL CREDITS FOR PROGRAM—186

4. Fisheries and Wildlife

The fisheries and wildlife curricula are designed to offer students essential basic training in the biological and physical sciences and 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

² Students who plan to take biochemistry as a minor in graduate programs are advised to substitute analytical chemistry, physical chemistry, or additional organic chemistry for BioC 5-001, 5-002.

Curricular Programs

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.

REQUIREMENTS

Pre-Fisheries and Wildlife Curriculum Status

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 freshman and transfer students to establish (a) definite curriculum goals projecting 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: Completion of 90 quarter credits with a grade point average of 2.30 or better, including completion of the following specific courses or their equivalents:

Rhet 1-101 and 1-102; FW 0-001; Biol 1-011, Bot 1-001 and Zool 1-013; Math 1-141 or 1-411; Phys 1-031, 1-032; Chem 1-004 and 1-005; VAna 1-120 (Developmental Anatomy); and Ecol 3-004.

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 years. A Graduate Study Preparation Option is available in fisheries (page 30). Courses should be taken as scheduled according to class year as closely as possible.

College Man and Society Requirement—15 credits in the social sciences, not more than two courses in any one discipline to be applied. (See Man and Society requirement.)

College Artistic Expression Requirement—8 credits in humanities, literature, and the arts. The Rhet 1-301 and 1-302 or 1-303 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 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 equivalent.

Grade Point Average Requirements for Graduation

Specific grade point average requirements for graduation with a major in fisheries or wildlife are as follows:

A minimum overall cumulative GPA of 2.30.

A minimum GPA of 2.50 for science courses required in the junior and senior years for the respective fisheries and wildlife majors including courses in animal science, biochemistry, statistics, botany, chemistry, ecology, entomology, fisheries and wildlife, forestry, mathematics, microbiology, veterinary medicine, and zoology.

Program Requirements and Suggested Courses for
FISHERIES AND WILDLIFE
(Freshman and Sophomore Years)

A. Communication, Language, Symbolic Systems—17 credits

English, Communication (8)

Rhet 1-101, 1-102

Public Speaking (4)

Rhet 1-222

Pre-Calculus (5)

Math 1-141 or 1-411**

B. Physical and Biological Sciences—56 credits

Fisheries and Wildlife Orientation (0)

FW 0-001

Biology (14)

Biol 1-011, Bot 1-001, and Zool 1-013

General Chemistry (10)

Chem 1-004, 1-005

Geology (5)

Geo 1-001

Physics (10)

Phys 1-031, 1-032

Soils (4)

Soil 1-222

Genetics (4)

GCB 3-022

Ecology (4)

Ecol 3-004

Anatomy (5)

VAna 1-120

C. Man and Society—10 credits

Economics (5)

AgEc 1-020

American Government, Politics (5)

Pol 1-001

** Additional calculus is recommended but not required—Math 1-411, 1-421, and 1-431 would provide an excellent mathematics background.

Curricular Programs

D. Artistic Expression—8 credits

See complete CLE list of suggested courses

TOTAL CREDITS—93

Program Requirements and Suggested Courses for FISHERIES

(Junior and Senior Years)

A. Communication, Language, Symbolic Systems—8 credits

Professional Writing or Scientific and Technical Writing (3)

Rhet 3-551 or 3-562

Statistics (5)

Stat 3-081

B. Physical and Biological Sciences—55-56 credits

Advanced Chemistry (9)

Chem 1-006 (4)

Chem 3-100, 3-101 (5)

Algae (5)

Bot 5-231 or 5-811¹

Limnology (4-5)

Geo 5-601 or Ecol 5-812¹

Entomology (5)

Ent 3-175 or 5-020¹

Aquatic Invertebrates

Zool 5-814¹ or Ent 5-130¹

Ichthyology (3)

Zool 5-121

Microbiology (5)

MicB 3-103

Animal Physiology (6)

AnSc 1-300

Fisheries and Wildlife (13)

FW 5-451, 5-452, 5-453, 5-678

C. Man and Society—5 credits elected

See complete CLE list of suggested courses

D. Artistic Expression

If requirement not yet fulfilled

E. Other Requirements—7 credits

Technical Drawing (3)

AgEn 1-010

Surveying (4)

AgEn 1-400

Summer Field Requirement (see page 26)

¹ Course offered at Lake Itasca Forestry and Biological Station during Summer Session.

F. Electives

Recommended elective courses in fisheries: Stat 5-061 (Computers); Bot 3-131, 3-132 (Plant Physiology); Bot 5-812¹ (Aquatic Plants); Ecol 5-814² (Ecosystems); FW 5-280 (Seminar); For 5-233 (Recreation Design); For 5-259 (Recreation Amenities); GCB 3-025 (Genetics Lab); AgEn 3-400 (Sanitation, Water Supply); AgEn 3-410 (Hydrology, Water Control); AgEn 5-000 (Radioisotope Measurements); Chem 3-301, 3-302 or BioC 1-301, 1-302 (Organic Chemistry, Biochemistry); PIPa 5-103¹ (Aquatic Fungi); Zool 5-093 (Animal Parasitology); Zool 5-116 (Population Dynamics); Stat 5-021, 5-022 (Statistical Analysis I, II); Math 1-421, 1-431 (Calculus)

TOTAL CREDITS—198

Program Requirements and Suggested Courses for
WILDLIFE
(Junior and Senior Years)

A. Communication, Language, Symbolic Systems—8 credits

Professional Writing or Scientific and Technical Writing (3)
Rhet 3-551 or 3-562
Statistics (5)
Stat 3-081

B. Physical and Biological Sciences—57-62 credits

Advanced Chemistry (9-10)
Chem 3-301, 3-302 or BioC 1-301, 1-302
Plant Taxonomy (7-8)
Bot 3-201
Bot 5-205, 5-805¹, 5-801¹
Plant Physiology (3)
Bot 3-131
Animal Physiology (6)
AnSc 1-300
Mammalogy (4)
FW 3-227
Ornithology (5)
Zool 5-077 or Zool 5-834¹
Plant Ecology (5)
Ecol 5-014 or 5-814¹
Animal Ecology (3-5)
Ent 5-400 or Ecol 5-814¹
Wildlife Diseases, Parasites (3)
VPaP 5-103 or 5-104
Fisheries and Wildlife (12)
FW 5-551, 5-552, 5-678

C. Man and Society—5 credits elected

See complete CLE list for suggested courses.

¹ Course offered at Lake Itasca Forestry and Biological Station during Summer Session.

Curricular Programs

D. Artistic Expression

If requirement not yet fulfilled

E. Other Requirements—4 credits

Air Photo Interpretation (3)
For 5-200

Seminar: Wildlife (1)
FW 5-281

Summer Field Requirement (see page 26)

F. Electives

Recommended elective courses in wildlife: AnSc 1-401 (Animal Nutrition); AnSc 5-311 (Physiology of Reproduction); Stat 5-061 (Computers); Bot 3-132 (Plant Physiology Lab); Ecol 5-812¹ or Geo 5-601 (Limnology); Ecol 5-015 (Ecosystems); Ecol 5-016 (Plant Geography); Ent 3-175 or 5-020¹ (Entomology); FW 5-451 (Fish Populations); For 1-100 (Dendrology); For 3-203 or Geog 5-421 (Climatology); For 5-230 (Forest Fire); For 5-231 (Range Management); For 5-233 (Recreation Design); For 5-259 (Amenities Lands); GCB 3-025 (Genetics Lab); Ger 1-101, 1-102² (Beginning German); Math 1-421, 1-431² (Analytic Geometry, Calculus); AgEn 1-010 (Technical Drawing); AgEn 1-400 (Surveying); VAna 5-250 (Embryology); Zool 5-071 (Invertebrate); Zool 5-116 (Population Dynamics); Zool 5-121 (Ichthyology).

TOTAL CREDITS—198

GRADUATE STUDY PREPARATION OPTION IN FISHERIES

Students with high competence and whose educational objective is toward research or university teaching may, after completing the Lower Division requirements with a B average, elect the following option in the junior 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 5-393, 5-394, 5-395, 5-396) 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.

¹ Course offered at Lake Itasca Forestry and Biological Station during Summer Session.

² Recommended for students planning to continue with graduate study.

Fisheries and Wildlife

Program Requirements and Suggested Courses for FISHERIES-GRADUATE STUDY PREPARATION OPTION (Junior and Senior Years)

A. Communication, Language, Symbolic Systems—28 credits

- Professional Writing or Scientific and Technical Writing (3)
Rhet 3-551 or 3-562
- Statistics (5)
Stat 3-081
- Language (10)
Ger 1-101, 1-102, or Russ 1-101, 1-102
- Calculus (10)
Math 1-421, 1-431

B. Physical and Biological Sciences—38-39 credits

- Organic Chemistry (10)
Chem 3-301, 3-302
- Microbiology (5)
MicB 3-103
- Animal Physiology (6)
AnSc 1-300
- Limnology (4-5)
Ecol 5-812¹ or Geo 5-601
- Fisheries and Wildlife (13)
FW 5-451, 5-452, 5-453, 5-678

C. Man and Society—5 credits

D. Artistic Expression

If requirement not yet fulfilled

E. Other Requirements—11 credits

- Seminar: Fisheries (1)
FW 5-280
- Research Project (10)
FW 5-393, 5-394, 5-395, 5-396
- Summer Field Requirement (see page 26)

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 of fisheries. Courses may include such subjects as analytic chemistry, aquatic ecology, ichthyology, algae and aquatic plants, entomology, etc.

TOTAL CREDITS—198

¹ Course offered at Lake Itasca Forestry and Biological Station during Summer Session.

5. Food Science and Industries

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, preservation, and marketing situations. The food scientist and food technologist are concerned with the theoretical and practical aspects of the food industry which encompasses the food chain from production of the raw material to the ultimate utilization of the product by the consumer. Therefore, a curriculum 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 curriculum 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 curriculum provides the student with attitudes, knowledge, and skill essential for an understanding of the principles of food science. Many graduates of the curriculum 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 opportunities 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 synthesize new foods from unconventional ingredients. The students educated in this curriculum will acquire the ability to recognize and critically analyze problems of the food industry and to arrive at solutions through the application of the principles of 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.

Program Requirements and Suggested Courses for FOOD SCIENCE AND INDUSTRIES

A. Communication, Language, Symbolic Systems—20 credits

English, Communication (8)

Rhet 1-101, 1-102

- Public Speaking (4)
Rhet 1-222
- Exposition or Technical Writing (3)
Rhet 3-551, Rhet 3-562
- College Algebra and Analytical Geometry (5)
Math 1-141 or Math 1-441
- (or) Introduction to Calculus (5)
Math 1-442, 1-443

B. Physical and Biological Sciences—39 credits

- General Chemistry (10)
Chem 1-004, 1-005
- Organic Chemistry** (5)
BioC 1-301
- Biochemistry** (4)
BioC 1-302
- Physics (10)
Phys 1-030, 1-032
- Biology (5)
Biol 1-011
- General Microbiology (5)
MicB 3-103

C. Man and Society—14 credits

See complete CLE list of suggested courses

D. Artistic Expression—8 credits

See complete CLE list of suggested courses

TOTAL CREDITS—186

Most of the courses under categories A and B, except Rhet 3-551, should be taken during the freshman and sophomore years. Courses referred to under categories C and D should be distributed over all 4 years.

MAJOR COURSE REQUIREMENTS

Students majoring in Food Science and Industries take the following courses:

- FScI 3-110—Food Process Chemistry (5)
- FScI 3-135—Food Process Engineering (5)
- FScI 5-120—Food Microbiology (5)
- FScI 5-122—Sanitation, Process Microbiology (4)

In addition to the above core courses, a minimum of 17 credits from among the following courses:

General Courses

- FScI 1-010—Man's Food (3)

** Students interested in chemistry, microbiology, and nutrition areas of interest may substitute Chem 3-301, 3-302, and BioC 5-001, 5-002.

Curricular Programs

Functional Courses

- FScI 5-100—Food Industries Literature Seminar (2)
- FScI 5-310—Advanced Food Chemistry Topics (4)
- FScI 5-320—Advanced Dairy and Food Microbiology (4)
- FScI 5-321—Special Problems in Dairy and Food Microbiology (1-5)
- FScI 5-311—Special Problems in Food Chemistry (1-5)
- FScI 5-350—Food Formulation and Product Development (4)
- FScI 5-360—Sensory Testing (2)
- FScI 5-380—Food Packaging (3)

Processing and Product-Oriented Courses

- FScI 1-500—Meat Science (4)
- FScI 1-520—Milk Production (3)
- FScI 5-510—Muscle Chemistry and Physiology (4)
- FScI 5-512—Meat Chemistry and Processing (4)
- FScI 5-522—Principles of Dairy Processing I (4)
- FScI 5-523—Principles of Dairy Processing II (3)
- FScI 5-524—Judging Dairy Products (1)
- FScI 5-530—Industrial Processing of Fruits and Vegetables (4)
- FScI 5-555—Freezing and Dehydration of Foods (4)
- FScI 5-561—Supervised Industry Practice (4)
- FScI 5-571—Special Problems in Food Manufacturing (1-5)
- FScI 5-581—International Food Technology (3-5)

AREAS OF EMPHASIS

In addition to the previously defined course requirements, each student must select one of the following areas as well as sufficient electives to meet the 186-credit requirement for graduation.

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 3-100, 3-101—Quantitative Analysis (5)
- Chem 1-006—Solution Chemistry (4)
- Chem 3-301, 3-302—Elementary Organic Chemistry (10)
- Chem 5-120, 5-121—Elementary Physical Chemistry (6)
- BioC 5-001, 5-002—Introduction to Biochemistry (8)

Industrial Engineering

The food industrial engineer is concerned with the application to the food industry of quality control, production programming, inventory control, work simplification, time and motion studies, plant location and layout, technical management, decision making, and computer use. This area of emphasis is designed for the student with competence and interest in this facet of the food industry. The following courses are to be taken in addition to the previously listed requirements:

- Math 1-142—Calculus (5)
- ME 3-720—Introduction: Engineering Analysis (3)
- Stat 3-092—Introduction: Probability, Statistics (3)

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 problem 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 1-020, 1-030—Introduction to Economics, Principles of Macro-Economics, Principles of Micro-Economics (9)
(or) Econ 1-001, 1-002—Principles of Macro-Economics, Principles of Micro-Economics (7)
Statistics (3-4 credits)

At least 20 credits from course offerings in the Department of Agricultural Economics, the Department of Economics, and the School 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 areas must be selected and usually include the following:

Chem 3-301, 3-302—Elementary Organic Chemistry (10)**
BioC 5-001, 5-002—Introduction to Biochemistry (8)**
MicB 5-321—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 1-002—Human Physiology (4)

About 20 credits of nutrition-oriented course offerings in home economics, biochemistry, animal science, and related areas.

Public Health

This area of emphasis provides the necessary background for the variety of activities of the sanitarian in either government or industrial employ related to the regulatory and quality control of raw materials and finished products in the food field. At least 20 credits 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 his adviser, a student may set up a course of study designed to meet specific requirements in another area of emphasis or

**Recommended to replace BioC 1-301 and 1-302.

Curricular Programs

a combination of suggested areas. Examples include advertising, journalism, sales, mechanical engineering, statistics, and experimental design.

6. Resource and Community Development

The program in Resource and Community Development prepares students for careers in resource development: community development; public land use; rural and urban zoning; conservation; recreation; resource economics and sociology; environmental design; landscape architecture; and related 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 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 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 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, 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 development, regional economics, or planning.

Program Requirements and Suggested Courses for RESOURCE ECONOMICS

A. Communication, Language, Symbolic Systems—29 credits

English (8)

Rhet 1-101, 1-102

Public Speaking (8)

Rhet 1-222 and 3-254 or 3-256

Resource and Community Development

Professional Writing (3)

Rhet 3-551

Mathematics (10)

Math 1-141, 1-142, or 1-442, 1-443

B. Physical and Biological Sciences—31-33 credits

Chemistry (10)

Chem 1-104 and 1-105

Biology (13-14)

Biol 1-011 and Bot 1-001 or Zool 1-013

Ecol 3-004

Physics, or Geology and Soils (8-9)

Phys 1-010, 1-015, 1-020, 1-025, or Geo 1-001 and Soil 1-122

C. Man and Society—21 credits

Sociology (4)

Soc 1-001 or 1-002

Agricultural Economics (9)

AgEc 1-020, 1-030

Other Social Sciences (8)

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

D. Artistic Expression—8 credits

See complete CLE list of suggested courses

E. Resource Economics—40 credits

Agricultural Economics (20)

In agricultural economics, AgEc 1-250 and 5-010 may not count toward this requirement; no more than one marketing course beyond AgEc 1-400 will count toward this requirement; AgEc 5-620 and 5-630 are strongly recommended for those who qualify.

Economics (16)

Econ 3-101, 3-102, 3-851 and one other course

Planning (4)

Soc 5-611

F. Techniques of Analysis—17-19 credits

Statistics (8)

Stat 5-021, 5-022

Other (9-11)

Choose from among Geog 3-970, 3-281, 3-511, 5-511, 5-512; AgEc 1-400; Law 5-003; ChEn 5-403; AgEc 1-250, 5-010; Stat 5-201, 5-300; Math 1-443, 1-444; Phil 1-001

G. Resource and Community Development—15 credits

AgEc 3-610; Soc 5-651 or 5-401

RCD 5-100, 5-101

H. Electives—27-31 credits

Recommended courses: Soc 5-301, 5-401, 5-655, 5-651; Pol 5-315, 5-316, 5-317, 5-318; Geog 3-341, 5-371, 5-375, 5-381, 5-391; PubH

Curricular Programs

3-151, 5-002, 5-151; For 1-201, 5-200, 5-212, 5-102, 5-250; AgEn 3-410; Geo 1-001; RCD 5-110; Soil 1-122; Ecol 3-001; FW 3-050; PA 5-256, 8-130, 8-140, 8-241, 8-501. Other courses in agricultural economics, mathematics, economics and statistics also suggested.

TOTAL CREDITS FOR PROGRAM—192

Recreation Resource Management

The recreation resource management major is designed to train recreation specialists for the broad area of recreation resource planning and management involving land and water areas. The program provides the background necessary for participation in the expanding county, regional, state, and federal resource-oriented recreation programs. Students who complete this program may elect graduate study in more specialized training areas.

Program Requirements and Suggested Courses for RECREATION RESOURCE MANAGEMENT

A. Communication, Language, Symbolic Systems—33 credits

- English (8)
 - Rhet 1-101, 1-102
- Public Speaking (4)
 - Rhet 1-222
- Professional Writing or Scientific and Technical Writing (3)
 - Rhet 3-551 or 3-562
- Discussion Methods or Advanced Public Speaking (4)
 - Rhet 3-254 or 3-256
- Mathematics (10)
 - Math 1-141
 - Math 1-142
- Statistics (4)
 - Stat 5-021

B. Physical and Biological Sciences—58 credits

- Chemistry (10)
 - Chem 1-004, 1-005
- Biology (5)
 - Biol 1-001 (5)
- Botany (5)
 - Bot 1-001
- Ecology (7)
 - Ecol 3-004, 5-014
- Physics (10-12)
 - Phys 1-031, 1-032 (10)
 - (or) Phys 1-010, 1-015, 1-020, 1-025, 1-030, 1-035 (12)
- Geology (5)
 - Geo 1-001

Resource and Community Development

- Forestry (7)
 - FRD 1-201 (3)
 - FBio 1-100 (4)
- Horticulture (4)
 - Hort 1-021
- Soils (4)
 - Soil 1-122

C. Man and Society—36 credits

- Sociology (12)
 - Soc 1-001 and 1-002 or Pol 1-041
 - Soc 5-201, 5-401 or 5-651
- Economics (9)
 - AgEc 1-020, 1-030
- Geography (5)
 - Geog 1-401 or 1-301
- Recreation (5)
 - Rec 1-520 or 5-130 or 5-150
- Psychology (5)
 - Psy 1-001

D. Artistic Expression—8 credits

- Horticulture (4)
 - Hort 1-024

See complete CLE list of suggested courses

E. Recreation Resource Management—13 credits

- Forestry (10)
 - FRD 5-232, 5-233 (7)
 - FRD 5-257 or 5-259 (3)
- Fisheries and Wildlife (3)
 - FW 3-050

F. Technical Background—11 credits

- Surveying (4)
 - AgEn 1-400
- Hydrology (4)
 - AgEn 3-410
- Aerial Photogrammetry (3)
 - FRD 5-200

G. Resource and Community Development—11 credits

- AgEc 3-610 (4)
- RCD 5-100, 5-101 (7)

H. Electives—22 credits

- RCD 5-110

TOTAL CREDITS FOR PROGRAM—192

Curricular Programs

Soil and Water Resource Management

The objectives of this program are to prepare students for careers in the management of soil and water resources. The student is 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 option may be advised in either the Department of Soil Science or Department of Agricultural Engineering.

Program Requirements and Suggested Courses for SOIL AND WATER RESOURCE MANAGEMENT

A. Communication, Language, Symbolic Systems—20 credits

English (8)

Rhet 1-101, 1-102

Professional Writing or Scientific and Technical Writing (3)

Rhet 3-551 or 3-562

Public Speaking (4)

Rhet 1-222

Mathematics (5)

Math 1-111 or 1-141 or 1-411

B. Physical and Biological Sciences—42 credits

Chemistry (10)

Chem 1-004, 1-005

Biology (10)

Biol 1-011 and Bot 1-001

Ecology (3)

Ecol 3-004

Microbiology (5)

MicB 3-103

Physics (5)

Phys 1-031

Geology (5)

Geo 1-001

Soils (4)

Soil 1-122

C. Man and Society—18 credits

Economics (9)

AgEc 1-020, 1-030

Geography (5)

Geog 1-401

Social Science (4)

Soc 1-001 or 1-002

D. Artistic Expression—8 credits

See complete CLE list of suggested courses

Resource and Community Development

E. Resource and Community Development—11 credits

AgEc 3-610 (4)
RCD 5-100, 5-101 (7)

F. Specialized Courses—43 credits

Drawing (3)
 AgEn 1-010
Surveying (4)
 AgEn 1-400
Agricultural Engineering (12)
 AgEn 3-800, 3-410, 5-400
Soil Science (15)
 Soil 5-220, 5-512, 5-540, 5-240
Forestry (9)
 For 1-201, 5-200, 5-232

G. Electives—50 credits

Soil 5-310, 5-232, 5-520, 5-550; Geo 5-261, 5-601; Geog 5-441, 5-443, 5-743; AgEn 5-810; Hort 3-025; Ent 5-400; Ecol 5-014; RCD 5-110; other with consent of instructor

TOTAL CREDITS FOR PROGRAM—192

Landscape Architecture

This program is organized to provide the basic professional training for practice of landscape architecture and allow for specialization in one of the expanding areas of professional interest. To accomplish this, 103 credits are required in a core sequence of courses taken by all students in the program. Each student then completes 58 credits in one of four options: Site Planning and Design, Urban Landscape Design, Regional Landscape Design, and Recreation Planning and Design. Mathematics, communications, special institute requirements and electives complete the 215-credit program. The student earns the professional degree, bachelor of landscape architecture.

This is an inter-institute program and students may enroll in the Institute of Agriculture or the Institute of Technology. Students registered in the Institute of Agriculture participate in the Resource and Community Development curriculum and usually choose Regional Landscape Design or Recreation Planning and Design for their advanced studies.

Recreation Planning and Design—This option provides an ecological and design base for a broad spectrum of recreation planning and design. The student will develop those skills necessary for designing recreational facilities such as parks, golf courses, ski areas, camp and resort grounds, recreational streams and rivers. County and large area recreation planning will be considered from both the resource and design potential point of view.

Regional Landscape Design—Students in this option will focus on large-scale land areas to analyze the development potential and differentiate land uses such as agricultural, residential, commercial, industrial, recreational and

Curricular Programs

lands for preservation purposes. Students will prepare analyses and develop other special skills related to the large-scale planning process.

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 natural processes toward the arrangement of urban concentration on the land.

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 environmental determinants 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 housing, commercial, industrial, educational, and urban recreational development.

Program Requirements and Suggested Courses for LANDSCAPE ARCHITECTURE (B.L.A. Degree)

A. Communication, Language, and Symbolic Systems—23 credits

- English (8)
Rhet 1-101, 1-102
- Public Speaking (4)
Rhet 1-022
- Professional Writing or Scientific and Technical Writing (3)
Rhet 3-551 or 3-562
- Mathematics (8)
Math 1-008, 1-111

B. Physical and Biological Sciences—23 credits

- Chemistry (5)
Chem 1-004
- Biology (10)
Biol 1-011
Bot 1-001
- Ecology (4)
Ecol 3-004
- Soils (4)
Soil 1-122

C. Man and Society—14 credits

- Economics (5)
AgEc 1-020
- Sociology (4)
Soc 1-001
- Geography (5)
Geog 1-301 or 1-401

D. Artistic Expression—10 credits

- Art or Related Art

Resource and Community Development

E. Professional Studies (Core)—70 credits

- Design and Planning (42)
 - LA 1-022, 1-024, 1-025, 3-081, 3-082, 3-083, 3-091, 3-092
- Ecology and Plant Sciences (12)
 - Hort 1-021, 1-022, 3-074
- Landscape Technology (16)
 - LA 3-071, 3-072, 5-175
 - AgEn 1-400

F. Professional Studies (Option)—58 credits

G. Electives—17 credits

TOTAL CREDITS—215

Recreation Planning and Design Option—58 credits

- Planning and Design (39)
 - RCD 5-100, 5-101
 - LA 5-010, 5-105, 5-106, 5-110
 - Soil 5-540
 - AgEc 3-610
 - Hort 3-099
- Landscape Technology (4)
 - For 5-200
- Ecology and Plant Science (7)
 - FW 3-050
 - Hort 3-076 or PIPa 3-050 or Ent 3-050
- Sociology (4)
 - Soc 5-401 or 5-651
- Related Electives (4)

Regional Landscape Design Option—58 credits

- Planning and Design (43)
 - RCD 5-100, 5-101
 - LA 5-107, 5-108, 5-110
 - Soil 5-540
 - AgEc 3-610
 - Hort 3-099
 - Arch 5-138
- Landscape Technology (4)
 - For 5-200 or LA 3-073
- Sociology (4)
 - Soc 5-401 or 5-651
- Related Electives (7)

Site Planning and Design Option—58 credits

- Planning and Design (42)
 - LA 3-093, 5-101, 5-102, 5-110, 5-115, 5-116, 5-124, 5-262
 - Arch 1-021
 - Art 1-001
- Landscape Technology (8)
 - LA 3-073, 5-126
- Planning and Design Electives (8)

Curricular Programs

Urban Landscape Design Option—58 credits

Planning and Design

LA 3-093, 5-103, 5-104, 5-110, 5-115, 1-021, 1-023

Arch 5-137, 5-138

Landscape Technology (8)

LA 3-073, 5-126

Planning and Design Electives (8)

7. Technical Communication

The major in Technical Communication is designed to develop professional communicators trained for opportunities available at the Bachelor's degree level or to serve as a base for graduate studies in communications. An appreciation of the interrelationships that exist between scientific and humanistic cultures is integral to this major.

Professional communicators must be capable of writing and editing reports, instruction manuals, proposals, advertising brochures, popular and technical articles, and speeches. They must be familiar with the fields of graphics, audio-visual aids, and computer information input and retrieval. Through the use of their elective credits students in the major are expected to achieve enough competency in some engineering or scientific discipline that the goals and methods of science and technology are clear to them. Because a communicator touches many fields in his work, the general education portions of this curriculum are considered particularly important.

Program Requirements and Suggested Courses for TECHNICAL COMMUNICATION

A. Communication, Language, Symbolic Systems—72 credits

English (8)

Rhet 1-101, 1-102

Communication (8)

Choose two courses from the following:

Rhet 1-147, 1-251, 1-506; AgJo 3-530, AgJo 5-534

Public Speaking (12)

Rhet 1-222, 3-254, 3-266

Technical Communication (23)

Rhet 3-562, 5-170, 5-175, 5-561, 5-180

College Algebra and Analytic Geometry (5)

Math 1-111

Statistics (4)

Stat 1-041

Computers (4)

AgEn 5-050

Graphics (8)

AgEn 1-010, Jour 3-221, or Jour 3-156

B. Physical and Biological Sciences—18 credits

- General Chemistry (10)
Chem 1-004, 1-005
- Biochemistry (9)
BioC 1-301, 1-302
- Physics (8)
Phys 1-031, 1-032
- Biology (9)
Biol 1-011, Bot 1-001, or Zool 1-013

C. Man and Society—16 credits

- Sociology (4)
Soc 1-001 or 1-004
- Psychology (8)
Psy 1-001, 1-002
- Plus at least one course from complete CLE course list IIIB to total 16 credits

D. Artistic Expression—27 credits

- Humanities (15)
Rhet 1-301, 1-302, 1-303
Choose 3 courses from the following (12):
Rhet 1-401, 1-442, 1-451, 3-321, 3-322, 3-323, 3-455

E. Electives—47 credits

TOTAL CREDITS—180

B. CURRICULA RELATING TO AGRICULTURE

(Offered Jointly with Other Colleges and in Which Students Register in Other Colleges)

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. This curriculum has the same basic requirements in the physical sciences as other engineering curricula. However, biological sciences also are included, together with specific agricultural engineering topics, because agricultural engineers develop machines, structures, and practices used primarily with living things.

Additional information can 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 given in the *Institute of Technology Bulletin*.

Agricultural Journalism

This curriculum is offered jointly by the College of Agriculture and the School of Journalism 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 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 promotion 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.

The student takes general courses in agricultural science, but the emphasis is upon preparation for technical journalism. Stress is laid also upon economic aspects of agriculture.

Students majoring in agricultural journalism usually register in the College of Agriculture. Ordinarily they will transfer to the College of Liberal Arts during their senior year. They must have their programs of agricultural subjects approved by the adviser in agricultural journalism for the College of Agriculture.

The curriculum requires 180 credits for graduation and leads to the degree of bachelor of arts or bachelor of science. Four different programs are available. They are: (a) news-editorial; (b) advertising; (c) broadcast journalism; and (d) photographic communications sequences. In addition, students may adapt their programs to specialize in science writing, public relations, and other special areas.

LOWER DIVISION

General

- AgEc 1-020—Principles of Macro-Economics (5), and AgEc 1-030—Principles of Micro-Economics (4) (Econ 1-001 and 1-002 may be substituted)
- Rhet 1-101—Communication I (4) and 1-102—Communication II (4) and Rhet 1-222, Public Speaking (4) or equivalent courses in College of Liberal Arts
- Comp 1-027—Advanced Writing (3) or Rhet 3-551—Exposition (3)
- 5 credits in American government or politics
- 5 credits in American history
- Soc 1-651—Rural Sociology (4)
- Jour 1-001—Introduction to Mass Communications (2)
- Jour 1-005—Visual Communications (3)
- Electives in College of Agriculture or College of Forestry to total 15 credits in addition to AgEc 1-020 and 1-030 and Soc 1-651
- Electives to meet College of Liberal Arts distribution and language requirements

For News-Editorial Sequence

- Jour 1-101—Reporting (5)
- Jour 1-701—Mass Communication Law (2) or 3-776—Mass Communication Law (4)

For Advertising Sequence

- Jour 1-201—Principles of Advertising (4)
- 5 credits introductory psychology

For Broadcast Journalism

- Jour 1-101—Reporting (5)
- Jour 1-701—Mass Communication Law (2) or 3-776—Mass Communication Law (4)

Agricultural Journalism

Spch 1-102—Communication in Modern World: Interpersonal Communication (3) and 1-106—Fundamentals of Speech (3) or 1-101—Fundamentals of Speech (5) (These may be substituted for Rhet 1-222)

For Photographic Communication

Jour 1-101—Reporting (5)
Jour 1-301—Beginning Photojournalism (4)
Jour 1-701—Mass Communication Law (2) or 3-776—Mass Communication Law (4)

UPPER DIVISION

News-Editorial Sequence

Jour 3-121—Public Affairs Reporting (4)
Jour 3-155—Publications Editing (2)
Jour 3-156—Design and Typography (2)
Jour 5-131—Interpretative Reporting (4)
Jour 5-501—Communication and Public Opinion (4)
Jour 5-601—History of Journalism (4)
AgTo 3-530—Publicity (3)

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

Jour 5-141—Opinion Writing in America (4)
Jour 5-143—Interpretation of Science and Technology (4)
Jour 5-171—Critical Writing (4)
Jour 3-173—Magazine Writing and Editing (4)

8 additional elective Upper Division credits in agricultural journalism or journalism
Jour 5-133—Science Communication is recommended

Advertising Sequence

Jour 3-231—Advertising Graphics (4)
Jour 3-241—Advertising Copywriting (4)
Jour 5-251—Psychology of Advertising (4)
Jour 5-501—Communication and Public Opinion (4)
Jour 5-261—Advertising Media Analysis (4)
Jour 5-274—Current Advertising Developments and Problems (4)
Mktg 3-000—Principles of Marketing or substitute courses in agricultural economics (3)

For advertising management emphasis: 5-263—Advertising Campaign Planning and Media Strategy (4)

For creative emphasis: 5-252—Psychology of Creativity in Advertising (4) and 5-272—Advertising Copy-Graphics (4)

Other options allow for sequences in broadcast advertising and marketing.

Broadcast Journalism

Jour 5-402—Film Production (5)
Jour 3-121—Public Affairs Reporting (4)
Jour 3-401—Basic Cinematography (4)
Jour 3-451—Television and Radio News (5)
Jour 5-442—Advanced Television News (5)
Jour 5-611—Development of American Broadcasting (4)

One of:

Jour 5-501—Communication and Public Opinion (4)
Jour 5-615—Development of Photojournalism and Documentary Film
Jour 5-721—Mass Media in a Dynamic Society, and 4 additional Upper Division credits in journalism or agricultural journalism

Spch 3-201—Introduction to Broadcasting Production (3)

Spch 3-203—Radio Production (3) or 3-204—Television Production (3)

Spch 5-211—Radio and Television Programming (3)

Additional speech courses are recommended.

Photographic Communication Sequence

Jour 5-353—Photographic Communication (4) or Jour 3-401—Basic Cinematography (4)
Jour 5-376—Advanced Photojournalism (5) or Jour 5-402—Film Production (5)

Curricular Programs

Jour 3-121—Public Affairs Reporting (4) or Jour 3-486—Radio and Television Script Writing (4)

Jour 5-615—Development of Photojournalism and Documentary Film (5)

Jour 5-501—Communication and Public Opinion (4) or Jour 5-721—Mass Media in a Dynamic Society (4)

Eight elective Upper Division journalism or agricultural journalism credits including AgJo 3-530—Publicity

Other courses in speech and art are recommended

Modifications in all sequences may be approved by the adviser.

Each student must have a minor or enrichment program—18 credits in an agricultural or forestry field of specialization or 9 credits in each of two fields.

Each student must meet distribution requirements of the College of Liberal Arts.

Minor or Enrichment Program in Journalism

Students with a specialization in the College of Agriculture or College of Forestry may select one of several minors or 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 Minor—Jour 1-001 (2), 1-201 (4), 3-241 (4), 5-251 (4), and AgJo 3-530 (3). For those wanting further depth, Jour 5-261 (4) is recommended.

News-Editorial Minor—Jour 1-011 (5); 3-176 (4), or 3-173 (4); AgJo 3-530 (3), 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 world-wide 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.

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. Your faculty adviser will help you plan a program which will qualify you for the certificate. You should select three areas in each of which you will complete 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 international understanding. 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.

C. PREVETERINARY MEDICINE

Preparing for a Career in Veterinary Medicine—Preparation for a career in veterinary medicine requires completion of the minimum course requirements of the preprofessional curriculum and the 4-year professional curriculum for the doctor of veterinary medicine (D.V.M.) degree granted by the College of Veterinary Medicine. The preprofessional curriculum can be completed in the College of Agriculture with faculty advising provided by the Office of the Dean of the College of Veterinary Medicine. The preprofessional requirements may also be completed at any accredited college that offers the required courses.

Veterinary medicine is modern medical science applied to animals. The study of veterinary medicine is concerned with gaining a thorough knowledge of the fundamental biological and physical sciences relating to animal functions in health and disease. In the clinical years one correlates and applies this knowledge to the many areas of professional service. With this broad biological knowledge and clinical training, the veterinarian may choose from among many challenging and interesting career opportunities following graduation. Individuals interested in animals and biology can find a position in veterinary medicine that will bring them satisfaction and a rewarding career.

Private Practice of Veterinary Medicine—Of the several fields of work available to veterinarians, private practice is one of the most popular. Following licensing and accreditation, the veterinarian may elect to enter general practice, meaning that all types of animals are cared for, or he may enter a more specialized type of practice and work with only one or two species of animals. In the latter category, veterinarians may be concerned primarily with a special area such as large-animal or small-animal practice, dairy cattle practice, poultry practice, equine practice, zoo animals, etc.

Public Service and Industry—Almost unlimited opportunities are open to veterinarians as professional specialists, research scientists, and administrators in industry and government.

Veterinary medical knowledge and skill are necessary in the advancement of science and the protection and maintenance of the health of animals and man by such agencies as the Public Health Service, the Department of Agriculture, the Atomic Energy Commission, and the Food and Drug Administration.

All the veterinary medical specialties are needed in programs ranging from space medicine and radiological health to the control of production and use of vaccines and drugs. These programs include the control and eradication of costly animal diseases; the supervision of food processing to provide people with wholesome meat, poultry, and other foods; the investigation and control of diseases, such as rabies, that are transmitted from animal to man; and studies of the comparative medical aspects of diseases. Many opportunities are also available for veterinarians in the rapidly expanding field of laboratory animal medicine.

Industries, particularly pharmaceutical companies, are employing an increasing number of veterinarians to serve as research and development scientists, field specialists, consultants, and executives.

Curricular Programs

A veterinary student who enjoys working with others as a member of a team contributing to the health and welfare of animals and man might consider a veterinary medical career in public service or industry.

An increasing number of veterinarians are taking advantage of graduate study for advanced degrees. On completion of these programs they may engage in teaching and research, or employment with local, state, or federal government, industry, or with the military services. There is a growing demand for veterinarians in public and private institutions which support both fundamental and applied research.

Opportunities in the Future—The demand for veterinarians far exceeds the supply. New areas of service are constantly developing and expanding, such as space biomedical programs, comparative medical research, and public health. With the tremendous growth in population, more food-producing animals are needed and the expansion in size of herds and flocks offers new challenges and opportunities.

More families and more children mean a greater number of household pets which will need to increase the number of veterinarians from 22,000 to 47,000 in the United States by the year 1980.

ADMISSION REQUIREMENTS AND SUGGESTED PREPARATION

1. The student must meet the general requirements for admission to the College of Agriculture as listed in the *General Information Bulletin*. The following high school units are required for admission: 3 units in mathematics (1 unit elementary algebra, 1 unit plane geometry, and 1 unit higher algebra) and 1 or more units in natural science or agriculture.
2. Completion of trigonometry while in high school is recommended as the student with an acceptable performance will not be required to take trigonometry at the college level.
3. Prospective students are encouraged to include biology, chemistry, and physics in their high school programs.

PREVETERINARY CURRICULUM

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 preveterinary requirements should be evaluated with the A-F 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 preveterinary courses for those enrolled in the College of Agriculture are as follows:

A. Communication, Language, Symbolic Systems—17-20 credits

English, Communication (8)
Rhet 1-101, 1-102

Public Speaking (4)
Rhet 1-222

Mathematics (5-8)

Trigonometry, College Algebra, its equivalent or Calculus (number of credits will depend on high school math background)
Math 1-008, 1-111 or Math 1-141

B. Physical and Biological Sciences—48-49 credits

Chemistry: General inorganic and qualitative, quantitative, and organic (not terminal); all courses must include laboratory

General Inorganic (10)
Chem 1-004, 1-005

Solution (4)
Chem 1-006

Quantitative Analysis (5)
Chem 3-100, 3-101

Organic (10)
Chem 3-301, 3-302

Physics (10)
Mechanics, Heat, Electricity, Sound, Light (with laboratory)
Phys 1-031, 1-032

Biology (9-10)
General Biology, Zoology or its equivalent (with laboratory)
Biol 1-011, 3-011 or Zool 1-013

C. Man and Society—8 credits

An introductory course in agricultural economics or economics:
AgEc 1-020

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

May be selected from the following areas: art, literature, or music

E. Electives

An introductory course in genetics is recommended in that it fulfills a requirement of the first-year program in the College of Veterinary Medicine:

GCB 3-022

Additional electives may be selected on the basis of the student's interest in a broad educational program. Students planning a career in veterinary medical practice are encouraged to take courses in animal nutrition and business management. Students planning academic or research careers should give consideration to additional chemistry, physics, and mathematics while those lacking experience and knowledge of food-producing animals may wish to elect courses in the animal sciences.

HOW TO APPLY FOR ADMISSION TO THE COLLEGE OF VETERINARY MEDICINE

Application materials are available at the St. Paul Campus Office of Admissions and Records, 130 Coffey Hall, and the application form should be returned to that office not later than November 15 preceding the fall quarter you wish to enter (approximately 1 year before you desire to enter the college). The minimum admission requirements may be satisfied before or during the academic year in which the student makes application.

Students applying for admission to the College of Veterinary Medicine compete for the limited number of positions available in the first-year class on the basis of scholastic achievement in the required preveterinary courses, performance on tests required for admission as well as their interest, character, and personal fitness for a career in the veterinary medical profession.

For more 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 of Veterinary Medicine, consult the *College of Veterinary Medicine Bulletin*, or write to the Office of the Dean, College of Veterinary Medicine, University of Minnesota, St. Paul, Minnesota 55101.

SECTION III
COURSE OFFERINGS

Courses in Agriculture

Agricultural and Applied Economics (AgEc)

- 1-020. PRINCIPLES OF MACRO-ECONOMICS.** (5 cr)
Determinants of national income and employment levels; prices and money; the banking system; monetary and fiscal policy; economic growth and development; the role of government in the economy.
- 1-030. PRINCIPLES OF MICRO-ECONOMICS.** (4 cr; prereq 1-020)
Economics of the firm and household; factor and product price determination; theory of production, consumption, and distribution; supply and demand analysis; equilibrium analysis.
- 1-040. ECONOMIC DEVELOPMENT OF AMERICAN AGRICULTURE.** (3 cr; prereq 1-030)
A review of the economic, political, social, and technical forces that have shaped the development of American agriculture; the role of agricultural development in national economic development in the United States; the implications for presently developing countries.
- 1-250. PRINCIPLES OF ACCOUNTING.** (4 cr; prereq soph, St. Paul Campus students only)
Fundamentals of business accounting; basic finance concepts; use of accounting data for income tax and managerial decision making.
- 1-400. AGRICULTURAL MARKETS AND PRICES.** (4 cr; prereq 1-030)
The 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.
- 3-500. AGRICULTURAL FINANCE.** (5 cr; prereq 1-030)
The 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.
- 3-610. COMMUNITY RESOURCE DEVELOPMENT.** (4 cr; prereq 1-030 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.
- 3-710. AGRICULTURAL AND MARKET POLICIES.** (4 cr; prereq 1-400 or Econ 3-101, 3-102 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.
- 3-820. FARM MANAGEMENT ECONOMICS.** (4 cr; prereq 1-030)
The use of cost and production theory in farm management; the nature and process of management.
- 3-840. ECONOMICS FOR VETERINARY MEDICINE.** (2 cr; for majors in veterinary medicine only)
Economic principles important in dealing with health problems of animals or herd, in dealing with animal production on farms, and in understanding the economy as it affects livestock production.

Course Offerings

- 3-980. 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.
- 3-990. PROBLEMS OR INDEPENDENT STUDY.** (Cr ar; prereq #)
Independent study, supervised reading, or research on agricultural economics problems not covered in regularly offered courses.
- 5-010. STATISTICAL METHODS FOR SOCIAL SCIENCES.** (5 cr for undergrad, 4 cr for grad; prereq Biom 5-010 or QA 3-053 or equiv)
Application of statistical methods to research in the social sciences; time series analysis, index numbers, multiple regression and correlation, elementary sampling procedures, analysis of variance and covariance.
- 5-110. AGRICULTURAL ECONOMIC ANALYSIS.** (3 cr; not open to students majoring in agricultural economics; prereq 1-030)
The economic behavior of households, firms, and industries with special applications to agriculture; competition and monopoly power; factors affecting pricing and production decisions.
- 5-120. AGRIBUSINESS MANAGEMENT AND MARKETING.** (3 cr; not open to students majoring in agricultural economics; prereq 5-110 or #)
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.
- 5-130. LAND RESOURCE USE.** (3 cr; not open to students majoring in agricultural economics; prereq 5-110 or #)
Land as a factor of production; rural and urban utilization; rents and land values; land classification; taxation; exchange; public land management.
- 5-140. AGRICULTURAL PRODUCTION.** (3 cr; not open to majors in agricultural economics; prereq 1-030 or 5-110)
The application of economic analysis to the planning and evaluation of the operation of agricultural businesses, with emphasis on the farm; economic principles, budgeting, linear programming, practice.
- 5-150. AGRICULTURAL POLICY.** (3 cr; not open to students majoring in agricultural economics; prereq 5-110 or #)
The application of economic analysis to agricultural price and income policy issues; the development of present-day price and income programs.
- 5-290. AGRIBUSINESS MANAGEMENT.** (4 cr for undergrad, 3 cr for grad; prereq Econ 3-101 and 3-102 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.
- 5-400. INTERMEDIATE MARKET AND PRICE ANALYSIS.** (4 cr for undergrad, 3 cr for grad; prereq 1-400)
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.
- 5-401. SEMINAR: MARKETING OF DAIRY PRODUCTS.** (1 cr; prereq 5-400 or ¶5-400 or #)
Institutional and functional variations in market and price analysis unique to the study of dairy products.
- 5-402. SEMINAR: MARKETING OF GRAIN CROPS.** (1 cr; prereq 5-400 or ¶5-400 or #)
Institutional and functional variations in market and price analysis unique to the study of grain.
- 5-403. SEMINAR: MARKETING OF LIVESTOCK.** (1 cr; prereq 5-400 or ¶5-400 or #)
Institutional and functional variations in market and price analysis unique to the study of livestock.
- 5-404. SEMINAR: MARKETING OF FRUITS AND VEGETABLES.** (1 cr; prereq 5-400 or ¶5-400 or #)
Institutional and functional variations in market and price analysis unique to the study of fruits and vegetables.

Agricultural and Applied Economics

- 5-440. COOPERATIVES AND AGRIBUSINESS ORGANIZATION.** (4 cr for undergrad, 3 cr for grad; prereq 1-400)
Analysis of the economic problems and issues facing agricultural cooperatives including changing market organization, financing, taxation, anti-trust regulations, and others.
- 5-480. COMMODITY MARKETS AND FUTURES TRADING.** (4 cr for undergrad, 3 cr for grad; prereq Econ 3-101 or #)
Economics of cash and futures trading on organized markets; futures trading theory; hedging and speculation.
- 5-510. AGRICULTURAL CAPITAL MARKETS.** (4 cr for undergrad, 3 cr for grad; prereq Econ 3-102)
Analysis of capital accumulation in agriculture; finance and credit institutions; farm appraisal and agricultural credit policies.
- 5-580. ECONOMIC ORGANIZATION OF THE HOUSEHOLD.** (4 cr for undergrad, 3 cr for grad; prereq 1-030 or Econ 1-002...Econ 3-101 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.
- 5-590. GOVERNMENT AND CONSUMERS.** (4 cr for undergrad, 3 cr for grad; prereq Econ 3-101...3-102 recommended)
Demand and consumption relations for publicly supplied goods and services and with government policies and actions as they affect individuals as consumers, not either as taxpayers or as purchasers of the products of regulated industries. The markets for publicly supplied goods and services with particular attention to the demand and consumption relations and the effects on consumers of governmental policies and behavior. Informational defects in public as well as private markets along with alternative means of consumer redress.
- 5-600. LAND ECONOMICS.** (4 cr for undergrad, 3 cr for grad; prereq Econ 3-101, 3-102 or #)
Land as a factor of production; land use, classification, and value; sale and rental markets for land; domestic and foreign land policies.
- 5-620. REGIONAL ECONOMIC ANALYSIS.** (4 cr for undergrad, 3 cr for grad; prereq 1-030)
Basic concepts and theories used and problems encountered in economic study of subregions, including those applicable to space and planning, population and employment change, income estimation and social accounting, industrial location, identification of the planning region, intraregional and interregional analyses, planning goals, and national and regional planning programs.
- 5-630. REGIONAL DEVELOPMENT SYSTEMS.** (4 cr for undergrad, 3 cr for grad; prereq 1-030)
Regional subsystems in resource productivity cycle. Public service delivery subsystems. Public intervention strategies in environmental management. Settlement planning and resource development.
- 5-640. FINANCING PUBLIC SERVICES IN RURAL AREAS.** (4 cr for undergrad, 3 cr for grad; prereq Econ 3-101)
Public financing potentials in rural and urban areas. Flow of funds accounts. Public expenditure criteria. Implications of regional financing alternatives.
- 5-720. ECONOMICS OF WORLD AGRICULTURE.** (4 cr for undergrad, 3 cr for grad; prereq Econ 3-101, 3-102 or #)
Distribution, quality, and utilization of agricultural resources, agricultural organization and structure; location of agricultural activity; national and international agricultural policies.
- 5-750. AGRICULTURAL TRADE AND COMMERCIAL POLICIES.** (4 cr for undergrad, 3 cr for grad; prereq Econ 3-101, 3-102)

Course Offerings

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.

- 5-790. WORLD FOOD SUPPLY PROBLEMS.** (4 cr, §PIPa 5-220, §Soc 5-875, §VMed 5-790, §HE 5-381; prereq 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, the plant sciences, and the animal sciences for their application to food problems.
- 5-800. FARM RECORDS AND BUSINESS ANALYSIS.** (4 cr; prereq 1-030 or §)
Analysis of farm records and their role in management of the farm business; types of farm records; calculation of farm earnings by various measures.
- 5-830. FARM PLANNING.** (3 cr; prereq 3-820 or §)
Special problems in farm planning.
- 5-860. 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 production.

FOR GRADUATE STUDENTS ONLY

- 8-200/8-201/8-202. General Seminar: Agricultural Economics**
- 8-205. Research Methodology in Agricultural Economics**
- 8-206. Foundations of Applied Economics**
- 8-231. Agricultural Prices**
- 8-245. Agricultural Marketing Economics**
- 8-264. Resource Economics**
- 8-273. Agricultural Policy**
- 8-278. Agricultural and Economic Development**
- 8-287. Production Economics I**
- 8-288. Production Economics II**
- 8-335. Seminar: Price Analysis**
- 8-344. Seminar: Cooperative Marketing**
- 8-345. Seminar: Agricultural Marketing**
- 8-346. Seminar: Law and Agricultural Economics**
- 8-356. Seminar: Consumption Economics**
- 8-360. Seminar: Land Economics and Tenure**
- 8-364. Seminar: Resource Economics and Policy**
- 8-373. Seminar: Agricultural Policy**
- 8-378. Seminar: Agricultural Development**
- 8-382. Seminar: Farm Management and Production Economics**

Agricultural Education (AgEd)

- 1-001. INTRODUCTION TO AGRICULTURAL EDUCATION.** (1 cr; prereq §)
Orientation to employment and service in agricultural education. Qualifications of teachers, survey of preparatory offerings, and an overview of the program of agricultural education in Minnesota.

Agricultural Education

- 1-010. RURAL EDUCATION, COMMUNITY LEADERSHIP.** (3 cr)
Appraisal of community educational agencies, process of and responsibilities for community leadership; role of the school in the rural community; coordination of the school with nonschool educational agencies.
- 3-020. RURAL EDUCATION THROUGH EXTENSION METHODS.** (3 cr; prereq soph)
Role of the Extension Service in rural education; methods and techniques of instruction in nonschool educational programs.
- 3-029. DIRECTED EXPERIENCE IN AGRICULTURAL EDUCATION.** (1-3 cr)
Observation of the activities of teachers of agriculture; familiarization with the staff, the curriculum, and the physical facilities and equipment in a department of vocational agriculture with opportunity to participate in the functions of a teacher.
- 3-030. TEACHING AGRICULTURE IN THE SECONDARY SCHOOL.** (4 cr; prereq SeEd 3-155 and #)
Fundamentals of teaching agriculture to high school students; use of the home, farm, and community in structuring courses of study; Future Farmers of America; Vo-Ag Planning and Summary Book, building and utilizing teaching units.
- 3-031. STUDENT TEACHING IN AGRICULTURE.** (6-10 cr; prereq sr, 3-030, SeEd 3-155 and #)
Supervised experience in work of agriculture instructor. Includes instruction in development of individual farming programs, contacting parents, program analysis of community needs, conducting classes, community activities, Future Farmers, and case studies.
- 5-010. RURAL EDUCATION, COMMUNITY LEADERSHIP.** (3 cr; prereq grad or #)
Appraisal of community educational agencies, process of and responsibilities for community leadership; role of the school in the rural community; coordination of the school with nonschool educational agencies.
- 5-021. RURAL EDUCATION THROUGH EXTENSION METHODS.** (3 cr; prereq grad or #)
Role of the Extension Service in rural education; methods and techniques of instruction in nonschool education programs.
- 5-023. EXTENSION METHODS FOR AGRICULTURAL PRODUCTION IN DEVELOPING COUNTRIES.** (2 cr)
A study of effective extension methods to promote the rapid adoption of improved agricultural practices.
- 5-032. THE HIGH SCHOOL CURRICULUM IN AGRICULTURE.** (3 cr; prereq sr, 10 cr in education)
Philosophy, organization, and administration of instruction in agriculture departments in the secondary schools.
- 5-033. TECHNIQUES OF INSTRUCTION IN RURAL ELECTRIFICATION.** (3 cr; prereq AgEn 5-020 or equiv)
Developing a program of instruction in electricity and rural electrification; teaching aids, units of instruction, job sheets and demonstrations, facilities and materials for adults, young farmers, and high school classes.
- 5-034. PROCEDURES IN TEACHING AGRICULTURE.** (3 cr; prereq #)
Study of new developments in methodology in teaching agriculture. To assess innovations and procedures. Includes consideration of various levels of instruction.
- 5-035. METHODS AND PRACTICES IN TEACHING POST-HIGH SCHOOL AGRICULTURE.** (3 cr)
Problems unique to area vocational-technical school and junior college teaching with emphasis upon improving the ability to organize and present subject matter effectively.
- 5-040. YOUNG FARMER EDUCATION IN AGRICULTURE.** (4 cr; prereq sr, grad or #)
Developing and organizing a continuing program of educational activities for farm youth not in school and not established in an occupation. Coordinating community resources, determining needs, deriving goals and individual plans of procedure for establishment in farming and related occupations. Observation of young farmer programs.

Course Offerings

- 5-050. ADULT EDUCATION IN AGRICULTURE.** (4 cr; prereq sr)
Systematic instruction for established farmers. Analysis of the agricultural situation with special emphasis on adoption of appropriate management practices. Determining needs in production, marketing, credit, conservation, etc. Developing a continuing program. Observation of adult education programs.
- 5-051. ENTERPRISE ANALYSIS.** (3 cr; prereq sr or #)
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.
- 5-052. ADVANCED FARM BUSINESS MANAGEMENT EDUCATION.** (3 cr; prereq 5-050 or #)
A study of the administration, organization, and operation of farm business management education programs for adults in the secondary schools. Special emphasis on the development and utilization of curriculum materials based on farm business record data.
- 5-060. PLANNING PROGRAMS.** (3 cr; prereq last qtr undergrad regis or #)
Developing a program of agricultural education in a community school. Integration with total school program. Administrative relationships and professional improvement.
- 5-065. EVALUATION OF LOCAL VOCATIONAL EDUCATION PROGRAMS.** (3 cr; primarily for school administrators and local directors of vocational programs)
Techniques for evaluation of local programs as required under present legislation will be developed.
- 5-066. POLICY AND PROGRAM DEVELOPMENT IN AGRICULTURAL EDUCATION.** (3 cr)
Appraisal of the situation in local schools and the development of plans for improving the program development process.
- 5-070. SUPERVISED FARM PRACTICE IN VOCATIONAL AGRICULTURE.** (3 cr per qtr [total 9 cr]; prereq grad or #...10 cr in education or #)
Selection, planning, supervising, and summarizing of individual farming programs. Adaptation to meet needs of high school F.F.A. students, young farmers, and adults.
- 5-071. SUPERVISED OCCUPATIONAL EXPERIENCES IN AGRICULTURE.** (3 cr)
The organization and administration of an occupational experience program in agriculture for high schools and area schools.
- 5-072. PRACTICUM: AGRICULTURAL BUSINESS AND INDUSTRY.** (1-3 cr per qtr [total 9 cr])
Observation, study, and experience in agricultural business and industry: application to educational programs in agriculture.
- 5-080. ORGANIZATION AND MANAGEMENT.** (3 cr; prereq #)
Administrative structure and function of subcollegiate programs of agricultural education.
- 5-085. CAREER DEVELOPMENT IN AGRICULTURAL EMPLOYMENT.** (3 cr)
Methods and materials in teaching career development for agricultural industries.
- 5-090. INDEPENDENT FIELD STUDY OR RESEARCH.** (1-3 cr; prereq sr or #)
Conducting independent inquiry or research into topics of student interest. Topics may be chosen to permit in-depth study of areas within education or to supplement areas of inquiry not provided in the regular course structure.
- 5-095. INTEGRATING PAPER IN AGRICULTURAL EDUCATION.** (3 cr; prereq candidate for M.Ed. degree in agricultural education)
- 5-940. EDUCATIONAL PROGRAMS FOR ESTABLISHMENT IN AGRICULTURE.** (3 cr)
Instructing and counseling potential farm operators; in farming opportunity, farm appraisal, securing and using credit, transfer of farm property and problems of getting established in production agriculture.

FOR GRADUATE STUDENTS ONLY

- 8-001. Research in Agricultural Education
8-010. Seminar: Current Issues in Agricultural Education

8-020. Seminar: Agricultural Education

8-081. Supervision of Vocational Education

8-082. Organization and Administration of Educational Programs in Agriculture

8-091. Field Problems

Agricultural Engineering

Students may major in *agricultural engineering technology* through either the Agricultural Science and Industries program or the Resource and Community Development program. This curriculum encompasses the utilization of machines, structures, and equipment in the management of water, soils, plants, and animals in the production, processing, storage, and marketing of agricultural products. Students should consult with their advisers during their freshman year to plan the remainder of their program.

A professional 4-year program in *agricultural engineering* is offered jointly with the Institute of Technology. Detailed information on this program is given in the *Institute of Technology Bulletin*. Students normally seek admission to this program through the Institute of Technology, but may enter through the Biological and Physical Sciences in Agriculture program and transfer later to the Institute of Technology.

Agricultural Engineering Technology (AgEn)

COURSES FOR OTHER THAN AGRICULTURAL ENGINEERING TECHNOLOGY MAJORS

- 3-205. POWER AND POWER USE. (4 cr; prereq Math 1-111, Phys 1-031; 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.
- 3-215. MACHINERY AND EQUIPMENT. (4 cr; prereq Math 1-111, Phys 1-031; 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.
- 3-405. SOIL AND WATER MANAGEMENT. (4 cr, §3-410, §5-400; prereq Math 1-111, Phys 1-031; 3 lect and 3 lab hrs per wk)
Basic principles of erosion control, drainage, irrigation, and hydrology. Introduction to surveying.
- 3-605. STRUCTURES AND ENVIRONMENTAL PROCESSES. (4 cr; prereq Math 1-111, Phys 1-031; 3 lect and 3 lab hrs per wk)
Principles of building design, construction, and utilization. Layout, sizing, and fabrication of structures. Environmental relationships important to ventilation of animal housing and the drying of forages and grain.
- 3-606. LAYOUT AND MANAGEMENT OF ANIMAL ENTERPRISE SYSTEMS. (4 cr; prereq Math 1-111, Phys 1-031; 3 lect and 3 lab hrs per wk)
Layout of buildings for dairy, beef, hogs, and poultry enterprises to include systems for handling feed, water, manure, and the product produced. Considerations favoring warm housing or cold housing with emphasis on insulation, ventilation, sanitation, condensation, and compliance with codes.

Course Offerings

5-020. PROGRAM PLANNING AND INSTRUCTIONAL METHODS IN AGRICULTURAL MECHANICS. (4 cr; prereq 10 cr in agricultural engineering technology, AgEd 3-031 or §AgEd 3-031)

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 the student-supervised study programs in agricultural engineering.

5-030, 5-031, 5-032, 5-033, 5-034, 5-035. PROBLEMS AND FIELD STUDIES IN ADVANCED AGRICULTURE. (3 cr per qtr [max 9 cr]; prereq 5-020 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.

5-030. Agricultural Tractor and Engine Power

5-031. Agricultural Machinery and Mechanization

5-032. Electrical Power and Processing

5-033. Farm Buildings and Environmental Control

5-034. Natural Resources Development and Management

5-035. Metal Fabrication Materials and Techniques

5-040. 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 in 1st summer term)

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.

COURSES FOR BOTH AGRICULTURAL ENGINEERING TECHNOLOGY AND OTHER MAJORS

1-000. SLIDE RULE COMPUTATION. (1 cr; prereq Math 1-111 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.

1-010. TECHNICAL DRAWING. (3 cr)

Drafting instruments and their uses. Lettering, scale reading, conventional symbols, tracings, and reproductions. Multiview drawings, pictorial drawings, plats of surveys, and contour maps.

1-020. AGRICULTURAL SHOP—METALWORK. (4 cr; prereq Chem 1-004 or §; 2 lect and 6 lab hrs per wk)

Arc and oxyacetylene welding, soldering, use and conditioning of metalworking tools and the identification and characteristics of metals used in farm machinery.

1-400. SURVEYING. (4 cr; prereq 1-010, Math 1-008)

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.

3-410. HYDROLOGY, WATER CONTROL. (4 cr; prereq Phys 1-032, Math 1-111, Soil 1-122; 3 lect hrs per wk and 1 to 3 hrs ar)

The hydrologic cycle—precipitation, infiltration, and runoff. Uniform flow in open channels, flow measurement. Estimating peak runoff. Terraces and grass waterways for erosion and sediment control. Water resources and problems. Water control on a watershed basis. Choice of laboratory, discussion group, or individual project.

3-800. RURAL SANITATION AND WATER SUPPLY. (4 cr; prereq Phys 1-031, Chem 1-005; 3 lect hrs per wk)

Wells, pumps, water supply, and treatment. Water supply and waste disposal systems for homes, farmsteads, resorts, and recreational use.

5-000. PRINCIPLES OF RADIOISOTOPE MEASUREMENTS. (3 cr; prereq sr, 1 yr physics, Math 1-008; 2 lect and 3 lab hrs per wk)

Agricultural Engineering

Theory and technique of radioisotope measurements including atomic and nuclear structure; properties of alpha, beta and gamma rays; interaction of radiation with matter. Geiger-Muller proportional and scintillation counters.

- 5-015. ANALOG COMPUTER TECHNIQUES.** (2 cr; prereq #; 1 lect and 3 lab hrs per wk)
The principles of analog computers. Emphasis placed on the usefulness to solution of biological problems. Selection of computing techniques (analog, digital, and/or hybrid) dependent upon the nature of the problem. Laboratory experience in use is given.
- 5-400. DRAINAGE AND IRRIGATION.** (4 cr; prereq Math 1-142 or Δ , Phys 1-032, Soil 1-122; 3 lect and 2 lab hrs per wk)
Soil moisture excesses and deficiencies. Theory and design of tile drainage, surface drainage, and sprinkler irrigation systems. Development of irrigation water supplies. Selection of pumps and power units for drainage and irrigation. Economic feasibility. Legal problems and procedures.
- 5-810. AGRICULTURAL WASTE MANAGEMENT.** (4 cr; prereq Phys 1-031, Chem 1-005, Biol 1-001; 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 PRIMARILY FOR AGRICULTURAL ENGINEERING TECHNOLOGY MAJORS (Open to Others with Prerequisites)

- 3-021. MECHANICS OF AGRICULTURAL SYSTEMS.** (4 cr; prereq Math 1-142, Phys 1-032; 4 lect hrs per wk)
Principles of statics, dynamics, and strength of materials including study of common engineering materials used in agriculture.
- 3-022. ENERGY TRANSFER AND UTILIZATION PROCESSES IN AGRICULTURE.** (4 cr; prereq Math 1-142, Phys 1-032; 4 lect hrs per wk)
Elementary thermodynamics, heat utilization, and transfer processes related to agricultural systems.
- 3-023. FLUID AND ELECTRICAL SYSTEMS.** (4 cr; prereq Math 1-142, Phys 1-032; 4 lect hrs per wk)
Elementary fluid mechanics, flow of liquids, hydraulic machinery. Electric circuits, power, and control.
- 5-230. MECHANISMS IN AGRICULTURAL MACHINERY.** (5 cr; prereq 1-000, 1-010, 3-021; 3 lect and 3 lab hrs per wk)
Analysis of the motion (position, velocity, and acceleration) forces, energy and power transmission, and control mechanisms in agricultural machinery.
- 5-240. AGRICULTURAL POWER.** (4 cr; prereq 3-021, 3-022, 3-023; 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.
- 5-290. PROBLEMS IN POWER AND MACHINERY.** (2-5 cr; prereq 5-230, 5-240 and #; hrs ar)
Individual problems in agricultural power and machinery based on work given in prerequisite courses.
- 5-490. PROBLEMS IN SOIL AND WATER MANAGEMENT.** (2-5 cr; prereq 3-410, 5-400 and #; hrs ar)
Individual problems in engineering phases of soil and water management based on work given in prerequisite courses.
- 5-620. FARMSTEAD ENGINEERING.** (4 cr; prereq 3-021, 3-022; 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.

Course Offerings

- 5-690. PROBLEMS IN AGRICULTURAL BUILDINGS.** (2-5 cr; prereq 5-620 and #; hrs ar)
Individual problems, studies, and applications based on work given in prerequisite courses.

Agricultural Engineering (AgEn)

The following courses are offered in the Institute of Technology and are open to students in the professional 4-year curriculum and to those having the prerequisite courses. For descriptions of courses see the *Institute of Technology Bulletin*.

- 1-050. WATER SUPPLY AND IRRIGATION IN DEVELOPING COUNTRIES. (4 cr)
1-060. AGRICULTURAL ENGINEERING ORIENTATION. (1 cr)
1-070. INTRODUCTORY AGRICULTURAL ENGINEERING. (4 cr)
3-050. SOIL-PLANT RELATIONS IN AGRICULTURAL ENGINEERING. (4 cr)
3-060. SIMULATION AND EVALUATION. (4 cr)
5-050. INTERN REPORTS. (1 cr)
5-060. PROCESSING. (4 cr)
5-070. AUTOMATIC CONTROL AND INSTRUMENTATION. (4 cr)
5-081, 5-082, 5-083, 5-084. DESIGN. (4 cr)
 5-081. Power and Machinery
 5-082. Soil and Water
 5-083. Structures and Environment
 5-084. Food Engineering
5-130. FOOD ENGINEERING I. (4 cr)
5-140. FOOD ENGINEERING II. (4 cr)
5-330. AGRICULTURAL MACHINERY. (4 cr)
5-340. AGRICULTURAL TRACTORS. (4 cr)
5-390. PROBLEMS IN AGRICULTURAL ENGINEERING—POWER AND MACHINERY.
 (2-5 cr per qtr)
5-540. EROSION CONTROL, WATERSHED ENGINEERING. (4 cr)
5-550. DRAINAGE AND IRRIGATION ENGINEERING. (4 cr)
5-590. PROBLEMS IN AGRICULTURAL ENGINEERING—SOIL AND WATER (2-5
 cr per qtr)
5-730. AGRICULTURAL STRUCTURES DESIGN. (4 cr)
5-740. ENVIRONMENTAL CONTROL FOR AGRICULTURAL PRODUCTION. (4 cr)
5-790. PROBLEMS IN AGRICULTURAL ENGINEERING—STRUCTURES AND EN-
 VIRONMENT. (2-5 cr per qtr)
5-910. AGRICULTURAL WASTE MANAGEMENT ENGINEERING I. (4 cr)
5-920. AGRICULTURAL WASTE MANAGEMENT ENGINEERING II. (4 cr)

FOR GRADUATE STUDENTS ONLY

- 8-100. Seminar
8-140. Agricultural Engineering Similitude
8-190, 8-191, 8-192. Advanced Problems and Research
8-500. Hydrologic Modeling—Small Watersheds
8-700. Moisture and Heat Transfer

Agricultural Journalism (AgJo)

- 3-530. PUBLICITY.** (3 cr; prereq rhet comm req)
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.
- 5-301. FUNCTIONAL PHOTOGRAPHY FOR THE PLANT SCIENCES.** (2 cr; prereq #)
Use of photography in plant sciences. Includes still photography, both color and black and white, to produce photographs and slides of quality acceptable for teaching and for use in publications, press, television, exhibits, and group presentations.
- 5-340. RURAL COMMUNICATION MEDIA AND MEDIA BEHAVIOR.** (3 cr; prereq 3-530, introductory psychology and sociology, or #)
Mass media behavior in rural communities; theoretical approaches relevant to problems of rural mass media behavior; analysis of research aimed at adult education efforts through mass media.
- 5-535. COMMUNICATIONS IN INTERNATIONAL AGRICULTURAL DEVELOPMENT.**
(3 cr; prereq 3-530 or equiv in journalism, or #)
For United States and foreign students. Analyzes U.S. and foreign rural communications as developing tools. Develops ability to plan and execute communication programs in developing nations.
- 5-936. SPECIAL PROBLEMS IN AGRICULTURAL COMMUNICATIONS.** (Cr ar; prereq #)
Communications problems related to specific aspects of student's major field of study.

Agronomy and Plant Genetics (Agro)

Students whose major interests are in the production, management, or improvement of field crops should elect agronomy as their specialization in the plant and soil science major. Studies in agronomy will prepare students for careers in the production, processing, marketing, and distribution of field crops. Some positions illustrative of career opportunities available to agronomists include those of fieldmen for agricultural chemical, seed, and production companies, technical sales representatives, agricultural extension, crop regulatory and control activities, U.S. government services, and positions in foreign service.

Students enrolling in agronomy will establish a firm background in biological and physical sciences. This training will permit them to adapt and apply biological and physical principles to problems encountered in agronomy. Specific courses of study for a specialization in agronomy will be developed in consultation with an adviser in the Department of Agronomy and Plant Genetics. 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, and plant pathology.

- 1-001. INTRODUCTION TO AGRONOMY—SEMINAR.** (1 cr)
Introduction to agronomy—its programs and objectives in teaching, research, and extension through informal seminars with staff and students. Research and teaching facilities will be visited to acquaint students with the personnel and facilities of the department.
- 1-010. 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 will be placed 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.

Course Offerings

- 1-011. PRINCIPLES OF AGRONOMY—DISCUSSION.** (1 cr)
Informal small group discussion of questions and problems identified in lectures in 1-010, readings, or other sources, and review of examinations and papers.
- 1-020. SPECIAL PROBLEMS.** (1-3 cr; prereq #)
Research or studies in depth 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 the guidance of the staff.
- 1-100. MORPHOLOGY AND IDENTIFICATION OF CROPS AND WEEDS.** (4 cr)
The developmental morphology of seeds, seedlings, and plants and the utilization of morphological features of seeds and plants in keys to aid in the identification of crops and weeds of major economic importance in the world. Lecture and laboratory.
- 1-110. SEED ANALYSIS AND GRAIN GRADING.** (3 cr; prereq 1-100 or #)
Principles and practice in the evaluation of field crop seeds for purity and quality and in the grading of grain. Lecture and laboratory.
- 3-010. ADAPTATION, DISTRIBUTION, AND SELECTION OF FIELD CROPS.** (3 cr; prereq Biol 1-011)
Principles and concepts of origin, adaptation and distribution of world crops as influenced by environmental, ecological, and evolutionary factors.
- 3-011. ADAPTATION, DISTRIBUTION, AND SELECTION OF FIELD CROPS—DISCUSSION.** (1 cr)
Informal small group discussion of questions and problems identified in lectures in 3-010, readings, or other sources, and review of examinations and papers.
- 3-020. GROWTH, DEVELOPMENT, AND CULTURE OF FIELD CROPS.** (4 cr; prereq Biol 1-011, Chem 1-005)
Principles of growth and development of field crops and their regulation to achieve maximum crop productivity. Emphasis will be placed on seeds and seeding, physiological basis of growth and development, growth regulation, and the effects of environment on crop growth, development, and culture. Lecture and laboratory.
- 3-021. GROWTH, DEVELOPMENT, AND CULTURE OF FIELD CROPS—DISCUSSION.** (1 cr)
Informal small group discussion of questions and problems identified in lectures in 3-020, readings, or other sources, and review of examinations and papers.
- 3-030. MATURATION, HARVEST, AND STORAGE OF FIELD CROPS.** (4 cr; prereq Biol 1-011, Chem 1-005)
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.
- 3-031. MATURATION, HARVEST, AND STORAGE OF FIELD CROPS—DISCUSSION.** (1 cr)
Informal small group discussion of questions and problems identified in lectures in 3-030, readings, or other sources, and review of examinations and papers.
- 3-150. ADVANCED SEED AND GRAIN EVALUATION.** (4 cr; prereq 1-100 or #...1-110 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.
- 3-200. SEMINAR.** (1 cr; prereq jr or sr and #)
Investigation through literature review and group discussion of selected topics in agronomy. Major emphasis will be placed on recent advances in agronomy.
- 5-010. PASTURE AND GRASSLAND CROPS.** (3 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.

- 5-020. INTRODUCTION TO PLANT BREEDING.** (3 cr; prereq GCB 3-022 or equiv)
An introductory course in the application of genetic principles to the improvement of crop plants.
- 5-030. WEED CONTROL.** (5 cr; prereq 1-010 or §)
Survey of the magnitude of the weed problem. Discussion of regulatory aspects of weed control and herbicide usage. Outline of principles and methods of weed control. Lecture and discussion.
- 5-050. PHYSIOLOGY OF FIELD CROPS.** (3 cr; prereq PIPh 3-091, Phys 1-032 or §)
Physiological and ecological principles applicable to growing field crops, doing field research, and developing new varieties or cultural practices to take best advantage of the micro-environment in which plants grow.
- PIPh 5-183. PLANT PHYSIOLOGY.** (3 cr; prereq Bot 1-001, or equiv...Chem 3-302 and physics recommended)
Membrane phenomena, water relations, mineral metabolism and translocation in plants.
- PIPh 5-184. PLANT PHYSIOLOGY.** (3 cr; prereq Bot 1-001 or equiv...Chem 3-302, physics recommended)
Growth of higher plants, including regulation by hormones, light, and temperature.
- PIPh 5-188. RESEARCH PERSPECTIVES IN PLANT PHYSIOLOGY.** (1-4 cr; prereq analytical chemistry, 8 cr in biochemistry and §)
Laboratory course in which the student undertakes a well-defined research problem of limited scope.
- PIPh 5-702. PHOTOSYNTHESIS; GAS EXCHANGE.** (2 cr; prereq §)
Laboratory course dealing with measurements of gas exchange between intact plants and the environment.

FOR GRADUATE STUDENTS ONLY

- 8-010. Research in Farm Crops
- 8-020. Seminar: Farm Crops
- 8-100. Pasture and Forage Research Techniques
- 8-200. Principles of Plant Breeding I
- 8-210. Principles of Plant Breeding II
- 8-220. Application of Quantitative Genetics to Plant Breeding
- 8-230. Cytogenetics
- 8-270. Seminar: Plant Breeding
- 8-280. Current Topics in Plant Breeding
- 8-290. Current Topics in Plant Genetics
- 8-310. Laboratory Methods in Plant Breeding
- 8-320. Methods in Plant Genetics
- 8-330. Research in Plant Genetics
- 8-380. Applied Statistics
- PIPh 8-251. Seminar: Plant Physiology

Animal Science (AnSc)

Programs of study for students majoring in animal science are planned in consultation with a faculty adviser and according to the student's needs. Those whose vocational goals include employment in business enterprises related to

Course Offerings

agriculture, the extension service, or farming usually follow the curriculum in agricultural science and industries. Students who plan to continue their studies at the graduate level in preparation for teaching and research at the college level or for research in industry are advised to follow the biological and physical sciences curriculum in agriculture. Animal science is a broad field including many areas of interest; therefore, students may elect a broad program of courses or they may select an area of emphasis in genetics, management, meats, nutrition, or physiology. Courses required for all students with an animal science major are: AnSc 1-100, 1-300, 1-401, 1-500, 3-220, 5-703, one production course (5-601, 5-602, 5-603, 5-604, or 5-605), and GCB 3-022.

- 1-100. 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 the production of livestock and poultry.
- 1-105. 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.
- 1-110. 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.
- 1-120. 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.
- 1-300. SYSTEMIC PHYSIOLOGY. (6 cr; prereq Biol 1-001, BioC 1-301 or equiv)**
(Same as VPP 1-300) Introduction to animal physiology, emphasizing the function of the organ systems.
- 1-401. 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 nonruminants; digestion, absorption, and utilization of nutrients; and sources of nutrients for livestock and poultry. Feeding standards and their uses.
- 1-500. MEAT SCIENCE. (4 cr; prereq Biol 1-001)**
(Same as FSci 1-500) 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.
- 1-520. MILK PRODUCTION. (3 cr; prereq 1-100 or §)**
(Same as FSci 1-520) The relationships of production and management concepts to dairy farm planning and the production and marketing of high quality milk.
- 1-600. HORSE PRODUCTION. (4 cr)**
Breeds, selection, diseases, feeding, reproduction, management, and color inheritance of light horses. Demonstrations of equitation, tack, and farriery.
- 3-130. LIVESTOCK EVALUATION. (2 cr; prereq soph or §...1-120 recommended)**
Evaluation of beef cattle, horses, sheep, and swine on the basis of economic traits related to productivity and market value. Spring quarter offering is designed for students interested in livestock selection and marketing. Fall quarter is for students interested in intercollegiate livestock judging competition.
- 3-141. ADVANCED DAIRY JUDGING. (1 cr; prereq 1-110)**
Evaluation and selection of dairy cattle. Visits to local dairy herds. Training in present. of oral and written reasons. Students selected from this course participate in intercollegiate judging contests.
- 3-142. ADVANCED LIVESTOCK JUDGING. (1 cr; prereq 1-120, 3-130)**
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.

- 3-143. ADVANCED MEATS JUDGING.** (1 cr; prereq 1-120)
In-depth training in beef, pork, and lamb judging, writing reasons, and carcass grading. Field trips to packing plants are taken. Students selected from this course participate in the International Intercollegiate Meats Judging Contest.
- 3-220. PRINCIPLES OF ANIMAL BREEDING.** (5 cr; prereq GCB 3-022 recommended)
Application of qualitative genetic principles to animal breeding. Introduction to quantitative genetics. Concepts of livestock improvements through breeding and selection systems.
- 3-305. REPRODUCTIVE PHYSIOLOGY, ARTIFICIAL INSEMINATION, AND LACTATION.** (5 cr; prereq 1-300)
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.
- 3-402. NONRUMINANT NUTRITION.** (4 cr; prereq 1-401)
Nutrient requirements of chickens, turkeys, and swine, feed supplies, their composition and utilization in the formulation of adequate diets. The role of feed additives, their use and limitations. Consideration of nutritional interrelationships and feeding systems.
- 3-403. RUMINANT NUTRITION.** (4 cr; prereq 1-401)
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 will be considered also.
- 5-230. SYSTEMS AND METHODS OF ANIMAL BREEDING.** (4 cr; prereq 3-220)
Application of quantitative genetic principles to animal breeding; systems of breeding as related to beef and dairy cattle, poultry, sheep, and swine; and industry-related problems and research in animal breeding.
- 5-240. ANIMAL CYTOGENETICS AND IMMUNOGENETICS.** (4 cr; prereq GCB 3-022 or #)
Application of cytogenetics and immunogenetics to problems in animal breeding, systemics, pathology, and animal biology.
- 5-310. GENERAL ENDOCRINOLOGY.** (3 cr; prereq 1-300 or 6 cr of systemic physiology or #)
(Same as VPP 5-310, Zool 5-310) The physiological effects of the endocrine organs and hormones.
- 5-313. AVIAN PHYSIOLOGY.** (3 cr; prereq 1-300 or 6 cr of systemic physiology or equiv)
(Same as VPP 5-313, Zool 5-313) Physiology of various species of wild and domestic birds.
- 5-314. BEHAVIORAL PHYSIOLOGY.** (3 cr; prereq 1-300 or 6 cr of systemic physiology, Biol 5-051 or #)
(Same as VPP 5-314, Zool 5-314) 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.
- 5-402. NONRUMINANT NUTRITION.** (4 cr; prereq 1-401)
See AnSc 3-402.
- 5-403. RUMINANT NUTRITION.** (4 cr; prereq 1-401)
See AnSc 3-403. Term paper required.
- 5-404. RUMINANT NUTRITION FOR VETERINARY MEDICINE STUDENTS.** (3 cr)
Fundamentals of nutrition, nutrient requirements of ruminants, nutrient content of feedstuffs, protein and nonprotein nitrogen utilization, energy utilization, formulation of adequate rations, and nutritional disorders and deficiencies in ruminants.

Course Offerings

- 5-510. MUSCLE CHEMISTRY AND PHYSIOLOGY.** (4 cr; prereq 1-300 [1-500 recommended], BioC 1-302 or equiv; offered 1971-72 and alt yrs)
(Same as FScI 5-510) 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.
- 5-512. MEAT CHEMISTRY AND PROCESSING.** (4 cr; prereq 1-500 and BioC 1-302)
(Same as FScI 5-512) 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).
- 5-601. SWINE PRODUCTION.** (4 cr; prereq 1-401...3-220 recommended)
Status and characteristics of the swine industry; application of the principles of animal breeding, nutrition, physiology, and economics to swine production; considerations in the development of a successful swine enterprise.
- 5-602. SHEEP PRODUCTION.** (4 cr; prereq 1-401...3-220 and 3-403 recommended)
Status and characteristics of the sheep industry; application of the principles of animal breeding, nutrition, physiology, and economics to management of sheep breeding flocks. Ration formulation, management, and marketing of feedlot lambs.
- 5-603. BEEF CATTLE PRODUCTION.** (4 cr; prereq 1-401...3-220 and 3-403 recommended)
Status and characteristics of the beef cattle industry; application of the principles of animal breeding, nutrition, physiology, and economics to management of beef cattle breeding herds. Ration formulation, management and marketing of feedlot cattle.
- 5-604. DAIRY FARM MANAGEMENT.** (4 cr; prereq 3-403 or §...3-220 recommended; given spring qtr)
Application of the principles of animal breeding, nutrition, physiology, and economics to the planning and management of the dairy farm; genetic influences, housing requirements, health programs for large herds, feed budgets, and record analysis are emphasized.
- 5-605. COMMERCIAL POULTRY PRODUCTION.** (4 cr; prereq 1-401...3-402 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.
- 5-606. BEEF PRODUCTION FOR VETERINARY MEDICINE STUDENTS.** (3 cr)
Development and application of principles of animal breeding, nutrition, physiology, and economics to the production of feedlot and beef breeding herds. Ration formulation, management and marketing.
- 5-607. DAIRY FARM MANAGEMENT FOR VETERINARY MEDICINE STUDENTS.** (3 cr; prereq 5-404 or §)
Application of principles of animal breeding, nutrition, and economics to the management of the dairy farm; genetic influences, breed differences, housing requirements, and record analysis are emphasized.
- 5-703. 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.
- 5-710. SPECIAL PROBLEMS.** (Cr ar; prereq §)
Research in an area of animal science under the supervision of a staff member. A written report of the research is required. Open to students who have completed pertinent prerequisites.
- 5-715. 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, will

Entomology, Fisheries, and Wildlife

be suggested and the preparation of written essays of high quality will be required. Tutorials are available in cryobiology, cytogenetics, genetics, meats, nutrition, and physiology.

FOR GRADUATE STUDENTS ONLY

- 8-220.° Advanced Animal Breeding
- 8-221.° Quantitative Inheritance
- 8-420.° Energy in Animal Nutrition
- 8-421.° Protein and Amino Acid Nutrition
- 8-422.° Vitamin Nutrition
- 8-423.° Mineral Nutrition
- 8-440.° Ruminant Nutrition
- 8-740. Concepts and Developments in Ruminant Nutrition
- 8-741. Concepts and Developments in Avian Nutrition
- 8-742. Concepts and Developments in Swine Nutrition
- 8-750x. Concepts and Developments in Meat Science and Technology
- 8-760x. Graduate Seminar: Animal Science
- 8-810x.° Research in Animal Science
- 8-820x.° Research in Animal Genetics
- 8-830x. Research in Animal Physiology
- 8-840x.° Research in Animal Nutrition
- 8-850x.° Research in Muscle Chemistry and Physiology

Entomology, Fisheries, and Wildlife

Three fields of specialization are available in this department: (a) entomology, (b) fisheries, and (c) wildlife. Students interested in the fisheries or wildlife fields should consult the fisheries and wildlife curricula (see Index). The sequence of required and elective courses recommended for a 4-year program leading to a terminal B.S. degree in entomology or leading to a graduate degree in entomology is available in the department office. Students wishing to major in entomology at the undergraduate level will follow the curriculum in Biological and Physical Sciences in Agriculture.

Qualified students are advised to continue their training in the Graduate School where a wide variety of specializations, all dependent upon basic technical knowledge, is possible. A graduate study preparation option in fisheries is available for qualified students who propose to continue beyond the B.S. degree and work toward the M.S. or Ph.D. degree in fisheries.

Entomology (Ent)

- 1.005 **ECONOMIC ENTOMOLOGY.** (4 cr; prereq Biol 1-002 or #)
Brief introduction to the 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.

Course Offerings

- 1-020. PRINCIPLES OF BEEKEEPING.** (4 cr; prereq Biol 1-002 or equiv)
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.
- 3-100. ENTOMOLOGICAL TECHNIQUES.** (Cr ar; prereq 3-175 or equiv, or #)
Practical laboratory instruction in mounting, preservation of insect larvae; preparation of microscopic mounts of minute insects; labeling, classifying, and cataloging specimens of insects for scientific study.
- 3-175. INTRODUCTORY ENTOMOLOGY.** (5 cr; prereq Biol 1-002 or equiv)
General morphology, life histories, habits, and classification of insects.
- 5-001, 5-002, 5-003. BASIC ENTOMOLOGY.** (Cr ar; prereq Δ)
These courses provide a special arrangement for the making up of certain deficiencies in biological background.
- 5-020. FIELD ENTOMOLOGY.** (5 cr; prereq Biol 1-002 or equiv; offered at Itasca)
The insect fauna in various natural habitats of the park and surrounding areas. The course includes field trips, collection and classification of insects, as well as studies of general morphology, life histories and habitats of local species under ecological conditions governing the distribution of insect fauna of the region.
- 5-025. INSECT MORPHOLOGY.** (5 cr; prereq 3-175 or #)
Comparative studies of external and internal anatomy and histology of insects; phylogeny and function.
- 5-026. EMBRYOLOGY AND DEVELOPMENT OF INSECTS.** (5 cr; prereq 5-025, Chem 3-302, #)
Reproductive behavior, embryology, and postembryonic development of insects.
- 5-027. INSECT METABOLISM AND COORDINATION.** (5 cr; prereq #...BioC 5-002 or MdBc 101 recommended)
Homeostasis, permeability, circulation, metabolic systems and products, properties of muscles and nerves, sensation, behavior.
- 5-050. 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.
- 5-130. AQUATIC ENTOMOLOGY.** (5 cr; prereq 3-175, 5-020 or equiv or #; offered at Itasca)
Identification and biology of aquatic and littoral insects in all stages.
- 5-131. AQUATIC ENTOMOLOGY.** (2 cr; prereq 3-175 or equiv; offered 1971-72 and alt yrs)
Identification and biology of aquatic and littoral insects in all stages.
- 5-133. INSECT TAXONOMY.** (4 cr; prereq 3-175 or equiv)
Identification of taxa within the insect orders; use of taxonomic literature and catalogs; formation of an insect collection.
- 5-150. PRINCIPLES OF SYSTEMATIC ENTOMOLOGY.** (2 cr; prereq 15 cr in entomology or zoology, #; offered 1971-72 and alt yrs)
Lectures on history of systematic entomology, the species concept and higher categories, systematic procedures, and zoological nomenclature.
- 5-200. APICULTURE.** (4 cr; prereq 9 cr in 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.
- 5-210. INTEGRATED CONTROL.** (4 cr; prereq 3-175 or equiv, #)
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.
- 5-215. INSECTS IN RELATION TO PLANT DISEASES.** (4 cr; prereq 5 cr in entomology and 5 cr in plant pathology or equiv, or #)
(Same as PIPa 5-215) Insect transmission and dissemination of plant pathogens; development of plant-insect relationships, habits of principal insect vectors with emphasis on practical methods of control.

Entomology, Fisheries, and Wildlife

- 5-250. PRINCIPLES OF ECONOMIC ENTOMOLOGY.** (4 cr; prereq 15 cr in zoology and entomology incl 1-005 or §; offered 1972-73 and alt yrs)
Methods and principles of insect control. Lectures and laboratory demonstration.
- 5-275. MEDICAL ENTOMOLOGY.** (4 cr; prereq 15 cr incl 3-175 or equiv and §)
Principal arthropods noxious to man and animals. Emphasis on those that serve as vectors of pathogenic organisms of man and animals.
- 5-400. EXPERIMENTAL ECOLOGY.** (3 cr; prereq 9 cr in biology or equiv and 3 cr in animal or plant ecology, §, ¶8-300)
Experimental approach to study of environmental factors affecting animal populations.
- 5-425. SPECIAL LECTURES IN ENTOMOLOGY.** (Cr ar; offered when feasible)
Lectures in special fields of entomological research given by a visiting professor.
- 5-500. PROBLEMS IN MICROTÉCHNIQUE.** (Cr ar; prereq §)
Guidance for independent study of material of student's choice, with particular reference to insects.
- 5-510. BIOLOGICAL MICROSCOPY.** (4 cr; prereq 15 cr in biological sciences, §; offered on demand)
Necessary elements of optics, use and limitations of various types of microscopes, interpretation of microscopical data. Laboratory; demonstration plus project in the field of student's interest.
- 5-901, 5-902, 5-903. ADVANCED WORK IN ENTOMOLOGY.** (Cr ar; prereq §)
Library and laboratory research in various lines of entomology.
- 5-904. SPECIAL PROBLEMS IN ENTOMOLOGY.** (Cr ar; prereq §; offered at Itasca)
Advanced work with ample opportunity for individual research, especially in various faunistic studies in terrestrial, aquatic, and forest entomology.

FOR GRADUATE STUDENTS ONLY (Entomology)

- 8-200x. Seminar**
- 8-210. Current Topics in Forest Entomology**
- 8-300.° Experimental Ecology Laboratory**
- 8-305.° Insect Ecology**
- 8-315. Biology of Immature Insects**
- 8-323.° Topics in Insect Physiology**
- 8-350.° Insect Microbiology**
- 8-400.° Insecticides and Their Action**
- 8-405.° Insecticides Laboratory**
- 8-500, 8-501, 8-502, 8-503.° Research in Entomology**

Fisheries and Wildlife (FW)

- 0-001. ORIENTATION IN FISHERIES AND WILDLIFE.** (No cr)
A survey of technical requirements and training of fishery and wildlife technicians and scientists; introduction to fields of work, problems, and career outlets.
- 3-050. PRINCIPLES OF FISHERIES AND WILDLIFE MANAGEMENT.** (3 cr, §5-451, §5-551; for non-FW majors; prereq Biol 1-002 or equiv, Biol 3-041 or For 3-101, or Ecol 3-001)
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.
- 3-051. PRINCIPLES OF FISHERIES AND WILDLIFE MANAGEMENT—LABORATORY.**
(2 cr, §5-451, §5-552, §Ecol 5-817; prereq 3-050 or §)

Course Offerings

Primarily field, and to some extent, laboratory experiences as demonstrations of the principles of fisheries and wildlife management.

- 3-167. **TECHNIQUES OF FOREST WILDLIFE MANAGEMENT.** (2 cr; prereq 3-050; given at Cloquet)
Biology and management of important forest wildlife species; methods of evaluating forest wildlife populations and habitats.
- 3-277. **MAMMALOLOGY.** (5 cr; prereq VAna 1-120)
Distinguishing characteristics and life histories of the various mammal groups, particularly those represented in the state.
- 5-103, 5-104, 5-105. **BASIC FISHERY BIOLOGY OR BASIC WILDLIFE BIOLOGY.** (Cr ar; prereq Δ)
These courses provide a special arrangement for the making up of certain deficiencies in biological background.
- 5-279. **SPECIAL LECTURES IN FISHERIES AND WILDLIFE.** (Cr ar; offered when feasible)
Lectures in special fields of fishery and wildlife research given by a visiting professor.
- 5-280. **SENIOR SEMINAR: FISHERIES.** (1 cr)
Discussion and presentation of papers in fisheries and related subjects.
- 5-281. **SENIOR SEMINAR: WILDLIFE.** (1 cr)
Discussion and presentation of papers in wildlife and related subjects.
- 5-393, 5-394, 5-395. **ADVANCED WORK IN FISHERY BIOLOGY—ADVANCED WORK IN WILDLIFE BIOLOGY.** (Cr ar; prereq #)
Library and laboratory research in various lines of fishery biology or wildlife biology.
- 5-396. **SPECIAL PROBLEMS IN VERTEBRATE ECOLOGY.** (Cr ar; prereq #; offered at Itasca)
Advanced work with ample opportunity for individual research, especially in various phases of faunistic studies in fisheries and wildlife.
- 5-451. **ECOLOGY OF FISHERY POPULATIONS.** (3 cr; prereq Ecol 3-001 or equiv... Ecol 5-812 or Geo 5-601, Zool 5-121, Math 1-142 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 on structure and yield of exploited populations; fishery yield models.
- 5-452. **FISHERY MANAGEMENT.** (3 cr; prereq 5-451 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.
- 5-453. **TECHNIQUES OF FISHERY BIOLOGY.** (3 cr; prereq 5-452, 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, electro-fishing; tagging and marking; methods of creel census.
- 5-454. **FISHERY ECOLOGY IN POLLUTED WATERS.** (3 cr; prereq 5-451, Chem 1-004, 1-005, 1-006, Chem 3-100, 3-101, #)
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 indicators of degraded water quality.
- 5-551. **WILDLIFE ECOLOGY AND MANAGEMENT I.** (4 cr; prereq 3-277, Zool 5-076 and 5-077 or 5-834, Ecol 3-001, Ent 5-400 or Ecol 5-817, AnSc 1-300 or Zool 5-104...or #)
A discussion of population characteristics and the factors affecting them. Will include natality, recruitment, and mortality rates, density, and behavior. The role of these factors in relation to proper management of populations will be stressed.

Food Science and Industries

- 5-552. WILDLIFE ECOLOGY AND MANAGEMENT II.** (4 cr; prereq 5-551, Ecol 5-014 or 5-814, Bot 3-131)
Principles and concepts pertaining to relationships between wildlife populations and their habitats; habitat requirements and relationships of important game species; relationships to land use and land management practices; habitat evaluation and management.
- 5-553. WILDLIFE STATISTICS.** (2 cr; prereq Biom 5-010 or equiv, or #)
Emphasizes statistical procedures commonly used in wildlife ecology, including sampling techniques, chi-square analyses, and certain probability distributions as applied to population estimation and computer modeling.
- 5-678. FISHERIES AND WILDLIFE ADMINISTRATION.** (4 cr; prereq 3-050, 5-452, 5-552 or #)
Organization and function of federal and state agencies; laws and regulations; and internal policies concerning personnel, budgets and financing, research management, law enforcement, and public education.

FOR GRADUATE STUDENTS ONLY (Fisheries and Wildlife)

- 8-200x. Seminar
- 8-364, 8-365, 8-366, 8-367.* Research in Fishery Biology
- 8-377, 8-378, 8-379, 8-380.* Research in Wildlife Biology
- 8-448/8-449.*† Fishery Biology
- 8-450.* Fisheries Resources of the United States
- 8-451.* Production Biology of Fishery Environments
- 8-574.* Wildlife Management: Upland Game
- 8-575.* Wildlife Management: Waterfowl
- 8-576.* Wildlife Management: Big Game

Courses Offered by Other Departments

- Zool 5-093. Introduction to Animal Parasitology
- Zool 5-121. Ichthyology
- Zool 5-144. Parasitic Protozoa
- Zool 5-146. Experimental Parasitology
- Ecol 5-812. Aquatic Ecology
- Ecol 5-817. Vertebrate Ecology
- Geo 5-601. Limnology

Food Science and Industries (FSci)

- 1-010. MAN'S FOOD.** (3 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.
- 1-020. INTRODUCTORY MICROBIOLOGY.** (4 cr; especially for students in home economics; prereq 3rd qtr fr, #)
Fundamental principles of microbiology, characteristics of bacteria, yeasts, molds, and other microorganisms, their importance in the preparation and preservation of foods, relation to health and well-being of the individual and the family.
- 1-500. MEAT SCIENCE.** (4 cr; prereq Biol I-001)
(Same as AnSc 1-500) Role of ante- and postmortem factors in altering the

Course Offerings

- 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.
- 1-520. MILK PRODUCTION.** (3 cr; prereq Biol 1-001 or #)
(Same as AnSc 1-520) Production and management concepts and their application to dairy farm planning and the production and marketing of high quality milk.
- 3-110. FOOD PROCESS CHEMISTRY.** (3 or 5 cr [3 cr for lect taken separately]; prereq BioC 1-302 or #)
The chemical properties of foods and food constituents as influenced by processing and storage.
- 3-135. FOOD PROCESS ENGINEERING.** (5 cr; prereq 6 cr in physics and math requirement completed; 9 hrs per wk)
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.
- 5-100. SEMINAR: FOOD INDUSTRIES LITERATURE.** (2 cr; prereq Rhet 1-222, 3-351, three courses in food science and industries)
Selected topics. Food literature. Preparation of bibliographies. Each student presents papers and reports on assigned subjects and reviews scientific investigations in food industries.
- 5-120. FOOD MICROBIOLOGY.** (3 or 5 cr [3 cr for lect taken separately with #]; prereq MicB 3-103)
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.
- 5-122. SANITATION AND PROCESS MICROBIOLOGY.** (4 cr [3 cr for lect taken separately with #]; prereq 5-120 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.
- 5-310. ADVANCED FOOD CHEMISTRY TOPICS.** (4 cr; prereq sr or #)
An in-depth study of food chemistry and current food chemistry research topics.
- 5-311. SPECIAL PROBLEMS IN FOOD CHEMISTRY.** (1-5 cr; hrs ar)
Laboratory or library research on problems related to chemistry, applied to foods or food processing.
- 5-320. ADVANCED DAIRY AND FOOD MICROBIOLOGY.** (4 cr; prereq sr, 5-122, 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.
- 5-321. SPECIAL PROBLEMS IN DAIRY AND FOOD MICROBIOLOGY.** (1-5 cr; prereq sr or #; hrs ar)
Laboratory or library research on problems related to the microbiology of dairy and food products.
- 5-350. FOOD FORMULATION, PRODUCT DEVELOPMENT.** (4 cr; prereq course in statistics; lab hrs ar)
Application of concepts and techniques of experimental design to the solution of food science problems. Case studies, computer programming and use will be emphasized.
- 5-360. SENSORY TESTING OF FOODS: THEORY AND METHODOLOGY.** (2 cr; 1 lect and 3 lab hrs per wk)

Food Science and Industries

Fundamentals of flavor perception; sensory evaluation of the properties of food products with emphasis on methodology and interpretation of test results.

- 5-380. FOOD PACKAGING.** (3 cr; prereq Phys 1-030, 1-032 or equiv)
Lecture and demonstration of the properties of various packaging materials and their uses in the food industry.
- 5-510. MUSCLE CHEMISTRY AND PHYSIOLOGY.** (4 cr; prereq 1-300 [1-500 recommended], BioC 1-302 or equiv; offered 1971-72 and alt yrs)
(Same as AnSc 5-510) 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.
- 5-512. MEAT CHEMISTRY AND PROCESSING.** (4 cr; prereq 1-500 and BioC 1-302)
(Same as AnSc 5-512) 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).
- 5-522. PRINCIPLES OF DAIRY PROCESSING I.** (4 cr; prereq 3-110, 5-120 or #)
Application of scientific principles to problems involved in the processing of fluid and concentrated milk products. Physical and chemical properties of fluid milk systems and their control. Demonstrations of basic processing operations including heating, cooling, homogenization, evaporation, crystallization, and freezing.
- 5-523. PRINCIPLES OF DAIRY PROCESSING II.** (3 cr; prereq 3-110, 5-120; 2 lect and 3 lab hrs per wk)
Manufacture of cheese and fractionated milk proteins with emphasis on the application of chemical, microbiological, and physical principles.
- 5-524. JUDGING DAIRY PRODUCTS.** (1 cr; prereq 5-523 or #)
Laboratory and commercial procedures for evaluating the sensory properties and market quality of dairy products. Identification of common defects in flavor, physical properties, and appearance.
- 5-530. INDUSTRIAL PROCESSING OF FRUITS AND VEGETABLES.** (4 cr; prereq 3-110, 3-120, and 3-130 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.
- 5-555. FREEZING AND DEHYDRATION OF FOODS.** (4 cr; prereq 3-135, 3-110, 5-120, or #)
Principles involved in the processing, handling, and storage of frozen, dry, and intermediate moisture foods with emphasis on the physical-chemical properties of water in foods.
- 5-561. SUPERVISED INDUSTRY PRACTICE.** (4 cr; prereq 15 cr)
Practical training and experience in some operational phase of the dairy and food industries. Includes a minimum of 2 months' employment in an approved position and written reports.
- 5-571. SPECIAL PROBLEMS IN FOOD MANUFACTURING.** (1-5 cr; prereq sr or #; hrs ar)
Individual laboratory or library research on chemical, physical, and engineering problems involved in processing and utilization of food products.
- 5-581. INTERNATIONAL FOOD TECHNOLOGY.** (3-4 cr; prereq sr; hrs ar)
Independent study of food processing problems and developments throughout the world. The relation of food technology to adequate feeding of peoples of the world will be emphasized.

FOR GRADUATE STUDENTS ONLY

- 8-205. General Seminar**

Course Offerings

Horticultural Science (Hort)

There are seven areas of educational emphasis in the Department of Horticultural Science: 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 plant and soil science. 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 should follow the curriculum in Biological and Physical Sciences in Agriculture.

1. *Agricultural Science and Industries*—All students should take the following courses:

Hort 1-001, 3-099; Stat 1-051 or 3-081; PIPh 3-091, 3-092; Ent 1-005; GCB 3-022; PIPa 1-001 or 3-050; Soil 1-122.

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

HORTICULTURAL FOOD PRODUCTION

a. *Vegetable Science*

Hort 3-032, 5-006, 5-033, 5-040, 5-041, 5-044; Agro 5-020; PIPa 5-700

b. *Fruit Science*

Hort 1-026, 1-036, 3-031, 3-032, 5-006, 5-007, 5-033, 5-040, 5-041

ORNAMENTAL HORTICULTURE

a. *Floriculture*

Hort 1-016, 1-022, 1-036, 3-053, 3-077, 3-079, 5-040, 5-052, 5-053, 5-054

b. *Nursery Management*

Hort 1-016, 1-021, 1-022, 1-026, 3-074, 3-075, 3-076, 3-079, 5-040, 5-042, 5-045; LA 1-024

c. *Urban Park and Landscape Management*

Hort 1-021, 1-022, 1-026, 3-074, 3-075, 3-076, 5-040, 5-042; LA 1-024, 5-010; For 1-201, 5-232; AgEn 3-205

d. *Turf Management*

Hort 1-021, 1-022, 5-042; AgEn 3-205; Soil 5-232, 5-430

2. *Landscape Architecture*—See bachelor of landscape architecture program in Resource and Community Development curriculum.

3. *Biological and Physical Sciences in Agriculture*—Consult adviser for subjects recommended for an area of emphasis in horticulture.

1-001. FUNDAMENTALS OF HORTICULTURE. (4 cr; prereq Biol 1-011)

Fruit, vegetable, and ornamental plants, including factors which influence their culture, value, and importance. Lectures, laboratory, and field trips.

1-010. HOME LANDSCAPE GARDENING AND DESIGN. (4 cr)

Designed for the student who does not plan to major in landscape horticulture. Gives working knowledge of propagation and culture of common house plants and landscape materials: turf, flowers, trees, and shrubs. Principles of home landscape design are applied to a home property of the student's own choosing. Lectures, laboratory, and reference reading.

Horticultural Science

- 1-016. GREENHOUSE MANAGEMENT.** (3 cr; prereq Bot 1-001; offered 1972-73 and alt yrs)
Fundamentals of greenhouse construction and management; thorough discussion of cultural and physiological principles involved.
- 1-021. PLANT MATERIALS I.** (4 cr)
Taxonomy, ecology, and landscape uses of trees, vines, evergreens, and native deciduous shrubs. Lecture, laboratories, and field trips.
- 1-022. 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.
- 1-026. RESIDENTIAL LANDSCAPE DESIGN.** (4 cr; prereq 1-021 or 1-021)
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 plans, landscape drafting techniques, and methods of presentation. Lectures, drawings, and practical problems.
- 1-036. PLANT PROPAGATION.** (4 cr; prereq Bot 1-001)
Principles and techniques of propagating plants by seeds, cuttings, grafts, buds, layers, and division. Lectures deal with principles while the laboratories give student the opportunity to practice various propagating techniques. Field trips.
- 3-031. FRUIT SCIENCE.** (4 cr; prereq 1-001, Soil 1-122)
Principles of fruit production. Fruits of the world with emphasis on temperate climate crops. Topics include site selection, cultural and management practices, physiological and environmental control of plant development, dwarfing, growth regulating compounds, insecticides and herbicides. Lectures and laboratory.
- 3-032. VEGETABLE SCIENCE.** (4 cr; prereq 1-001, Soil 1-122)
Principles of vegetable agriculture, including reference to world food problems; geography of production; scope of the industry; physiological adaptation of species as food for man, and such principles of production practice as propagation, irrigation, nutrition, seed production, and postharvest handling. Lectures and laboratory.
- 3-053. ORNAMENTALS FOR INTERIOR DESIGN.** (3 cr; offered 1972-73 and alt yrs)
Identification, utilization, and culture primarily of foliage plants used in interior decoration. Lectures, reference reading, and field trips.
- 3-074. LANDSCAPE MANAGEMENT AND HORTICULTURAL PRACTICES.** (4 cr; prereq 5 cr in biology, Soil 1-122)
The 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.
- 3-075. LANDSCAPE CONSTRUCTION.** (4 cr)
Survey of garden and landscape construction, grading, materials, planting, and maintenance, including plans, specification, and computation of costs. Materials and construction of walks, walls, fences, landscape structures, steps, pools, terraces, turf and planting areas, flower beds, etc. Lectures, field trips, reports, and construction problems.
- 3-076. ARBORICULTURE.** (4 cr; prereq 3-074...1-021 or For 1-100)
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 the organization and administration of community shade tree programs. Lectures, demonstrations, and field trips.
- 3-079. ORNAMENTAL HORTICULTURE BUSINESS PRACTICES.** (3 cr)
Business management principles and practices in the operation of horticultural retail firms. Scope of the industry and its place in horticulture and the modern business world. Lectures, discussion, field trips.

Course Offerings

- 3-099. SEMINAR.** (1 cr per qtr [max 2 cr]; prereq jr)
Student seminars on horticultural problems, research projects, work experience, and employment opportunities.
- 5-006. SYSTEMATICS OF TEMPERATE AND TROPICAL HORTICULTURAL FOOD CROPS.** (4 cr; offered 1971-72 and alt yrs)
Designed to acquaint students with systematic relationships of the world's resources of fruit and vegetable taxa. Lectures, literature review, and laboratory.
- 5-007. ADVANCED FRUIT SCIENCE.** (4 cr; prereq 3-031; offered 1972-73 and alt yrs)
Students review and discuss research papers dealing with physiological, breeding, genetic, and cultural aspects of small and tree fruit crops. New developments are emphasized. Lectures, literature review, and discussion.
- 5-033. TOPICS: OPTIMIZING HORTICULTURAL FOOD PRODUCTION.** (1 cr)
A discussion analysis of current and futuristic concepts in fruit and vegetable production. Topics will include mechanical harvesting, population density, new cultural concepts, and environmental modifications as they apply to maximizing yield and quality
- 5-038. RESEARCH METHODS IN PLANT PROPAGATION.** (3 cr; prereq 1-036 or #)
Basic concepts, theory, and techniques involved in propagating plants are studied through literature search and discussion. Students design and conduct experiments with plants or propagation techniques of special interest.
- 5-040. PLANT GROWTH REGULATORS.** (3 cr; prereq 15 cr in plant sciences incl 3 cr in plant physiology; offered 1971-72 and alt yrs)
The physiology and agricultural technology of phytohormones and synthetic growth regulators in horticulture. Emphasis on the practical uses of such substances in the control of fruit and leaf abscission, parthenocarpy, growth rate, plant size, apical dominance, organ initiation, dormancy, germination flowering, callusing, and others.
- 5-041. ENVIRONMENTAL REQUIREMENTS OF HORTICULTURAL PLANTS.** (4 cr; prereq 15 cr in plant sciences incl 3 cr in plant physiology)
Lectures and assigned reading on the relation of light, temperature, and water to the growth and culture of horticultural plants.
- 5-042. TURF MANAGEMENT.** (4 cr; prereq 1-001, Soil 1-122; offered 1971-72 and alt yrs)
Taxonomy, ecology, and culture of grasses for landscape purposes. Included are basic principles, terminology, construction, maintenance, and soil-plant relationships in turf management for lawns, golf courses, athletic fields, and production operations. Lecture and laboratory.
- 5-044. MARKET GRADES AND VARIETAL ADAPTATION OF FRUITS AND VEGETABLES.** (4 cr; prereq 3-031, 3-032)
Characteristics of leading varieties of fruits and vegetables, market grades, variety testing, impact of environmental factors on varietal types and market grades.
- 5-045. TOPICS IN NURSERY MANAGEMENT.** (1 cr; prereq 1-036, PIPh 3-091; offered 1971-72 and alt yrs)
Relationship of plant growth requirements to production, storage, and distribution of nursery crops. Discussion and field trips.
- 5-052. COMMERCIAL FLORICULTURE, FALL CROPS.** (3 cr; prereq 1-016; offered 1971-72 and alt yrs)
Physiological and cultural aspects of the production of the principal florist crops of economic importance. Major emphasis on chrysanthemums, carnations, cut flowers, and potted plants especially adapted to Christmas sales. Lectures, reference reading, and field trips to greenhouses, wholesaler, and retail flower stores.
- 5-053. COMMERCIAL FLORICULTURE, WINTER CROPS.** (3 cr; prereq Bot 1-001, PIPh 3-091 or #; offered 1971-72 and alt yrs)
Physiological and cultural aspects of bulbous plants (tulips, narcissi, bulbous iris, hyacinths, crocus, and lilies) and year-round production of azaleas. Major emphasis will be placed on latest research in growth, developmental and flowering physiology of these commercially important floricultural crops. Lectures, reference reading, laboratory experience, and field trips.

- 5-054. COMMERCIAL FLORICULTURE, SPRING CROPS.** (3 cr; prereq 1-016; offered 1971-72 and alt yrs)
Physiological and cultural aspects of the production of the principal florist crops of economic importance. Major emphasis on roses, bulbous plants, and materials adapted to spring sales. Lectures, reference reading, and field trips to greenhouses, wholesalers, and retail flower stores.
- 5-090, 5-091, 5-092. SPECIAL PROBLEMS.** (1-4 cr per qtr; prereq #)
Written report based on library, laboratory, or field research.

Plant Physiology (PlPh)

- 5-167. PHYSIOLOGY OF THE PLANT CELL.** (3 cr; prereq plant anatomy, organic chemistry or biochemistry; offered 1972-73 and alt yrs)
Characteristics of the living state, elements of the cell, general aspects of cell metabolism, development of the cell, polarity, differentiation, and irritability of the cell and cellular movements.
- 5-168. EXPERIMENTAL PROTOPLASMATOLOGY.** (3 cr; prereq #; offered 1972-73 and alt yrs)
Physical and physicochemical properties of living protoplasm in plant cells, including viscosity, wall attachment, permeability, primary and secondary fluorescence, vital staining and changes in these qualities in harmful and harmless environments.
- 5-183. PLANT PHYSIOLOGY.** (3 cr; prereq Bot 1-001, BioC 1-301 or physics)
A discussion of membrane phenomena, water relations, mineral metabolism, and translocation in plants.
- 5-188. RESEARCH PERSPECTIVES IN PLANT PHYSIOLOGY.** (Cr ar; hrs ar)
- 5-721 to 5-727. METHODS OF PLANT ANALYSIS.** (1-6 cr; enrollment limited; prereq Chem 3-100, 8 cr biochemistry, and #)
Six discrete and independent laboratory units in plant physiology. In-depth experimental laboratory approach to microscopic analysis, sample preparation, fractionation, isolation, and measurement of plant compound employing modern methods of plant physiology.
- 5-721. *The Primary Plant Metabolites.* (Cr ar; offered 1972-73 and alt yrs)
 - 5-723. *Plant Hormones and Tissue Culture.* (Cr ar; offered every yr)
 - 5-724. *Photosynthesis and Photosynthetic Pigments.* (Cr ar; offered 1972-73 and alt yrs)
 - 5-725. *Plant Nucleic Acids.* (Cr ar; offered 1971-72 and alt yrs)
 - 5-726. *Analysis of Cell Structure.* (Cr ar; offered 1972-73 and alt yrs)
 - 5-727. *Phytochrome.* (Cr ar; offered 1972-73 and alt yrs)

Landscape Architecture (LA)

- 1-022. HISTORY OF ENVIRONMENTAL DEVELOPMENT: LANDSCAPE ARCHITECTURE.** (4 cr)
Discussions focused on investigating those forces and individuals that shaped the form of landscape in 19th- and early 20th-century America.
- 1-024. THEORY OF LANDSCAPE DESIGN.** (4 cr)
Analysis of design elements and forms involving line, direction, shape, proportion, and color, with emphasis on their function in design; a study of perception and man's relationship to his environment, and the social effects and psychological basis for design. Lectures and laboratory
- 1-025. LANDSCAPE GRAPHICS.** (4 cr)
Perspective drawing, landscape sketching, visual analysis of landscape materials, presentation techniques for plans, sections, and elevations.
- 1-031. INTRODUCTION TO LANDSCAPE ARCHITECTURE.** (4 cr)
Analysis of design potential of materials of the landscape; exercises in critical assessment of land developments and detail landscapes; exploration of the role of the landscape architect in shaping the natural and cultural environment; brief historical review of site developments.

Course Offerings

- 3-071, 3-072, 3-073. LANDSCAPE TECHNOLOGY I.** (4 cr per qtr)
Lectures, exercises, and projects in: ground form manipulation, earthwork, computation, and drainage techniques; layout of circulation and landscape utilities systems; land analysis procedures and techniques.
- 3-081, 3-082, 3-083. BASIC DESIGN.** (6 cr per qtr)
Lectures and projects which begin to expand awareness of the design potential of environment, develop processes and graphic techniques for problem solving, begin a search toward developing methods of presenting ideas verbally and visually. Design of small-scale site systems with simple variables.
- 3-091, 3-092. INTERMEDIATE DESIGN.** (6 cr per qtr; prereq 3-083)
Lectures and projects in exploration of the design potential of natural land materials, exploration of landscape survey and analysis techniques, assessment of the elements of environment as they condition design potential, exploration of methodologies for solving design problems, exploration of methods of expressing landscape form both graphically and through models; design of site systems with simple variables.
- 3-093. DETAIL SITE DESIGN.** (6 cr; prereq 3-092)
Design of small-scale site systems with complex variables.
- 3-101. COMMUNICATING LANDSCAPE QUALITY.** (3 cr; prereq 3-093 or #; 1 lect and 6 lab hrs per wk)
Lectures and exercises in drawing techniques focused on developing graphic skills.
- 5-010. PRINCIPLES OF OUTDOOR RECREATION DESIGN AND PLANNING.** (4 cr)
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.
- 5-101, 5-102. SITE PLANNING AND DESIGN I AND II.** (6 cr per qtr; prereq 3-093)
Case study analysis and design of site organizational systems.
- 5-103, 5-104. URBAN LANDSCAPE DESIGN I AND II.** (6 cr per qtr; prereq 3-093)
Case study analysis and design of urban environments.
- 5-105, 5-106. RECREATIONAL PLANNING AND DESIGN I AND II.** (6 cr per qtr; prereq 5-010)
Analysis, development, and presentation of landscape design solutions for diverse recreational land use.
- 5-107, 5-108. REGIONAL LANDSCAPE DESIGN I AND II.** (6 cr per qtr; prereq 3-092)
Emphasis will be placed on the study of large-scale land areas, analyzing development potential and evolving solutions for integration of divergent land use patterns such as agricultural, residential, commercial, industrial, and recreation.
- 5-110. ADVANCED LANDSCAPE PLANNING AND DESIGN.** (6 cr; prereq #)
Advanced studies in area of student's option.
- 5-115, 5-116. THEORY OF LANDSCAPE FORM AND STRUCTURE.** (2 cr per qtr; prereq 3-091 or #)
Studies in landscape perception; lectures, discussions, and exercises in application of abstract design principles to the assessment of land developments; review of psychological and social implications of land developments; exploration of the design potential of landscape materials; investigation of contemporary problems in land development including all scales and types of land uses.
- 5-124. LANDSCAPE ARCHITECTURAL SEMINAR.** (2 cr; prereq terminal yr of study)
Analysis of design principles and design goals in modern profession. Assessment of role of landscape architect in modern society. Review of current site development projects. Investigation in depth into specific areas of land development.
- 5-175. LANDSCAPE TECHNOLOGY II.** (4 cr)
Lectures, exercises, and projects in materials and construction techniques and working document preparation.
- 5-226. 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.

- 5-262. **HISTORY AND LITERATURE OF LANDSCAPE ARCHITECTURE.** (4 cr)
A search for design principles as expressed in landscape created by man from ancient times to the contemporary period. Specific focus on analysis of the visual form of environments as outgrowths of geographical, cultural, and technological determinants.

FOR GRADUATE STUDENTS ONLY

- Hort 8-021.* Breeding of Sexually Propagated Horticultural Crops
Hort 8-022. Breeding Asexually Propagated Crops
Hort 8-023. Evolution of Crop Plants
Hort 8-041. Organization of Horticultural Research
Hort 8-042. Horticultural Seminar
Agro 8-270.* Seminar: Plant Breeding
Hort 8-045. Plant Hardiness
Hort 8-051x.* Advanced Problems in Horticultural Crop Breeding
PIPh 8-251x.* Seminar: Plant Physiology
Hort 8-052x.* Advanced Problems in Physiology of Horticultural Crops
GCB 8-900. Seminar: Genetics

Plant Pathology (PIPa)

- 1-001. **INTRODUCTORY PLANT PATHOLOGY.** (5 cr, §3-050; prereq soph, 9 cr in plant science with at least 6 cr in botany or Biol 1-002)
Introductory course in plant diseases. Lectures, laboratory, and special problems.
- 3-050. **FOREST PATHOLOGY.** (4 cr, §1-001; prereq 6 cr in botany or Biol 1-002)
Diseases of forest and shade trees; wood decay. Symptoms, etiology, and control. Lectures, laboratory, and field work.
- 3-090. **RESEARCH IN PLANT PATHOLOGY.** (Cr and hrs ar; prereq 1-001 or 3-050 or #)
Assignment of special problems to undergraduate students who desire opportunity for independent research in plant pathology.
- 5-002. **INTRODUCTORY PLANT PATHOLOGY FOR ADVANCED STUDENTS.** (3 cr, §1-001 or §3-050; prereq 14 cr in plant science or #)
- 5-013. **PLANT PATHOLOGY.** (2 cr; prereq 1-001 or equiv...§5-100 recommended; offered 1972 and alt yrs)
Diseases of ornamental plants, trees, and field fruit and vegetable crops. Laboratory and field work continues throughout the summer.
- 5-051. **ADVANCED FOREST PATHOLOGY.** (3 cr; prereq 3-050 or equiv; offered 1972 and alt yrs)
Basic concepts in the etiology, epidemiology, and pathogenesis of tree diseases and wood deterioration.
- 5-100. **FUNGUS DISEASES OF PLANTS.** (4 cr; prereq 1-001 or equiv; offered 1972 and alt yrs)
Morphological and anatomical effects of infection, relationships of parts of the fungus life cycle to factors affecting infection and control measures.
- 5-102. **INTRODUCTORY MYCOLOGY.** (6 cr; prereq 9 cr in botany, or #; offered at Itasca)
General characters of fungi, especially those used in identification; cultural and taxonomic procedures and practices.
- 5-103. **AQUATIC FUNGI.** (5 cr; limited to 12 students; prereq 3 cr in mycology or #; offered at Itasca)
Collection, culture, taxonomy, and morphology of freshwater fungi.

Course Offerings

- 5-106/5-107. MYCOLOGY.** (3 cr per qtr; prereq 1-001 or 3-050 or MicB 3-103)
Lectures and laboratory exercises on the taxonomy, identification, life histories, genetics, and ecology of the fungi.
- 5-109. PHYSIOLOGY AND BIOCHEMISTRY OF FUNGI.** (3 cr; prereq BioC 5-001 or §; offered 1973 and alt yrs)
Physiological and biochemical processes in fungi with major emphasis on elucidation of metabolic pathways.
- 5-132. BIOLOGY OF FUNGI.** (3 cr; prereq Biol 1-002, Chem 3-302 or BioC 1-302 or §; offered 1973 and alt yrs)
Survey of the fungi; their morphology, taxonomy, genetics, physiology, biochemistry, and ecology.
- 5-133. BIOLOGY OF FUNGI LABORATORY.** (1 cr; offered 1973 and alt yrs)
Exercises with fungi, their growth and ecology.
- 5-200. POISONOUS PLANTS.** (2 cr; prereq §)
(Same as VM 5-220) Systematic study of important plants poisonous to animals. Special emphasis is placed on identification, toxicology, diagnosis, and treatment.
- 5-215. INSECTS IN RELATION TO PLANT DISEASES.** (4 cr; prereq 5 cr in entomology and 5 cr in plant pathology or equiv, or §)
(Same as Ent 5-215) Insect transmission and dissemination of plant pathogens; development of plant-insect relationships; habits of principal insect vectors with emphasis on practical methods of control.
- 5-220. WORLD FOOD SUPPLY PROBLEMS.** (4 cr; limited enrollment; prereq sr and grad students with Δ or §)
(Same as AgEc 5-790, AnSc 5-780, HE 5-381, Soc 5-675, VM 5-790) A multidisciplinary approach will examine the problems of feeding the world's growing population. Principles from the socio-economic sciences, plant sciences, public health, and animal sciences will be applied in lectures and informal discussions.
- 5-300. VIRUS DISEASES OF PLANTS.** (3 cr; prereq 1-001 or 3-050 or 5-002; offered 1971-72 and alt yrs)
Nature of plant viruses and types of diseases they cause; emphasis on methods for studying virus diseases.
- 5-400. BACTERIAL DISEASES OF PLANTS.** (3 cr; prereq 1-001 or 3-050 or 5-002 and 3 cr in bacteriology; offered 1972-73 and alt yrs)
Bacteria as plant pathogens; representative types with particular reference to techniques used in studying bacterial diseases of plants.
- 5-500. PLANT NEMATOLOGY.** (3 or 5 cr; prereq 1-001 or 3-050 or 5-002 and Biol 1-002, or §; offered 1973 and alt yrs)
Nematode taxonomy, morphology, life cycles, biology, and control; nematodes as plant pathogens and their effects on plants.
- 5-702. CONTROL AND PREVENTION OF PLANT DISEASES.** (5 cr; prereq 1-001 or 3-050 or §; offered 1972 and alt yrs)
Principles and practices relating to plant disease control with emphasis on quarantine, eradication, cultural practices, and fungicides.

FOR GRADUATE STUDENTS ONLY

- 8-090. Research in Plant Pathology**
- 8-110. Problems in Mycology**
- 8-111. Genetics of Plant Pathogens**
- 8-112. Ecology of Plant Pathogens**
- 8-301. Research in Plant Virology**
- 8-401. Research in Plant Bacteriology**
- 8-501. Current Topics and Problems in Plant Nematology**
- 8-600. Seminar: Plant Pathology**
- 8-610. Physiology of Host-Parasite Relationships**
- 8-620. Principles of Plant Pathology**

Rhetoric (Rhet)

All students in the College of Agriculture are required to take the following courses in rhetoric: Freshman Communication (8 cr); Public Speaking (Rhet 1-222); and Professional Writing (Rhet 3-551) or Scientific and Technical Writing (Rhet 3-562). Additional requirements as to number of credits and specific courses depend upon the particular curriculum for which the student is registered.

The Rhetoric Department also offers courses in humanities, literature, original writing, speech, and dramatics. A number of these courses may be used to fulfill the distribution requirements in Categories I, III, and IV.

- 1-101. COMMUNICATION I (4 cr)**
Writing from observation and experience about contemporary issues. Attention to grammar, sentence and paragraph construction, punctuation, spelling. Integrated assignments in reading, listening, and speaking. Progress tests.
- 1-102. COMMUNICATION II (4 cr)**
The expository paper. Note-taking, outlining. Short themes, library research about contemporary issues, term paper, documentation. Integrated assignments in reading, listening, and speaking.
- 1-147. EFFICIENT READING. (3 cr; Arts College students see *College of Liberal Arts Bulletin*; SBA students see *School of Business Administration Bulletin*)**
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.
- 1-222. PUBLIC SPEAKING. (4 cr; prereq rhet comm req, soph)**
Practical course in fundamentals of speechmaking. Emphasis upon organizing the speech and projecting it to the audience.
- 1-225. PARLIAMENTARY PROCEDURE. (1 cr)**
Parliamentary procedure applied to group organization and management. Duties of officers and disposition of motions emphasized. Individual participation stressed through role playing and other workshop procedures.
- 1-251. EFFECTIVE LISTENING. (3 cr)**
Designed to increase listening comprehension by developing three central abilities. Readings, research, theory, and practice.
- 0-291. AMERICAN SPEECH FOR FOREIGN STUDENTS. (No cr; 3 hrs per wk)**
Primarily for graduate students who wish to improve their command of oral English. Individual attention; laboratory procedure. Audio-visual equipment used to expedite work in vocabulary, enunciation, and pronunciation.
- 1-301. HUMANITIES: THE ENLIGHTENMENT. (5 cr)**
An 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.
- 1-302. HUMANITIES: THE INDUSTRIAL REVOLUTION. (5 cr)**
Examination of 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.
- 1-303. HUMANITIES: THE AGE OF DARWIN. (5 cr)**
Examination of the impact of evolutionary thought; religion and morality in a changing society. Readings in Darwin and the evolutionists; Nietzsche, Shaw, Thomas Mann, and others.
- 1-401. INTRODUCTION TO LITERATURE. (4 cr; prereq rhet comm req)**
Analysis of literary structural forms and stylistic devices: poetry, drama, and prose fiction.

Course Offerings

- 1-421. **ENGLISH LITERATURE I.** (3 cr; prereq rhet comm req)
Historical and stylistic development from the Anglo-Saxon period through the Renaissance.
- 1-422. **ENGLISH LITERATURE II.** (3 cr; prereq rhet comm req)
Historical and stylistic development from the Puritans through the neoclassical period.
- 1-424. **WORLD LITERATURE I.** (5 cr; prereq rhet comm req)
Examination and analysis of selected master works of continental and Middle-Eastern literature from the ancients through the Renaissance.
- 1-425. **WORLD LITERATURE II.** (5 cr; prereq rhet comm req)
Examination and analysis of selected master works of continental literature from the neoclassical period to the present.
- 1-442. **NOVEL AND SHORT STORY.** (4 cr; prereq rhet comm req)
Analysis of selected European and American fiction. Emphasis on literary style in relation to themes of prose fiction.
- 1-451. **INTRODUCTION TO DRAMATIC LITERATURE.** (4 cr; prereq rhet comm req)
Selected readings from Greek literature to the present. Emphasis upon the development of dramatic art form.
- 1-506. **ORIGINAL WRITING.** (3 cr)
Systematic analysis of short story techniques. Through reading and writing short stories, the student is acquainted with the basic constants of the art. Emphasis is on writing, but the course also provides a different way of reading and appreciating short stories.
- 3-192. **COMMUNICATION PROBLEMS FOR FOREIGN EXCHANGE GROUPS.** (3 cr; prereq elem knowledge of oral and written English)
For any exchange group composed of members of similar national origins. English studied as a second language.
- 3-254. **ADVANCED PUBLIC SPEAKING.** (4 cr; prereq 1-222)
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.
- 3-266. **DISCUSSION METHODS.** (4 cr; prereq rhet comm req)
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.
- 3-321. **HUMANITIES: THE GREEK HERITAGE.** (5 cr)
Examination of the literature, philosophy, and arts of ancient Greece central to understanding contemporary Western society. Readings in Homer, the Tragedians, Plato, Aristotle, Thucydides.
- 3-322. **HUMANITIES: THE ROMAN AND MEDIEVAL HERITAGE.** (5 cr)
Examination of 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.
- 3-323. **HUMANITIES: THE RENAISSANCE AND REFORMATION.** (5 cr)
Examination of 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.
- 3-324. **HUMANITIES: ASIATIC CULTURE.** (5 cr)
Examination of Asiatic religious and philosophical systems; introduction to the art, architecture, and music of Asia. Readings in early Indian literature, Buddhism, Taoism, Confucianism.
- 3-371. **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.

- 3-372. **HUMANITIES: RELIGION IN AMERICAN THOUGHT AND EXPERIENCE.** (5 cr)
Examination of 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.
- 3-373. **HUMANITIES: NATIONALISM IN AMERICAN THOUGHT AND EXPERIENCE.** (5 cr)
Examination of 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.
- 3-374. **HUMANITIES: SPECIAL PROBLEMS.** (1-5 cr; prereq #)
Primarily for supervised reading and research on topics not covered in regularly scheduled humanities offerings.
- 3-381. **HUMANITIES: 20TH-CENTURY CULTURE.** (5 cr)
Examination of the changing structure of 20th-century culture from World War I to the present. Freudianism, communism, fascism, the modern movements in literature, the visual arts, and music; existentialism.
- 3-455. **SHAKESPEARE.** (5 cr; prereq rhet comm req)
Reading of selected plays from the early, middle, and late periods. Emphasis upon the understanding of Elizabethan dramatic art.
- 3-471. **AMERICAN LITERATURE.** (5 cr; prereq rhet comm req)
Analysis of philosophical and social concepts that have shaped American culture, as reflected in literature.
- 3-473. **CONTEMPORARY LITERATURE.** (4 cr; prereq rhet comm req)
Reading and analysis of significant literary works from modern literature.
- 3-551. **PROFESSIONAL WRITING.** (3 cr; either 3-551 or 3-562 is required of all students unless exempted through deptl exam; prereq jr)
Projects and reports in professional communication: the résumé, application letter, interview; study of professional journals; the review of literature; specialized bibliographic tools; the feature article. Selected exercises in exposition. Review of usage and style.
- 3-562. **SCIENTIFIC AND TECHNICAL WRITING.** (3 cr; either 3-562 or 3-551 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.
- 5-147. **ADULT READING PROGRAMS.** (2 cr)
Problems, methods, and research in this field. Survey and evaluation of program designs, including those suitable for TV.
- 5-169. **COMMUNICATION PROBLEMS AND PROCESSES.** (3 cr; grad level)
An analysis of contemporary communication theories and research. Problems of language, perception, and status in the application of communication theory to professional activity and growth.
- 5-170. **MANAGERIAL COMMUNICATIONS.** (4 cr)
Systematic analysis of communication techniques and procedures for the manager. Emphasis is placed on the manager's ability to achieve vertical and horizontal understanding and acceptance. Class activities include readings, guest speakers, and a term project.
- 5-175. **PRINCIPLES OF LANGUAGE DEVELOPMENT.** (4 cr)
Analysis through history and semantics of the 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.
- 5-180. **INTERNSHIP IN TECHNICAL COMMUNICATION.** (Cr ar)
Designed to give technical communication majors practical on-the-job experience with communication problems. Students will intern as writers or editors either at the University of Minnesota or in industry.
- 5-301. **HUMANITIES SEMINAR: THE INDIVIDUAL AND SOCIETY.** (3 cr; prereq 1-301, 1-302, 1-303 or #)

Course Offerings

Examination of contemporary ethical and cultural values as manifested in such conflicts as: liberty and authority, freedom and organization, art and technology, science and religion.

5-551. REPORT AND THESIS WRITING. (3 cr; prereq 3-551 or #)

For graduate students and for seniors anticipating graduate work. Organization of reports and theses; library investigation; presentation of data; methods of documentation. Emphasis upon revision of manuscripts and improvement in style of writing.

5-561. WRITING FOR PUBLICATION. (4 cr; prereq Rhet 3-551 or Rhet 3-562)

The professional as communicator; analysis of markets: professional, trade, and general; information sources and topic selection; adaptation to the specialized and the general reader; writing and preparing manuscripts for publication; marketing techniques.

FOR GRADUATE STUDENTS ONLY

8-251. Seminar: Listening Comprehension

Soil Science (Soil)

Students selecting soil science as an area of emphasis in the Agricultural Science and Industries, Biological and Physical Sciences in Agriculture, or in the Resource and Community Development curricula are expected to take a minimum of 18 credits in soil science. These should include soil sciences taken in the junior or senior year and at least one 3-credit special problem in Soil 5-114. Students should select with the help of the adviser a sufficient number of applicable courses to complete the major sequence. The courses taken will be dependent upon the objective of the area of emphasis and the interest of the student.

1-122. INTRODUCTORY SOIL SCIENCE. (4 cr; prereq ¶Chem 1-004 or equiv)

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

1-262. INTRODUCTION TO METEOROLOGY. (4 cr)

(Same as Geog 1-425) Pre-calculus introduction to nature of the atmosphere and its behavior. Topics include 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.

3-118. SEMINAR: SOIL POLLUTION AND PUBLIC POLICY. (1 cr; P-N only; offered fall 1972-73 and alt yrs)

Round table discussions on assigned readings of subject matter.

3-218. SEMINAR: SOIL DRAINAGE AND IRRIGATION—THEIR EFFECT ON THE ENVIRONMENT. (1 cr; P-N only; offered winter 1971-72 and alt yrs)

Round table discussions and assigned readings on subject matter.

3-220. SOIL AND WATER MANAGEMENT AND CONSERVATION. (3 cr; prereq 1-122)

Principles of soil water, temperature, and aeration; their effect on plant growth, and interaction with other soil properties. Effect of soil tillage methods and cropping systems on structure, erosion control, water storage, and water infiltration. Techniques and organizations involved in soil and water conservation. Field trips, consultation, and reference work.

3-418. SEMINAR: LEACHING AND RUNOFF OF FERTILIZERS. (1 cr; offered winter 1972-73 and alt yrs)

Round table discussions on assigned readings on the subject matter.

- 3-518. **SEMINAR: SOIL JUDGING.** (1 cr; P-N only)
Discussions on and use of the high school and FFA soil judging scorecard.
- 3-528. **SEMINAR: USE AND INTERPRETATION OF SOIL SURVEYS.** (1 cr; P-N only; offered fall 1971-72 and alt yrs)
Round table discussions on assigned readings on the subject matter.
- 5-114. **SPECIAL PROBLEMS IN SOILS.** (1-5 cr per qtr [10 cr max]; prereq 1-122 or #)
Research, readings, instruction.
- 5-220. **SOIL AND WATER MANAGEMENT AND CONSERVATION.** (2 cr; prereq 1-122)
See Soil 3-220.
- 5-232. **SOIL PHYSICS.** (4 cr; prereq 1-112, Math 1-111 and 1 yr physics)
Soil structure, compaction, tilth, tillage; water infiltration, retention, availability, movement, and evaporation; heat capacity, flow, air porosity, diffusion, deficiency effects on plants, drainage requirement. Lectures and laboratory.
- 5-240. **MICROCLIMATOLOGY (SOILS).** (3 cr; prereq Math 1-111, 10 cr in physics)
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 agricultural practices; weather instruments and use of climatic data.
- 5-310. **SOIL CHEMISTRY AND MINERALOGY.** (4 cr; prereq 1-122 or #; offered 1971-72 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.
- 5-333. **SOIL ANALYTICAL CHEMISTRY TECHNIQUES.** (3 cr; limited to 10 students; prereq 1-122 or 5 cr in physics, one course in analytical chemistry)
Instrumental methods of inorganic and organic chemical analyses in soils. Lectures and laboratory.
- 5-340. **ORGANIC AND PESTICIDAL RESIDUES.** (5 cr; prereq 1-122 and 9 cr in biochemistry and/or organic chemistry)
Examination of the fate of natural and synthetic organic materials in soil, with emphasis upon the chemical, physical, and biological factors of the soil which influence composition or persistence.
- 5-412. **SOIL FERTILITY EVALUATION.** (4 cr; prereq 1-122)
Methods of soil fertility evaluation; soil tests and tissue tests and their use in fertilizer and lime recommendations; fertility demonstration techniques. Lectures, laboratory.
- 5-420. **FERTILIZERS.** (3 cr; prereq 1-122 or #)
History of the fertilizer industry; manufacture, characteristics, and use of important fertilizer nutrients.
- 5-430. **SOIL FERTILITY.** (3 cr; prereq 1-122)
Plant root-soil relationships, chemistry of essential elements in the soil and plant; diagnosing soil deficiencies.
- 5-512. **SOIL GEOGRAPHY.** (4 cr; prereq 1-122)
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 the world. Interpretation of this geography with the use of soil maps and aerial photographs in various types of resource development. Lecture, laboratory, field trips.
- 5-520. **SOIL DEVELOPMENT AND CLASSIFICATION.** (3 cr; prereq 5-512 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.
- 5-532. **SOILS AND THE ECOSYSTEM.** (5 cr; limited to 20 students; prereq course in ecology; offered at Itasca)

Course Offerings

The formation and distribution of soils in relationship to vegetation, climate, and other soil-forming factors. The interrelationships of soils in the ecosystem.

- 5-540. **SOIL RESOURCES AND ENVIRONMENTAL RELATIONSHIPS.** (4 cr; prereq 1-122 or #)

Examines current types of soil resource concepts, land use as related to soils, and the interactions of technology on the soil environment. The possible short- and long-term effects of fertilizers, soil amendments, and other substances on the soil-water ecosystem will be included in the course.

- 5-550. **ORGANIC SOILS.** (3 cr; prereq 1-122)

Formation, classification, and properties of organic soils; their use and management. Lectures and laboratory.

- 5-612. **ECOLOGY OF SOIL MICROORGANISMS.** (4 cr; prereq MicB 3-103 or 3-013)

(Same as MicB 5-612) Soil as a microhabitant; the nature of the microbial population of soil; interactions among microorganisms in the soil ecosystem; and significant activities of soil microorganisms. Lectures and laboratory.

FOR GRADUATE STUDENTS ONLY

- 8-122. Advanced Soil Science

- 8-124. Research Problems in Soils

- 8-128. Seminar

- 8-322. Selected Methods of Clay Mineral Analysis

- 8-330. Soil Physical Chemistry

- 8-620. Soil Organic Matter and Microbial Transformations

Courses in Programs Serving All Departments in the College of Agriculture

Plant Physiology (PlPh)

Students majoring in the Biological and Physical Sciences curriculum in the College of Agriculture will be interested in the following listing of courses in plant physiology. With the approval of the student's adviser the introductory courses in plant physiology may be used in partial fulfillment of the science requirement. Upper Division courses in plant physiology may also be taken when the student has the necessary prerequisites. These courses will serve to introduce the undergraduate to the field of plant physiology and will illustrate how knowledge in this special area of plant science may be utilized in private or government 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*.

- 3-131. **SURVEY OF PLANT PHYSIOLOGY.** (3 cr, §Bot 3-131; prereq Biol 1-002, Biol 1-011, or Biol 3-012, BioC 1-301, Chem 3-301 or #)

Physiological principles underlying processes that occur in living plants; emphasis on higher plants. Growth and development, mineral nutrition, water relations and solute metabolism, respiration, and photosynthesis.

- 3-132. **PLANT PHYSIOLOGY LABORATORY.** (2 cr, §Bot 3-132; prereq 3-131 or §3-131)

A laboratory course to accompany PlPh 3-131.

Plant Physiology

- 5-141. **SURVEY OF PLANT PHYSIOLOGY.** (3 cr, §Bot 5-141; prereq Biol 1-002, 1-011 or 3-012, course in organic chemistry or biochemistry)
Critical study of the physiological processes which occur in living plants with emphasis on higher plants. Growth and development, energy relations, mineral nutrition, water relations, respiration, photosynthesis, and nitrogen metabolism.
- 5-142. **PLANT PHYSIOLOGY LABORATORY.** (2 cr, §Bot 5-142; prereq 5-141 or §5-141)
A laboratory course to accompany PIPh 5-141.
- 5-167. **PHYSIOLOGY OF THE PLANT CELL.** (3 cr; prereq plant anatomy, inorganic and organic chemistry or biochemistry; offered 1972-73 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.
- 5-168. **EXPERIMENTAL PROTOPLASMATOLOGY.** (3 cr; prereq §; offered 1971-72 and alt yrs)
Physical and physicochemical properties of living protoplasm in plant cells, including viscosity, wall attachment, permeability, primary and secondary fluorescence, vital staining.
- 5-182. **PLANT PHYSIOLOGY.** (3 cr, §Bot 5-182; prereq course in biochemistry)
Plant metabolism including photosynthesis, respiration, and the 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.
- 5-183. **PLANT PHYSIOLOGY.** (3 cr, §Bot 5-183; prereq course in organic chemistry or biochemistry, biology, physics)
Water relations, translocation, and mineral metabolism of plants including transport of substances through membranes and its driving forces at the cellular level. The effects of external factors on the water relationships of intact plants and the absorption, translocation, and metabolism of organic and inorganic elements.
- 5-184. **PLANT PHYSIOLOGY.** (3 cr, §Bot 5-184; prereq course in biology, course in 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.
- 5-185. **PHYSIOLOGY OF PHOTOSYNTHETIC MICROORGANISMS.** (3-5 cr; prereq §; offered 1972-73 and alt yrs)
Primarily a lecture course. Application of spectrophotometry, manometry, and other techniques toward elucidation of physiological behavior, chemical makeup, and intermediary metabolism of algae and photosynthetic bacteria.
- 5-188. **RESEARCH PERSPECTIVES IN PLANT PHYSIOLOGY.** (1-4 cr; prereq Chem 3-100 and 3-101, 8 cr in biochemistry and §)
A laboratory course in which the student undertakes a well-defined research problem of limited scope.
- 5-701, 5-702, 5-703. **MEASUREMENT OF PLANT-ENVIRONMENT INTERACTIONS.** (1-5 cr; prereq §)
A laboratory course dealing with measurements using intact plants, including water balance, plant-radiation interactions, and gas exchange between plants and the environment.
- 5-701. **ENERGY TRANSFER AND PLANT TEMPERATURE.** (2 cr)
- 5-702. **PHOTOSYNTHESIS, GAS EXCHANGE.** (2 cr)
- 5-703. **INTERNAL WATER BALANCE.** (2 cr; offered 1972-73 and alt yrs)
- 5-721, 5-723, 5-724, 5-725, 5-726, 5-727. **METHODS OF PLANT ANALYSIS.** (1-6 cr; enrollment limited; prereq Chem 3-100 and 3-101, 8 cr in biochemistry, and §)
In-depth experimental laboratory approach to microscope analysis, sample preparation, fractionation, isolation, and measurement of plant compounds employing modern methods of plant physiology. Discrete and independent units in:

Course Offerings

- 5-721. The Primary Plant Metabolites. (Cr ar; offered 1972-73 and alt yrs)
5-723. Plant Hormones and Tissue Culture. (Cr ar; offered every yr)
5-724. Photosynthesis and Photosynthetic Pigments. (Cr ar; offered 1972-73 and alt yrs)
5-725. Plant Nucleic Acids. (Cr ar; offered 1971-72 and alt yrs)
5-726. Analysis of Cell Structure. (Cr ar; offered 1972-73 and alt yrs)
5-727. Phytochrome, Photomorphogenesis and the Physiology of Flowering. (Cr ar; offered 1972-73 and alt yrs)
- 5-970. SPECIAL PROBLEMS IN PLANT PHYSIOLOGY. (Cr ar)
Research readings, instruction.

FOR GRADUATE STUDENTS ONLY

- 8-251. Seminar: Plant Physiology
8-281. Growth and Differentiation of Plants
8-282. Advanced Topics in Plant Metabolism
8-285. Photosynthesis
8-286. Radioisotope Techniques Applied to Biology

Additional courses treating the area of plant physiology are offered by several departments within the University of Minnesota. Your attention is directed to such courses as Soil 5-240, Soil 5-340, Agro 5-030 and 5-040, PIPa 5-109, Hort 8-045 as examples of such courses offered by departments in the College of Agriculture.

Resource and Community Development (RCD)

(See pages 36-44)

- 1-010. 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. Cooperative offering available at several Minnesota institutions.
- 5-100. INTERDISCIPLINARY SEMINAR I. (3 cr; prereq RCD sr)
Designed to help students develop the competence necessary for identifying and analyzing resource development problems. Subject matter discussions to reflect diverse disciplinary contributions. Students to contribute as members of a team combining disciplinary skills. Invited speakers. Student assignments.
- 5-101. INTERDISCIPLINARY SEMINAR II. (4 cr; prereq 5-100)
(Continuation of RCD 5-100) Papers, presentations, critiques on selected complex resource development problems related to discussion programs in Seminars I and II.
- 5-110. SPECIAL PROBLEMS. (1-4 cr [max 12 cr]; prereq RCD sr, §)
Projects, plans, and written reports related to RCD 5-100, 5-101; resource and environmental inventory and analysis.

Statistics (Stat)

- 1-051 (old Biom 40). INTRODUCTORY STATISTICS. (4 cr, §5-021; prereq college algebra or §)
Basic concepts in data description, random sampling, probability, estimation, hypothesis testing, correlation.

Veterinary Medicine

- 3-081. **EXPERIMENTAL TECHNIQUES AND STATISTICAL INFERENCE.** (5 cr, §5-021; prereq college algebra or §)
Sampling, variability, description and analysis of data, tests and confidence intervals, multiple comparisons; choosing the experimental design, material, and size; introduction to correlation and regression.
- 5-021 (old Biom 100). **STATISTICAL ANALYSIS I.** (4 cr; prereq college algebra or §)
Frequency distributions, descriptive statistics, elementary probability; binomial, Poisson and normal distributions, estimation and testing, analysis of variance, multiple comparisons, linear regression.
- 5-022 (old Biom 101). **STATISTICAL ANALYSIS II.** (4 cr; prereq 3-081 or 5-021)
(Continuation of Stat 5-021) Multiple regression and correlation. Multiway analysis of variance, variance components, covariance. Basic nonparametric methods.
- 5-061 (old Biom 110). **COMPUTER PROGRAMMING IN STATISTICS.** (3 cr; prereq 5-022 or §)
Basic Fortran programming; use of libraries of statistical routines.
- 5-201 (old Biom 171). **SAMPLING METHODOLOGY IN FINITE POPULATIONS.** (4 cr; prereq 5-021 or equiv)
Simple random, systematic, stratified, and unequal probability sampling. Ratio and regression estimation. Multistage and cluster sampling.
- 5-301 (old Biom 181). **DESIGNING EXPERIMENTS.** (4 cr; prereq 5-021 or equiv)
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.
- 5-601. **NONPARAMETRIC STATISTICAL METHODS.** (4 cr; prereq 5-021 or §)
Discrete probability, normal chi-square, binomial, hypergeometric and discrete uniform distribution, estimation and testing in these. Use of ranking, contingency coefficients and Kolmogorov-Smirnov statistics.
- 5-071. **STATISTICAL APPLICATION OF MATRIX ALGEBRA.** (3 cr; prereq Math 3-142 or equiv or §...Stat 5-021 or equiv or §)
An introduction to specific matrix operations with vector realizations, presuming no prior knowledge. Uses in analysis of variance and multivariate methods. Correlation structures, characteristic vectors, quadratic forms.
- 5-302. **APPLIED REGRESSION ANALYSIS.** (4 cr; prereq 5-021 or equiv)
Multiple regression procedures for many variables, curvilinear regression in one or several variables. Partial correlations, residual analysis, causal models.

Courses in the College of Veterinary Medicine Offered Cooperatively with Other Colleges for All University Students

Veterinary Anatomy (VAna)

- 1-120. **ESSENTIALS OF VERTEBRATE DEVELOPMENT AND STRUCTURE.** (5 cr; not open to veterinary medical students; prereq Biol 1-002 or 3-011 or §)
Principles and patterns of vertebrate anatomy, based on the developmental approach.
- 5-120. **ESSENTIALS OF VERTEBRATE DEVELOPMENT AND STRUCTURE**
Same as VAna 1-120.

Course Offerings

Veterinary Medicine (VM)

- 3-502. ANIMAL HYGIENE.** (5 cr; not open to veterinary medical students)
Principles of animal health and disease with emphasis on prevention, control, and eradication.
- 5-790. SEMINAR: WORLD FOOD SUPPLY PROBLEMS.** (4 cr; limited enrollment; prereq major in agriculture, veterinary medicine, nutritional sciences, social science field or #...grad students by Δ only)
(Same as AgEc 5-790, HE 5-393, PlPa 5-220, and Soc 5-675) 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, the plant sciences, the animal sciences, and the nutritional sciences for their application to food problems.

Veterinary Microbiology (VMic)

- 3-103. GENERAL MICROBIOLOGY.** (5 cr; not open to veterinary medical students; prereq 10 cr in chemistry, 4 cr in biologic sciences)
Lectures and laboratory exercises concerning the morphology, taxonomy, genetics, physiology, and ecology of microorganisms. Practical application of the fundamental principles of microbiology to other phases of science and industry.
- 5-300. POULTRY DISEASE CONTROL.** (3 cr; not open to veterinary medical students; prereq Biol 1-002, and AnSc 1-100, MicB 3-103 or equiv)
General anatomy; physiology of digestion and reproduction; prevention and control of the more important diseases affecting poultry.

Veterinary Pathology and Parasitology (VPaP)

- 5-103. PARASITES OF WILDLIFE.** (3 cr; prereq #)
Economic and biological relationships of animal parasites and disease to regional wildlife.
- 5-104. DISEASES OF WILDLIFE.** (3 cr; prereq #)
Economic and biological relationships of infectious and noninfectious diseases of wildlife.
- 1-300. SYSTEMIC PHYSIOLOGY.** (6 cr, §old 41, §old 42, §old Poul 105, §old Poul 106; not open to veterinary medical students; prereq Biol 1-002, BioC 1-301 or equiv)
(Same as AnSc 1-300) Introduction to animal physiology, emphasizing the function of organs.
- 3-305. REPRODUCTIVE PHYSIOLOGY, ARTIFICIAL INSEMINATION, AND LACTATION.** (5 cr; prereq 1-300)
(Same as AnSc 3-305) 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.
- 5-313. AVIAN PHYSIOLOGY.** (3 cr; prereq 1-300 or 6 cr in systemic physiology or equiv, #; offered winter 1971-72 and alt yrs)
(Same as AnSc 5-313, Zool 5-313) Physiology of various species of wild and domestic birds.
- 5-314. BEHAVIORAL PHYSIOLOGY.** (3 cr; prereq 1-300 or 6 cr in systemic physiology, Biol 5-051, or #)
(Same as AnSc 5-314, Zool 5-314) 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.

SECTION IV
SPECIAL INFORMATION

Grading System

Academic progress in the College of Agriculture may be evaluated by one of two grading systems, the traditional letter grade system (A-F) or the P-N system.

A-F System

Under the A-F system (A-B-C-D-F) each letter grade carries the following meaning and number of grade points per credit:

<i>Grade</i>	<i>Grade Points Per Credit</i>
A (Excellent)	4
B (Good)	3
C (Satisfactory)	2
D (Passing)	1
F (Failure)	0

The grade point average is determined by dividing the sum of the grade points by the sum of the credits passed and failed. A cumulative average of 2.00 (C) is required for graduation. Additional requirements related to the grade point average may be found in materials descriptive of specific curricula (see Agricultural Education, Horticultural Education, and Fisheries and Wildlife).

P-N System

An experimental grading system directed toward encouraging students to explore academic areas other than those closely related to the major is now available. The P-N system hopefully reduces to some extent the pressures associated with the traditional grading system and encourages students to seek greater breadth in the educational experience.

Under the P-N system the symbol P stands for "pass" and N for "no credit." The dividing line between P and N is approximately the same as that between D and F. P and N grades are not included in the computation of the grade point average, but credits of P count toward graduation.

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

1. All courses available to undergraduate students (those numbered under 8-000) are available on the P-N and the A-F basis except where specifically restricted by the department offering the course. (Consult course listings in this bulletin.)

Special Information

2. A candidate 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 the student received a grade of "P."
3. The P-N system shall be available to a student of the college irrespective of his academic standing.
4. A student will be limited to one course per quarter on the P-N grading system until such time as he has completed 36 credits. This option shall be in excess of any courses offered on the P-N basis only.
5. P-N registration must be declared at time of registration and may not be changed after the opening day of the second week of classes. A course for which a student has on some previous occasion registered on the A-F system shall not be taken at a later date on the P-N basis.
6. Where a course is identified by title and number in bulletin copy as being required, or as being *the* course recommended to fulfill a curriculum requirement, it will be taken under the A-F grading system. Prerequisites for required courses, and courses in the major, will be taken under the A-F system, unless exceptions are established.

A student's adviser or the Office of the Dean (277 Coffey Hall) will answer questions about use of the P-N system.

Other Symbols That May Be Used on the Transcript

The registration symbol I (incomplete) shall be assigned when a student neither earns a final grade by completing a course nor qualifies for a W (withdrawal) as defined below. A student may earn a permanent grade in place of an I with the permission of the instructor (or of the department, in the unavailability of the instructor). For the convenience of both students and instructors, I's should be made up early in the next regular quarter of attendance, but instructors may extend the time if they believe delay is justified. Students do not need to be registered in order to make up I's.

An I which is not made up remains on the student's record; it does not count in the grade point average. When an I is made up it is removed from the record.

The registration symbol W indicates official cancellation from a course without grade. This shall be assigned in all cases of official cancellation during the first 6 weeks of classes irrespective of the student's standing. After 6 weeks, W shall be posted only if the student is not failing at the time of official cancellation. Whether or not cancellation is permitted is within the authority of the student's adviser and the Student Scholastic Standing Committee to determine.

The symbol X may be reported in continuation courses in which a student is permitted to continue but in which a grade cannot be determined until the sequence is completed. A grade will be submitted by the instructor for each X when the student has completed the entire sequence.

Registration as an auditor or visitor is indicated by the registration symbol V (visitor). Such registration requires the permission of the instructor and the adviser.

A symbol T (transferred) indicates credits transferred from another institution, or from one college to another within the University of Minnesota when

Scholarship Requirements

reevaluation is required. It is posted as a preceding supplement to the original grade.

If additional information about grading symbols is needed, a student should contact the Office of Admissions and Records, 130 Coffey Hall, or the Office of the Dean, College of Agriculture, 277 Coffey Hall.

Scholarship Requirements

Satisfactory Progress—A student in the College of Agriculture is expected to make satisfactory progress in the curriculum he has selected. This is interpreted to mean a C average. The cases of students who are not reaching this standard are considered by the Committee on Student Scholastic Standing. It is always best for a student to see his class instructor or his faculty adviser as soon as he feels himself in difficulty rather than to wait until he has already received a poor grade.

In some curricula, as indicated in the curricular descriptions, a higher grade point average is required.

Scholastic Probation—If a student's scholastic work should be considerably below a satisfactory level of performance, he will be placed on probation and his program or work will be restricted, as seems advisable to the Student Scholastic Standing Committee.

A student will be placed on probation if, at the end of 3 quarters of work or earlier, he has not attained a grade point average of 1.75. At the end of 6 quarters or earlier, he will be placed on probation if he has not attained a grade point average of 1.90.

Exclusion from College—Students may be excluded from the college under one of the following headings:

1. *Dropped for Low Scholarship*—When it becomes apparent that a student's work is of a quality that will not lead to graduation, he will be dropped and usually will not be permitted to apply for readmission until 9 months later.

A freshman may be asked to withdraw when his grade point average is less than 1.50 after 2 or 3 quarters of work in this college. A sophomore may be dropped if his average is less than 1.75 after 6 quarters (or 5 quarters if he began his freshman work in the winter or spring quarter). When the factors which contributed to the unsatisfactory work have been removed or satisfactorily corrected, a student may petition for permission to return. Otherwise, he is encouraged to make other plans.

2. *Hold for Committee Clearance*—Sometimes a student's scholastic difficulty indicates that he should not continue for the time being even though the record hardly requires official drop action. In such case his later return must be approved by the Student Scholastic Standing Committee.

3. *Discontinued*—If a student is pursuing an appropriate course but is handicapped by conditions he cannot control (ill health, necessary outside work, etc.) he may be required to discontinue his registration until these conditions have improved. When discontinuance takes place at any time other than the end of the quarter, the courses for which he is registered may be recorded as canceled without grade (W).

Readmission—If a student is dropped, he may not return without the permission of the Student Scholastic Standing Committee. Credits earned at other institutions during the period of suspension will not apply toward graduation from this college unless permission to earn such credits was given in advance by the Student Scholastic Standing Committee. If he is permitted to return, he will be placed on probation and may be dropped again at any time when his work is unsatisfactory.

Classification of Students

Sophomore—If a student is within 18 credits of the number usually earned in the curriculum for the first year and if he has completed 3 quarters of college work, he will be classified as a sophomore. The 3 quarters may include time spent at another institution of collegiate rank. A sophomore who lacks not more than 12 credits of being a junior and who has a B average may be permitted to register for courses in the 5-000 group. Students who have not attained junior classification and who are below a C average will not be permitted to register for courses numbered 5-000 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, a student must not be more than 9 credits short of the number required for the first 3 years in his curriculum.

Transfer Students—To enter this college as a junior, a transfer student from an institution outside the University of Minnesota should have a grade point average of not less than 2.00 at the end of his first year. If his grade point average is less than 2.00, he will be classified as a sophomore.

Student Personnel Services

Faculty Advisers—In choosing a curriculum from the many different offerings in the College of Agriculture, a student will be assisted by a member of the faculty who will become his adviser. This adviser will interpret the program, will guide in program planning, and will be concerned with a student's general progress. When problems arise and a student needs special attention, the adviser may refer him to other faculty members, to the Office of the Dean (277 Coffey Hall), or to one of the specialized personnel agencies.

Student Scholastic Standing Committee—Almost every student on occasion makes use of the Student Scholastic Standing Committee in the College of Agriculture. This is a committee of the faculty which interprets and enforces faculty regulations. It also may make exceptions to regulations when they work to the educational disadvantage of a particular student, provided the basic spirit of the regulation is maintained. Questions concerning the interpretation of faculty regulations may be discussed with the adviser or at the Office of the Dean. By means of petition (the forms for which are procured in the Office of Admissions and Records), a student may request adjustments of his program where departure from normal procedures appears to be justified. These requests, after they have been approved by his adviser, are turned in to the Office of the Dean, 277 Coffey Hall.

If a student transfers from another institution to the College of Agriculture, his transfer credits are evaluated in the Office of Admissions and Records. The admissions and records supervisor should be contacted on questions about the use of transfer credits. If necessary, referral will be made to the Student Scholastic Standing Committee which makes final decisions in evaluating transfer credits in terms of this college and the requirements of the various curricula.

College Placement Services—Assistance in securing employment after graduation is provided by the college. The Office of the Dean through its Placement Service (277 Coffey Hall) will bring job opportunities to the attention of students and will assist in arranging interviews with employer representatives. Representatives of over 100 firms and agencies annually visit the campus for purposes of interviewing degree candidates. While major attention is given to placement of graduates, arrangements frequently are made for placement of students in summer jobs with companies offering internships or other types of summer employment.

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 all major areas of the Colleges of Agriculture, Forestry, Home Economics, Veterinary Medicine, and Biological Sciences.

The council cooperates with the Minnesota Student Association (MSA) and the Senate Committee on Student Affairs. It brings questions from the student body to the administration of the colleges and discusses 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 students, the faculty, and the administration of the College of Agriculture. The board provides students the opportunity to participate in such matters as consideration of proposed curricula, questions related to instruction, improvement of educational facilities, development of administrative policy, and the establishing 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 honor. Under the honor system the faculty permits students to conduct the examinations.

If a student observes dishonesty during an examination period, he may take some appropriate step at the time to halt the dishonest act, or may report the incident later to the classroom instructor or 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.

Special Information

The honor system is essentially 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 post office (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 rich program of social, cultural, and recreational activities and contributes in many ways to the educational objectives of the campus. Student participation in this varied program 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.

Reserve Officers Training Corps

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

SECTION V
FACULTY

DEPARTMENTS IN AGRICULTURE

**Agricultural and Applied
Economics**

Professor

Wesley B. Sundquist, Ph.D., *head*
Martin E. Abel, Ph.D.
Sherwood O. Berg, Ph.D.
John Blackmore, Ph.D.
O. Uel Blank, Ph.D.
W. Keith Bryant, Ph.D.
Willard W. Cochrane, Ph.D.
Dale C. Dahl, Ph.D.
Reynold P. Dahl, Ph.D.
Selmer A. Engene, Ph.D.
Darrell F. Fienup, Ph.D.
Paul R. Hasbargen, Ph.D.
John D. Helmberger, Ph.D.
Clifford G. Hildreth, Ph.D.
James P. Houck, Ph.D.
John S. Hoyt, Jr., Ph.D.
Harald R. Jensen, Ph.D.
E. Fred Koller, Ph.D.
Wilbur R. Maki, Ph.D.
Lee R. Martin, Ph.D.
Truman R. Nodland, Ph.D.
Philip M. Raup, Ph.D.
Vernon W. Ruttan, Ph.D.
Frank J. Smith, Ph.D.
Arley D. Waldo, Ph.D.

Associate Professor

James L. App, Ph.D.
Martin C. Christiansen, Ph.D.
Willis L. Peterson, Ph.D.
Malcolm J. Purvis, Ph.D.
John J. Waelti, Ph.D.

Assistant Professor

Willis E. Anthony, Ph.D.
Boyd M. Buxton, Ph.D.
Charles H. Cuykendall, Ph.D.
Kenneth E. Egertson, Ph.D.
Walter L. Fishel, Ph.D.
Mathew D. Shane, M.S.
Jerome M. Stam, Ph.D.

Agricultural Education

Professor

R. Paul Marvin, Ph.D., *chairman*
Keith N. McFarland, Ph.D.
Milo J. Peterson, Ph.D.
Gordon I. Swanson, Ph.D.

Associate Professor

Martin B. McMillion, Ph.D.
Edgar A. Persons, Ph.D.

Assistant Professor

Curtis D. Norenberg, Ph.D.

Agricultural Engineering

Professor

Landis L. Boyd, Ph.D., *head*
Evan R. Allred, Ph.D.
W. Forrest Bear, Ph.D.
Arnold M. Flikke, M.S.
Kenneth A. Jordan, Ph.D.
Curtis L. Larson, Ph.D.
John Strait, M.S.

Associate Professor

William A. Junnila, M.S.
Russell E. Larson, M.S.
Jesse H. Pomroy, M.S.
Cletus E. Schertz, Ph.D.
John A. True, Ph.D.

Assistant Professor

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

Instructor

James R. Gilley, M.S.
James A. Moore, M.S.

Agricultural Journalism

Professor

Harold B. Swanson, Ph.D., *head*
Gerald R. McKay, M.S.

Associate Professor

Eldon E. Fredericks, M.S.
Milton M. Morris, Ph.D.
Raymond S. Wolf, B.S.

Agronomy and Plant Genetics

Professor

Herbert W. Johnson, Ph.D., *head*
Richard Behrens, Ph.D.
Charles R. Burnham, 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.
Dale N. Moss, Ph.D.
Harley J. Otto, Ph.D.
Donald C. Rasmusson, Ph.D.
Lawrence H. Smith, Ph.D.

Associate Professor

Carl Borgeson, M.S.
William A. Brun, Ph.D.
Verne E. Comstock, Ph.D.
Roger A. Kleese, Ph.D.
Gordon C. Marten, Ph.D.
Robert G. Robinson, Ph.D.
Alois R. Schmid, Ph.D.
James C. Sentz, Ph.D.

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Dale R. Hicks, Ph.D.
Ronald L. Phillips, Ph.D.
David E. Polson, Ph.D.
Robert E. Stucker, Ph.D.
Deon D. Stuthman, Ph.D.

Animal Science

Professor

Robert W. Touchberry, Ph.D., *head*
John D. Donker, 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.
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.
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Associate Professor

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William J. Boylan, Ph.D.
Charles J. Christians, Ph.D.
Richard D. Goodrich, Ph.D.
Donald E. Otterby, Ph.D.

Assistant Professor

William H. Burke, Ph.D.
Garth E. Miller, Ph.D.
James W. Nordstrom, Ph.D.
John D. Smith, Ph.D.
George M. Speers, Ph.D.

Entomology, Fisheries, and Wildlife

Professor

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Huai-chang Chiang, Ph.D.
Edwin F. Cook, Ph.D.
Laurence K. Cutkomp, Ph.D.
L. Daniel Frenzel, Jr., 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.

Associate Professor

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Marion A. Brooks, Ph.D.
Basil Furgala, Ph.D.
Herbert M. Kuhman, Ph.D.
Edward B. Radcliffe, Ph.D.

Food Science and Industries

Professor

Samuel T. Coulter, Ph.D., *head*
Howard A. Morris, Ph.D.
Elmer L. Thomas, Ph.D.

Associate Professor

Paul B. Addis, Ph.D.
Francis F. Busta, Ph.D.
Theodore Labuza, Ph.D.
Charles V. Morr, Ph.D.

Assistant Professor

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Peter B. Manning, Ph.D.
Larry L. McKay, Ph.D.
Gary A. Reineccius, Ph.D.
Ronald L. Richter, Ph.D.
John R. Rosenau, Ph.D.
Sita R. Tatini, Ph.D.

Horticultural Science

Professor

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A. J. Linck, Ph.D.
F. I. Lauer, Ph.D.
R. E. Nylund, Ph.D.
O. C. Turnquist, Ph.D.
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R. A. Phillips, M.S.
P. E. Read, Ph.D.
C. Stushnoff, Ph.D.

Plant Pathology

Professor

Milton F. Kernkamp, Ph.D., *head*
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Carl J. Eide, Ph.D.
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Roy D. Wilcoxson, Ph.D.

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Lucas Calpouzou, Ph.D.
Bill W. Kennedy, Ph.D.
David H. MacDonald, Ph.D.
Chester J. Mirocha, Ph.D.
Matthew B. Moore, M.S.

Instructor

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Rhetoric

Professor

Ralph G. Nichols, Ph.D., *head*
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Ronald M. Brown, Ph.D.
Paul H. Cashman, Ph.D.
Francis E. Drake, Ph.D.
Thomas E. Pearsall, Ph.D.
William A. Rosendahl, Ph.D.
Edward B. Savage, Ph.D.
Eugene S. Wright, Ph.D.

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Starling W. Price, Ph.D.

Assistant Professor

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

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Soil Science

Professor

William P. Martin, Ph.D., *head*
Harold F. Arneman, Ph.D.
Donald G. Baker, Ph.D.
George R. Blake, Ph.D.
Alfred C. Caldwell, Ph.D.
Rouse S. Farnham, Ph.D.
John M. MacGregor, Ph.D.
Richard H. Rust, Ph.D.
Edwin L. Schmidt, Ph.D.
Charles A. Simkins, Ph.D.

Associate Professor

Russell S. Adams, Jr., Ph.D.
Robert G. Gast, Ph.D.
Janis Grava, Ph.D.
Lowell D. Hanson, Ph.D.
James B. Swan, Ph.D.

Assistant Professor

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

INDEX

	Page		Page
Administrative Officers	1	Agronomy and Plant Genetics	
Admission to Programs in Agriculture ..	3	Courses in	63
Adult Special Students	4	Animal Science	
Advanced Standing	4	Courses in	65
High School Graduates	4	Majors in (see Agricultural Science	
Non-High School Graduates	4	and Industries and/or Biological	
Pre-Veterinary Medicine	50	and Physical Sciences in Agricul-	
School of Agriculture Graduates	4	ture Programs)	23, 24
Transfer Credits in Agricultural		Area of Emphasis, Definition	15
Courses Taken at Non-Land		Artistic Expression, Requirement	12
Grant Colleges	5	Auditors	7
Adult Special Students	4		
Advanced Standing	4	Biological and Physical Sciences in	
Advisers	6, 96	Agriculture Program	24
Agricultural and Applied Economics		Board of Regents	1
Courses in	53		
Major in (see Agricultural Science		Cancellation	8
and Industries Program)	19	Changes in Registration	7
Agricultural Business Administration		Chemistry, Areas of Emphasis (see	
Program	15	Food Science and Industries Program) 34	
Agricultural Education		Class Attendance	9
Courses in	56	Classification of Students	96
Major (see Agricultural Science and		College of Veterinary Medicine (see	
Industries Program)	20	Veterinary Medicine)	52
Agricultural Engineering		Committee on Student Scholastic Standing 96	
Courses in	59	Communication, Language, Symbolic	
Courses for Both Agricultural Engi-		Systems Requirement	12
neering and Technology and		Complete C.L.E. List of Suggested	
other Majors	60	Courses	12
Courses Primarily for Agricultural		Council on Liberal Education Course	
Engineering Technology Majors ..	61	List (Complete C.L.E. List of	
Curriculum (Professional)	45, 62	Suggested Courses)	12
Major in Agricultural Engineering		Course Descriptions	
Technology (see Agricultural		Agriculture	53
Science and Industries Program) ..	22	Programs Serving All Departments in	
Agricultural Extension (see Agricultural		College of Agriculture	88
Science and Industries Program and		Veterinary Medicine Courses for	
Agricultural Education)	17, 20	Students in College of Agriculture. 91	
Agricultural Journalism		Course Numbering Inside front cover	
Courses in	63	Courses in Programs Serving All	
Curriculum	46	Departments	88
Minor or Enrichment Program in		Credit and Grade Arrangements for	
Journalism	48	Courses Repeated	9
Agricultural Science and Industries		Credit by Special Examination	8
Program	17	Curricula Relating to Agriculture	45
Majors		Curricular Programs	
Agricultural Economics	19	Agriculture	14
Agricultural Education	20	Pre-Veterinary Medicine	50
Agricultural Engineering Technology 22		Curriculum and Departmental	
Animal Science	23	Relationships	6
Plant and Animal Protection	23	Curriculum Requirements, Attention to ..	7
Plant and Soil Science	23		
Agriculture		Degrees Offered and Their Require-	
Courses in	53	ments	10
Faculty	99	Departments, Directory of	2
Programs	15		

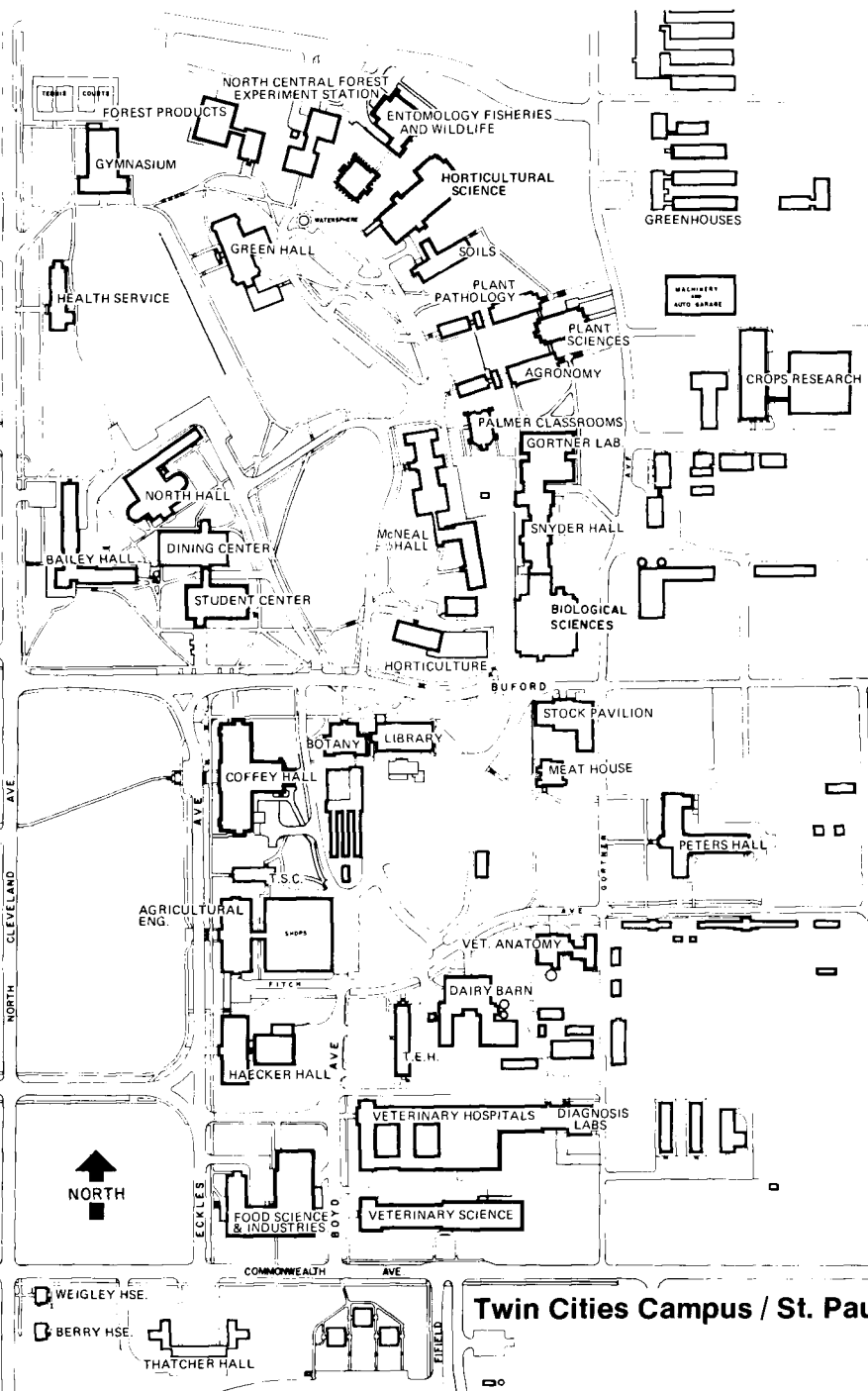
* See University of Minnesota *General Information Bulletin*.

	Page		Page
Elective Credits, Use of	12	Journalism, Agricultural (see Agricultural Journalism)	46, 63
Employment	97	Journalism, Minor or Enrichment Program in	48
English		Landscape Architecture	41
Courses in (see Rhetoric)	83	Limitations on Use of Elective Credit	13
Requirements for Graduation	12	Loans, Student	6
Enrichment Program in International Affairs	48	Major, Declaring	7
Entomology, Fisheries, and Wildlife Courses in	69	Major, Definition	15
Entomology, Major in (see Biological and Physical Sciences Program)	24	Man and Society Requirement	12
Entrance Examinations	5	Management, Areas of Emphasis (see Food Science and Industries Program)	35
Examinations		Mathematics, Placement	10
Entrance	5	Mechanized Agriculture (see Agricultural Engineering Technology)	59
Proficiency	8	Courses in	59
Special	8	Major in (see Agricultural Science and Industries Program)	22
Exclusion from College	95	Objectives of Programs and College	3
Expenses	*	Personnel Services	96
Extension Courses, General Extension Division	*	Physical and Biological Sciences Requirement	12
Extra Credit	9	Physical Education Requirement	13
Faculty, Agriculture	99	Placement Services	97
Faculty Advisers	6, 96	Plant and Animal Protection, Major in (see Agricultural Science and Industries Program)	23
Fees	*	Plant and Soil Science, Major in (see Agricultural Science and Industries Program and/or Biological and Physical Science in Agriculture Program)	23
Fisheries and Wildlife Program	25	Plant Pathology, Courses in	81
Courses in	71	Plant Physiology, Courses in	88
Graduate Study Preparation Option	30	P-N Grading System	93
Food Science and Industries		Pre-Veterinary Medicine	
Courses in	73	Admission	50
Major in (see Biological and Physical Sciences in Agriculture Program)	24	Curriculum	50
Food Science and Industries Program	32	Probation	95
Areas of Emphasis		Proficiency Examinations	
Chemistry	34	Introductory Courses	8
Industrial Engineering	34	Rhetoric 3-551 or 3-562	12
Management	35	Programs in Agriculture	15
Public Health	35	Progress, Academic or Scholastic	
General Extension Division, Transfer of Credit from	5	Exclusion from College	95
General Information	3	Probation	95
Grading System	93	Readmission	95
Graduate School Credit	13	Satisfactory	95
Graduate Study Preparation Option (see Fisheries and Wildlife Program)	30	Public Health, Area of Emphasis (see Food Science and Industries Program)	35
Graduation, Requirements for	10	Quality Credits	10
Graduation with Honors	11	Quantity of Work	7
Honor System	97	Reading Course	8
Honors, Graduation with	11	Readmission	95
Horticultural Education Specialization	21	Recreation Resource Management, Major in (see Resource and Community Development Program)	38
Horticultural Science, Courses in	76		
Human Rights	5		
Humanities Requirement (see Rhetoric Department Offerings)	12, 83		
Independent Study and Extra Credit	8		
Industrial Engineering, Area of Emphasis (see Food Science and Industries Program)	34		
Information, General	3		
International Affairs, Enrichment Program in	48		

* See University of Minnesota *General Information Bulletin*.

	Page		Page
Registration Process	6	tries and/or Biological and Physical Sciences in Agriculture Programs)...	23
Changes in	7	Soil Science, Courses in	86
Requirements		Special Examinations	8
Academic, General	10	Specialization	7
Admission	3	Statistics, Courses in	90
All Students	11	Student Government	97
Graduation	10	St. Paul Campus	
Scholarship	95	Board of Colleges	97
Reserve Officers Training Corps	98	College of Agriculture Student Board	97
Resource and Community Development Program	36	Student Center Board of Governors	98
Courses in	90	Student Loans	6
Majors in		Student Personnel Services	96
Landscape Architecture	41	Student Scholastic Standing Committee..	96
Recreation Resource Management..	38	Symbols, Explanation of..	Inside front cover
Resource Economics	36	Technical Communication	44
Soil and Water Management	40	Transfer Credit in Agricultural Courses Taken at Minnesota Non-Land Grant Colleges	5
Resource Economics, Major in (see Resource and Community Development Program)	36	Transfer of Credit from General Extension Division	5
Rhetoric, Courses in	83	Tuition	°
Rhetoric 1-222 and 3-551 or 3-562 Requirement	12	Veterinary Medicine, College of Admission	52
ROTC	98	Veterinary Medicine, Courses for Agriculture Students	91
Scholarship Requirements	95	Visitors (see Auditors)	7
Scholarships and Other Financial Aids..	6	Wildlife Management, Fisheries and Wildlife Curriculum	26
Schools of Agriculture, Graduates of ...	4	Withholding Elective Credit from Courses Offered for Graduation	12
Social Science Requirement (see Man and Society, Category III)	12		
Soil and Water Resource Management, Major in (see Resource and Community Development Program)	40		
Soil, Plant and Soil Science, Major in (see Agricultural Science and Indus-			

° See University of Minnesota *General Information Bulletin*.



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