

415 Human Resource Management: Changes and Challenges
 Spring. 3(3-0) P:M: (ABM 100 or EC 201 or EC 202 or EEP 201) R: Open only to juniors or seniors.
 Human resource management strategies used in food industries. Changing demographics and labor force issues. Diversity, labor markets, regulations, employer policies, job analysis and staffing, compensation and benefits, motivation, performance appraisal, food labor unions, and cases.

422 Vertical Coordination in the Agri-Food System
 Fall. 3(3-0) Interdepartmental with Agribusiness Management. Administered by Department of Agricultural Economics. P:M: (ABM 100 and EC 201) R: Open only to juniors or seniors. SA: FSM 443
 Analysis of vertical coordination in the industrialized agri-food system. Agricultural cooperatives, contracts, marketing orders, and trade associations. Analysis of imperfect competition and methods of conducting business. Interaction with legal systems and government.

424 Information and Market Intelligence in the Agri-Food Industry
 Spring. 3(3-0) Interdepartmental with Agribusiness Management. P:M: (FIM 220 or concurrently and EC 201)
 Researching agri-food issues, food industry business environments, and agri-food industry trends. Information gathering. Electronic library reference sources. Synthesis of data and information into market intelligence.

427 Global Agri-Food Industries and Markets
 Fall. 3(3-0) Interdepartmental with Agribusiness Management. Administered by Department of Agricultural Economics. P:M: (FIM 220 or ABM 225)
 Strategic understanding of the international agri-food system. Analysis of global production, marketing, and consumption. Knowledge of changing conditions in international industries and markets. Global trends and opportunities.

439 Food Business Analysis and Strategic Planning (W)
 Fall. 3(4-0) Interdepartmental with Marketing and Supply Chain Management. P:M: (FIM 220) and completion of Tier I writing requirement. R: Open only to juniors or seniors SA: ML 439, MTA 439
 Principles and techniques of business analysis and strategic planning applied to food firms. Food trend forecasts, market potential, competition and cost analyses, and business and strategic planning.

480 International Studies in Food Industry Management
 Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Not open to freshmen. Approval of department; application required.
 Study and travel experience emphasizing contemporary problems affecting food and agribusiness systems in world, national, and local communities.

490 Independent Study in Food Industry Management
 Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P:M: (ABM 100) R: Open only to sophomores or juniors or seniors in the Food Industry Management major. Approval of department: Application required. Students are limited to a combined total of 6 credits in ABM 490 and FIM 490. SA: FSM 490
 Independent supervised study in topics in food industry management.

493 Professional Internship in Food Industry Management
 Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P:M: (ABM 100) R: Open only to juniors or seniors in the Food Industry Management major. Approval of department; application required. A student may earn a maximum of 6 credits in all enrollments for any or all of these courses: ABM 493, AEE 493, ANR 493, ANS 493, CSS 493, EEP 493, FIM 493, FW 493, HRT 493, PKG 493, PLP 493, PRR 493, and RD 493.
 Supervised professional experience in the food industry.

275 Seafood Systems Management
 Spring. 3(3-0) Interdepartmental with Fisheries and Wildlife; Animal Science. Administered by Department of 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.

320 Muscle Foods
 Spring. 3(2-3) Interdepartmental with Animal Science. Administered by Department of Animal Science. P:M: (ANS 210 or FSC 211 or HNF 150)
 Structure of muscle. Meat technology and merchandising concepts.

325 Food Processing: Unit Operations
 Fall, Spring. 4(2-6) P:M: (ANS 210 or FSC 211) and completion of Tier I writing requirement. SA: FSC 229, FSC 339
 Principles, technologies, and applications in conversion of raw products into high quality foods. Unit operations: thermal processing, irradiation, freezing, membrane fractionation, enzyme technologies, dehydration and refrigeration. Field trip required.

329 Fundamentals of Food Engineering
 Spring. 3(3-0) Interdepartmental with Biosystems Engineering. Administered by Department of Biosystems and Agricultural Engineering. P:M: (FSC 325) and (MTH 126 or LBS 118) and (PHY 231 or LBS 271) RB: (FSC 211) SA: FE 329
 Unit operations in food industry: fluid mechanics, heat transfer, rate processes, refrigeration, freezing, and dehydration. Thermal process calculations.

342 Food Safety and Hazard Analysis Critical Control Point Program
 Fall. 3(3-0) RB: (FSC 211 or concurrently or HNF 150 or concurrently or HNF 311 or concurrently) or a prior or concurrent basic course in microbiology, chemistry or biological sciences. SA: FSC 442
 Sources of microbiological, chemical and physical hazards; minimizing microbial growth and survival; good manufacturing, cleaning and sanitation practices; Hazard Analysis Critical Control Point Programs in food processing and food service.

401 Food Chemistry
 Fall. 3(3-0) P:M: (BMB 200 or CEM 352 or BMB 401 or concurrently) R: Not open to freshmen or sophomores.
 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(0-3) P:M: (FSC 401 or concurrently) and 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.

420 Quality Assurance
 Fall. 2(2-0) P:M: (STT 200 or STT 201 or STT 231 or STT 315 or STT 351) and (FSC 211 or concurrently or ANS 210 or concurrently or HRT 204 or concurrently) R: Open only to juniors or seniors or graduate students in the Department of Food Science and Human Nutrition or in the Food Processing and Technology Specialization.
 Theory and application of quality assurance programs for food processing industries.

FOOD SCIENCE FSC

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

120 What's for Dinner: Science on Your Plate
 Fall, Spring. 1(2-0) Not open to students with credit in FSC 229.
 Relationship between science and food. Current issues and future challenges in food science. Impact of technology, government, consumers and the media.

150 Introduction to Human Nutrition
 Fall, Spring, Summer. 3(3-0) Interdepartmental with Human Nutrition and Foods. Administered by Department of Food Science and Human Nutrition.
 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, Spring. 3(3-0)
 Scientific principles, historical perspective, and current status of technology related to food composition, safety, toxicology, processing, preservation, and distribution.

Food Science—FSC

- 421 Food Laws and Regulations**
Spring. 3(3-0) P:M: (HNF 150 or HNF 311 or FSC 211 or FIM 100)
Adoption, interpretation, and enforcement of laws and regulations governing food processing and foodservice systems. Impact of regulation on food production, availability, marketing, and safety.
- 423 Functional Foods and Human Health**
Spring of even years. 3(3-0) P:M: (HNF 150 or HNF 311 or concurrently) and (MMG 205 or MMG 301 or FSC 342) and (BMB 200 or concurrently or BMB 401 or concurrently)
Concept, nature and classification of functional foods. Spectrum of biological activity. Positive and negative impacts on health, and regulatory aspects.
- 430 Food Processing: Fruits and Vegetables**
Fall. 3(2-3) P:M: (FSC 211) R: Not open to freshmen or sophomores. SA: FSC 330
Fruit and vegetable composition and quality indices. Harvest technology, post-harvest physiology, and preparatory systems. Principles and applications of thermal processing, freezing, and specialized techniques.
- 431 Food Processing: Cereals**
Spring. 3(2-3) P:M: (FSC 211) R: Not open to freshmen or sophomores. SA: FSC 331
Classification and composition of cereals. Milling processes. Cereal product manufacture.
- 432 Food Processing: Dairy Foods**
Spring. 3(2-3) P:M: (FSC 211 or ANS 210) R: Not open to freshmen or sophomores. SA: FSC 332
Principles for production and processing of safe and wholesome dairy foods. Practical experience in safety and quality assurance systems and in the processing of fluid milk, cultured products, cheese, and frozen desserts.
- 433 Food Processing: Muscle Foods**
Fall. 3(2-3) P:M: (FSC 211 or ANS 210) R: Not open to freshmen or sophomores. SA: FSC 333
Manufacturing practices and principles of fresh, frozen, and cured meats and fish. Processed products from muscle foods. Egg characteristics. Product formulation and quality control.
- 440 Food Microbiology**
Spring. 3(3-0) Interdepartmental with Microbiology and Molecular Genetics. P:M: (MMG 201 or MMG 301) and completion of Tier I writing requirement. R: Not open to freshmen. SA: MPH 440
Major groups of microorganisms of importance to the food industry. Ecological, physiological, and public health aspects.
- 441 Food Microbiology Laboratory**
Spring. 2(0-4) Interdepartmental with Microbiology and Molecular Genetics. P:M: (FSC 440 or concurrently) and completion of Tier I writing requirement. RB: (MMG 206 or MMG 302) SA: MPH 441
Methods for studying major groups of microorganisms important to the food industry. Isolation, enumeration, characterization, identification, and use of microorganisms.
- 455 Food Analysis**
Fall. 3(2-3) P:M: (BMB 200) or (BMB 401 or concurrently) and 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, and proximate composition.
- 470 Integrated Approaches to Food Product Development**
Fall, Spring. 3(2-3) P:M: (FSC 402 or concurrently or FSC 441 or concurrently or FSC 455 or concurrently) RB: (FSC 325 and BE329) R: Open only to seniors or graduate students.
Food product development including obtaining, screening, and selecting ideas. Integration of food processing, chemistry, analysis, and microbiology for the design, production, and evaluation of a food product.
- 477 Food Engineering: Fluids**
Fall. 3(2-2) Interdepartmental with Biosystems Engineering. Administered by Department of Biosystems and Agricultural Engineering. P:M: (BE 350 and BE 351) RB: (CE321 or CHE311 or ME332) SA: FE 465
Unit operations, process engineering, equipment, and industrial practices of the food industry. Manufactured dairy products: thermal processing, pipeline design, heat exchange, evaporation, dehydration, aseptic processing, membrane separation, cleaning, and sanitation.
- 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 or sophomores. Approval of department; application required.
Individual study of selected topics in food science. Supervised independent study.
- 493 Professional Internship in Food Science**
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to juniors or seniors in Food Science. Approval of department; application required. A student may earn a maximum of 6 credits in all enrollments for any or all of these courses: ABM 493, AEE 493, ANR 493, ANS 493, CSS 493, EEP 493, FSC 493, FIM 493, FW 493, HRT 493, PKG 493, PLP 493, PRR 493, and RD 493.
Supervised professional experiences in agencies and businesses related to food science.
- 801 Chemistry of Food Lipids**
Fall of odd years. 3(3-0) RB: (FSC 401 and BMB 461)
Composition and structure of lipids: physical and chemical properties in relation to their function in foods.
- 802 Food Proteins**
Spring of even years. 3(3-0) RB: (BMB 461 and 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 years. 3(3-0) Interdepartmental with Animal Science; Human Nutrition and Foods. R: Approval of department.
Toxicology related to food safety. Metabolism of toxicants as influenced by food constituents, mutagenesis, and chemical carcinogenesis. Risk assessment.
- 823 Diet and Immune Function**
Spring of odd years. 3(3-0) RB: Biochemistry and Microbiology.
Influence of diet on the immune system and relationship to infectious and non-infectious diseases, adverse reactions such as food allergy, and alcohol and substance abuse. Methods to evaluate immune function.
- 831 Advanced Cereal Science**
Fall of even years. 3(3-0) RB: (BMB 401 and FSC 331 and 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.
- 840 Advanced Food Microbiology**
Spring of odd years. 3(3-0) RB: (FSC 440)
Detection, characterization, identification, and enumeration of food-associated pathogens. Applications and regulation of food biotechnology.
- 842 Foodborne Diseases**
Spring of odd years. 3(3-0) RB: (FSC 440 or FSC 840)
Epidemiology, isolation, characterization, clinical manifestations, pathogenicity, incidence and control of bacterial, parasitic and viral foodborne pathogens and associated toxins.
- 860 Research in Food Processing Technology**
Summer of even 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 master's 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.

Master's thesis research.

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.

Doctoral dissertation research.

FORENSIC SCIENCE FRS

School of Criminal Justice College of Social Science

809 Issues in Forensic Science
Fall, Spring. 2 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course.

Forensic science research, practice and legal processes.

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

Individual research and writing under faculty supervision.

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

Observation, study, and work in selected forensic science agencies.

899 Master's Thesis Research
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course.

Planned research and writing directed by student's thesis committee.

FORESTRY FOR

Department of Forestry College of Agriculture and Natural Resources

101 Michigan's Forests
Spring. 3(3-0)
Ecological, social and economic roles of Michigan's forests in historic and contemporary context. Geographic similarities and differences in forest resources.

201 Foundations of Forestry
Fall. 2(2-0) R: Open only to students in the Department of Forestry.
History, founding principles, and core concepts of forestry. Stewardship, conservation, professional ethics, and current forestry issues.

202 Introduction to Forestry
Fall, Spring. 3(3-0)
Historical development of forestry. Forest growth, protection, management, and products. Relationship of national and world economy and policy to forestry. Emphasis on multiple uses of forests.

204 Forest Vegetation
Fall. 4(3-3)
Nomenclature, classification, and identification of woody plants. Tree structure as it relates to growth and ecosystem dynamics.

210 Fundamentals of Soil and Landscape Science
Fall, Spring. 3(2-3) Interdepartmental with Crop and Soil Sciences. Administered by Department of Crop and Soil Sciences. RB: (CEM 141)
Agricultural and natural resource ecosystems: soil, vegetation and ground water components. Energy, water and nutrient cycles. Soil classification and mapping. Land management and use issues.

211 Introduction to Gender and Environmental Issues
Spring. 3(3-0) Interdepartmental with Fisheries and Wildlife; Environmental Economics and Policy; Resource Development; Women's Studies. Administered by Department of Fisheries and Wildlife. R: Not open to freshmen. SA: PRM 211
The concept of gender. Overview of environment and habitat. Historical gender roles in environmental management. Gender-based theoretical perspectives. Case studies on developing and developed countries. Environmental management with emphasis on fisheries, wildlife and wetlands. Women environmental professionals.

220 Forests and the Global Environment
Fall. 3(3-0)
Relationships between forests, climatic and edaphic factors, and human influences upon forest resources. Deforestation, biodiversity, sustainable forest management and timber trade.

304 Wood Technology
Fall. 4(3-2) P:M: (CEM 141 and PHY 231) and (MTH 116 or MTH 104 or LBS 117) R: Not open to freshmen or sophomores.
Structure and identification of wood. Physical and mechanical characteristics. Major industrial timber utilization processes including manufacture of lumber, furniture, composites, and paper.

305 Wood Composites
Spring. 2(2-0) P:M: (CEM 141 or CEM 151 or CEM 181H)
Physical and chemical principles of wood adhesion. Wood gluing. Wood adhesives and their properties. Manufacturing principles of wood-based composites. Composite design, process unit operations, property evaluation, and applications. New wood-based composite developments.

306 Forest Biometry
Spring. 4(3-2) P:M: (MTH 124 or MTH 132 or LBS 118) RB: (FOR 204) R: Not open to freshmen or sophomores.
Describing location and area of forest resources. Quantification of site, stand, and tree characteristics. Sampling and inventory. Predicting growth and yield.

330 Social Applications in Forestry
Spring. 2(2-0) P:M: (ISS 210 or ISS 215 or ISS 220 or ISS 225)
Social factors underlying forest resource management issues. Public values, attitudes, knowledge, and behavior with respect to forests. Public participation, conflict resolution, and communicating forestry issues.

393 Forest Products Internship
Summer. 2 credits. RB: (FOR 304 or FOR 305) R: Open only to juniors in the Forestry major.
Pre-professional educational employment experience in forest products industry, government, or public agency.

400 Forest Harvest Operations
Spring. 2(1-2) P:M: (CSS210) and (FOR404) and (MTH124 or concurrently or MTH132 or concurrently) RB: (FOR 406 and FOR 420) R: Open only to juniors or seniors.
Forest harvest systems, components and equipment, non-timber products, and road and transport planning. Soil, slope, riparian and wetland limitations. Erosion prediction and control. Harvest contracting and best management practices.

404 Forest and Agricultural Ecology
Fall. 3(3-0) Interdepartmental with Crop and Soil Sciences. P:M: (CSS 210) and (BOT 105 or BS 110) RB: (ZOL 355)
Ecological interactions crucial to the sustainable management of crop and forest ecosystems. Plant resources, competition, community development and dynamics, biodiversity, primary productivity, nutrient cycling, ecosystem structure and function, and impacts of global environmental change.

404L Forest and Agricultural Ecology Laboratory
Fall. 1(0-3) Interdepartmental with Crop and Soil Sciences. P:M: (CSS 210) and (BOT 105 or BS 110) and (FOR 404 or concurrently) RB: (ZOL 355)
Field studies and data analysis of ecological processes central to the sustainable management of forest and agricultural resources. Field exercises cover primary production, community structure, soil resources, biodiversity, succession, nutrient cycling, critiques of primary literature. Two weekend field trips required.

406 Silviculture
Spring. 4(3-3) P:M: (FOR 204 and FOR 404) R: Not open to freshmen or sophomores.
Ecophysiology of tree growth and reproduction. Stand structure, composition and growth. Intermediate stand treatments. Natural and artificial reproduction. Silvicultural techniques.