This is the Course Descriptions section of the 1996-1999 University of Minnesota College of Agricultural, Food, and Environmental Sciences Bulletin.
Agriculture (Agri)

Agri 1000H. Honors Colloquium. (2 cr; prereq COAFES Honors Program; A-F only)
Colloquium courses for the College of Agriculture, Food, and Environmental Sciences Honors Program. Topics change quarterly. Each colloquium introduces a topic related to “Agriculture in the 1990’s” and is designed for all COAFES majors. Flexible format may include learning opportunities such as symposia, field trips, guest speakers, and other college/university events. Contact college office for topics.

Agri 3000. Seminar in International Agriculture. (1 cr)
Oral presentation and discussion of students’ research papers, literature review of selected topics, discussions with students and staff about their experiences in international agriculture.

Agri 3100H. Honors Experience. (3-4 cr; prereq COAFES Honors Program, Honors Committee approval; A-F only)
Honors experience course for the College of Agriculture, Food, and Environmental Sciences Honors Program individually tailored by student in conjunction with a COAFES faculty supervisor. The experience could include such things as: foreign study-travel, research experience, a position or policy paper, or any experience demonstrating advanced study-service-understanding.

Agricultural Education (AgEd)

AgEd 1001. Introduction to Agricultural Education. (1 cr)
Orientation to employment and service in agricultural education; qualifications of teachers, survey of preparatory offerings, the program in Minnesota.

AgEd 1002. Principles of Career Planning in Agriculture. (1 cr)
Self-assessment and analysis of interests, skills, abilities, values, and life goals. Analysis of various agricultural occupations, employment potential, and demands in relation to employee expectations for work. Industries will be examined using information interviews.

AgEd 1042. Current Technical Competencies. (3 cr)
Preparation of teachers for mechanical/technical/technology instruction. Basic competencies in the skills and knowledge used in planning, implementing, operating and maintaining structural and mechanical systems are developed. Experiential learning principles, applied problem solving, observation and practice are key elements.

AgEd 3001. Experiential Learning: Production Agriculture. (1-14 cr [max 14 cr]; prereq #; S-N only)
Experiential learning in a production agriculture business. Planned, organized, monitored, and evaluated based on a pre-experience diagnosis of learning prerequisite to higher level courses in technical agriculture.

AgEd 3002. Experiential Learning: Agricultural Business. (1-14 cr [max 14 cr]; prereq #; S-N only)
Experiential learning in an agricultural non-farm business. Planned, organized, monitored, and evaluated based on a pre-experience diagnosis of learning required to meet competency expectations for persons employed in agricultural businesses.

AgEd 3029. Directed Experience in Agricultural Education. (1-3 cr)
Observation of activities of teachers of agriculture; familiarization with the staff, curriculum, and physical facilities and equipment in a department of vocational agriculture, with opportunity to participate in the functions of a teacher.

AgEd 3041. Practicum: Agricultural Education Technology. (1-3 cr [may be repeated for max 5 cr])
Individualized study packages of 1 credit each of technology in agriculture, horticulture, off-farm agriculture, agricultural mechanics, adult and beginning farmer programs, youth organizations, program evaluation, and visual aids.

AgEd 5000. Professional Experience Program. (4 cr; prereq #; not for grad cr; UC only)
Professional experience in agricultural education or government agencies gained through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

AgEd 5010. Rural Leadership Development. (3 cr, F, S, O)
Role, function, and unique features of rural community leaders; personal leadership and vision development for individuals and rural community groups. Focus on unique aspects of rural communities, leadership environment, and qualities essential in successful rural leaders.

AgEd 5021. Education Through Extension Methods. (3 cr; prereq grad or #)
Methods and techniques of formal and nonformal education used by Extension Service and other organizations.

AgEd 5023. Methods for Change in Developing Countries. (3 cr)
Devising strategies, programs, projects, and methodologies for individual and community, economic and social change in developing countries.

AgEd 5028. Teaching Methods in Agricultural Education. (5 cr)
Methods used in teaching agriculture in public schools; use of media, principles of learning, problem solving, test construction, classroom management, and specific practice in problem-solving teaching techniques; use of competency-based individualized instruction as a medium for course presentation and a model for teaching methods.

AgEd 5032. High School Curriculum in Agriculture. (3 cr; prereq 10 cr education)
Philosophy, organization, and administration of instruction in agriculture departments in secondary schools.

AgEd 5034. Procedures in Teaching Agriculture. (3 cr)
New developments in methodology; assessment of innovations and procedures; consideration of various levels of instruction.

AgEd 5041. Workshop: Agricultural Education Technology. (1-6 cr [max 12 cr])
New understandings, techniques, and materials in animal science, plant science, horticulture, soil science, agricultural mechanics, forestry, natural resources, youth organization, visual aids, and occupational exploration.

AgEd 5042. Agricultural Mechanics. (1-3 cr [max 12 cr])
Technical and managerial information, techniques, and materials. Facilitates participant’s instructional planning, resource development, and instruction. Topic to be identified with each offering.

AgEd 5043. Farm Management. (1-3 cr [max 12 cr])
Application of agricultural economic theory, principles, techniques, and materials. Facilitates participant’s instructional planning, resource development, and instruction. Topic to be identified with each offering.

AgEd 5049. Agricultural Education for Adults. (3 cr)
Organization and implementation of systematic education programs for beginning and established farmers; organization of local programs to meet needs of production agriculture in areas of enterprises; agricultural mechanics and management; development of continuing programs.

AgEd 5051. Enterprise Analysis. (3 cr)
Analyzing farm business as basis for identifying problems; planning learning experiences to improve farm management at high school, young farmer, and adult levels.

AgEd 5052. Farm Business Management Education. (3 cr)
Administration, organization, and operation of farm business management education programs for adults; development and use of curriculum materials based on farm business record data.
AgEd 5055. Methods in Farming Systems Research and Extension. (3 cr; §Agro 5055)
Methodology for integrating research and extension programs designed to identify and solve farm family system problems using interdisciplinary and holistic approaches.

AgEd 5061. Program Planning and Evaluation. (3 cr; prereq sr or grad)
Development of program of agricultural education in community school, integration with total school program, administrative relationships, techniques and use of program evaluation in planning.

AgEd 5071. Supervised Occupational Experiences in Agriculture. (3 cr)
Organization and administration of an occupational experience program in agriculture for high schools and area schools.

AgEd 5072. Practicum: Agricultural Business and Industry. (1-3 cr per qtr [max 9 cr]; prereq 5071 or #)
Observation, study, and experience in agricultural business and industry; application to educational problems in agriculture.

AgEd 5078. FFA Organization and Management. (2 cr)
Development of FFA (vocational agribusiness education student organization) knowledge, organization, and integration of activities into the curriculum, and management of chapter operations.

AgEd 5080. Organization and Management. (3 cr; prereq #)
Administrative structure and function of collegiate programs.

AgEd 5081. Current Issues for the Beginning Agriculture Teacher. (1-3 cr [max 3 cr]; prereq #)
Teaching methods, organizing learning resource materials, managing classroom and lab learning activities, curriculum planning and organization, managing discipline situations, school and community relationships for the beginning teacher.

AgEd 5082. Current Issues in Agricultural Education. (1-3 cr [max 9 cr]; prereq #)
Emphasizes study and clarification of current issues, strategies of response, implications of reaction actions, and related leadership roles.

AgEd 5087. Mentorship for Beginning Ag Teachers. (6 cr [2 cr per qtr]; prereq less than 2 yrs exp as an ag teacher, §5081, #; continuous regis required in 3 consecutive qtrs; S-N only)
Year-long program of professional development during the induction year of teaching agriculture in the public schools. Emphasis on solving problems, dealing with issues and concerns of new teachers, and making a smooth transition into the teaching profession.

AgEd 5090. Independent Study. (1-3 cr; prereq sr or #)
Topics chosen to permit study of areas within education or to supplement areas of inquiry not provided in the regular course structure.

AgEd 5095. Integrating Paper: Master of Education. (3 cr; prereq MEd candidate in agricultural ed)
Preparing a paper dealing with studies in agricultural education applied to professional responsibilities.

AgEd 5128. Methods of Teaching. (3 cr; prereq non-agricultural ed major or #)
Methods of teaching agriculture or related subjects; development of competencies in planning, organizing, implementing, and evaluating instruction, with practice in instructional techniques.

AgEd 5244. Topics in Program Planning for Extension Education. (1-6 cr [max 9 cr], §FE 5244)
Effective extension education programming in relation to situation and needs analysis; coordination of content, people, methodology; development of program models; managing available resources.

AgEd 5245. Topics in Administering Extension Education. (1-6 cr [max 9 cr], §FE 5245)
Issues and current literature; focus on personnel hiring and supervision, financial management, leadership styles, long-range planning; application of theory to administrative practice.

AgEd 5246. Topics in Teaching and Delivering Extension Education. (1-6 cr [max 9 cr], §FE 5246)
Teaching techniques involving media, telecommunications, computers, group process methods, experiential learning in extension education settings.

AgEd 5247. Topics in Evaluating Extension Education. (1-6 cr [max 9 cr], §FE 5247)
Overall evaluation design; issues in choosing quantitative versus qualitative evaluation methods; developing skills and conceptual frameworks to apply theory to extension settings.

For Graduate Students Only
(For descriptions, see Graduate School Bulletin)

AgEd 8001. Research in Agricultural Education
AgEd 8020. Seminar: Agricultural Education
AgEd 8091. Field Problems
AgEd 8303. Seminar: Graduate Studies Review

Agricultural Industries and Marketing (AIM)

AIM 5001. Marketing Practicum I. (2 cr)
Multidisciplinary lecture/seminar involving development of a marketing plan for an agricultural input or product.
Includes market definition and feasibility analysis, business proposition, action plan, financial evaluation, and monitoring and measurement strategies.

AIM 5002. Marketing Practicum II. (2 cr; prereq AIM 5001)
Multidisciplinary lecture/seminar involving development of a marketing plan for an agricultural input or product.
Includes planning and development of promotion and advertising materials, critique of marketing plan, and presentation of completed marketing plan.

Agronomy and Plant Genetics (Agro)

Agro 1007. Biology of Plant Food Systems and the Environment. (4 cr)
Biological principles and processes are learned in the context of food production systems and the environment. Basic elements of biology, whole plant and animal systems, and plants and animals in ecosystems. Lecture and lab.

Agro 1010. Principles of Agronomy. (5 cr, §3010, §3020, §3030)
Principles and practices of plant and related sciences as they apply to increasing efficiency, productivity, and genetic improvement of field crops. Topics include crop selection, improvement of crops through plant breeding, seeds and seedling, growth and development, minimizing production hazards, harvesting and storage. Lecture and lab.

Agro 1020. Special Problems. (1-3 cr; prereq 5 cr agr, #)
In-depth research or studies in agronomy. Intended for students who wish to pursue aspects of agronomy in greater depth than that offered in formal courses or who wish to investigate areas not presently offered in courses. Tutorial instruction under staff guidance.

Agro 3020. Growth and Development of Field Crops. (4 cr; prereq 1007 or Biol 1009, Chem 1002, Chem 1051 or equiv)
Principles of growth and development of field crops to achieve maximum crop productivity. Emphasis on physiological basis of growth and development, and effects of physical and biological environmental factors on crop growth and development. Lecture and lab.
Agro 3030. Harvest, Storage and Utilization of Field Crops. (4 cr; prereq 1007 or Biol 1009, Chem 1002 or Chem 1051 or equiv)
Crop quality traits associated with use as they influence crop harvest, processing, and storage. Principles and technology used in crop storage to minimize damage from fungi and insects and maximize crop quality. Lecture and lab.

Agro 3060. Field Plot Design in Agronomy. (4 cr; prereq jr)
Principles of field plot technique and design as applied to field demonstrations and experiments involving one or two variables. Experimentation procedures including analysis of data, tests of significance, and treatment comparisons. Computers are used for some data processing and statistical procedures.

Agro 3120. Grain Grading and Utilization. (2 cr; AgEc 3420 recommended)
Practice and principles of grain grading; factors influencing U.S. grain grades and their importance in affecting market value and subsequent use. Lecture and lab.

Agro 3130. Seed Technology. (2 cr; prereq 1010)
Principles and practices of seed analysis, seed handling, conditioning and viability testing.

Agro 3200. Seminar. (1 cr; prereq jr or sr, #)
Investigation through literature review and group discussion of selected topics in agronomy. Emphasis on recent advances in agronomy.

Agro 5000. Professional Experience Program. (4 cr; prereq #; not for grad cr; S-N only; UC only)
Supervised practical professional experience in agronomic industries and farm enterprise systems, together with studies of various aspects of the industry and related fields.

Agro 5001. Problems in Agronomy for Advanced Students. (1-5 cr; prereq 20 cr agro, #)
In-depth research or studies in agronomy. Intended for advanced students who wish to pursue aspects of agronomy in greater depth than that offered in formal courses or who wish to investigate areas not presently offered in courses. Independent study and research under staff guidance.

Agro 5020. Introduction to Plant Breeding. (4 cr; prereq GCB 3022, Hort 3003 or equiv)
Applying genetic principles to improve crop plants. Includes self-pollinated, cross-pollinated, and asexually propagated crops. Lecture. Discussion for graduate students only.

Agro 5030. Weed Control. (5 cr; prereq 1010 or #; 3020 or PBio 3131 recommended)

Agro 5050. Management Technologies for Crop Production in Minnesota. (4 cr; prereq one course in Agro)
Appropriate solutions to crop management problems, emphasizing corn/soybean, small grains, and forage crop systems. Quality, productivity, and profitability emphasized in discussion, lectures, and reading.

Agro 5070. Agroecology. (3 cr; prereq 3020, 3030 or #)
Describing, managing, and evaluating agricultural ecosystems. Emphasis on structure-function relationships in agricultural ecosystems. How current agricultural problems can be effectively addressed by ecological analysis of agricultural systems. Case studies, discussion, experiential learning, field trips.

Agro 5095. History of U.S. Agriculture. (3 cr; prereq jr, sr, or grad, 2 courses in phys and biol sciences, 2 courses in history and social sciences or #)
Social, scientific, and political development of U.S. agriculture, focusing on issues of food supply and consumption and the interaction with nature/sol, water “pests,” and with fellow humans (including cooperation, competition, surpluses, subsidies); basis for contemporary sustainable agriculture.

Agro 5120. Growth and Development of Field Crops. (4 cr, $3020; prereq 1007 or Biol 1009, Chem 1002; Chem 1051 or equiv)
Principles of growth and development of field crops to achieve maximum crop productivity. Emphasis on physiological basis of growth and development, and effects of physical and biological environmental factors on crop growth, development. Lecture, lab, and discussion.

Agro 5130. Harvest, Storage and Utilization of Field Crops. (4 cr, $3030; prereq 1007 or Biol 1009, Chem 1002; Chem 1051 or equiv)
Crop quality traits associated with use as they influence crop harvest, processing, and storage. Principles and technology used in crop storage to minimize damage from fungi and insects and maximize crop quality. Lecture and lab.

Agro 5200. World Food Problems. (3 cr, AgEc 5790, SCAPS 5280, SFScN 5643; prereq sr or grad with #)
Multidisciplinary approach to the social, economic, and technical problems of feeding the world’s growing population. Principles sought from the social and economic sciences and plant, animal, and food sciences for their application to world food problems.

Agro 5310. Orientation to Field Crop Breeding. (1 cr; prereq 5020 or #)
Field study of plant breeding programs and techniques.

Agro 5320. Orientation to Agronomy and Soils Field Research. (1 cr; prereq 5050 or equiv)
Field survey and discussion of research techniques in crop physiology, crop and soil management, and weed science programs in agronomy and soils.

Agro 5330. Plant Biotechniques. (2 cr; prereq 3xxx genetics and biochemistry courses)
Molecular and traditional biotechniques will be discussed by postdoctoral research associates in the Department of Agronomy and Plant Genetics to give a broader understanding of molecular and quantitative techniques in agricultural research.

Agro 5999. Special Workshop in Agronomy. (1-4 cr; prereq #)
Workshops on a variety of topics in Agronomy and Plant Genetics offered for credit in locations other than the Twin Cities campus. Consult Class Schedule or department for current offerings.

Also see these courses taught by faculty from Agronomy and Plant Genetics: ANPL 3010, 5060; AIM 5001, 5002; NRES 3020, 5020.

For Graduate Students Only
(For descriptions, see Graduate School Bulletin)

Agro 8000. Supervised Teaching Experience

Agro 8010. Research in Agronomy

Agro 8020. Seminar: Agronomy

Agro 8030. Mode of Action of Herbicides

Agro 8050. Physiology of Field Crops

Agro 8080. Current Topics in Agronomy

Agro 8200. Plant Breeding Principles and Methods I

Agro 8210. Plant Breeding Principles and Methods II

Agro 8220. Application of Quantitative Genetics to Plant Breeding

Agro 8230. Cytogenetics

Agro 8240. Cellular and Molecular Genetics of Plant Improvement

Agro 8250. Advanced Plant Genetics

Agro 8260. Statistical Topics in Plant Sciences

Agro 8270. Seminar: Plant Breeding

Agro 8280. Current Topics in Plant Breeding

Agro 8330.* Research in Plant Genetics
Animal and Plant Systems (AnPl)

AnPl 3010. Environment and World Food Production. (4 cr)
Ecological properties of world agricultural systems including issues of biodiversity, natural resource conservation, agricultural pollution, water quality, and waste management.

AnPl 5060. Integrated Management of Cropping Systems. (4 cr)
Case study/simulation and discussions considering integrated production management of selected agronomic and horticultural cropping systems. Emphasis on problem analysis, principle application, and decision making involving the integration of disciplines.

Animal Science (AnSc)

AnSc 1100. Introductory Animal Science. (5 cr)
Emphasis on fundamental concepts of physiology, nutrition, animal breeding, and management as they apply to production of livestock and poultry. Species surveys.

AnSc 1110. Dairy Cattle Judging. (2 cr; prereq #)
Evaluation of dairy animals on the basis of physical appearance, including classes of heifers and cows from the six major breeds. Visits to many herds in the area. Training in presentation of oral reasons.

AnSc 1120. Market Livestock and Carcass Evaluation. (4 cr)
Evaluation, grading, and pricing of market cattle, swine, and sheep; followed by evaluation of the conformation, quality, and finish of carcasses and cuts.

AnSc 1143. Beginning Meats Judging and Grading. (1 cr; prereq 1510 or ¶)
Introduction to meat judging grading and specifications; permits students to enroll in AnSc 3143.

AnSc 1301. Management Technique: Swine. (1 cr; prereq #: S-N only)
Practical experience in management skills and routines in the care of swine.

AnSc 1302. Management Technique: Sheep. (1 cr; prereq #: S-N only)
Practical experience in management skills and routines in the care of sheep.

AnSc 1303. Management Technique: Beef. (1 cr; prereq #: S-N only)
Practical experience in management skills and routines in the care and production of beef cattle.

AnSc 1304. Management Technique: Dairy. (1 cr; prereq #: S-N only)
Practical experience in management skills and routines in the care of dairy cattle and production of milk.

AnSc 1305. Management Technique: Poultry. (1 cr; prereq #: S-N only)
Practical experience in management skills and routines in the care of poultry and the production of poultry meat and eggs.

AnSc 1306. Introduction to Equine Science. (2 cr)
Survey of visual appraisal, structure, uses and care of light horses. Breeds of horses and their characteristics; soundness of evaluation. Course lectures via ITV from University of Minnesota, Crookston. Lab (AnSc 1307) taught summer session at Crookston Equestrian Center; half-day sessions for two weeks.

AnSc 1307. Introduction to Equine Science Laboratory. (1 cr; prereq 1306)
Lab for AnSc 1306. Taught summer session at Crookston Equestrian Center; half-day sessions for two weeks.

AnSc 1510. Consumer Meat Science. (2 cr)
Compositional variation, processing, selection, storage, cookery, palatability, and nutritional value of red meat.

AnSc 1520. Milk Production. (3 cr; prereq 1100 or #)
Relationships of production and management concepts to dairy farm planning and production and marketing of high-quality milk.

AnSc 1530. Stable Management. (3 cr; 1306 or equivalent)
Fundamentals of horse care and management, efficient stable management including computer record keeping, marketing, and sales techniques. Course lectures via ITV from University of Minnesota, Crookston. Lab (AnSc 1531) taught summer session at Crookston Equestrian Center; half-day sessions for two weeks.

AnSc 1531. Stable Management Laboratory. (1 cr; prereq 1530)
Lab for AnSc 1530. Taught summer session at Crookston Equestrian Center; half-day sessions for two weeks.

AnSc 3111. Introduction to Animal Behavior. (4 cr; prereq Biol 1008 or Biol 1009 or #)
Survey of the biological study of animal behavior including questions of causation, development, function, and evolution; emphasizes the evolution of adaptive behavior, especially social behavior, in the natural environment.

AnSc 3113. Animal Welfare. (4 cr; prereq soph or above)
Socioeconomics of the use of other animals by humans. Assessment of animal suffering and welfare. Historical roots of attitudes toward other animals. Management practices and welfare of domestic and wild animals.

AnSc 3120. Advanced Meat Animal, Carcass Evaluation. (1-2 cr; prereq 1143, #; 3130 or 3131, 3142, 3143 recommended)
Evaluation, grading, and pricing of live meat animals and carcasses; judging, placing, breeding animals using growth and reproduction records. Preparation for collegiate meat animal evaluation team competition.

AnSc 3130. Beginning Livestock J Judging. (2 cr; prereq soph or above or #: 1120 recommended)
Visual evaluation of beef cattle, swine, and sheep for type, muscling, degree of finish, structure, and soundness. Short oral presentations. For students with limited livestock judging experience; preparation for collegiate livestock judging team competition.

AnSc 3131. Live Animal Performance and Selection. (3 cr)
Meat animal performance and selection through the use of live animal, carcass, and record evaluation. Each class includes a one-hour lecture and a two-hour lab. Recommended for students planning vocations in meat animal production, extension, vocational agriculture, and agribusiness.

AnSc 3141. Advanced Dairy Judging. (1 cr; prereq 1110)
Evaluation and selection of dairy cattle. Visits to local dairy herds. Training in presentation of oral and written reasons. Students selected from this course participate in intercollegiate judging contests.

AnSc 3142. Advanced Livestock J Judging. (2 cr; prereq 1120, 3130)
Visual evaluation of beef cattle, swine, and sheep for type, muscling, finish, structure, and soundness. Use of production (growth and reproduction) records in evaluation. Oral presentations. For students with previous livestock judging experience; preparation for national collegiate livestock judging team competition.

AnSc 3143. Advanced Meats J Judging and Grading. (2 cr; prereq 1143)
In-depth training in beef, pork, and lamb judging, writing reasons, and carcass grading. Field trips to packing plants. Students selected from this course participate in Intercollegiate Meats Judging Contests.

AnSc 3144. Wool Evaluation. (2 cr)
Principles of classification and grading. Active learning with practical experience to determine fiber diameter, yield, and economic value of fleeces. Evaluation and judging of fleece classes. Preparation for collegiate wool judging team competition.
AnSc 3220. Principles of Animal Breeding. (5 cr; GCB 3022 recommended)
Application of qualitative genetic principles to animal breeding. Quantitative genetics. Concepts of livestock improvements through breeding and selection systems.

AnSc 3301. Systemic Physiology. (6 cr; prereq Biol 1009; BioC 3221 recommended)
Animal physiology, emphasizing the function of the organ systems.

AnSc 3305. Reproductive Physiology, Artificial Insemination, and Lactation. (5 cr; prereq 3301)
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.

AnSc 3401. Principles of Animal Nutrition. (4 cr; prereq Chem 1002 or Chem 3301)
Classification and function of nutrients; use of nutrients for body maintenance, growth, egg production, gestation, and lactation; comparative study of the digestive systems of farm animal species.

AnSc 3510. Introduction to Human and Animal Growth and Development. (4 cr; prereq 3301, Biol 1009)
Basic principles of human and animal growth; critical evaluation of interaction of nutrition, hormones, exercise, heredity, and disease in regulating growth.

AnSc 3520. Horse Production. (3 cr; prereq 1530 or equivalent)
Capstone course combining knowledge from previous equine courses with business to complete a management project; involves establishing, maintaining, and improving an equine business using computer technology.

AnSc 3521. Horse Production Laboratory. (1 cr)
Lab for AnSc 3520. Taught in a two-week session at the Crookston Equestrian Center.

AnSc 5000. Professional Experience Program. (4 cr; prereq #; S-N only; free elective for animal science undergrads; not for grad cr; UC only)
Professional experience in animal science firms or government agencies through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

AnSc 5231. Dairy Cattle Breeding. (4 cr; prereq 3220 or #)
Applying quantitative genetic principles to the breeding of dairy cattle. Primary emphasis on evaluation of males, females, and systems of breeding. Rates of genetic improvement with and without artificial insemination.

AnSc 5322. Physiology of Reproduction. (5 cr; prereq 6 cr systemic physiology)
Principles of reproductive physiology with emphasis on endocrinological aspects.

AnSc 5327. General Endocrine Physiology. (3 cr; prereq 3301 or #)
Biological effects, biochemistry, methods of assay, and regulatory aspects of hormones.

AnSc 5328. General Endocrine Physiology Laboratory. (2 cr; prereq 5327 or #)
Demonstration of concepts in endocrinology using experimental approaches.

AnSc 5330. Current Topics in Endocrinology. (1 cr; prereq 3301, BioC 3021 or Biol 5001)
Current developments in endocrinology including introductory and review material, methodology, applicability of results to basic and applied research, and impact on existing endocrinology principles.

AnSc 5401. Swine Nutrition and Feeding. (4 cr; prereq 3401)
Nutrient requirements of swine, all phases of life cycle considered; feed sources, their composition and use in formulation of adequate diets. Least cost formulations, nutritional interrelationships, and feeding systems. Use of feed additives.

AnSc 5403. Ruminant Nutrition. (4 cr; prereq 3401)
Nutrient requirements of ruminants (beef and dairy cattle, sheep); nutrient content of feeds; primarily forages; protein and nonprotein nitrogen use; energy use; nutritional disorders; and formulation of adequate rations.

AnSc 5404. Applied Animal Nutrition. (2 cr; prereq CAPS 5165)
Applying nutrition principles to feeding programs for livestock, poultry, and small animals. For veterinary students without previous nutrition courses.

AnSc 5405. Poultry Nutrition. (3 cr; prereq 3401)
Nutrient requirements of chickens and turkeys; feed composition and use in formulation of adequate diets. Role of feed additives, Least cost formulations, nutritional interrelationships, and feeding systems.

AnSc 5601. Swine Production. (4 cr; prereq 3401; 3220 recommended)
Applying principles of animal breeding, nutrition, physiology, and economics. Swine production systems including swine feeding, breeding programs, selection of breeding animals, management of all classes of swine, housing, diseases, parasites.

AnSc 5602. Sheep Production. (4 cr; prereq 3401 or #; 3220, 5403 recommended)
Status and characteristics of the sheep industry; applying principles of animal breeding, nutrition, physiology, and economics to management of sheep flocks. Sheep production systems including breeding programs, selection of breeds and breeding animals, feeding, health programs, dairy sheep, marketing and budgets.

AnSc 5603. Beef Cattle Production. (4 cr; prereq 3401; 3220, 5403 recommended)
Status and characteristics of the beef cattle industry; applying principles of animal breeding, nutrition, physiology, and economics to management of beef cattle breeding herds. Ration formulation, management, and marketing of feedlot cattle.

AnSc 5604. Dairy Farm Management. (4 cr; prereq 1520, 5403 or #; 3220 recommended)
Applying principles of animal breeding, nutrition, physiology, and economics to planning and management of the dairy farm; genetic influences, housing requirements, health programs for large herds, feed budgets, and record analysis emphasized.

AnSc 5605. Poultry Production. (4 cr; prereq 3401; 5405 recommended)
Physiology, genetics, diseases, and nutrition of poultry and their relation to current management practices for production of eggs, broilers, and turkeys. Technical and practical phases of production and marketing in relation to their underlying principles. Visits to commercial production units.

AnSc 5609. Principles of Farm Animal Environment. (4 cr; prereq jr, 3301 or #)
Biological and physical processes involved in the adjustment of animals to ambient environments and their applications to farm animal management.

AnSc 5710. Special Problems. (Cr ar; prereq #)
Research in an area of animal science under supervision of a staff member. Written report on the research required.

AnSc 5715. Tutorial. (Cr ar; prereq #)
Informally structured course to encourage study in depth of a specific discipline in animal science. Pertinent readings, centered on fundamental propositions suggested; preparation of written essays of high quality required. Tutorials available in cryobiology, cytogenetics, genetics, meats, nutrition, and physiology.

AnSc 5999. Special Workshop in Animal Science. (1-4 cr; prereq #)
Workshops on a variety of topics in animal science offered for credit at locations other than the Twin Cities campus. Consult Class Schedule or department for current offerings.
For Graduate Students Only
(For descriptions, see Graduate School Bulletin)
AnSc 8210. Genetic Improvement of Animals
AnSc 8230. Linear Model Methods
AnSc 8325. Physiology of Fertilization and Gestation
AnSc 8326. Immunoreproduction
AnSc 8332. Preservation of Spermatozoa and Embryo
AnSc 8335. Molecular Biology Techniques in Animal Science
AnSc 8420.* Animal Bioenergetics and Nutritional Physiology
AnSc 8421.* Protein and Amino Acid Nutrition
AnSc 8440.* Ruminant Nutrition
AnSc 8441. Research Techniques in Ruminant Nutrition
AnSc 8740. Concepts and Developments in Ruminant Nutrition
AnSc 8741. Concepts and Developments in Avian Nutrition
AnSc 8742. Concepts and Developments in Swine Nutrition
AnSc 8743. Concepts and Developments in Nutritional Physiology
AnSc 8810.* Research in Animal Science
AnSc 8820.* Research in Animal Genetics
AnSc 8830. Research in Animal Physiology
AnSc 8840.* Research in Animal Nutrition

Applied Economics (ApEc)
ApEc 1000. Orientation to Agricultural and Applied Economics. (1 cr; S-N only)
Curricula, areas of specialization, coursework, employment opportunities, faculty, and functions of the Department of Agricultural and Applied Economics.
Economics of the firm and household; factor and product price determination; theory of production, consumption, and distribution; supply and demand analysis, equilibrium analysis.
Determinants of national income and employment levels; prices and money; the banking system; monetary and fiscal policy; economic growth and development; role of government in the economy.
Fundamentals of business accounting; basic finance concepts; use of accounting data for income tax and managerial decision making.
ApEc 3000. Seminar in International Agriculture. (1 cr; prereq Agri 3000; S-N; free elective for ApEc undergraduates)
Oral presentation and discussion of students’ research papers, literature review of selected topics, discussions with students and staff about their experiences in international agriculture.
ApEc 3001. Applied Microeconomics: Consumers and Markets. (4 cr, §Econ 3101; prereq 1101 or Econ 1101, Math 142 or Math 1251, Stat 1001, BA 1550 or IDS 1010, OMS 1020 or #)
Microeconomic theory relating to the consumer, the household, and demand for both public and private goods. Empirical applications integrated with theory, including the estimation of demand functions from actual data.
ApEc 3002. Applied Microeconomics: Managerial Economics. (4 cr; prereq 3001, Acct 1050 or AgEc 1250 or #)
Microeconomic theory relating to the firm and its application to managerial problems. Empirical applications integrated with theory, including programming and the estimation of cost and production functions.
ApEc 3006. Applied Macroeconomics: Government and the Economy. (4 cr, §Econ 3102; prereq 1101, 1102 or Econ 1101, Econ 1102)
ApEc 3007. Applied Macroeconomics: Policy, Trade, and Development. (4 cr, prereq 1101, 1102 or Econ 1101, Econ 1102)
History of agricultural and economic development; determinants of development on factor and commodity markets; elements and effects of agricultural and trade policy in the course of economic development; macroeconomic and international aspects of agricultural development, policy, and trade.
ApEc 3040. Economic Development of American Agriculture. (4 cr; prereq 1101 or Econ 1101)
Review of the economic, political, social, and technical forces that have shaped the development of American agriculture; role of agricultural development in national economic development in the United States; implications for presently developing countries.
ApEc 3070. Agriculture and Economic Growth in Developing Countries. (4 cr; prereq 1101, 1102 or Econ 1101, Econ 1102)
Agricultural development problems; contribution of economics to analyzing these problems; use of economics in agricultural development policy and planning.
ApEc 3240. Strategic Management of Agribusinesses. (4 cr; prereq 3002, 3500 or #)
Identifying and analyzing strategic issues and problems of farms and agribusinesses, establishing business goals and developing realistic plans of action; strategy formulation, implementation and control issues; analysis of case studies.
ApEc 3260. Operations Management of Agribusiness. (4 cr; prereq 3002, 3500 or #)
Operations strategy, quality management, process selection, forecasting, risk management, aggregate planning, scheduling, inventory, materials, just-in-time, work force management. Taught from systems viewpoint for agribusiness production, wholesaling, retailing, and service.
ApEc 3300. Agricultural and Food Sales. (3 cr; prereq GC 1537 or equiv or #)
Applied sales of agricultural and food products. Emphasis on development and refinement of technical sales abilities. Discussion of career preparation for sales occupations.
ApEc 3400. Markets, Marketing and Prices. (4 cr; prereq AgEc 1101 or equiv, Math 1142 recommended)
Market structure, demand and supply structure, regulations, and institutions that influence the behavior of firms in agricultural marketing systems will be examined. Performance in food assembly, manufacturing, and distribution industries will be investigated with respect to conduct and strategies of firms.
ApEc 3410. Economic Organization of the Hospitality Industry. (4 cr; prereq Mktg 3000 or #)
Principles of economics applied to markets and firms serving people away from home, including food, lodging, travel, recreation, health care, and related activities.
ApEc 3420. Grain Marketing Economics. (4 cr; prereq 1101 or Econ 1101)
Economic relationships in the marketing of grain and grain products; analysis of supply and demand; grain grades, storage, and transportation; market structure, channels, pricing, and competition; government programs and policies.
The following symbols are used throughout the course descriptions in lieu of page footnotes.

- Courses in which graduate students may prepare Plan B projects.
- The comma, used in prerequisite listings, means "and.
- All courses preceding this symbol must be completed before credit will be granted for any quarter of the sequence.
- Credit will not be granted if credit has been received for the course listed after this symbol.
- Concurrent registration is required or allowed in the course listed after this symbol.
- Approval of the instructor is required for registration.
- Approval of the department offering the course is required for registration.
- Honors course (follows the course number).
- University College (formerly Continuing Education and Extension.
- Series courses, separated by commas, may be entered any quarter.
- Courses primarily for freshmen and sophomores are numbered 1000 through 1998; for juniors and seniors, 2000 through 3999; for juniors, seniors, and graduate students, 5000 through 9999. Courses numbered 8000 and above are restricted to seniors.

### Applied Economics

#### ApEc 3430. Dairy Marketing Economics. (4 cr; prereq 1101 or Econ 1101)
Economic relationships in the marketing of milk and milk products; analysis of supply and demand; market structure, channels, pricing, and competition; federal milk marketing price regulations; dairy programs and policies.

#### ApEc 3440. Livestock and Meat Marketing Economics. (3 cr; prereq 1101 or Econ 1101)
Economic relationships in the marketing of livestock and livestock products; analysis of supply and demand; livestock grades, inspection, and transportation; market structure, channels, pricing, and competition; government regulations and policies.

#### ApEc 3450. Agricultural Input Marketing Economics. (4 cr; prereq 1101 or Econ 1101)
Demand for farm inputs: structure of farm sector, factors affecting input purchases, derived demand from production functions, time series demand analysis, farmland as a production input; farmland markets; farm labor input; farm labor usage and markets; farm-generated inputs and alternative enterprise combinations. Purchased farm inputs: farm machinery and buildings, animal production input markets, crop production input markets.

#### ApEc 3500. Agribusiness Finance. (4 cr; prereq 1250 or Acct 1050, AgEc 3002 or #)
Analysis of financing and investment strategies for agribusiness firms and their effects on liquidity, solvency and profitability; financial intermediaries in agriculture.

#### ApEc 3610. Resource Development and Environmental Economics. (4 cr; prereq 1101, 1102 or Econ 1101, 1102 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; generation of alternative program elements and development of consequences; problems in choosing elements for an optimum resource development program.

#### ApEc 3810. Principles of Farm Management. (4 cr; prereq 1101 or Econ 1101; not open to ag bus and applied econ majors)
Strategic and operational aspects of farm management. Economic principles, financial analysis, and budgeting procedures; strategic management, quality management, process selection; forecasting and investment analysis, materials requirements, and whole-farm planning; scheduling; risk, work force, and control management.

#### ApEc 3920. Agricultural Law. (4 cr; prereq 1101 or Econ 1101)
The legal system; contracts; torts; labor; property; meaning, acquisition, rights; water drainage; environmental concerns; animals; credit; finance; UCC; sales; taxation; tenancy; partnerships, corporations, cooperatives; estate and tax planning.

#### ApEc 3980. Current Issues in Agricultural Economics. (Cr ar; prereq #)
Discussion and analysis of important and timely problems in agricultural economics. Topics vary quarterly and are listed in Class Schedule. For full details, inquire at the department office before registration.

#### ApEc 3990. Independent Study in Agricultural and Applied Economics. (Cr ar; prereq #)
Independent study and supervised reading and research on subjects and problems not covered in regularly offered courses.

#### ApEc 5000. Professional Experience Program. (4 cr; prereq #; S-N only; not for grad cr; UC only)
Professional experience in agribusiness firms or government agencies gained through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

#### ApEc 5020. Applied Linear Programming. (4 cr; prereq 3002 or Econ 3101 or #)
Applications of linear programming to economic problems of the firm. Resource allocation, product mix, investment and distribution decisions in the context of cost minimization and profit maximization.

#### ApEc 5030. Methods of Economic Data Analysis. (4 cr; prereq Stat 5021 or equiv; familiarity with matrix algebra recommended)
Primarily for M.S. students. Emphasizes practical aspects of economic data analysis and familiarizes students with various econometric methods and models commonly used in applied economics, and the economic and statistical theory underlying these methods.

#### ApEc 5400. Intermediate Market and Price Analysis. (4 cr; prereq 3002 or Econ 3101 or #)
Development of analytical models and their application in various market situations. Unique market institutions that have developed in response to marketing problems and policies.

#### ApEc 5440. Cooperatives and Agribusiness Organization. (4 cr; prereq 3002 or Econ 3101 or #)
Analysis of economic problems and issues facing agricultural cooperatives, including changing market organization, financing, taxation, and antitrust regulations.

#### ApEc 5480. Futures Markets and Prices. (4 cr; prereq 3002 or Econ 3101 or #)
Economics of futures trading; the basis and theoretical price relationships in storable and nonstorable commodities; hedging and commercial use of futures markets with illustrations; arbitrage; options on agricultural futures; financial futures; speculation; futures market performance and regulation.

#### ApEc 5500. Financial Markets and Agricultural Credit Institutions. (4 cr; prereq 3500 or BFin 3000 or grad or #)
Analysis of financial institutions and financial markets; managerial policy issues confronting managers of financial intermediaries with particular reference to those operating in an agricultural setting; current problems confronting financial intermediaries.

#### ApEc 5550. Food Marketing Economics. (4 cr, IFSch 5474; prereq 3001 or Econ 3101 or #)
Economics of food marketing in the United States. Food consumption trends; consumer food behavior; food expenditure and consumption data; consumer survey methodology; the food distribution retailing system; food policy issues related to food marketing. Students pursue individual and group projects.

#### ApEc 5580. Household Economics: Time Labor and Human Capital Around the Globe. (3 cr; prereq 3002 or Econ 3101 or #)
Investment in household formation, child education, health, labor force participation and non-market work will be analyzed in the context of household economics and national productivity; effects of economic variables on investment decisions and returns.

#### ApEc 5600. Land and Water Economics. (3 cr; prereq 3002 or Econ 3101 or #)
Land and water as public resources and as factors of production; economic analysis of policies that influence asset use; sale and rental markets; valuation of rights to land and water; taxation and regulation as instruments and influencing private management decisions; comparative land and water legal and market settings.

#### ApEc 5620. Regional Economic Analysis. (3 cr; prereq 3006 or Econ 3102 or #)
Analysis of regional economics; alternative theories of firm location (neoclassical profit cycle, competitive advantage, cumulative causation); labor markets and migration; alternative development approaches and public incentive; special emphasis on medium-sized metro areas, rural areas and value-added industries.
ApEc 5630. Regional Development Systems. (3 cr; prereq 3006 or Econ 3102 or #)
Regional system analysis (economic base, input-output, and computable general equilibrium); application of impact models to development problems; theoretical foundations of models; basic skills in developing and interpreting regional input-output analyses with real-world date and problems.

ApEc 5637. Law and Agricultural Policy. (3 cr; prereq grad in applied economics)
Economic regulation of agriculture. Industrial organization and market structure in agribusiness, public lands and water law, agricultural cooperative, farm labor, farm finance, crop insurance and disaster assistance, agricultural biotechnology, food and drug law, price and income regulation and international agricultural markets. Same as Law 5637.

ApEc 5640. Financing State and Local Governments. (4 cr; prereq 3002 or Econ 3101 or #)
Problems and issues in financing state and local public services in the United States, State and local revenue systems, debt and expenditures. Intergovernmental fiscal relations. Budget analysis.

ApEc 5650. Economics of Natural Resource and Environmental Policy. (4 cr; prereq 3002 or 3610 or Econ 3101 or #)
Application of economic analysis, including project evaluation, to current natural resource and environmental issues. Emphasis on conservation and resource scarcity, environmental quality, and resource use issues and their implications for public policy.

ApEc 5660. Economics of Public Services. (3 cr; prereq 3002 or Econ 3101 or #)
Issues of finance and supply and demand for public services; pricing, producing, and financing public goods; bureaucratic decision making; implementing policies.

ApEc 5710. U.S. Agriculture: Farm, Food, and Environmental Policy. (3 cr; prereq ApEc 3002 or Econ 3101, ApEc 3006, ApEc 3007 or Econ 3102 or #)
Development of U.S. agriculture and U.S. agricultural and trade policy; agricultural input and commodity markets; U.S. environmental policies effects on agriculture; design and economic effects of U.S. agricultural policy; determinants of U.S. agricultural and trade policies.

ApEc 5720. Economics of World Agriculture. (3 cr; prereq ApEc 3002 or Econ 3101, ApEc 3006 or Econ 3102 or #)
Theories of agricultural development, comparative agricultural organization and structure, and institutional change on agricultural development, national development policies, bilateral and multilateral assistance, international policy conflicts.

ApEc 5730. European Agriculture: Farm, Food and Environmental Policy. (4 cr; prereq 3002 or Econ 3101 or #)
Characteristics of agriculture in Europe; determinants of development of European agriculture; goals and instruments of European Community agricultural policy.

ApEc 5740. Agricultural Policy in Planned Economies. (4 cr; prereq 3001 or Econ 3101 or #)
Principle of economics used to analyze agricultural policy and performance in centrally planned economies. Emphasis on Soviet agriculture; some attention to China and Eastern Europe.

ApEc 5750. Agricultural Trade and Commercial Policies. (3 cr; prereq 3002 or Econ 3101 or #)
Trade policies and practices of export and import nations, commodity agreements; agricultural trade policies of common market areas; negotiations and potential trade developments.

ApEc 5790. World Food Problems. (3 cr, 1Agro 5200, 9ScCh 5643, 9CAPS 5280; prereq ag or pre-vet med or home econ or soc sci major or # or agricultural econ grad with #)
Multidisciplinary approach to the social, economic, and technical problems of feeding the world’s growing population. Principles sought from the social, economic, plant, and animal sciences for their application to food problems.

ApEc 5860f. Economics of Agricultural Production. (3 cr; prereq 3002 or 3101 or #)
Production economics applied to agriculture; profitable combination of production factors; comparative advantage and location production.

ApEc 5890. Independent Study: Advanced Topics in Farm and Agribusiness Management. (1-6 cr; prereq #)
Special topics or individual work suited to the needs of particular groups of students.

ApEc 5990. Special Topics and Independent Study in Applied Economics. (1-4 cr; prereq #)
Special classes, independent study, and supervised reading and research on subjects and problems not covered in regularly offered courses.

ApEc 5999. Special Workshop in Applied Economics. (1-4 cr; prereq #)
Workshops on a variety of topics in applied economics offered for credit in locations other than the Twin Cities campus. Consult Class Schedule or department for current offerings.

For Graduate Students Only
(For descriptions, see Graduate School Bulletin)

ApEc 8100. Graduate Seminar
ApEc 8200. Advanced Topics in Agriculture and Applied Economics
ApEc 8210. Applied Econometrics
ApEc 8220. Applied Mathematical Programming
ApEc 8231. Agricultural Prices
ApEc 8245. Agricultural Marketing Economics
ApEc 8264. Resource Economics
ApEc 8266. Applied Regional Economics
ApEc 8278. Agricultural and Economic Development
ApEc 8287. Production and Supply
ApEc 8288. Dynamic Production Economics
ApEc 8345. Seminar: Agricultural Marketing
ApEc 8360. Seminar: Land and Institutional Economics
ApEc 8370. Agricultural and Trade Policy in Developed Countries
ApEc 8373. Seminar: Food and Agricultural Policy in the United States
ApEc 8378. Seminar: Agricultural Development
ApEc 8382. Seminar: Farm Management and Production Economics
ApEc 8590. Economics of Food and Consumer Policy
ApEc 8591. Consumption Economics
ApEc 8777. Thesis Credits: Master’s
ApEc 8888. Thesis Credits: Doctoral
Biosystems and Agricultural Engineering

Courses in Agricultural Engineering Technology (AgET)

Agricultural engineering technology is the application of scientific and engineering knowledge and methods combined with technical skills for problem solving in agriculture.

Courses in Agricultural Engineering and Agricultural Engineering in IT (BAE)

The following courses, offered by the Institute of Technology, are open to students in the four-year engineering curriculum and those who have completed the prerequisite courses.

Symbols

The following symbols are used throughout the course descriptions in lieu of page footnotes.

* Courses in which graduate students may prepare Plan B projects.

+ The comma, used in prerequisite listings, means "and/or".

† All courses preceding this symbol must be completed before credit will be granted for any quarter of the sequence.

§ Credit will not be granted if credit has been received for the course listed after this symbol.

# Concurrent registration is required (or allowed) in the course listed after this symbol.

Å Approval of the instructor is required for registration.

Δ Honors course (follows the course number).

UC University College (formerly Continuing Education and Extension

1, s, u, j Following a course number, indicates fall, winter, spring, or summer terms.

101, 1012, 1013 Series courses, separated by commas; may be entered any quarter.

101-1012-1013 Sequence courses, separated by hyphens; must be taken in order listed.

Courses primarily for freshmen and sophomores are numbered 1000 through 3999. Courses numbered 4000 through 6999 are open to juniors, seniors, and graduate students. Courses numbered 8000 and above are restricted to graduate students registered in the Graduate School.

Courses listed by number only (e.g., prereq 5346) is in the same department as the course being described.

BAE 1060. Biosystems and Agricultural Engineering Orientation. (1 cr; S-N only; 2 hrs per wk) Lectures, readings, discussions, and presentations by practicing engineers and fellow students. For students interested in majoring in biosystems and agricultural engineering or exploring the profession. Discussion of various areas of specialization along with the environment, safety, ethics, and professionalism. Identification of internships, employment opportunities, and advanced studies.

BAE 2461. Biosystems and Agricultural Engineering. (4 cr; prereq IT student, CSci 3101, CSci 3102 or CSci 3113, Math 3261 or ¶Math 3261; 3 lect, 2 rec hrs per wk) Computational techniques applied to biosystems and agricultural engineering problems: spreadsheets, elementary numerical methods, computer drafting, engineering economics, selected engineering software. Effective presentation of quantitative and graphical information.

BAE 3052. Engineering Principles of Soil-Water-Plant Systems. (4 cr; prereq IT student, 3031, AEM 3200 or CE 3400, Biol 1009; 3 lect, 3 lab hrs per wk) Mechanical and hydraulic properties of soil; moisture relations; strength parameters for structural and mechanical design. Soil-machine action in tillage and traction. Energy and water balance in the soil-water-plant system. Plant structure and growth. Engineering and management requirements.

BAE 3150. Biology for Engineering. (4 cr; prereq IT student, 3031, Biol 1009, ME 3301 or ¶ME 3301; 3 lect, 3 lab hrs per wk) Introduction to the fundamentals of biological science for engineers. Understanding biology in terms of mathematics, chemical reactions, transport phenomena, material science, mechanics, and electronics. Applications to engineering.

BAE 3390. Directed Studies in Biosystems and Agricultural Engineering. (1-5 cr; prereq #) Independent study of topic(s) involving physical principles as applied to agricultural production and land resources.

BAE 5050. Intern Reports. (2 cr per qtr; S-N only; prereq IT or COAFES student in BAE, #) Student exposure to engineering practice through an intern program. Engineering reports on work assignments are reviewed by faculty and coordinated with industry advisers.

BAE 5070. Instrumentation and Control for Biological Systems. (4 cr; prereq upper div IT or forest products major or grad, EE 1400, EE 3009, ME 3900 or Stat 3091; 3 lect, 2 lab hrs per wk) Measurement of motion, force, pressure, flow, temperature, size, shape, color, texture, rheology, moisture, water mobility, fat, and pH. Control principles and instrumentation for biological systems. Linking of physical and biological control systems.

BAE 5072. Finite Element Method: Fundamentals and Applications. (4 cr; prereq upper div IT or grad IT major, Math 3261; 4 lect hrs per wk) Basic theory and principles of implementation of the finite element method for a number of fundamental engineering areas. Applications in heat transfer, fluid mechanics, solid mechanics, radial and axisymmetric field problems, and time-dependent field problems.

BAE 5074. Microcomputer Interfacing. (4 cr; prereq upper div IT or grad IT major, CSci 3101, CSci 3102 or CSci 3113, EE 1400, EE 3009; 2 lect, 4 lab hrs per wk) Introduction to digital components, integrated circuits and microcomputers. Interfacing of microcomputers for data acquisition and control.

BAE 5140. Thermal Processes for Food. (4 cr; prereq upper div IT or grad IT major, ChEn 5103 or ME 5342; 3 lect, 3 lab hrs per wk) Engineering principles of thermal processing of food, pasteurization, microwave heating, heat exchange, evaporation, refrigeration and freezing. Process design and evaluation.
BAE 5191-5192. Special Problems in Biosystems and Agricultural Engineering. (1-5 cr per qt; prereq #) Individual study project at an advanced level involving application of engineering principles to a specific problem.

BAE 5350. Agricultural Machinery and Terramechanics. (4 cr; prereq upper div IT or grad IT major, AEM 3016, AEM 3036; 3 lect, 3 lab hrs per wk) Engineering principles governing the performance of machinery used in agriculture. Emphasis on soil-machine interaction (traction and tillage), off-road vehicle dynamics, operator-machine interaction, drive-line design, power unit selection, and duty cycle analysis.

BAE 5540. Watershed Engineering. (4 cr; prereq upper div IT or grad IT major, 3052 or §3052 or CE 3300, CE 3400; 3 lect, 3 lab hrs per wk) Application of engineering principles to the management of surface runoff and soil water in agricultural, range and urban lands. Designing facilities for control of surface runoff to mitigate problems of flooding and degradation of surface water quality.

BAE 5550. Water Management Engineering. (4 cr; prereq upper div IT or grad IT major, 3052 or CE 3300, CE 3400; 3 lect, 3 lab hrs per wk) Application of engineering principles to the management of water for production and environmental protection in agricultural systems. Design of facilities to irrigate and drain croplands and to enhance water quality.

BAE 5560. Mechanics of Flow in the Unsaturated Zone. (4 cr; prereq upper div IT or grad IT or COAFES grad student, Math 3261, Soil 5232 or #; 3 lect hrs per wk) Fluid retention and transmission properties of unsaturated porous media. Equations of mass conservation and Darcy’s law for unsaturated porous media. Simultaneous flow of immiscible fluids. Analytical, finite difference and finite element solutions to the governing equations.

BAE 5745. Ventilating Systems for Indoor Air Quality. (4 cr; prereq upper div IT or grad IT major, AEM 3200 or CE 3400, ME 3301; 4 lect hrs per wk) Impact of indoor air quality on humans, animals, and plants. Contaminant sources. Ventilating processes, systems, control strategies, and equipment for indoor air quality control. Case studies from residential, commercial and agricultural systems.

BAE 5751. Biochemical Engineering I. (3 cr; §ChEn 5751; prereq BAE major or grad student in Chem Eng major or #; 3 lect hrs per wk) Applications of material and energy balances and concepts from thermodynamics, kinetics, and transport phenomena to cellular and enzyme systems.

BAE 5891. Senior Design I. (3 cr; prereq upper div IT; 20 cr BAE completed or in progress; 4 rec hrs per wk) Introduction to design processes. Safety and ethics in design. Development of a proposal for a senior design project (individual or group). Poster presentation of proposal to the department at mid-quarter. Development of product specifications, timeline and concepts for the design. Review of case studies, constructive review of existing designs.

BAE 5892. Senior Design II. (3 cr; prereq 5891; 4 rec hrs per wk) Completion of a design project started in BAE 5891 culminating in a design report and poster display of the final design. Continuation of the development of design methodology including decision making, hazard analysis, and detailed system descriptions.

For Graduate Students Only
(BAES Graduate School Bulletin)

BAE 8000. Supervised Teaching Experience

BAE 8100. Seminar

BAE 8190, 8191, 8192. Advanced Problems and Research

BAE 8500. Hydrologic Modeling—Small Watersheds

BAE 8700. Coupled Moisture, Heat, and Chemical Transfer in Porous Media

Clinical and Population Sciences (CAPS)

Offered by the College of Veterinary Medicine

CAPS 3502. Animal Health and Disease. (5 cr) For nonveterinary students. Veterinary science as it applies to health and disease of domestic animals. Emphasis on basic concepts of disease and common animal diseases that demonstrate these concepts. How stress and management practices aggravate and create new disease conditions.

CAPS 5280. World Food Problems. (3 cr; §ApEc 5790, §Agro 5200, §FScN 5643; prereq major in ag or vet med or nutr sci or social sci or #; grads by #) Multidisciplinary approach to the social, economic, and technical problems of feeding the world’s growing population. Principles sought from the social, economic, plant, animal, and nutritional sciences for their application to food problems.

Entomology (Ent)

Ent 1009. Economic Entomology. (4 cr; prereq Biol 1009 or #) Introduction to structure and classification of insects; management of insect populations; life histories, habits and recognition of insect pests of livestock, orchards, field crops, vegetables, and landscape plants. One hundred specimen insect collection is required.

Ent 3005. Insect Biology. (3 cr; prereq Biol 1009 or equiv) Biodiversity and natural history of insects; functional roles in natural and managed environment;effects of insects on human history and approaches to managing problems caused by insects.

Ent 3200. Social Insects. (4 cr; prereq college level course in general biology) Termites, ants, social wasps, and social bees. Natural history, caste determination and regulation, group effects and control of nestmates. Communication and pheromones, the superorganism concept, and the evolution of sociality.

Ent 5000. Professional Experience Program. (4 cr; prereq #; S-N only; free elective for ag undergrads; not for grad cr; UC only) Professional experience in entomology firms or government agencies through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

Ent 5010. Insect Morphology. (5 cr; prereq 3005 or #; offered 1997 and alt years) Comparative study of insect structure within an evolutionary and phylogenetice perspective.
Ent 5020. Insect Taxonomy. (6 cr; prereq 3005 or equiv)
Identification of adult insects to family; evolution and classification of insects; techniques of collecting and curating insects; principles of phylogeny reconstruction.

Ent 5030. Insect Physiology. (3 cr; prereq 5010, biochemistry course or #)

Ent 5040. Insect Ecology. (4 cr; prereq Biol 5041 or EBB 5122 or #, offered 1998 and alt yrs)
Synthetic analysis of the causes of insect diversity and of fluctuations in insect abundance. Focus on abiotic, biotic, and evolutionary mechanisms influencing insect populations and communities.

Ent 5210. Insect Pest Management. (4 cr; prereq 1005 or #)
Prevention or suppression of injurious insects by the comprehensive and coordinated integration of multiple control tactics, e.g., chemical, biological, cultural. Strategies to optimize the dynamic integration of control methodologies in context of their economic, environmental, and social consequences.

Ent 5215. Insects in Relation to Plant Diseases. (3 cr; #/Pr/A 5216; # 5 cr plant path or equiv or #; offered 1998 and alt yrs)
Insect transmission and dissemination of plant pathogens; development of plant-pest-insect relationships and habits of principal insect vectors.

Ent 5250. Forest and Shade Tree Entomology. (4 cr; prereq any two courses among the forestry, zoological, botanical, biological, or agricultural sciences)
Lectures and lab concerning ecology and population management of forest and shade tree insects, with heavy emphasis on tree factors and integrated control.

Ent 5275. Medical Entomology. (3 cr; prereq 3005 or #; offered 1998 and alt yrs)
Biology of arthropod vectors of human disease. Emphasis on disease transmission and host, vector, and pathogen interactions.

Ent 5280. Livestock Entomology. (4 cr)
Biology and management of insects, mites, and ticks that affect domestic livestock and pets.

Ent 5310. Sampling Biological Populations. (4 cr; prereq Stat 5021 or equiv; offered 1997 and alt yrs)
Design and sampling plans for studying field and lab populations of living organisms. Sampling distributions and techniques for detecting and coping with aggregation. Randomization, required sample size, and optimal resource allocation within alternative sampling designs.

Ent 5320. Ecology of Agriculture. (4 cr; prereq one 3xxx+ level course in agro or hort or an sci, one 3xxx+ level course in ent or plant path or soil or #)
Ecological perspective on post-industrial agriculture: origins of agriculture, social functions, and ecology of contemporary and extinct agricultural systems. Soils, plant development, pest ecology, forage quality, animal production, and food quality as an interactive network of factors.

Ent 5340. Biological Control of Insects. (2 cr; prereq 5210, intro ent course, course in eco)
Principles of biological control: history, ecological basis, classical biological control, augmentation, analysis of selected projects.

Ent 5350. Insect Pathology. (3 cr; prereq 5030; offered 1997 and alt yrs)
Survey of the major pathogenic microorganisms that cause diseases in insects; routes of infection of insects; lab propagation of disease agents; factors involved in application of disease to control of pest insects with safety considerations.

Ent 5360. Aquatic Insects. (3 cr; prereq 3005 or equiv #; offered 1997 and alt yrs)
Taxonomy and natural history of aquatic insects, including their importance in aquatic ecology, water resource management, recreation, and conservation. Emphasis on family level identification. Field trips scheduled to local aquatic habitats. A collection is required.

Ent 5370. Principles of Systematics. (3 cr; prereq #; offered 1998 and alt yrs)
Theoretical and practical procedures of biological systematics, including phylogeny reconstruction, classification, systematic literature, nomenclature, and presentation of results of systematic research.

Ent 5380. Lepidopterology. (2 cr / 3 cr with term paper; prereq one ent course or #, one course each in ecology and genetics recommended)
Overview of Lepidoptera, with emphasis on processes and phenomena such as polymorphism, mimicry, and individual quality that are well demonstrated by this insect order.

Ent 5480. Invertebrate Neurobiology. (2 cr, #NSc 5480)
Fundamental principles and concepts underlying cellular bases of behavior and “systems” neuroscience. Particular invertebrate preparations discussed.

Ent 5900. Basic Entomology. (Cr ar; prereq #)
Opportunity to make up certain deficiencies in biological background.

Ent 5910. Special Problems in Entomology. (Cr ar; prereq #)
Individual field, lab, or library studies in various aspects of entomology.

Ent 5920. Special Lectures in Entomology. (Cr ar; offered when feasible)
Lectures or laboratories in special fields of entomological research given by a visiting scholar or regular staff member.

Ent 5999. Special Workshop in Entomology. (1-4 cr; prereq #)
Workshops on a variety of topics in entomology offered for credit in locations other than the Twin Cities campus. Consult Class Schedule or department for current offerings.

For Graduate Students Only
(For descriptions, see Graduate School Bulletin)

Ent 8040. Advanced Insect Genetics
Ent 8050. Toxicology
Ent 8200. Colloquium in Social Insects
Ent 8210. Colloquium in Insect Evolution
Ent 8240. Colloquium in Insect Ecology
Ent 8300. Graduate Seminar
Ent 8500.* Research in Entomology

Environmental Science (ES)

ES 1001. Orientation to Environmental Science. (1 cr)
Students explore the environmental science major through discussions of current events, faculty research, alumni reports and portfolio preparation.

ES 1010. Issues in the Environment. (3 cr)
Critical analysis of environmentally stressed situations, and modes of avoiding and redressing pollution.

ES 3050. Field or Work Experience in Environmental Science. (1-4 cr)
Students are required to obtain internship forms prior to registering. A written and oral report on the student’s internship is required. For 1 credit, the written report is 4-8 pages. Additional credits require a more in-depth report.
**Food Science and Nutrition (FScN)**

**FScN 1020. Introductory Microbiology. (4 cr)**
Fundamental principles of microbiology. Characteristics of bacteria, yeasts, molds, and other microorganisms; their importance in the preparation and preservation of foods, and their relation to the health and well-being of the individual and the family.

**FScN 1102. Food: Safety, Risks and Technology. (4 cr)**
Processing technology in relationship to risk, benefits and safety issues for the prevention of biological, microbiological and physical and chemical deterioration of foods while enhancing nutritional and sensory quality.

**FScN 1612. Principles of Nutrition. (4 cr; prereq high school bio, high school chem)**
Fundamental concepts: human nutritional requirements, the function of nutrients, and nature of deficiencies. Vegetarianism, weight loss, fat diets, activity, obesity, cancer, heart disease, food processing, safety, and world food problems.

**FScN 3102. Introduction to Food Science. (4 cr; prereq Chem 1002 or Chem 1052)**
Composition and chemical and physical properties of foods; interaction, reaction, and evaluation of foods due to formulation, processing, and preparation.

**FScN 3112. Food Analysis. (4 cr; prereq 3102)**
Application of analytical techniques in the analysis of food composition (proximate, mineral, vitamins, and food contamination). Physical methods of analysis.

**FScN 3135. Food Processing I. (4 cr; prereq 1102, 3102, Math 1031)**
Qualitative and quantitative discussion of principles of product movement and modification used in food processing. Operations needed for proper functioning of a food processing facility such as pumping, homogenization, membrane separations, milling, and dry blending.

**FScN 3136. Food Processing II. (4 cr; prereq 3135)**
Discussion of major food processing operations including heating and cooling, evaporation, drying, and process automation, from the perspective of the introduction and principles of equipment and quantitative base for operations.

**FScN 3400. Food Marketing Communications. (3 cr; prereq Phet 1222)**
Communication of information associated with food marketing, including developing proposals, project planning, and creative innovative marketing and strategies for food products selected. Individual and team oral product presentations and demonstration, written plans, memos and reports; videotaping TV commercials; food photography.

**FScN 3472. Food Selection Principles. (4 cr; prereq 4 cr food sci and nutrit)**

**FScN 3610. Community Nutrition. (3 cr; prereq 1612 or equiv, 5 cr anth or psych or soc)**
Goals of community food and nutrition programs including national, international, public and private programs; an overview of cultural food patterns; and the management of (assessing needs, planning, implementation, and evaluating) food and nutrition programs for groups of people.

**FScN 3612. Life Cycle Nutrition. (4 cr; prereq 1612, Chem 3302 or equiv)**
Nutrition changes through the life cycle, especially nutrient needs during pregnancy and lactation; nutritional needs as affected by exercise; digestion and absorption, other nutrient balances; nutrition and immunology.

**FScN 3662. Introduction to the Clinical Practice of Dietetics. (2 cr; prereq 12 cr in food sci and nutrit, regis in coordinated program in dietetics)**
Introduction to the practice of dietetics in hospitals, outpatient clinics, public service agencies, and food services.

**FScN 3703. Field Experience in Food Service Management. (3-18 cr; prereq regis in coordinated program in dietetics or #)**
Supervised food service production and management experience in a community or health care facility.

**FScN 3730. Quantity Food Production Management. (3 cr; prereq 3102, 3472)**
Participation in the management procedures used in the selection, storage, preparation, pricing, and service of food in quantity. Quantity food service facilities used as laboratories. Field trips may be required.

**FScN 3732. Lecture in Quantity Food Production Management. (2 cr; prereq 3102, 3472)**
Understanding of management procedures used in selection, storage, preparation, pricing, and service of food in quantity.

**FScN 5000. Professional Experience Program. (4 cr; prereq 15 cr in food sci and nutrit; #, not for grad cr; UC only)**
Up to 12 weeks of planned experience in a selected position in the food industry; evaluative reports and consultations with faculty advisers and employers.

**FScN 5100. General Seminar. (1 cr; A-F only; prereq 3100 or #)**
Literature review and presentation of papers in selected areas of food science and nutrition.

**FScN 5110. Food Chemistry. (4 cr; prereq 3102, BioC 3021 or Biol 5001)**
Study of chemical structures and functional properties of food components in relationship to their roles as parts of complex biochemical systems and as modified by various environmental and processing factors.

**FScN 5111. Independent Study in Food Science and Nutrition. (1-5 cr [may be repeated for cr]; prereq A)**
Individual lab or library research in some area related to food science or nutrition.

**FScN 5120. Food Microbiology. (5 cr; prereq 1102, 3112, MicB 5105 or VPB 3103 or #)**
Relationship of environment to occurrence, growth, and survival of microorganisms in foods: methods of evaluation, mechanisms to control, genera and species of importance, control of food-borne pathogens and toxins. Enumeration, isolation, and identification of microbes in foods.

**FScN 5122. Control Systems in Food Microbiology. (2 cr; prereq 5120)**
Control and destruction of microorganisms in foods; hazard analysis; critical control points for control of microbes; chemical, physical, and microbiological considerations in cleaning and sanitizing food contact surfaces and equipment; microbiological criteria for raw and processed foods; sampling methodologies.

**FScN 5123. Food Fermentations and Biotechnology. (3 cr; prereq 5120)**
Food fermentation processes; characteristics of microorganisms involved in food fermentations and production of food ingredients; composition and factors influencing activity of starter culture; microbiology of natural and controlled fermentation; properties of lactic bacteriophages and methods of control during dairy fermentations.

**FScN 5135. Food Engineering Unit Operations. (5 cr; prereq 3136, Phys 1042)**
Principles and food system applications of these unit operations: fluid flow, heat transfer, drying, evaporation, contact equilibrium (distillation, extraction, crystallization, and membrane processes), and mechanical separation (filtration, centrifugation, sedimentation, and sieving).

**5312. Instrumental Analysis of Foods. (3 cr; prereq 3112, 5110)**
Applying instrumental methods of analysis to the examination of food products.
FScn 5314. Physicochemistry of Foods. (4 cr; prereq 5100)
Characterization of crystalline systems, gels, emulsions, and foams; functionality of food macromolecules in these systems.

FScn 5316. Quantitative Light Microscopy in Agriculture and Food Research. (4 cr; prereq Biol 1009 or Chem 1052)
The light microscope and its variants. Description and applications of quantitative instruments for characterizing cell, tissue, and other raw or processed materials. Digital image analysis, scanning microspectrophotometry, laser scanning microscopy.

FScn 5360. Sensory Evaluation of Food Quality. (4 cr; prereq 3102, Stat 3012 or Stat 5021)
Fundamentals of sensory perception. Test designs and methods used in studying sensory quality of foods.

FScn 5380. Food Packaging. (3 cr; prereq 1102, 3102, Phys 1042)
Basics of packaging materials and the principles of packaging development and product protection as they apply to foods.

FScn 5390. Introduction to Food Law. (4 cr; prereq 1102 or #)
Federal and state legal requirements and case law history affecting production, processing, packaging, marketing, and distribution of food and food products.

FScn 5401. Special Topics in Food Science and Nutrition. (1-4 cr; prereq varies with topic, check with department)
In-depth investigation of a specific topic not covered by other courses. Announced in advance.

FScn 5404. Current Issues in Food and Nutrition. (2-4 cr; prereq 15 cr food sci and nutr or #)
Evaluation of popular and scientific literature dealing with nutrition, food additives, food safety, health foods, environmental contamination, the consumer movement, naturally occurring food toxicants, processed foods, synthetic foods, organically grown foods.

FScn 5474. Food Marketing Economics. (4 cr, §ApEc 5560; prereq AgEc 3001 or equiv)
Economics of food marketing in the United States. Food consumption trends; consumer food behavior; food expenditure and consumption data; consumer survey methodology; the food distribution and retailing system; food policy issues related to food marketing. Students pursue individual and group projects.

FScn 5512. Meat Technology. (4 cr; prereq 5110)
Industrial processing of meat, fish, and poultry products, including protein functionality, thermal processing, curing, smoking, and deterioration during storage. Use of preblending and least-cost analysis in product development and formulation.

FScn 5522. Technology of Fluid and Concentrated Milk Products. (4 cr; prereq 3136, 5110)
Applying scientific principles to problems involved in processing fluid and dehydrated milk systems and their control. Demonstration of basic processing operations, including heating, cooling, homogenization, evaporation, drying, crystallization, and freezing.

FScn 5523. Technology of Fermented Milk Products. (4 cr, §ApEc 5790, §Agro 5200, 5CAPS 5280, Soc 5675; prereq 5 or grad; limited enrollment)
Integration of chemical, microbiological, and physical principles involved in the manufacture and storage of cheeses and fermented milks.

FScn 5524. Sensory Evaluation of Dairy Products. (1 cr; prereq 3102)
Lab and commercial procedures for evaluating the sensory properties and market quality of dairy products. Cause and identification of common defects in flavor, physical properties, and appearance.

FScn 5550. Grains: Introduction to Cereal Chemistry and Technology. (4 cr; prereq Biol 1009 or Chem 1052)
Origins, structure, biochemistry and cellular properties of major cereal grains, as they relate to primary processing (milling), and secondary processing (production of cereal products). Relationship between structure and functionality as determinants of quality in grains and grain products. Quality evaluation technologies.

FScn 5555. Freezing and Dehydration of Foods. (5 cr; prereq 1102, 5135)
Principles involved in the processing, handling, and storage of frozen, dry, and intermediate moisture foods with emphasis on physicochemical properties of water in foods.

FScn 5560. Introduction to New Product Development. (3 cr; prereq 8 cr food sci)
Identifying and testing new product concepts, prototype testing, and basic process design; interactive format and industrial examples. Statistical and chemical control of new processes and methods for evaluating consumer acceptance.

FScn 5562. Flavor Technology. (4 cr; prereq 1102, 5110)
Flavor and off-flavor development in foods. Industrial production of food flavorings and their proper application to food systems.

FScn 5600. Nutrition Seminar. (1 cr; prereq #; UC only)
Literature review and presentation of papers in selected areas of nutrition.

FScn 5612. Experimental Nutrition. (2 cr; prereq 3612, ¶BioC 3021 or Biol 5001)
Lab experience in chemical and biochemical methods of analysis of nutritional status.

FScn 5614. Nutrition Education. (3 cr; prereq 3610)
Application of educational principles, models, and theories to the development, delivery, and evaluation of nutrition lessons, curricula, and communications.

FScn 5620. Nutrition and Metabolism. (3 cr; prereq 3612 or #, BioC 3021 or Biol 5001)
Physiological function and metabolic fate of carbohydrates, lipids, and proteins and their involvement in fulfilling energy needs for maintenance, growth, and work.

FScn 5622. Macro-Nutrient Metabolism. (4 cr; prereq 3612, BioC 3021 or Biol 5001, Phsl 3051)
Physiological function and metabolic fate of carbohydrates, lipids, and proteins and their involvement in fulfilling energy needs for maintenance, growth, and work.

FScn 5623. Vitamin and Mineral Biochemistry. (4 cr; prereq 3612, BioC 3021 or Biol 5001, Phsl 3051)
Nutritional, biochemical, and physiological function of essential vitamins and minerals in humans and experimental and animal models.

FScn 5624. Human Protein and Energy Utilization. (4 cr; prereq 5622, 5623)
Regulation of human protein and energy use, interactions, adaptations; critical evaluations of methods of determining requirements; technical and ethical problems in human experimentation, and determination of recommended levels of intake.

FScn 5642. Field Experience in Community Nutrition. (3-18 cr; prereq one human nutr course, #)
Application of nutrition information to problems of health and welfare; assigned readings, discussions, and experience in a community agency.

FScn 5643. World Food Problems. (3 cr, §ApEc 5790, §Agro 5200, 5CAPS 5280, Soc 5675; prereq 5 cr grad; limited enrollment)
Multidisciplinary approach to the social, economic, and technical problems of feeding the world’s growing population. Principles sought from the social, economic plant, animal, and food sciences for their application to world food problems.

FScn 5662. Current Issues in Clinical Nutrition. (3 cr; prereq 5660, 5667)
Evaluation of current scientific research and literature related to clinical nutrition.
FScN 5664. Field Experience in Clinical Nutrition. (3-18 cr; prereq one human nutr course, #) Applying nutrition information to problems of health and disease; assigned readings, discussions, and experience in a clinical facility.

FScN 5665. Applied Medical Nutrition Therapy I. (3 cr; prereq BioC 3021 or Biol 5001, LaMP 5177 or ¶5177, Phsl 1001 or Phsl 3051) Nutritional assessment and support; fluid and electrolyte balance; diet/drug interactions. Nutritional intervention in disorders of the gastrointestinal system and in cancer.

FScN 5666. Applied Medical Nutrition Therapy II. (3 cr; prereq 5665, 5662 or ¶5662) (Continuation of 5665.) Pathology, treatment, and nutritional therapy of diseases of cardiovascular and respiratory systems and common disorders of endocrine system, notably diabetes mellitus; nutrition intervention in obesity.

FScN 5667. Applied Medical Nutrition Therapy III. (3 cr; prereq 5666) Pathology, treatment, and nutrition therapy for diseases of urinary tract, inborn errors of metabolism and allergies. Nutritional considerations in eating disorders, and neurological, muscular, and skeletal disorders. Special nutrition considerations in the care of pediatric patients.

FScN 5693. Selected Aspects of Nutrition. (2-4 cr may be repeated for max 12 cr; prereq sr, 3102, 3612) In-depth investigation of a single, preselected aspect of nutrition in any one offering. Teaching procedure and approach determined by nature of topic and student needs. Special topic announced in advance of course offering.

FScN 5694. Metabolic Basis for Therapeutic Nutrition. (4 cr; prereq 5664 or #) Physiological and biochemical basis for dietary treatment, dietary principles related to adequate nutrition. Case study presentations and clinical experience included.

FScN 5702. Selected Aspects of Food Service Management in Health Care Facilities. (3 cr; prereq 3 cr elem stat, 6 cr econ, #) Management techniques applied to food services for health care facilities. Methods of analysis and control.

FScN 5705. Field Experience in Food Service Management. (3 cr; prereq 3 cr elem stat, 6 cr econ, #) Management techniques applied to food services for health care facilities. Methods of analysis and control.

FScN 5732. Principles of Food Service Organization and Management. (4 cr; prereq sr, 3732, Mgmt 3001, regis in coordinated program in dietetics) Management of food service personnel, financial control, regulations, related administrative problems.

FScN 5750. Principles of Food Service Management. (4 cr; prereq 3730 or 3732, Mgmt 3001) Applying management principles in a food service. Business procedures, personnel management, cost control, financial management, and related administrative problems. Field trips may be required.

FScN 5999. Special Workshop in Food Science and Nutrition. (1-4 cr; prereq #) Workshops on a variety of topics in food science and nutrition offered for credit in locations other than the Twin Cities campus. Consult class schedule or department for current offerings.

For Graduate Students Only (For descriptions, see Graduate School Bulletin)

FScN 8101. Research Seminar
FScN 8205. General Seminar
FScN 8311. Flavor Chemistry
FScN 8312. Reaction Kinetics of Food Deterioration
FScN 8315. Food Proteins
FScN 8322. Microbiology and Engineering of Food Sterilization Processes

FScN 8323. Microbial Starter Cultures
FScN 8324. Microbial Toxins and Toxic Microorganisms in Foods
FScN 8401. Independent Study: Food Science
FScN 8403. Advanced Topics in Food Science
FScN 8603. Advanced Topics in Nutrition
FScN 8777. Thesis Credits: Masters
FScN 8888. Thesis Credits: Doctoral
Nutr 8745. Seminar
Nutr 8777. Thesis Credits: Master’s
Nutr 8888. Thesis Credits: Doctoral
Nutr 8990. Graduate Research

Horticultural Science (Hort)

Hort 1010. Home Horticulture. (4 cr) For non-horticulture majors. Fundamental concepts of plant identification, growth, and culture with practical applications to home landscape, floral design, house plants, and fruit, flower, and vegetable gardening. Lecture and lab.

Hort 1020 Floral Design. (4 cr; UC only) Design for use in commercial flower shops or at home, including principles and elements of design, wedding and funeral arrangements, corsages, and the decorative use of dried materials.

Hort 1021. Woody Landscape Plants. (5 cr) Taxonomy, ecology, and landscape uses of trees, shrubs, and evergreens. Lecture, lab, field trips.

Hort 1022. Herbaceous Landscape Plants. (5 cr) Taxonomy, ecology, and landscape uses of perennial and annual flowers, ferns, weeds, tender and hardy bulbs, grasses, herbs and native plants. Lecture, lab, field trips and garden experience.

Hort 1023. Indoor Plants and Landscapes. (3 cr) Indoor plants and landscapes benefit people in many ways. This course focuses on the selection, identification, care, growth, and use of plants in the home and other human environments. Field trips provide examples of interior landscaping.

Hort 1036. Plant Propagation. (5 cr) Principles and techniques of propagating plants by seeds, cuttings, grafts, buds, layers, division, and plant tissue culture. Lecture and lab.

Hort 3001. Growth Regulation of Horticultural Plants. (5 cr; prereq Biol 1103 or equiv) Scientific basis for horticultural practices that manipulate growth, development, and yield. Comparative approach including lab encourages active learning.

Hort 3002. Horticultural Cropping Systems. (5 cr; prereq 1036, Biol 1103) Identification, manipulation, and management of production systems generic to all horticulture commodities. Greenhouse, field, and container production studied to provide basic optimum conditions for yield maximization with appropriate resources.

Hort 3003. Plant Genetics and Improvement. (4 cr; prereq Biol 1009) Principles of plant genetics, genetic and environmental variation, relationships of genetics to crop evolution and plant breeding, conservation and use of wild crop relatives in breeding. Lab experiments investigate hybridization, variation, and selection in horticultural crops and other plants.

Hort 3004. Applications of Plant Biotechnology. (4 cr; prereq 3003 or GCB 3022, Chem 1002 or Chem 1052 or BioC 1401) Fundamentals of plant molecular biology and biotechnology and their practical applications to plant propagation, crop improvement, and research. Labs on biotechnology skills.
Hort 3010. Growing Plants Organically: What It Means to Be "Green." (3 cr; prereq 1036 or Biol 1103 or PBio 3012 or equiv, jr or sr) Science and ethics of organic cultivation. What is meant by "green" from a legal, scientific, and ethical perspective. Students explore original literature in organic practices, prepare written reports, and lead a class discussion.
Hort 3072. Turf Management. (4 cr; prereq 1036 or Agro 3020, Soil 3125, PBio 1103) General landscape maintenance and turf culture. Work in areas of industrial grounds maintenance, park and recreation area maintenance, and general lawn care.
Hort 3097. Horticulture Practicum. (2-4 cr; prereq upper div hort emphasis or sequence, Δ) Approved field, lab, or greenhouse experiences in application of horticultural information and practices.
Hort 3099. Seminar. (1 cr [may be repeated for max 2 cr]; prereq [r] Horticultural problems, research projects, work experience, and employment opportunities.
Hort 3100. Special Topics in Horticulture. (1-5 cr; prereq varies with topic, #) Topics of public and scientific interest in horticulture. Content varies quarterly. For full details inquire at department office (305 Alderman Hall) before registration. Lab fees may be assessed.
Hort 5000. Professional Experience Program. (4 cr; prereq #: S-N only; free elective for hort undergrads, not for grad; UC only) Professional experience in horticulture firms or government agencies through supervised practical work evaluation of reports and consultations with faculty advisors and employers.
Hort 5001. Harvest to Market of Horticultural Crops. (3 cr; prereq PBio 3131) Physiological processes of horticultural crops after harvest related to maturity, time to harvest, quality, ripening, senescence, handling, storage, and marketing. Interdisciplinary approaches to problem solving and decision management.
Hort 5015. Restoration and Reclamation Ecology. (4 cr; prereq 1 course in plant biology or botany and ecology) Ecological and physiological concepts as a basis for the revegetation of grasslands, wetlands, forests, and other landscapes. Methods for plant materials selection, stand establishment, evaluating revegetation success. Overview of state and federal programs that administer restoration and reclamation programs. Weekend and evening trips to examine reclamation and restoration sites in several areas of Minnesota.
Hort 5020. Topics in Plant Sciences for Teachers. (1-4 cr; prereq 1 plant science or education course; UC only) Explore inquiry-based science instruction for elementary/secondary school educators while developing skills and activities for teaching plant science. Learn to manage classroom/schoolyard plant growth. Intensive workshop format. Not for non-horticulture majors. Eligible for credit in the horticulture graduate program.
Hort 5026. Landscape Management. (4 cr; prereq completion of 75 percent of credits required in landsc, nursery, and turf sequence and business enrichment) This course integrates the environmental horticulture industry disciplines and commodities, including appropriate business management principles. Use scientific methods and technical applications in problem solving and case studies.
Hort 5030. Landscape Design of Residential and Small Commercial Sites. (4 cr; prereq 1021, 1022, LA 1301 or #) Fundamentals of landscape design theory including organization of space, complementary shapes and forms, site analysis, and the relationship of structure, texture, and seasonal interest in the landscape; includes further study of plans and environmental requirements as they influence design.
Hort 5031. Temperate Fruit Production. (4 cr; prereq 3001; PBio 3131 recommended; offered fall qtr of odd yrs) Principles of fruit production emphasizing temperate fruit crops. Integrated management of fruit cropping systems, including site selection, cultural management practices, taxonomic classification, physiological and environmental control of plant development. Integration of writing into understanding various fruit cropping systems.
Hort 5034. Commercial Vegetable Agriculture. (5 cr; prereq 3002, Agro 1010 or Soil 3125) Crop cultural and product handling and use systems in various world regions. History and evolution of species and product development. Seed and stand establishment, propagation, pest management. Applied physiology and genetics of fruit, bulb, tuber initiation; sink development, maturation, and quality. Lecture, lab, field trips.
Hort 5040. Plant Growth Regulation. (4 cr; prereq 15 cr plant sci and 3 cr plant physiology; offered winter qtr of even years) Principles of plant growth and development in relation to optimizing cropping efficiency and product quality. Emphasis on analysis of physiological and morphogenetic basis of horticultural practices to regulate growth and development. Exercises in using these principles to solve horticultural problems.
Hort 5041. Landscape Design and Implementation. (5 cr; prereq 6530) Builds on design techniques from 5030. Architectural and graphic techniques as well as design concepts in relation to horticultural plant performance and maintenance. Grading, site manipulation, and plant installation.
Hort 5042. Turfgrass Science. (5 cr; prereq 3001, 3072, PIPA 3002) For advanced students in turf with career objectives in professional turf management. All phases of the turf industry, with emphasis on the ecology, physiology, and theory of turf population dynamics and on specialized management situations such as golf course, commercial sod production, and fine turf athletic situations.
Hort 5048. Nursery Management II. (4 cr; 5046-5047-5048; prereq 5047) Pest management and government regulations concerning the nursery industry. Container growing operations and marketing of all products. Specific topic research and nursery operation development by the student. Lab includes field trips and greenhouse and field training in nursery operations. Field trips required.
Hort 5054. Commercial Floriculture Production Practices. (4 cr; prereq 1036, 3002, PBio 3131) Principles of commercial bedding plant production systems. Major bedding plant crops and their cultural practices will be emphasized. Lecture, laboratories and field trips will illustrate commercial production techniques and provide opportunities for application of these methods to bedding plant crops.
Hort 5055. Commercial Floriculture Production Systems. (6 cr; prereq 1036, 3002, PBio 3131 or #) Emphasis on problem-solving and management practices in floriculture crop production. Topics include cultural practices, diagnosis of problems, interpretation of soil/leaf analyses, scheduling crop production, and mechanization and computerization of greenhouse operations. Lecture, lab, field trips.
Hort 5091. Directed Studies. (2-6 cr; prereq 8 cr upper div hort course, ∆) Opportunities for in-depth exploration of concepts, technology, materials, or programs in specific area to expand professional competency and self-confidence. Planning, organizing, implementing, and evaluating knowledge obtained from formal education and experience.

Hort 5999. Special Workshop in Horticulture. (1-4 cr; prereq #) Workshops on a variety of topics in horticultural science offered for credit in locations other than the Twin Cities campus. Consult Class Schedule or department for current offerings.

For Graduate Students Only
(For descriptions, see Graduate School Bulletin)
Agro 8200. Plant Breeding Principles and Methods I
Agro 8210. Plant Breeding Principles and Methods II
PBio 8281. Growth and Differentiation of Plants
Hort 8022. Breeding Asexually Propagated Crops
Hort 8023. Evolution of Crop Plants
Hort 8041. Discussions in Administrative Organization
Hort 8042. Horticultural Seminar
Hort 8045.* Plant Hardiness
Hort 8051.* Advanced Problems in Horticultural Crop Breeding
Hort 8052.* Advanced Problems in Physiology of Horticultural Crops
Hort 8060. Discussions in Potato Research
Hort 8062.* Discussions in Plant Hardiness
Hort 8063.* Discussions in Horticultural Plant Breeding
Hort 8065.* Discussions in Postharvest Physiology
Hort 8066. Discussions in Horticultural Research
Hort 8090. Graduate Horticultural Research

Landscape Architecture (LA)

The courses listed below are the landscape architecture courses most frequently required for pre-landscape architecture students. A complete list of landscape architecture courses is published in the College of Architecture and Landscape Architecture Bulletin.

LA 1024. Landscape Theory. (4 cr; UC only) Analysis of design elements and forms involving direction, shape, proportion and color with emphasis on their function in design perception and our relationship to the environment and the social effects of and psychological basis for design.

LA 1301. Introduction to Landscape Architectural Drawing. (4 cr, §Arch 1301; A-F only) Visualization and drawing of form and space in the physical environment. Basic elements of form using design drawing systems and conventions. Development of skills in visual literacy and expression through drawing.

LA 1401. The Designed Environment. (4 cr, §1031, §Arch 1401; A-F only) Principles and traditions in architecture, landscape architecture, and urban design, with references in the arts, sciences, and literature explored in a review of the formal constructs of the designed environment.

LA 3411. History of Architecture to 1750. (4 cr, §Arch 3411; A-F only) History of architecture and city planning from antiquity to 1750, as illustrated by major monuments from Western and non-Western cultures.

LA 3412. History of Architecture Since 1750. (4 cr, §Arch 3412; A-F only) A history of the major monuments, concepts, and theories of urbanism and architecture since 1750.

LA 3413. History of Landscape Architecture. (4 cr; A-F only) History and theoretical issues of landscape architecture in topologically based survey format. Landscape design from the ancient to the modern period.

Natural Resources and Environmental Studies (NRES)

NRES 3001. Colloquium in Natural Resources and Environmental Studies. (1 cr) Roundtable discussions of current topics in NRES.

NRES 3010. Ethics and Values in Resource Management. (3 cr) Formulating a natural resources philosophy based on ethical behavior. Ethical dilemmas inherent in managing natural resources.


NRES 5100. Problem Solving in Natural Resources and Environmental Studies. (5 cr; prereq sr) Solving a real-world natural resources and/or environmental problem. Discussions and assignments reflect diverse aspects of the problem. Oral and written presentations. Students participate as a member of a team.

NRES 5210. Survey, Measurement, and Modeling Methods for Natural Resources I. (4 cr; prereq 1020 or CSci 3101 or CSci 3102 or CSci 3113 or GC 1571, Math 1142 or Math 1251, Stat 3011 or Stat 5021) Introduction to survey design, measurement concepts, and modeling methods useful in studying natural resources and environmental issues. Emphasis on data collection and analysis.

Plant Pathology (PlPa)

PlPa 1001. The Good, Bad, and Ugly Effects of Microorganisms on Plants and Human Society. (2 cr) Positive or negative effects of microorganisms on plants and the ultimate effect on human history and society.

PlPa 1002. Plant Diseases and Your Garden. (2 cr) Characteristics of causes of plant diseases that can affect the growth of flowers, small fruits, and vegetables in Upper Midwestern gardens. Diseases that may appear in your garden, why they can occur and how to avoid them.

PlPa 1003. Diseases of Trees. (2 cr) Tree diseases with emphasis on diseases in the Upper Midwest. Labs emphasize disease diagnosis.
**PIPa 1004. Diseases of Turfgrasses.** (2 cr)

Turf diseases with emphasis on diseases in the Upper Midwest. Labs emphasize diagnostic disease.

**PIPa 3001. Management and Control of Field Crop Diseases.** (4 cr; prereq Biol 1009 or #)

Crop pathology in selected cropping rotations and procedures used to identify plant diseases and appropriate control measures. Field level problem solving using integrated pest management.

**PIPa 3002. Management of Horticultural Crop Diseases.** (4 cr; prereq Biol 1009 or equiv)

Characteristics of pathogens and incitants that cause horticultural crop diseases. Biological principles that affect disease incidence, and severity.

**PIPa 3004. Air Pollution, People and Plants.** (3 cr; prereq Biol 1009 or equiv or #, Chem 1052)

History of air pollution, its sources and types; global climate change; air pollution effects on human health, crops and forests; air pollution control and international perspective.

**PIPa 3090. Research in Plant Pathology.** (Cr ar; prereq 1001 or equiv or #)

Assignment of special problems to undergraduates desiring opportunity for independent research in plant pathology.

**PIPa 5000. Professional Experience Program.** (4 cr; prereq 15 cr plant path; not for grad cr; UC only)

Open to advanced students in integrated pest management. Up to 12 weeks of experience in a selected agricultural industry; evaluative reports and consultations with faculty advisers and employers.

**PIPa 5090. Issues in Plant Pathology.** (Cr ar; prereq grad status or #)

Consult Class Schedule or department for current offerings.

**PIPa 5102. Ecology of Fungi.** (3 cr; prereq 6 cr botany or #; limited to 20 students; offered at Lake Itasca alt yrs)

Ecological studies and identification of fungi. Fungal symbioses, morphology, coevolution, and application of ecological theory. Student teams determine species richness in aquatic, grassland, and forest habitats.

**PIPa 5109. Molecular Genetics and Biochemistry of Yeasts and Filamentous Fungi.** (4 cr; prereq one course each in gen and biochem or #; offered alt yrs)

Chromosome structure and function, regulation of nuclear gene expression, mitochondrial gene organization and expression, membrane and organelle biogenesis, cell cycle regulation, morphogenesis, mating and reproduction, recombination and gene switching, spore formation and germination, viruses, plasmids and toxins.

**PIPa 5201. Biology of Plant Diseases.** (5 cr; prereq Biol 3012 or equiv)

Principles and concepts of plant disease caused by selected bacteria, fungi, viruses and nematodes. Pathogen biology, factors that cause disease and interaction of pathogens with plants. Epidemiology and control measures for appropriate plant diseases.

**PIPa 5203. Physiology and Molecular Plant-Microbe Interactions.** (3 cr; prereq intro course in biochemistry or plant physiology or #)

A course for upper division undergraduates or graduate students covering the genetics, physiology, and molecular biology of plant-microbe interactions. Major topics include: communication between plants and microbes, signal transduction, control of gene expression, symbiosis and parasitism, plant host response mechanisms and plant disease physiology.

**PIPa 5204. Field Plant Pathology.** (2 cr; prereq 3001 or 3002 or 5201, 5202)

Characteristics and management of plant diseases in the field, forest, golf course, greenhouse, and urban environment.

**PIPa 5205. Plant Disease Diagnosis.** (2 cr; prereq intro plant pathology course or #)

Principles and methodology of diagnosing plant diseases. Biotic and abiotic disease agents, disease diagnosis at both field and lab level, and current detection methods utilizing immunological and electrophoretic techniques.

**PIPa 5206. Biology of Fungi.** (4 cr; prereq Biol 1009 or #)

Major groups of fungi, their roles in ecosystems and human society, environmental and nutritional needs, and their modes of dissemination and survival. Representative species of fungi will be observed and manipulated.

**PIPa 5209. Biochemistry of Plant Disease.** (3 cr; prereq organic chemistry, biochemistry or equiv)

Biochemistry of metabolic reactions in diseased plants; phytoalexins, phytotoxins, induced resistance mechanisms, carbon metabolism, metabolic sinks.

**PIPa 5211. Fungal Genetics.** (4 cr; prereq intro genetics; offered alt yrs)

Attributes of the genetics of fungi using classical approaches, including Mendelian and quantitative traits, ecological and population genetics, incompatibility systems, tetrad analysis, heterokaryosis, somatic recombination, plasmids, genetics of parasitism, and molecular genetics techniques.

**PIPa 5212. Diseases of Forest and Shade Trees.** (4 cr)

Tree diseases and ecological relationships among trees, microbes and the environment.

**PIPa 5213. Plant Nematology.** (4 cr; prereq 3002 or 5200, 5201 or 3001)

Modified case study approach to evaluation of significance of plant parasitic nematodes in upper midwest field, garden, turfgrass, and greenhouse situations.

**PIPa 5214. Plant Virology.** (4 cr; prereq PBio 3012 or equiv)


**PIPa 5215. Insects in Relation to Plant Diseases.** (3 cr; prereq one ent course, one plant path course or #; offered alt yrs)

Insect transmission and dissemination of plant pathogens; development of plant-insect relationships; habits of principal insect vectors.

**PIPa 5500. Epidemiology and Ecology of Plant Disease.** (3 cr; prereq 5002 or 5050 or #)

Concepts and methodology in the quantitative study of plant disease epidemics emphasizing the ecology of interacting host and microbial populations. Includes discussion of disease forecasting, disease in natural (non-agricultural) systems, and biological and chemical approaches to disease control.

**PIPa 5999. Special Workshop in Plant Pathology.** (1-4 cr)

Workshops on a variety of topics in plant pathology offered for credit at locations other than the Twin Cities campus. Consult Class Schedule or department for current offerings.

**For Graduate Students Only**

(For descriptions, see Graduate School Bulletin)

**PIPa 8000. Supervised Teaching Experience**

**PIPa 8090. Advanced Procedures and Research in Plant Pathology**

**PIPa 8200. Current Topics in Plant Pathology**

**PIPa 8201. Seminar**

**PIPa 8500. Research in Plant Pathology**
Rh 1000. Introduction to Scientific and Technical Communication. (1 cr)
Discussion, lectures, and guest speakers provide introduction to topics within STC and address application of STC to other areas such as health science, computer science, agriculture, and engineering.

Rh 1101. Writing to Inform and Persuade. (4 cr, §Comp 1011; A-F only)
Relationship of thesis construction and clear thinking to informative and persuasive writing. Importance of thesis sentences, evidence, coherence, clarity, and correctness. Emphasis on the writing process in producing several short papers (250-750 words).

Rh 1104. Library Research Methods. (1 cr; S-N only)
On-site and interactive video instruction in information retrieval techniques to strengthen skills in using the library. Students work independently to satisfactorily complete all exercises and problem-solving assignments. Students must attend an orientation session. Computer-assisted instruction.

Rh 1151. Writing in Your Major. (4 cr; prereq Rh 1104, fr comm req, soph status; A-F only)
Students investigate and write about subjects related to their majors. Emphasis on gathering, evaluating, synthesizing, and summarizing information; adapting it for various audiences. Assignments include literature review, abstract, fact sheet, instructions, and feature article.

Rh 1200. Information Technology in Scientific and Technical Professions. (3 cr; prereq COAFTES undergrad; A-F only)
How to use computers to communicate, gather, analyze, manage, and store information in scientific and technical professions. Main functions of and integration of data from word processing, telecommunications, database, and spreadsheet applications.

Rh 1220. Principles of Human Communication. (4 cr)
Elements and contexts of human communication. Readings, discussions, lectures, and experiential assignments; focus on communication that affects interpersonal gatherings and entertains, persuades, and instructs public audiences.

Rh 1222. Public Speaking. (4 cr; prereq fr comm req; A-F only)
Practical course in fundamentals of effective speechmaking. Emphasis on researching and organizing a speech and communicating with an audience.

Rh 1301. Humanities: Modern Thought and the Enlightenment. (4 cr)
Tracing the impact of the scientific revolution on human thought. Emphasis on scientific and religious movements and countermovements as they influence modern thinking.

Rh 1302. Humanities: Modern Thought and the Industrial Revolution. (4 cr)
The industrial transformation of Europe; rise of laissez-faire capitalism, socialism, Marxism; modern “individualism” and traditional views of community; utilitarianism and deontological approaches to ethics.

Investigation of Darwin’s theory of evolution and its effect on 19th- and 20th-century institutions. Emphasis on attempts of social philosophers to extrapolate from biological theory to political, cultural, and religious life; scientific and religious ways of knowing; rise of existentialism.

Rh 1310. Humanities: The Land in American Experience. (4 cr)
American attitudes toward the land from colonial times to the present as expressed in social history, literature, and the fine arts. Social thought and the relationship between farm and city, wilderness and countryside. The changing appearance of America.

Rh 1311. Humanities: The Family in American Experience. (4 cr)
American attitudes toward family life from colonial times to the present as expressed in literature, the fine arts, and social history. Impact of Protestantism, democracy, capitalism, and reform movements, including women’s rights, on the family ideal.

Rh 1376. Special Topics in Humanities. (4 cr)
Topics vary quarterly and are listed in Class Schedule. For full details, inquire at the department office before registration.

Rh 1380. Fictional History: Twentieth Century Through the Eyes of Novelist. (3 cr)
Reading of 20th-century documentary novels; the nature of artistic/historical truth; rhetoric of novels; cross cultural comparisons. Typical reading: novels about colonialism in Africa; partition of India; the Holocaust; Palestinian-Israel conflict.

Rh 1441. College Reading and Learning Skills. (4 cr)
Lecture and individual and small group practice in developing speed, comprehension, retention and flexibility in reading college assignments; clarity and precision in written expression; accurate and effective listening; control of communication related anxiety, including test-taking; vocabulary power.

Rh 3101. Functional Photography. (4 cr; prereq 3562 or DHA 1300)
Practical course in basic photographic communication. Techniques of producing 35mm color transparencies for use in group presentations, teaching, publications, and audiovisual productions.

Rh 3105. Corporate Video for Technical Communicators. (4 cr; prereq 3562 or equiv)
Video production including video team roles, production technology, and the development process. Students will apply rhetorical principles in analyzing video, develop a treatment, and write a script.

Rh 3254. Advanced Public Speaking. (4 cr; prereq 1222)
Training for specific speech situations most likely to be encountered professionally. Emphasis on analysis, design, preparation, and delivery of presentations to provide greater flexibility within a variety of speech environments.

Rh 3257. Scientific and Technical Presentations. (4 cr; prereq 1222, 3562 or #)
Presentations for specific situations related to technical or scientific topics. Audience analysis, adaptation, techniques of support and visualization, organization for clarity and accuracy, and techniques of interpreting and answering questions. Students make and evaluate technical and scientific presentations. Emphasis on seminar reports and professional conference papers.

Rh 3266. Communication, Discussion in Small Group Decision Making. (4 cr; prereq 1222 or #)
Role of communication techniques in the small group decision making process. Emphasis on problem-solving discussion requiring some kind of formal outcome.

Rh 3270. Speech: Special Problems. (1-5 cr; prereq #, Δ)
Supervised reading and research on advanced speech-communication topics not covered in regularly scheduled speech offerings. Because of the advanced and independent nature of this course, the primary burden of development usually rests with the student.

Rh 3276. Special Topics in Rhetoric and Communication. (1-6 cr; prereq #, Δ)
Supervised reading and research on advanced rhetoric, communication, speech topics not covered in regularly scheduled offerings.

Rh 3370. American Humanities. (4 cr)
Examination of the American character and changes it has undergone in the 19th and 20th centuries as exemplified by social, artistic, literary, and architectural records.
Rhet 3374. Humanities: Special Problems. (1-2 cr; prereq #, Δ) Primarily for supervised reading and research on topics not covered in regularly scheduled humanities offerings.

Rhet 3375. Humanities: Agricultural Heritage. (4 cr) Examination and analysis of significant events or periods affecting rural agricultural peoples as expressed in historical, cultural, and literary documents. Understanding of major values, attitudes, and philosophies related to agricultural change and development.

Rhet 3380. Humanities: The Literature of Social Reflection. (2 cr) Brief examination of contemporary social issues as reflected in cultural documents. Use of imaginative literature as a forum where social questions are discussed, evaluated, and resolved.


Rhet 3382. Humanities: Ethics of Total War. (3 cr) World War II included combatants and noncombatants in the ethical dilemmas of total war: the holocaust, unrestricted submarine warfare, indiscriminant bombing, the atomic bomb. These dilemmas are experienced through works of art: films, novels, music, painting.

Rhet 3390. Humanities: Technology, Self, and Society. (4 cr; prereq jr, STC major or preSTC or Δ) Major shifts in technology from 19th century to the present in the United States, especially in relation to capitalism. Technology and the concepts of nature, work, political and social organization, and self. Interdisciplinary materials used.

Rhet 3395. In Search of Nature. (4 cr) The human need for a relationship with nature, images of nature developed from this need, and the ways humans organize their surroundings to reflect this need. Contemporary American response.

Rhet 3400. Managing Information on the Internet. (3 cr; prereq 1200 or equiv; A-F only) Explore and construct information on the Internet. Discuss issues and controversies associated with the Internet. Prepare an on-line hypertext document that provides examples of Internet resources for students in their major.

Rhet 3441. Reading and Analyzing Scientific and Technical Text. (4 cr, §1441; prereq 1104 or equiv) Efficiently and effectively identify, read, analyze, and comprehend scientific and technical text.

Rhet 3562. Writing in Your Profession. (4 cr; prereq fr comm req, 1151, jr or sr status; A-F only) Projects in writing professional reports. Analyses of audience and situaton; writing effectively to meet the needs of particular readers. Assignments include writing instructions, feasibility report, proposal, memorandum, letter of application, and résumé.

Rhet 3565. Writing for Publication. (4 cr; prereq 3562, #) Writing and preparing manuscripts for publication: adaptation to specialized and general reader; professional, trade, and general publications; information sources and topic selection; marketing techniques.

Rhet 3572. Procedures and Policies Manual. (3 cr; prereq STC major or preSTC, fr comm req, 3562 or #) Problem analysis, process management, gathering information, writing procedures, verification, constructing the finished manual.

Rhet 3574. Publications Management. (3 cr; prereq 3562; A-F only) Management of publications from initial receipt of manuscript to first publication. Scheduling, layout and design, liaison with printers or authors, typography, processing illustration.

Rhet 3575. Newsletter. (3 cr; prereq STC major or preSTC, fr comm req, 3562 or #) Newsletter design and production. Students learn to write and edit newsletter articles and gain hands-on experience in typography, graphic design, formatting, layout, and distribution procedures. Production of a newsletter using desktop publishing software on Macintosh computer.

Rhet 3582. Senior Seminar. (3 cr; prereq sr) Discussions of professional and ethical issues and problems related to technical communication. A capstone course, integrating oral, written, visual, organizational, and theoretical competencies.

Rhet 3670. Visual Rhetoric: Theories and Applications. (4 cr; prereq 1200 or equiv, 3562 or equiv, STC or preSTC major or Δ) Theoretical and practical aspects of visual rhetoric in scientific and technical communication. Develops visual literacy by introducing terms, rhetorical considerations, design principles, tools and applications, and ethical and social responsibilities. Lecture and lab.

Rhet 3690. Scientific Controversy. (3 cr; prereq 1101 or equiv) Personal, social, and political challenges created by science and technology. Controversies include animal experimentation, organ transplants, frozen embryos, ozone depletion, pollution, and nuclear waste. Public discourse on these issues examined from a rhetorical point of view.

Rhet 3700. Rhetorical Theory: Persuasion and the Literature of Science. (3 cr; prereq fr comm req) Principles and history of rhetorical theory and criticism. Emphasis on classical theories, especially those of Plato and Aristotle. Practice of rhetorical criticism of contemporary communication, including scientific communication.

Rhet 5100. Technical Communication: Special Problems. (1 cr; prereq #, Δ) Supervised reading, research, and work on advanced technical communication projects not covered in regularly scheduled courses.

Rhet 5105. Corporate Video for Technical Communicators. (4 cr, §3105) Video production including video team roles, production technology, and the development process. Students apply rhetorical principles in analyzing video, develop a treatment, write a script, and prepare an annotated bibliography on a video-related topic.


Rhet 5170. Managerial Communications. (4 cr; prereq fr comm req or equiv or grad status) Analysis of a manager’s position in an organizational communication network. Focus on the possible forms, contexts, and functions of a manager’s communication. Assessing and developing personal competence and confidence in managerial communication. Lectures, discussions, readings, experimental exercises, field research.

Rhet 5180. Internship in Scientific and Technical Communication. (2-6 cr; prereq STC major or grad, #, Δ; S-N only) On-the-job experience at the University or in industry or government.

Rhet 5258. Interviewing: Dynamics of Face-to-Face Communication. (4 cr) Intrapersonal and interpersonal skills in interviewing situations. Students learn to understand and use appraisal, reprimand, complaint, persuasion, problem solving, and counseling interview techniques, and participate in a research interview project. Equal emphasis on the interviewer and interviewee roles.
Rhett 5400. Communication Program Planning and Evaluation. (4 cr; prereq jr, sr or grad status and/or comm work exper)
Methods and process for planning and evaluating communication and information activities in organizations. Study of examples, materials and resources for planning, budgeting, and assessing organizational communication programs.

Rhett 5500. Research in Communication Strategies. (4 cr)
Fundamental terminology of descriptive and experimental research, communication research, questionnaire techniques, interviewing techniques, survey and experimental designs, the steps in organizing and conducting field and empirical research, and basic statistical and computer techniques. Emphasis on application of various research methods to particular communication strategies or settings.

Rhett 5531. Scientific and Technical Communication Course Development: Philosophy and Methodology. (4 cr; prereq 3562, STC sr or RSTC grad or #)
Reading, observation, and discussion of teaching theories and methodologies as they relate to composition and to scientific and technical communication. Emphasis on learning to teach first-year college students written or oral persuasive strategies. Students practice assignment and course development, justification and evaluation.

Rhett 5532. Scientific and Technical Communication Course Development: Mentored Teaching. (2 cr; prereq 5531, STC or RSTC grad or #)
With a faculty mentor, students teach course units, prepare and evaluate course assignments, and conduct conferences with student writers or speakers. Through observation and practice, students help oversee the educational process within an actual course.

Rhett 5533. Scientific and Technical Communication Course Development: Teaching Seminar. (1 cr; prereq 5532, STC or RSTC grad or #)
Usually concurrently with their first teaching assignments, students share observations and solve teaching problems within the seminar setting.

Rhett 5540. Topics in Scientific and Technical Communication. (2 cr; prereq #)
Topics announced in Class Schedule.

Rhett 5560. Editing for Technical Communication. (4 cr; prereq STC premajor or major or grad; A-F only)
Editorial process; editor-writer relationship; copyediting; preparing scientific and technical documents; handling format, visuals, and quantitative materials.

Rhett 5562. Theory and Practice in International and Intercultural Communication. (4 cr; prereq 3562 or #)
Differences between international, intercultural, and development communication. Cultural contexts examined by comparing research and theoretical models in three types of communication and, on the personal level, through interviews; classes study demonstrate impact of cultural contexts on business globalization.

Rhett 5573. Grant Proposal. (3 cr; prereq STC major or preSTC, fr comm req, 3562 or grad status or #)
Writing the grant proposal, including establishing credibility, problem statement, program objectives, plan of action, evaluation, budget presentations, and proposal summary. Both real and hypothetical situations.

Rhett 5581. Document Design. (4 cr; prereq 3562, STC sr or grad; A-F only)
Designing document to meet user’s need, completing draft, and evaluating effectiveness. Forms and software documentation (user guides, reference manuals, tutorials, and input sheets) for databases, decision aids, computer-aided instruction, on-line programs, or visual displays. Mandatory lab time as part of project team of programmers, subject matter specialists, and communication specialists.

Rhett 5600. Transfer of Technology. (4 cr; prereq sci comm work exper or #)
Methods of transferring scientific and technical knowledge and practice. Review of research in diffusion and transfer methods at different technical levels. Tools, methodologies, and assessment procedures for managing a program. Assessment and design plan.

Rhett 5680. Gender and the Rhetoric of Science and Technology. (4 cr; prereq 1101 or equiv)
How cultural gender roles and biological sex attributes influence communication within scientific and technical communities. Communication strategies of professional writers, scientists, and technologists.

Rhett 5700. Rhetorical Theory and Scientific and Technical Communication. (4 cr; prereq grad or #; A-F only)
Principles and history of rhetorical theory and criticism. Classical theories, especially those of Plato and Aristotle. Practice of rhetorical criticism of contemporary communication, including scientific communication. Study of contemporary scholarship in the rhetoric of science and technical communication.

Rhett 5999. Special Workshop in Rhetoric. (1-4 cr; prereq #)
Workshops on a variety of topics in rhetoric offered for credit at locations other than the Twin Cities campus. Consult Class Schedule or department for current offerings.

For Graduate Students Only
(For descriptions, see Rhetoric in the Graduate School Bulletin)

Rhett 8100. Research Methods in Rhetoric and Scientific and Technical Communication

Rhett 8101. Rhetoric and Technical Communication Writing Seminar

Rhett 8110. Theory and Research in Audience Analysis

Rhett 8170-8171. Design Project

Rhett 8210. Theory and Research in Media Selection

Rhett 8258. Informational Research Interviewing in Scientific and Technical Communication

Rhett 8500. Qualitative Research: Strategies in Technical Communication

Rhett 8510. Theory and Practice in Designing Messages

Rhett 8515. Topics in the Rhetoric of Science and Technology

Rhett 8525. Topics in Culture and Communication

Rhett 8535. Topics in Scientific and Technical Communication Pedagogy

Rhett 8666. Doctoral Pre-Thesis Credits

Rhett 8777. Thesis Credits: Master’s

Rhett 8888. Thesis Credits: Doctoral

Rhett 8990. Special Problems in Rhetoric and Scientific and Technical Communication

Science in Agriculture (ScAg)

ScAg 1001f. Orientation to Science in Agriculture. (1 cr; S-N only)
Introduction to the Science in Agriculture major.
Discussion of program and career planning and professional development. Interviews with faculty and other resource persons. Current issues concerning science in agriculture.
Soil, Water, and Climate (Soil)

Soil 1020, The Soil Resource. (5 cr, §3125)
Physical, chemical, and biological aspects of soils. Use of the soil classification system to understand the use of soil survey information for land-use planning. Concepts of soil fertility for understanding plant growth requirements. Introduction to urban soils and their management. Understanding soil’s role in environmental planning and conservation decisions.

Soil 1425, Introduction to Meteorology. (4 cr, §Geog 1425)
Pre-calculus introduction to nature of atmosphere and its behavior. Atmospheric composition, structure, stability, and motion; precipitation processes, air masses, fronts, cyclones and anticyclones; general weather patterns; meteorological instruments and observations; plotting and analysis of maps; forecasting.

Soil 3125, Basic Soil Science. (5 cr, §1020; prereq Chem 1041)
Basic physical, chemical, and biological properties of soil. Soil genesis, classification, and principles of soil fertility. Lecture, lab, recitation.

Soil 3220, Soil Conservation and Land-Use Management. (4 cr; prereq 1020 or 3125 or #)
Soil erosion and land degradation processes on rural and urban landscapes. Technical, historical, economic, social, and international considerations of soil conservation. Land-use management practices for soil conservation and methods of natural resource assessment. Lecture, field trips, computer lab.

Soil 3416, Plant Nutrients in the Environment. (4 cr; prereq 3125)
Basic concepts related to plant nutrient availability in soils. Emphasis on the dynamic reactions of mineral elements in soil and water, and subsequent evaluation for plant growth and the environment. Lecture and recitation.

Soil 3417, Plant Nutrients in the Environment Laboratory. (1 cr, §Soil 3416)
Diagnostic techniques by measuring specific soil fertility parameters. Lab and recitation.

Soil 3421, Climatology. (4 cr, §Geog 3421; prereq 1425 or Geog 1425)
Radiation and energy budgets; the hydrologic cycle; general circulation; climatic classifications and world distribution of climatic types; climatic change and fluctuations.

Soil 3521, Collegiate Soil Judging. (1 cr; may enroll for max 3 cr; prereq 5510)
Methods of collegiate soil judging. Participation on soil judging team during regional or national contests required.

Soil 3612, Soil Biology and Fertility: Reaching for Sustainable Agricultural Production. (4 cr, Chem 1001 recommended)
developments in soil biology and fertility, role and significance of different groups of organisms in the soil, and how the interaction of humans and microbes affects the soil fertility and plant growth. It assumes minimum knowledge of chemistry and biology, and explains broad change rather than specific chemical reactions.

Soil 5000, Professional Experience Program. (4 cr; prereq 12 cr soil, #, not for grad cr; UC only)
Up to 12 weeks of experience in a position related to soil science. Evaluation of work experience by employer and faculty adviser in consultation with student and employer.

Soil 5020, Environmental Impact Assessment. (4 cr; prereq jr or sr, 5510, 16 cr sci, ApEc 3610, or #)
Understanding the environmental impact assessment process. Roles of governmental agencies, consultants, and private citizens. Steps needed to write an environmental impact statement (EIS). Examining case studies, writing additional components of EIS, and preparing an EIS for a small local project.

Soil 5022, Introductory Soil Science for Teachers. (4 cr, §1020; prereq 1 college chemistry course, ed degree, #; limited to 10)
Physical, chemical, and microbiological properties of soil. Soil classification system used to understand soil survey information for land use planning. Soil fertility as it relates to environmental planning and conservation decisions. Qualified students may register for graduate credit at the University of Minnesota. Meets concurrently with 1020.

Soil 5100, Problem Solving in Environmental Science. (5 cr; prereq jr)
Solving a real world problem. Discussion, assignments, and problems reflect diverse aspects of the environmental problem. Oral and written presentations. Students participate as a member of a team.

Soil 5104, Computer Applications in Soil Science. (2 cr; prereq 1020/3125 or equiv, #)

Soil 5110, Practicum Internship in Precision Agriculture. (2-4 cr; prereq sr or grad, #)
Precision agriculture internship in agri-industry or a governmental agency.

Soil 5114, Special Problems in Soils. (1-7 cr per qtr; prereq 3125 or #, A)
Research, readings, and instruction.

Soil 5183, Water Relations, Mineral Nutrition, and Translocation in Higher Plants. (4 cr; prereq Pbio 3131 or equiv)
Transport processes in plants, including water and nutrient absorption and distribution, effects of and adaptations to water and nutrient stress, functions of mineral nutrients, translocation of photosynthesis.

Soil 5210, Environmental Biophysics. (3 cr; prereq Math 1251, Phys 1041 or #)
Physical microenvironment and energy/mass exchange processes among soils, plants, animals, and atmosphere. Energy transfer (sensible, latent, radiation, mass [H20, CO2, trace gases]) calculation using mathematical models and energy budget analyses. Lecture and recitation.

Soil 5211, Environmental Instrumentation. (2 cr; prereq 5210, 5240 or #)
Measuring environmental variables and analyzing energy and mass exchange based on such measurements. Operating environmental instruments and finding sources of error in measurements. Hands-on use of instruments is emphasized. Lecture, recitation, and instrumentation lab.

Soil 5232, Soil Physics: Transport Processes in Soil. (4 cr; prereq Math 1142, 2 qtrs physics or #)
Soil 5241. Microclimatology. (3 cr; prereq Math 1031 or 10 cr physics or #) Meteoroerology and climatology in relation to the soil-atmosphere interface with emphasis on the microclimate, physical processes taking place within the microclimate, modification of the microclimate description of meteorological instruments, and use of weather data.

Soil 5310. Soil Chemistry. (3 cr; prereq Chem 3100 or #) Chemical processes in soil; composition of soil minerals and organic matter, solubility equilibria, adsorption/desorption, ion exchange, formation of soluble complexes, oxidation/reduction, acidity, alkalinity. Discuss solution of problems related to environmental degradation, plant nutrition, and soil genesis.

Soil 5311. Soil Chemistry Lab. (2 cr; §5310) Lab exercises illustrate principles of soil chemistry discussed in Soil 5310. Lab techniques used include pH, atomic adsorption spectrophotometry, ion specific electrodes, colorimetry, redox potential, and titration.

Soil 5360. Soil Clay Mineralogy. (3 cr; prereq sr or grad) Structural chemistry, origin, and identification of crystalline and noncrystalline soil clay materials. Extent, importance, and pedologic implications.

Soil 5361. Soil Clay Mineralogy Laboratory. (1-4 cr; prereq §5360, #) Individual lab assignments emphasizing techniques of clay mineral identification and analysis. X-ray diffraction, electron optical, thermal, selective dissolution, FTIR spectorscopic, and other methods of analysis.

Soil 5424. Applied Climatology. (3 cr; prereq 5240 or Geog 3421 or #) For advanced undergraduates and beginning graduate students who have a background in climatology or microclimatology principles. Sources of climatic data, methods of analysis, and selected set of specific applications focusing on agricultural and environmental management problems.

Soil 5510. Field Study of Soils: Morphology. (1 cr; prereq 1020 or 3125 or #) The art and science of writing and classifying soil profile descriptions in the field.

Soil 5511. Field Study of Soils: Mapping (1 cr; prereq 5510 or §5510) The art and science of making soil maps based on soil profile descriptions.

Soil 5515. Soil Development, Classification, and Geography. (4 cr; prereq 3125 or #) Soil profile characteristics; influence of parent material, climate, topography, vegetation, and time on soil development; system of soil classification and geographical distribution of soil orders.

Soil 5550. Peatlands: Formation, Classification, and Utilization. (3 cr; prereq 1020 or 3125 or #) Formation, properties, and management of peatlands important to crop, forestry, and energy production in this state and worldwide. Lecture.

Soil 5555. Wetland Soils. (4 cr; prereq 1020 or 3125 or #) Lecture and field-based instruction on the formation, classification and utilization of wetland soils with emphasis on hydric soil identification. Emphasis on soil hydrologic and biochemical processes. Field-based exercises to map hydric soils plus two Saturday field trips and laboratory exercises.


Soil 5605. Microbial Ecology. (3 cr; prereq 5610 or Biol 5013 or MicB 5105 or #) Interrelationship of microorganisms with terrestrial, aquatic, and organimnal environments; survey of bacterial, fungal, and algal components of ecosystems; evolution and structure of microbial communities; population interactions within ecosystems; quantitative and habitat ecology; biogeochemical cycling; biotechnological approaches to studying microbial ecology.

Soil 5610. Soil Biology. (4 cr; prereq sr or grad) Soil environment and its biological population. Role of living organisms in soil-plant environment and mineral transformations of agronomic importance (carbon, nitrogen, phosphorus, sulfur, and heavy metals). Effects of soil microflora on soil fertility and plant nutrition. Lecture, lab, weekly discussion.

Soil 5611. Soil Biology Laboratory. (1 cr; §5610) Lab exercises demonstrating principles discussed in Soil 5610. Techniques include counting microbes in the soil, purification and classification of soil microorganisms, the role of earthworms in nutrient cycling, nodulation and N₂ fixation, serology.

Soil 5710. Forest Soils. (3 cr; prereq 1020 or 3125) Factors affecting tree growth; estimation, modification, and management effects on site productivity; regeneration.

Soil 5999. Special Workshop in Soil, Water, and Climate. (1-4 cr; prereq #) Workshops on a variety of topics in soil, water, and climate offered for credit at locations other than the Twin Cities campus. Consult Class Schedule for current offerings.

For Graduate Students Only
(For descriptions, see Graduate School Bulletin)

Soil 8000. Supervised Teaching Experience
Soil 8111. Colloquia: Tropical Soils
Soil 8112. Colloquia in Soil Science II
Soil 8124. Research Problems in Soils
Soil 8128. Seminar
Soil 8250. Advanced Soil Physics
Soil 8330. Advanced Soil Chemistry
Soil 8400. Advanced Topics in Soil Fertility
Soil 8630. Current Topics in Biological Nitrogen Fixation

Statistics (Stat)
Offered by the College of Liberal Arts

Stat 1001. Introduction to Ideas of Statistics. (4 cr; prereq high school higher algebra) Controlled vs. observational studies; presentation and description of data; correlation and causality; sampling; accuracy of estimates; tests.

Stat 3011-3012. Statistical Analysis. (4 cr per qtr; prereq college algebra) Descriptive statistics; elementary probability; estimation; one- and two-sample tests; correlation; regression. ANOVA; randomized blocks; multiple comparisons; factorial experiments; multiple regression; goodness of fit; nonparametric methods; contingency tables; selected topics.

Stat 5021. Statistical Analysis. (5 cr, §3012; prereq college algebra or #) Intensive version of Stat 3011-3012. Primarily for graduate students needing statistics as a research technique.
Veterinary Medicine, College of (CVM)

Offered by the College of Veterinary Medicine

CVM 1100. Introduction to Veterinary Medicine. (1 cr)
History of the veterinary profession, careers within the profession, employment trends. Resources available to those interested in a career in the profession, including the College of Veterinary Medicine and animal health technology courses offered in Minnesota.

CVM 3100. Perspectives: Interrelationships of People and Animals in Society Today. (2 cr,
§PubH 3301, §PubH 5301)
Interrelationships of people and animals from several viewpoints. The social, economic, and health consequences of these relationships, including issues such as pets and people sharing an urban environment, animal rights, and the influence of cultural differences on animal-human relationships.

Veterinary PathoBiology (VPB)

Offered by the College of Veterinary Medicine

VPB 3103. General Microbiology. (3-5 cr; prereq 4 cr biol sci, 10 cr chem; not open to vet med students)
Lectures and lab exercises on the morphology, taxonomy, genetics, physiology, and ecology of microorganisms. Practical application of fundamental principles of microbiology to other phases of science and industry.

VB 5140. Vertebrate Microanatomy. (1-6 cr; prereq 5120 or #)
Microscopic structure and cytochemical and functional aspects of cells, tissues, and organs of representative examples of vertebrates. Four units: basic tissues (2 cr); gastrointestinal tract (1 cr); respiratory and integumentary systems (1 cr); and excretory, reproductive, and endocrine systems (2 cr). Depending on background and interest, students may register for any or all units.

VPB 5320. Avian Physiology. (5 cr; prereq AnSc 3301 or 6 cr systemic phys or equiv, #; offered even yrs)
Physiology of wild and domestic birds.

VPB 5603. Parasites of Wildlife. (2 cr; prereq 5601, 5602 or #; offered odd yrs)
In-depth examination of the epidemiology and disease potential of some of the more significant helminth, arthropod, and protozoan parasites of regional wildlife mammals and birds. Term paper required.

VPB 5707. Poultry Disease Control. (3 cr; prereq AnSc 1100, Biol 1106, VPB 3103 or equiv; not open to vet med students)
General anatomy; physiology of digestion and reproduction; prevention and control of the more important diseases affecting poultry.