

**804. Outdoor Environmental Education**  
Fall. 4(3-2) Juniors or approval of department.

Using the outdoors as a teaching laboratory for ecological studies of plant and animal communities. Designed primarily for secondary teachers.

**801. Seminar in Fisheries and Wildlife**  
Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 7 credits. Approval of department.

Graduate problems and current developments of importance.

**802. Advanced Topics**  
Fall, Winter, Spring Summer. 1 to 6 credits. May reenroll for a maximum of 15 credits. Approval of department.

Study of selected advanced topics in detail and depth.

**810. Human Dimensions of Fish and Wildlife Management**

Fall of even-numbered years. 3(3-0) Approval of department.

Methods of surveying, educating, and involving the public to achieve fish and wildlife management goals. Human dimensions research. Case studies of current management issues.

**826. Waterfowl Ecology and Management**

Winter of even-numbered years. 4(3-3) F W 412, F W 424 or approval of department.

Application of physiological, behavioral, and population characteristics of waterfowl to current issues and management.

**828. Conservation and Genetics**

Winter of odd-numbered years. 3(3-0) ZOL 441 or CSS 350 or ANS 314 or approval of department.

Application of population genetic principles to ecology and management of fish and wildlife.

**830. Environmental Requirements of Fish**

Winter of odd-numbered years. 3(3-0) Approval of department.

Adaptations and responses of fish to environmental changes; research methods for evaluating environmental limitations and effects of pollutants on fish growth, reproduction and survival. Applications for developing water quality criteria.

**831. Aquatic Toxicology**

Spring of odd-numbered years. 3(3-0) F W 830 or approval of department.

Acute and chronic toxicity of compounds and elements on aquatic organisms. Monitoring and predicting structural and functional changes: biochemical, histological, physiological, organismal, behavioral, populational, community, ecosystem.

**860. Wildlife Nutrition**

Winter of odd-numbered years. 4(3-2) Approval of department.

Application of nutritional concepts to wildlife management. Design of nutritional investigations including methods of sampling and analysis. Improvement of the nutritional status of wildlife habitat.

**871. Ecology of Fishes**

Summer of even-numbered years. 3 credits. Approval of department. Given at the W. K. Kellogg Biological Station. Interdepartmental with and administered by the Department of Zoology.

Exploration of ecological problems with particular emphasis on growth, food and habitat selection, population biology and niche relations. Field and experimental investigations of fish communities.

**872. Fish Communities and Aquatic Ecosystems**

Winter of even-numbered years. 3(3-0) Approval of department.

Processes by which fish influence the structure and function of aquatic ecosystems.

**874. Advanced Biological Limnology**

Fall of odd-numbered years. 3(4-0) F W 477, or approval of department.

Historical and current contributions to concepts of community structure, energy flow and materials cycling in aquatic eco-systems.

**875. Chemical Limnology**

Winter. 4(3-3) F W 476, F W 477 or approval of department.

Application of analytical chemistry concepts and technologies to fundamental chemical mechanisms in natural and polluted water systems. Special consideration given to selected heterogeneous equilibria.

**876. Applied Limnology**

Spring. 3(3-0) F W 874 or F W 875 or approval of department.

Aquatic ecology: quantitative relationship between physical, chemical and biological parameters in polluted and unpolluted lakes and streams.

**877. Fish Population Dynamics**

Winter of odd-numbered years. 3(3-0) Approval of department.

Quantitative analysis of fish populations; rates of change and their underlying causes.

**878. Dynamics of Aquatic Contaminants**

Spring of even-numbered years. 4(2-4) F W 476, F W 477 or approval of department.

Movement of contaminants through aquatic ecosystems. Chemical and physical processes controlling decomposition and disposition of contaminants. Relationship of chemical form to bioavailability and toxicity. Statistical and deterministic predictive simulation models.

**897. Ecosystem Ecology**

Fall. 3(3-0) ZOL 389 or BOT 450. Interdepartmental with and administered by the Department of Zoology.

Concepts of ecosystem structure, energy flow, and nutrient cycling in representative terrestrial and aquatic ecosystems.

**899. Master's Thesis Research**

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**999. Doctoral Dissertation Research**

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

## FOOD SCIENCE AND HUMAN NUTRITION

**College of Agriculture and Natural Resources  
College of Human Ecology**

**Food Science FSC**

**101. Food and Society (N)**

Fall, Winter, Spring. 3(3-0) Interdepartmental with Human Nutrition and Foods.

Analysis of the scientific, social and environmental aspects of food in determining the quality of human life. Introduction into the principles of food preservation and safety.

**205. Food Laws and Regulations**

Spring. 3(3-0) Interdepartmental with Human Nutrition and Foods.

Food laws and regulations that govern food processing and food service systems; procedures involved in adopting and enforcing food laws and regulations.

**211. Introduction to Food Science**

Winter, Spring. 3(3-0) CEM 141B.

Modern food processing, world food problems, and the basic characteristics of processed foods.

**256. Meats, Poultry and Fishery Products I**

Fall. 3(2-2) Interdepartmental with the Department of Animal Science.

Principles of evaluation and nutritive value. Identification of grades and cuts of beef, pork, lamb and poultry products.

**300. Dairy Products**

Spring. 3(2-2) CEM 143 or approval of department.

Chemical and physical properties of milk and milk products. Survey of dairy products and the technologies involved in their manufacture.

**310. Food Safety and Microbiology**

Fall. 4(3-3) CEM 143 or concurrently or approval of department. Not open to students with credit in FSC 440. Interdepartmental with the Department of Microbiology and Public Health.

Effects of food handling, preparation and service on food safety. Microorganisms in foods, sanitation, food borne disease and food service regulations.

**328. Food Plant Sanitation**

(FSC 332.) Winter. 3(3-0) FSC 211, MPH 200, CEM 141B.

Sanitary aspects of food processing operations, water quality, equipment design, bactericidal agents, pest control, personnel hygiene, biological hazards, and regulatory agencies. Field trips required.

**328L. Laboratory in Food Plant Sanitation**

Winter. 1(0-3) FSC 328 or concurrently.

Sanitary aspects of food processing operations water quality, and related hygienic aspects. Field trips required.

**329. Unit Operation and Food Processing I**

Fall. 4(3-2) PHY 237, MTH 109. Interdepartmental with and administered by Agricultural Engineering Technology.

Engineering concepts related to the unit operations found in the food industry. Fluid mechanics, heat transfer and rate processes including psychrometrics and refrigeration.

## Description — Food Science and Human Nutrition

### of Courses

- 330. Food Processing Operations**  
(FSC 331.) Winter. 3(3-0) PHY 237, FSC 211, or approval of department.  
Unit operations for food preservation by low temperature, heat, dehydration, evaporation and separation processes.
- 330L. Laboratory in Food Processing Operations**  
Winter. 1(0-2) FSC 330 or concurrently.  
Demonstrations, workshops, and pilot-scale processing illustrating selected unit operations in food manufacture.
- 333. Food Chemistry**  
Spring. 3(3-0) FSC 211 and CEM 241 or approval of department.  
Chemical changes in foods that affect the texture, color, flavor, odor, stability, and nutritive quality during processing and storage.
- 333L. Laboratory in Food Chemistry**  
Spring. 1(0-3) FSC 211, CEM 241 and FSC 333 or concurrently.  
Chemical changes in food that affect quality and stability.
- 400. Milk Processing Technology**  
Fall. 4(3-3) CEM 241 or approval of department.  
The fluid milk industry. Composition, quality, sanitation, nutritive value, processing, packaging and distribution of milk and milk products.
- 401. Industrial Food Fermentations**  
Fall. 3(3-0) FSC 440 and organic chemistry or approval of department.  
Physical, microbiological and chemical procedures in utilizing microbial cultures in controlled fermentations of foods and food constituents.
- 402. Chemistry and Technology of Lipids**  
Winter. 3(3-0) One term organic chemistry.  
Chemical and physical properties of edible fats and oils. Refining and processing of lipids into margarine, butter, shortening and salad oils. Chemical methods for analysis of lipids.
- 405. Technology of Manufactured Dairy Products**  
Winter. 4(3-3) FSC 400 or approval of department.  
Manufacturing technology of fermented dairy foods, frozen dairy desserts, and imitation dairy products.
- 421. Food Plant Management**  
Spring. 3(3-0) Seniors or approval of department.  
Business and technical management concepts associated with food plants. Efficiency factors, regulatory obligations, and administrative aspects.
- 430. Thermal Processes for Foods**  
Winter. 3(2-2) AET 329, FSC 328 or concurrently.  
Process design concepts with emphasis on heating and cooling of foods in containers. Parameters used to describe thermal resistance of product components. Process time calculations for thermal processes.
- 440. Food Microbiology**  
Spring. 3(3-0) MPH 200 or MPH 301 or approval of department. Interdepartmental with the Department of Microbiology and Public Health.  
Major groups of microorganisms of importance to the food industry are studied with emphasis on ecological, physiological, and public health aspects.
- 441. Food Microbiology Laboratory**  
Spring. 2(0-4) FSC 440 or concurrently or approval of department. Interdepartmental with the Department of Microbiology and Public Health.  
Laboratory practice with major groups of microorganisms of importance to the food industry. Concurrent enrollment in FSC 440 recommended.
- 445. Meat, Poultry and Fish Processing**  
Spring. 4(2-6) FSC 333 or approval of department.  
Muscle food and egg processing technology, product formulation and quality control. Manufacturing of cured meat, sausage and processed products.
- 455. Food Analysis I**  
Fall, Spring, Summer of even-numbered years. 4(2-4) CEM 162, CEM 241 or approval of department.  
Modern methods of analysis for fat, protein, moisture and other macroconstituents of food. Application of spectrophotometry in determination of microconstituents; use of dye-binding, complexometric and iodimetric techniques in food analysis.
- 456. Food Analysis II**  
Winter. 4(2-6) CEM 162 and CEM 241 or approval of department.  
Use of colorimetry and spectrophotometry, chromatographic methods and other techniques for the analysis of food constituents and additives.
- 457. Quality Control in the Food Industry**  
Winter of even-numbered years. 3(3-0) STT 201 or approval of department.  
Organization of and tools used for quality control: control charts, acceptance and auditing inspections, critical control points, reliability, safety, recall and liability.
- 460. Fruit and Vegetable Processing**  
Fall. 4(3-3) FSC 330 or approval of department.  
Product composition, harvesting, quality indexes, post-harvest changes, thermal process systems and freezing techniques.
- 470. Cereal Products Technology**  
Spring. 3(3-0) FSC 330 or approval of department.  
Classification and composition of food grains, milling processes, quality parameters, baking technology, breakfast cereals, and extrusion technology.
- 480. Special Problems in Food Science**  
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 9 credits.  
Advanced undergraduates may select research work in food chemistry, food microbiology, food engineering, food plant management, processing dairy products, meat, poultry and fishery products, fruits and vegetables, cereals or beverages.
- 490. Seminar**  
Fall. 1(1-0) Approval of department.  
Preparation and presentation of reports on a specialized aspect of food science.
- 830. Advanced Thermal Processes for Foods**  
Spring. 4(3-3) FSC 430, or approval of department.  
Integration of kinetic parameters for food product components and heat and mass transfer relationships into prediction models for food product quality.
- 831. Rheology and Texture of Food**  
Winter. 3(2-2) Approval of department.  
Definition, measurement, analysis of and relationship between the rheological and textural parameters which describe food. Relationship between basic rheology and food texture.
- 832. Microbiology of Food Processing**  
Winter of odd-numbered years. 2(2-0) FSC 440 or approval of department.  
Relationship of environment to occurrence, growth and survival of microorganisms in foods, control of food spoilage and food poisoning microorganisms in food processing. Role of spores in process selection.
- 834. Flavor Quality Control**  
Spring of odd-numbered years. 4(3-3) Approval of department.  
Sensory methods used for food evaluation and panel analyses. Flavor chemistry analytical methods. Sampling plans, control charts and acceptance sampling for statistical quality control.
- 835. Carbohydrates in Foods**  
Fall of odd-numbered years. 3(3-0) FSC 333.  
The chemistry and food technology of mono-, oligo-, and poly-saccharides.
- 850. Selected Topics in Food Science**  
Fall, Winter, Spring, Summer. 2 to 4 credits. May reenroll for a maximum of 12 credits. Approval of department.  
Advanced studies; food utilization, texture, additives, toxicants, food proteins, ingredient safety, nutrient stability, new processing techniques, flavors, quality control, storage stability, state and federal food regulations.
- 880. Special Problems in Food Science**  
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 12 credits. Approval of department.  
Investigation of food science areas of special interest to individual graduate students.
- 899. Master's Thesis Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
- 932. Histological and Chemical Techniques**  
Winter. 3(1-6) Approval of department.  
Research techniques in thin-layer and gas chromatography, differential thermal analysis, isoelectric focusing, histology, histochemistry, biological testing, polarography and pH stat measurements.

**Food Science and Human Nutrition — Description  
of  
Courses**

**934. Research Techniques with Proteins**  
Fall. 3(2-3) BCH 401 or BCH 451.

Physical and chemical techniques applicable to protein characterization (including—electrophoretic techniques, thin-layer chromatography, gel filtration, ultracentrifugation and amino acid analysis).

**951. Muscle Biochemistry**  
Spring of odd-numbered years. 3(3-0)  
BCH 453.

The structure and function of living muscle. Emphasis is placed upon the chemical and energy changes of muscle in contraction. Changes occurring after death during rigor development are also discussed.

**952. Advanced Lipids**  
Winter of even-numbered years. 3(3-0)  
FSC 402 or approval of department.

A course relating composition, structure, and physical and chemical properties of lipids to processing requirements of fats and oils to their function in food systems.

**955. Food Enzymology**  
Spring of even-numbered years. 3(3-0)  
FSC 333, BCH 401 or approval of department.

Production, utilization and application of enzymes in the food industry. Effects of enzymes on quality and nutrients of food.

**990. Food Science Seminar**  
Fall, Winter, Spring. 1(1-0) May  
reenroll for a maximum of 3 credits toward M.S.  
and 6 credits toward the Ph.D. Approval of  
department.

Preparation and presentation of reports on a specialized aspect of research findings in food science.

**999. Doctoral Dissertation Research**  
Fall, Winter, Spring, Summer. Variable  
credit. Approval of department.

**Human Nutrition  
and Foods**

HNF

**100. Principles of Food Preparation**  
Fall, Winter, Spring. 4(2-4)

Composition and properties of food related to quality characteristics; methods of preparation, evaluation of quality and use of selected foods.

**101. Food and Society (N)**  
Fall, Winter, Spring. 3(3-0) Interde-  
partmental with and administered by Food Sci-  
ence.

Analysis of the scientific, social and environmental aspects of food in determining the quality of human life. Introduction into the principles of food preservation and safety.

**102. Nutrition for Humans (N)**  
Fall, Winter, Spring, Summer. 3(3-0)

Fundamentals of nutrition with reference to diverse ways people provide for and attach meaning to food.

**200. Physical and Chemical Properties  
of Foods**  
Fall, Winter. 4(2-4) CEM 141B or con-  
currently.

Interrelationships between basic physical and chemical principles and food preparation: composition, methods of preparation, evaluation, quality standards and comparative analysis.

**205. Food Laws and Regulations**  
Spring. 3(3-0) Interdepartmental with  
and administered by Food Science.

Food laws and regulations that govern food processing and food service systems; procedures involved in adopting and enforcing food laws and regulations.

**221. Food and the Consumer**  
Fall, Spring. 3(3-0) Sophomores or  
approval of department.

Factors affecting the food supply, consumer protection, food buying and management of human and material resources in feeding the family.

**222. Food and the Consumer  
Laboratory**  
Winter. 2(0-4) HNF 221 or concur-  
rently.

Decision making in Foods and Nutrition with emphasis on food choices in the marketplace. Management of human and nonhuman resources in food consumerism activities.

**290. Professional Literature I**  
Fall, Spring. 3(3-0) HNF 102 or HNF  
200 or FSC 101; CPS 100 or concurrently; sopho-  
more majors.

Evaluation and communication of scientific information. Food and nutrition resources and misinformation, application of statistics, nutritional epidemiology, nutrient composition and computer diet analysis.

**300. Experimental Foods**  
Winter, Spring. 4(2-6) HNF 200, CEM  
143; FSC 310 or concurrently.

Experimental approach to the study of foods, relating chemical and physical properties to reactions and processes occurring in food in response to various treatments.

**310. Sensory Assessment of Foods**  
Winter. 2(1-2) HNF 290, HNF 300 or  
concurrently.

Sensory perception, chemistry of food flavors, and methods used in organoleptic evaluation of foods.

**330. Nutrition in the Life Cycle:  
Children**  
Winter. 3(3-0) HNF 102; FCS 262A,  
three terms of natural science or approval of  
department.

Functions and importance of nutrients to physical growth, development and health of the child. Eating behavior of children. Feeding in child care centers.

**375. Community Nutrition**  
Fall. 3(3-0) HNF 102 or approval of  
department.

Identification of nutritional needs of population groups and available resources in communities.

**379. Basic Nutritional Counseling**  
Fall, Winter. 3(2-3) HNF 102, HCP  
450 or approval of department.

Competencies required of professional dietitians. Skills in communicating, interviewing, problem solving and planning for nutritional care using simulated situations.

**400H. Honors Work**  
Fall, Winter, Spring, Summer. 1 to 16  
credits. May reenroll for a maximum of 24 cred-  
its. Seniors, approval of department.

**403. Fats and Carbohydrates in Food  
Systems**  
Fall. 4(3-3) HNF 300 or approval of  
department.

Chemical and physical reactions in fat and carbohydrate food systems, including sols, gels, emulsions, etc. Food evaluation techniques will be introduced.

**404. Role of Proteins in Food Systems**  
Winter. 4(3-3) HNF 300 or approval of  
department.

Physical and chemical reactions with protein foods, meats, eggs, cheese, seeds. Emphasis on time-temperature data in relation to quality.

**406. Cultural Aspects of Food**  
Spring, Summer. 3(3-0) Juniors.

A cross cultural investigation of food and its consumption. Factors such as history, religion, food sources and socio-economic status are considered.

**406L. Laboratory—Cultural Aspects of  
Food**  
Spring. 1(0-3) HNF 100 or HNF 200 or  
approval of department; HNF 406 concurrently.

Art and science of cookery in relation to historical, national, regional, racial and religious customs.

**407. Interactions of Culture and  
Nutrition**  
Spring. 3(3-0) Juniors; HNF 102 or  
ANP 171 or approval of instructor. Interdepar-  
tmental with the Department of Anthropology.

World and U.S. food behavior focusing on conflicts between behavior and nutritional needs at various stages of life cycle. Anthropological, psychological and social influences affecting food behavior are analyzed.

**411. Principles of Human Nutrition**  
Spring. 4(4-0) BCH 200.

Identification, function and food sources of nutrients required by humans. Metabolism as affected by deficiency or excess of specific nutrients.

**415. Consumer Trends in the Food  
Industry**  
(HNF 315.) Spring. 3(3-0) Juniors in  
the College of Human Ecology or approval of  
department.

Current and projected trends concerning American consumers in the food industry. Consumer behavior and market segmentation concepts influencing the food market place and food product development.

**440. Foodservice Management:  
Material Resources**  
Fall. 4(4-0) HNF 200, CPS 100 or CPS  
115 or concurrently, FSC 310 or approval of  
instructor.

Principles, processes and control strategies in non-commercial foodservice operations. Menu planning, procurement, on-premise storage and issue, production, consumer distribution, safety, and sanitation.

**440P. Foodservice Management  
Practicum**  
Winter, Spring. 3(2-4) HNF 440 or  
approval of department.

Receiving, storage, preparation and service of food along with safety, sanitation, design and layout of equipment in a noncommercial foodservice operation.

## Description — Food Science and Human Nutrition

of

### Courses

- 441. Foodservice Management: Financial Resources**  
Winter. 4(3-2) HNF 440.  
Costs of human and material resources in a non-commercial foodservice operation utilizing manual and electronic data processing strategies.
- 442. Foodservice Management: Problem Analysis and Decision Making**  
Spring. 3(2-3) HNF 440P or concurrently, HNF 441.  
Problem-solving techniques. Cause and effect factors, situational components, and development of alternative solutions to problems in non-commercial foodservice.
- 461. Energy Nutrients and Proteins for Human Nutrition**  
Fall. 4(4-0) BCH 200; PSL 432 or PSL 241.  
Metabolism of protein, fats and carbohydrates as applied to the nutritional requirements and food supplies of people.
- 462. Vitamins and Minerals for Human Nutrition**  
Winter. 4(4-0) HNF 461.  
Metabolism of vitamins and minerals as applied to the nutritional requirements and food supplies of people.
- 463. Nutrition and Human Development**  
Winter. 4(4-0) HNF 462 or approval of department.  
The role of nutrients in physiological systems and biochemical processes as related to the perspective of human growth and development.
- 470. Clinical Nutrition**  
Spring. 3(3-0) HNF 462; PHM 350 or approval of department.  
Changes in physiological and/or biochemical functions or processes due to illness and uses of modified diets as an essential part of treatment.
- 470P. Clinical Nutrition Practicum**  
Spring. 1(0-2) HNF 470 concurrently.  
Assessment of nutritional status. Modification of the hospital general menu for implementation of diets prescribed for treatment of disease.
- 473. Interpretation of Clinical Laboratory Tests in Dietetics**  
Spring. 4(3-2) HNF 470 or concurrently.  
Principles, procedures and interpretation of clinical laboratory methods with particular emphasis on their interpretation relative to nutritional status and therapeutic nutrition.
- 477. Issues in Dietetic Practice**  
Spring. 3(3-0) HNF 379, HNF 462, HNF 441, Seniors or approval of department.  
Identification of issues in clinical and community nutrition, foodservice management and health care delivery systems with emphasis on needed strategies for change in future practice.
- 490A. Professional Literature II: Foods**  
Fall. 2(2-0) HNF 290, HNF 300 or HNF 403 or approval of department.  
Selected topics in foods research. Emphasis on experimental data and basic scientific principles related to food quality, nutritive stability and food safety.
- 490B. Professional Literature II: Nutrition**  
Winter. 2(2-0) HNF 290, HNF 462 or approval of department.  
Emphasis on experimental data and scientific principles related to basic nutrition research. Focus on current developments in nutrient requirements, metabolism and interactions
- 490C. Professional Literature II: Clinical Nutrition**  
Spring. 2(2-0) HNF 290, HNF 470 or concurrently or approval of department.  
Selected topics in clinical nutrition research. Emphasis on human investigative data and scientific principles related to nutritional care of patients/clients including pathophysiologic correlations, nutritional assessment, diet planning, nutrition counseling.
- 490D. Professional Literature II: Foodservice Management**  
Winter. 2(2-0) HNF 290, HNF 441 or approval of department.  
Examination of trends, problems and research in food service systems operation. Focus on current issues and developments relating to materials handling, labor needs, operational accountability and public responsibility.
- 490E. Professional Literature II: Foods and Nutrition Information**  
Spring. 2(2-0) HNF 290, HNF 411 or HNF 462 or approval of department.  
Selected topics in foods and nutrition information. Emphasis on research related to method and effectiveness of nutrition education.
- 495. Independent Study**  
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 9 credits. Seniors; approval of department.  
Individual study of selected topics in foods, nutrition and food service management under staff guidance.
- 498. Field Study**  
Fall, Winter, Spring, Summer. 3 to 12 credits. May reenroll for a maximum of 12 credits. Approval of department.  
Planned program of research, observation, study or work in selected organizations under staff guidance.
- 800. Seminar in Foods and Nutrition**  
Fall, Winter, Spring. 1(1-0) HNF 403 or HNF 463.
- 805. Experimental Foods III**  
Spring. 4(1-9) HNF 404 or approval of department.  
Planning, executing, and reporting individual research project. Data collection, evaluation and interpretation to demonstrate understanding of research techniques and attitudes, and an awareness of significant problems in the field.
- 813A. Supervised Individual Study in Nutrition**  
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 10 credits. HNF 461.
- 813B. Supervised Individual Study in Experimental Foods**  
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 10 credits. Approval of department.
- 813C. Supervised Individual Study in Foodservice Management**  
Fall, Winter, Spring, Summer. 2 to 4 credits. May reenroll for a maximum of 10 credits. Approval of department.  
Special studies in facility management, personnel coordination and tools and methods of operational control.
- 816. Applied Human Nutrition**  
Spring. 3(3-0) HNF 462.
- 840. Topics in Nutrition (MTC)**  
Fall, Winter, Spring, Summer. 2 to 3 credits. May reenroll for a maximum of 15 credits if different subtitles are taken. HNF 462, PSL 432, BCH 401 or approval of department.  
Advanced studies in nutrition: assessment and surveillance, community, clinical, growth and development, behavior, infectious disease and environment, oral health, obesity, aging, diet.
- 841. Nutrition and Obesity**  
Winter of even-numbered years. 2(2-0)  
One undergraduate course in nutrition, biochemistry or physiology.  
Assessment, energy metabolism, and risk factors associated with obesity. Significance of nutrition and other factors for weight control and reduction.
- 842. Nutritional Counseling**  
Fall of odd-numbered years. 3(2-3) HNF 470 or approval of department.  
Provision of nutritional counseling for clients. Assessment, planning, implementation and evaluation of nutritional counseling.
- 899. Master's Thesis Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
- 921. Pathology of Nutritional and Metabolic Diseases**  
(HNF 921, LSM 921.) Spring of odd-numbered years. 4(3-2) ANT 420, ANS 525, BCH 452, HNF 462 recommended. Interdepartmental with and administered by the Department of Large Animal Clinical Sciences.  
Development, physiopathology and morphologic pathology of nutritional and metabolic diseases including carbohydrate, protein, fatty acid, vitamin and mineral deficiencies, their experimental induction and their medical or economic significance.
- 935. Comparative Nutrition—Lipids and Carbohydrates**  
(926.) Winter of odd-numbered years. 4(4-0) BCH 452 and a previous course on principles of nutrition. Interdepartmental with the Department of Animal Science.  
Regulatory aspects of carbohydrate and lipid metabolism as influenced by nutrition in mammals. Emphasis on normal and abnormal physiological states such as obesity, ketosis and diabetes.
- 936. Comparative Nutrition—Protein Metabolism and Developmental Biology**  
(927.) Winter of even-numbered years. 4(4-0) BCH 453, PSL 801 or approval of department. Interdepartmental with and administered by the Department of Animal Science.  
Protein quality assessment, protein status, protein calorie malnutrition, amino acid metabolism, protein turnover, digestion and absorption, hormonal control of protein metabolism, developmental aspects of protein metabolism and growth.

**937. Comparative Nutrition-Minerals**  
(A H 928.) Spring of even-numbered years. 3 credits. BCH 452, PSL 801. Interdepartmental with and administered by the Department of Animal Science.

Forms and location in body, metabolic roles, deficiency and toxicity signs, interrelationships, requirements and biological availability of sources.

**938. Comparative Nutrition-Vitamins**  
(A H 929.) Spring of odd-numbered years. 4(4-0) BCH 452, BCH 453 or approval of department. Interdepartmental with the Department of Animal Science.

Advanced concepts in function and metabolism of vitamins; mechanism of action at cellular/molecular level. Biosyntheses, deficiencies, toxicity. Modern approaches to isolation and assay. Use of animal models in research.

**999. Doctoral Dissertation Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

## FOOD SYSTEMS ECONOMICS AND MANAGEMENT

See Agricultural Economics.

## FOREIGN LANGUAGES

See Linguistics and Germanic, Slavic, Asian and African Languages, and Romance and Classical Languages.

## FORESTRY FOR

### College of Agriculture and Natural Resources

In 305 and 430, field trips are scheduled for several consecutive days away from the campus for integrated field experience, primarily in the second half of spring term of the junior year, so that these courses must be taken concurrently. This precludes enrollment in other courses during that term. The approximate cost of these field trips is \$200.

**202. Introduction to Forestry**  
Fall, Spring. 3(3-0)

Forestry in its broadest sense, including: historic development, forest growth, protection and management, products, national and world economy and policy. Emphasis on multiple use concepts. One-day field trip required.

**203. Resource Ecology**  
(IDC 200.) Fall, Winter, Spring, Summer. 3(3-0) Interdepartmental with the departments of Fisheries and Wildlife, Geography, Resource Development, and Zoology. Administered by the Department of Fisheries and Wildlife.

Basic concepts of ecology which are the unifying basis for resource management, conservation policy and the analysis of environmental quality. Extensive use of guest lecturers.

**204. Forest Vegetation**  
Fall, Spring. 4(3-2)

Nomenclature, classification, and identification of important trees, shrubs, and herbaceous plants of forest and field.

**209. Wood and Its Uses**  
Fall. 4(3-2)

Macroscopic and microscopic features of wood, species identification, moisture relations, physical and mechanical properties, growth characteristics, fungi and insect attack, and description of products.

**220. Plants and Their Environment**  
Winter. 3(3-0) Intedepartmental with Agriculture and Natural Resources.

Relationships between plants and fundamental climatic, edaphic, and biotic factors; structure and function of different ecosystems in relation to environmental factors.

**304. Forest Ecology**  
Spring. 4(3-3) BOT 205, CSS 210, FOR 204 or BOT 318.

Structure and function of forest ecosystems. Community dynamics in response to disturbance. Life histories of trees related to environment. Extended field trips required.

**305. Silviculture**  
Spring. 4(2-4) FOR 204, CSS 210.

Natural and artificial forest reproduction methods; intermediate stand treatments; nontimber aspects of silviculture; field studies of silvicultural methods. Extended field trips required.

**320. Forest Measurements**  
Spring. 4(3-3) MTH 109 or MTH 111 or approval of department.

Individual tree measurements. Estimation of site quality, stand volume, density, and stocking. Alternative sampling methods; systematic, simple random, and stratified sampling. Plot sampling and point sampling. Extended field trips required.

**329. Timber Harvesting**  
(FOR 429.) Spring. 3(2-3) FOR 309, FOR 305, FOR 402, FOR 424, FOR 425 concurrently.

Felling, bucking and transport of trees to mill site. Capabilities and limitations of mechanical devices, vehicles, and logging systems related to timber size and terrain. Extended field trips required.

**330. Forest Protection**  
Fall. 4(4-0) FOR 304, FOR 305, FOR 320. Interdepartmental with the departments of Botany and Plant Pathology and Entomology.

Procedures used to detect and respond to pest, fire and environmental problems in a variety of forest types.

**409. Forest Hydrology**  
Winter. 3(3-0) FOR 424, Seniors; or approval of department.

Hydrologic cycle, with emphasis on soil, water and ground water regimes; instrumentation and measurement of the various components. Effects of forest management on watersheds and water yields.

**410. Forest Tree Improvement**  
Fall. 3(2-2)

Distribution of genetic variation in natural tree populations. Introduction, selection, progeny testing, species hybridization, and polyploidy to obtain superior tree populations.

**411. Tree Physiology**  
Winter of even-numbered years. 3(3-0) BOT 301.

The fundamental principles of plant physiology with particular reference to the growth and development of woody plants, and consideration of the influence of genetic and environmental factors on physiological processes in trees.

**420. Modeling Forest Growth**  
Winter. 4(3-2) FOR 320, CPS 115 or approval of department.

Individual tree and stand-level growth models. Basic models for individual tree volume. Parameters to estimate growth and yield. Computer models for Lake States species.

**424. Forest Soils**  
Spring. 3(2-3) CSS 210; Juniors or approval of department. Forestry majors: FOR 305, FOR 402, FOR 425, FOR 429 concurrently. Interdepartmental with the Department of Crop and Soil Sciences.

Interrelationships of forest site and the growth of trees. Properties, classification, inventory, productivity and management of forest soils. Effects of silvicultural and forest management practices on the soil.

**428. Seminar**  
Fall. 1(1-0) Seniors.

Current forestry topics.

**430. Industrial Timber Utilization Processes**  
Winter. 3(2-2) FOR 429.

Mechanics and technologies of industrial wood conversion processes, including grading logs and lumber, manufacture of furniture, plywood, particleboard, fiberboard, and paper. Field trips required.

**431. Finishing, Preservation and Drying of Wood**  
Winter. 3(3-0) FOR 309.

Properties, selection, application of decorative and protective coatings, wood preservatives and fire retardants. Air and kiln drying of lumber.

**435. Law and Resources**  
Fall. 3(3-0) R D 417 or GBL 430. Interdepartmental with and administered by the Department of Resource Development.

Legal theories, cases, statutes and constitutional considerations are applied to natural resource utilization. Private and public property interests in natural resources are illustrated through case studies of use conflicts.

**446. Range Management**  
Winter of even-numbered years. 4(4-0) FOR 220 or FOR 304 or approval of department.

The science of range management, with emphasis on range regions, range vegetation management, livestock management practices, range improvements and multiple use values of rangelands.

**450. Natural Resource Administration**  
Spring. 4(4-0) Seniors. Interdepartmental with Agriculture and Natural Resources and the departments of Fisheries and Wildlife, Park and Recreation Resources, and Resource Development.

Concepts and methods of administering wildland properties. The legal, economic and social environment. Benefit-cost analysis of management changes. Unit organization, personnel management and accounting. Presents a systems view of administration.