

**376. Applied Limnology**  
Spring of even-numbered years. 3(3-0)  
?: Open only to graduate students in the Colleges of Agriculture and Natural Resources, Engineering, and Natural Science.  
Applied aquatic ecology. Quantitative relationships between physical, chemical, and biological parameters in polluted and unpolluted lakes.

**377. Fish Population Dynamics**  
Fall of even-numbered years. 3(2-2)  
?: Open only to graduate students in the College of Agriculture and Natural Resources or College of Natural Science.  
Quantitative analysis of fish populations. Evaluation, causes, and impacts of the rates of change in survival, growth, reproduction, and recruitment for fish populations and their yield.

**378. Dynamics of Trace Contaminants in Aquatic Systems**  
Spring of even-numbered years. 3(3-0)  
?: Open only to graduate students in the Colleges of Agriculture and Natural Resources, Engineering, Human Medicine, Natural Science, Osteopathic Medicine, and Veterinary Medicine.  
Chemical and environmental parameters controlling movement and disposition of trace contaminants in aquatic environments. Fate models.

**379. Advanced Limnology**  
Spring of odd-numbered years. 3(3-0)  
?: Open only to graduate students in the Colleges of Agriculture and Natural Resources, Engineering, and Natural Science.  
Physical, chemical, and biological processes affecting productivity of aquatic ecosystems.

**391. Advanced Topics**  
Fall, Spring, Summer. 2 to 4 credits. A student may earn a maximum of 10 credits in all enrollments for this course.  
In depth study of advanced topics in fisheries and wildlife.

**392. Biodiversity**  
Spring. 2(2-0) A student may earn a maximum of 4 credits in all enrollments for this course. Interdepartmental with Zoology. Administered by Zoology.  
?: ZOL 250.

Status of world biota and factors in the decline and extinction of major groups of plants and animals. Theory and design of natural reserves. Assessment and ecological meaning of diversity. Management for global and local diversity.

**393. Seminar in Fisheries and Wildlife**  
Fall, Spring. 1(1-0) A student may earn a maximum of 7 credits in all enrollments for this course.  
Study and research in advanced problems and current development in fisheries and wildlife.

**397. Community and Ecosystem Ecology**  
Spring. 4(4-0) Interdepartmental with Zoology, and Botany and Plant Pathology. Administered by Zoology.  
Structure and function of natural communities and ecosystems. Community analysis along environmental gradients. Succession, food web analysis, energy flow, nutrient cycling, and effects of human activities on ecosystems.

**398. Master's Research**  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 10 credits in all enrollments for this course.  
?: Open only to graduate students in Fisheries and Wildlife.  
Master's degree Plan B research paper.

**399. Master's Thesis Research**  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 99 credits in all enrollments for this course.  
R: Open only to graduate students in Fisheries and Wildlife.

**943. Techniques of Analyzing Unbalanced Research Data**  
Spring. 4(4-0) Interdepartmental with Animal Science, Forestry, Crop and Soil Sciences, and Horticulture. Administered by Animal Science.  
P: STT 464. R: Open only to graduate students in the College of Agriculture and Natural Resources.  
Linear model techniques to analyze research data characterized by missing and unequal number of observations in classes. Simultaneous consideration of multiple factors. Estimable comparisons. Hypothesis testing. Computational strategies. Variance and covariance components. Breeding values.

**976. Multivariate Methods in Agriculture and Natural Resources**  
Spring. 4(4-0) Interdepartmental with Forestry and Animal Science. Administered by Forestry.  
P: STT 422, MTH 314. R: Open only to graduate students in the College of Agriculture and Natural Resources and in the Interdepartmental Graduate Specializations in Ecology and Evolutionary Biology.  
Application of multivariate methods to research problems. Hotelling's T-test, profile analysis, discriminant analysis, canonical correlation, principal components, principal coordinates, correspondence analysis, and cluster analysis.

**999. Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course.  
R: Open only to Doctoral level graduate students in Fisheries and Wildlife.

## FOOD ENGINEERING FE

**Department of Agricultural Engineering  
College of Agriculture and Natural Resources  
College of Engineering**

**329. Fundamentals of Food Engineering**  
Spring. 3(3-0) Interdepartmental with Food Science.  
P: FSC 211, MTH 124, PHY 231. R: Not open to freshmen and sophomores.  
Unit operations in food industry: fluid mechanics, heat transfer, rate processes, refrigeration, freezing, and dehydration. Thermal process calculations.

## FOOD SCIENCE FSC

**Department of Food Science and Human Nutrition  
College of Agriculture and Natural Resources  
College of Human Ecology**

**150. Introduction to Nutrition and Food Science**  
Fall, Spring, Summer. 3(3-0) Interdepartmental with Human Nutrition and Foods. Administered by Human Nutrition and Foods.  
Nutrition needs in life stages from a human ecological perspective. Domestic and international factors affecting the availability of a safe, nutritious food supply. Relationships of food choices to health and disease.

**211. Principles of Food Science**  
Fall. 3(3-0)  
P: CEM 141.  
Scientific principles, historical perspective and current status of technology related to food composition, safety, toxicology, processing, preservation and distribution.

**275. Seafood Systems Management**  
Spring. 3(3-0) Interdepartmental with Animal Science and Fisheries and Wildlife. Administered by Fisheries and Wildlife.  
Domestic and international perspectives on major aquatic foods. Cultural and nutritional value; wild harvest; aquaculture; processing technology; food handling and food safety.

**329. Fundamentals of Food Engineering**  
Spring. 3(3-0) Interdepartmental with Food Engineering. Administered by Food Engineering.  
P: FSC 211, MTH 124, PHY 231. R: Not open to freshmen and sophomores.  
Unit operations in food industry: fluid mechanics, heat transfer, rate processes, refrigeration, freezing, and dehydration. Thermal process calculations.

**330. Food Processing: Fruits and Vegetables**  
Fall. 2(3-3)  
P: MTH 116, FSC 211. R: Not open to freshmen.  
Fruit and vegetable composition and quality indices. Harvest and post harvest technology. Preservation systems: canning, freezing and specialized techniques. Offered first half of semester.

**331. Food Processing: Cereals**  
Fall. 2(3-3)  
P: MTH 116, FSC 211. R: Not open to freshmen.  
Classification and composition of cereals. Milling processes. Cereal product manufacture. Offered second half of semester.

**332. Food Processing: Dairy Foods**  
Spring. 2(1-3)  
P: MTH 116, FSC 211. R: Not open to freshmen.  
Fluid milk. Principles and technology in manufacturing dairy products. Marketing, distribution and regulations of dairy foods. Offered first half of semester.

**333. Food Processing: Meat, Poultry and Fishery Products**  
Spring. 2(1-3)  
P: FSC 211, MTH 116. R: Not open to freshmen.  
Manufacturing practices and principles of fresh, frozen, and cured meats, eggs, and processed products. Product formulation and quality control. Offered second half of semester.

**401. Food Chemistry**  
Fall. 3(3-0)  
P: FSC 211, CEM 251. R: Not open to freshmen and sophomores. Not open to students with credit in HNF 300.  
Organic and biological reactions of food constituents. Chemical changes in foods during processing and storage affecting texture, color, flavor, stability and nutritive qualities.

**402. Food Chemistry Laboratory**  
Fall. 1 credit.  
P: FSC 401 or concurrently. R: Open only to majors in Food Science, Foods: Technology and Management, and Food Engineering. Completion of Tier I writing requirement.  
Chemical changes in food constituents which affect stability of food products and properties such as color, flavor and texture.

**Descriptions —Food Science  
of  
Courses**

**405. Application of Biotechnology to Food Science**

Fall of odd-numbered years. 3(3-0)

P: MIC 205 or MIC 301.

Advances in biotechnology and their application to food safety and quality. Scientific basis and methods used in genetic engineering of plant and animal cells. Use of molecular probes in detection of toxins and bacterial pathogens. Ethical concerns related to biotechnology.

**407. Food and Animal Toxicology**

Fall. 3(3-0) Interdepartmental with Animal Science. Administered by Animal Science.

P: BCH 200 or BCH 401. R: Not open to freshmen and sophomores.

Fate and effects of chemicals in the food chain. Impact on animal production. Residues in food products. Food safety assessment. Control methods.

**407L. Toxicology Methods Laboratory**

Fall. 2 credits. Interdepartmental with Animal Science. Administered by Animal Science.

P: ANS 407 or concurrently. R: Not open to freshmen and sophomores.

Laboratory techniques for evaluating potential toxicity of chemicals to living systems. Field trip to industrial toxicology laboratory required.

**417. Topics in Toxicology**

Spring. 1(1-0) Interdepartmental with Animal Science. Administered by Animal Science.

P: ANS 407. R: Not open to freshmen and sophomores. Selected topics including regulatory toxicology, risk assessment, environmental toxicology, food safety, and safe handling of toxic substances.

**420. Quality Assurance**

Fall. 2(2-0)

P: STT 201; FSC 330 or FSC 331 or FSC 332 or FSC 333. R: Not open to freshmen and sophomores.

Theory and application of quality assurance programs for food processing industries.

**421. Food Laws and Regulations**

Spring. 3(3-0)

P: HNF 150 or HNF 311 or FSC 211. R: Not open to freshmen and sophomores.

Adoption, interpretation and enforcement of laws and regulations governing food processing and foodservice systems. Impact of regulation on food production, availability, marketing and safety.

**432. Advanced Food Processing: Dairy Foods**

Fall of odd-numbered years. 3(2-3)

P: FSC 332. R: Not open to freshmen and sophomores.

Theoretical and practical principles of the manufacture of cheese, frozen desserts, butter and powders. Concentration and fractionation techniques for producing dairy based ingredients for food systems.

**433. Advanced Food Processing: Meat, Poultry and Fish**

Fall of even-numbered years. 3(2-3)

P: FSC 333. R: Not open to freshmen and sophomores.

Scientific principles of processing animal tissues for food. Field trips required.

**440. Food Microbiology**

Spring. 3(3-0) Interdepartmental with Microbiology.

P: MIC 205. R: Not open to freshmen and sophomores. Major groups of microorganisms of importance to the food industry. Emphasis on ecological, physiological, and public health aspects.

**441. Food Microbiology Laboratory**

Spring. 1 credit. Interdepartmental with Microbiology.

P: FSC 440 or concurrently; MIC 206. R: Not open to freshmen and sophomores. Open only to majors in Food Engineering, Food Science, Foods: Technology and Management, or Microbiology and Public Health. Completion of Tier I writing requirement.

Methods for studying major groups of microorganisms important to food industry. Isolation, enumeration, characterization, identification and use of microorganisms.

**455. Food Analysis**

Fall. 3(2-3)

P: BCH 200, CEM 262, FSC 401. R: Not open to freshmen and sophomores. Completion of Tier I writing requirement.

Principles and application of analytical techniques. Analysis for fats, proteins, carbohydrates, minerals, vitamins and additives. Techniques include spectroscopy, fluorimetry, chromatography, electrophoresis, proximate composition.

**490. Special Problems in Food Science**

Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course.

R: Not open to freshmen and sophomores. Approval of department; application required.

Individual study of selected topics in food science. Supervised independent study.

**492. Senior Seminar in Food Science**

Spring. 1(1-0)

R: Open only to seniors in Food Science.

Critical study and discussion of contemporary issues related to the food industry.

**801. Chemistry of Food Lipids**

Fall of odd-numbered years. 3(3-0)

P: FSC 401, BCH 461.

Composition and structure of lipids: physical and chemical properties in relation to their function in foods.

**802. Food Proteins**

Spring of odd-numbered years. 3(3-0)

P: BCH 461, FSC 401.

Use of proteins and enzymes in the food industry. Functional properties of proteins and enzymes in food systems.

**807. Advanced Food Toxicology**

Fall of even-numbered years. 3(3-0) Interdepartmental with Animal Science.

R: Approval of department.

Toxicology related to food safety. Metabolism of toxicants as influenced by food constituents, mutagenesis, and chemical carcinogenesis. Risk assessment.

**831. Advanced Cereal Science**

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

P: BCH 401, FSC 331, FSC 401 or approval of department.

Physico-chemical properties of major constituents in cereal grains. Relationship of constituent structures to functionality in the processing of cereal grains into food products, with emphasis on wheat.

**833. Muscle and Meat Biochemistry**

Spring of odd-numbered years. 3(3-0)

P: BCH 452 or concurrently.

Anatomical, physiological, and biochemical properties of muscle. Structure and function of muscle proteins. Regulation of muscle contraction. Post mortem biochemical changes and meat protein functionality.

**840. Advanced Food Microbiology**

Spring of odd-numbered years. 3(3-0)

P: FSC 440.

Detection, characterization, identification, and enumeration of food-associated pathogens. Applications and regulation of food biotechnology.

**850. Analytical Techniques in Food Science**

Summer of odd-numbered years. 2(1-2)

R: Open only to graduate students in Food Science or Human Nutrition.

Theory and application of dynamic rheological testing, nucleic acid and protein analysis, and immunological techniques. Other new technologies related to food science.

**860. Research in Food Processing Technology**

Summer of even-numbered years. 2(1-2)

R: Open only to graduate students in Food Science, Human Nutrition, Animal Science, and Horticulture.

Theory, application, and evaluation of food processing technology: ultrafiltration, food irradiation, and critical point extraction.

**890. Special Problems in Food Science**

Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 8 credits in all enrollments for this course.

R: Open only to graduate students in Food Science. Approval of department; application required.

Individual investigation of an area of food science.

**891. Selected Topics in Food Science**

Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course.

R: Open only to graduate students in Foods or Food Science or Human Nutrition.

Topics of current interest and importance in basic and applied areas of food science.

**892. Food Science Seminar**

Fall, Spring. 1(1-0) A student may earn a maximum of 4 credits in all enrollments for this course.

R: Open only to graduate students in Food Science.

Critical review of literature. Organization and communication of scientific data in food science.

**898. Master's Research**

Fall, Spring, Summer. 1 to 5 credits. A student may earn a maximum of 5 credits in all enrollments for this course.

R: Open only to graduate students in Food Science. Approval of department.

Directed research in support of Plan B master's degree requirements.

**899. Master's Thesis Research**

Fall, Spring, Summer. 1 to 10 credits. A student may earn a maximum of 99 credits in all enrollments for this course.

R: Open only to M.S. students in Food Science.

**999. Doctoral Dissertation Research**

Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course.

R: Open only to Ph.D. students in Food Science.