

Food Science (FS)

FS 201 Introduction to Food Science (3 credit hours)

Food science is an exciting, multidisciplinary career that draws on chemistry, microbiology, and engineering principles to produce, preserve, and protect the foods that we eat every day. This course is designed to help you understand the journey of foods from "farm to fork", the effect of diet on human health, and the laws governing food labeling and marketing. It's science you can eat!

GEP Natural Sciences

Typically offered in Fall, Spring, and Summer

FS 221 Discover: Chocolate, Coffee and Tea (3 credit hours)

The goal of this course is to discover the science and art behind the manufacturing of three widely consumed commodities, namely chocolate, coffee, and tea. While these are products commonly enjoyed by consumers, the quality, safety, and sensorial aspects associated with these products are not often understood and appreciated. Thus, this course will deal with the steps involved in making coffee, chocolate, and tea and explain the microbiological, chemical, and physical aspects associated with each step.

GEP Natural Sciences

Typically offered in Summer only

FS 222 Discover: Conventional, Organic and Genetically Engineered Foods (3 credit hours)

The goal of this course is to discover the differences between conventional, organic, and genetically modified foods and the associated manufacturing practices and regulations, including labeling. An overview of the science, safety, efficacy, advantages, and disadvantages of each of the production practices will be given. After the foundational concepts are covered, this course will focus on the impact of these practices on food manufacturing, sustainability, food security, and consumers.

GEP Natural Sciences

Typically offered in Summer only

FS 250 Basics of Food Safety & Quality (3 credit hours)

This course examines the programs that maintain food safety and quality in food processing environments. It is based on international standards for food safety prerequisite programs in food manufacturing. Students will learn how to evaluate and manage pre-requisite programs for food safety. Examples include Good Manufacturing Practices (GMPs), Sanitation Standard Operating Procedures (SSOPs), Sanitation Control Procedures, and Preventive Controls.

Typically offered in Fall and Summer

FS 290 Careers in Food and Bioprocessing Sciences (1 credit hours)

Careers and opportunities related to food and bioprocessing industries and regulatory agencies. Development of professional enhancement skills. Resume preparation, interviewing techniques, leadership development, oral and written communication, and team building. Benefits of undergraduate research, internships, and graduate education.

Typically offered in Fall only

FS 295 Special Topics in Food Science (1-4 credit hours)

Offerings of new or experimental courses in Food Science at the early undergraduate level.

Typically offered in Fall, Spring, and Summer

FS 301/NTR 301 Introduction to Human Nutrition (3 credit hours)

Functions, dietary sources, digestion and absorption, deficiencies and excesses of essential nutrients in humans; dietary guidelines; food labels; the study of diet-disease relationships; the role of diet in heart disease, diabetes, hypertension, osteoporosis; energy balance and weight control; dietary supplement regulation; diet and athletic performance.

Prerequisite: Sophomore standing

GEP Natural Sciences

Typically offered in Fall, Spring, and Summer

FS 322/PO 322/ANS 322 Muscle Foods and Eggs (3 credit hours)

Processing and preserving fresh poultry, red meats, seafood, and eggs. Ante- and post-mortem events as they affect quality, yield, and compositional characteristics of muscle foods. Principles and procedures involved in the production of processed meat items.

Prerequisite: ZO 160, BIO 181 or BIO 183

Typically offered in Fall only

FS 324/ANS 324 Milk and Dairy Products (3 credit hours)

Introduction to the manufacture of dairy products. Dairy processing procedures from the farm, through the dairy plant, and to the consumer are studied. The course consists of 15 learning modules, three exams, and a project.

Prerequisite: BIO 181 or 183, CH 101

Typically offered in Fall only

FS 325/BBS 325 Introduction to Brewing Science and Technology (3 credit hours)

For centuries brewing has been and remains a vitally important application of fermentation science, both economically and socially. This course will provide a detailed description of the fundamental chemical and biological processes involved in brewing beer, as well as the physical and hygienic aspects of modern beer production. Successful completion of this course will provide students with the understanding of the science and technology underlying the key steps in a commercial brewing process and provide the basic knowledge necessary for an entry level position in a commercial brewery.

Prerequisite: CH 101 and BIO 183 or BIO 181

Typically offered in Spring only

FS 326/BBS 326 Brewing Practices and Analyses (3 credit hours)

This course will provide a hands on learning experience to both complement the classroom lectures offered in BBS/FS 325 and acquaint the student with the equipment and practices encountered in real-world analytical labs of breweries of all scales. The laboratory experience will replicate the sequence of events encountered in actual beer production and illustrate the relevant evaluations and analyses which are concurrent with those processing steps, stressing at each stage not only the execution of the appropriate analytical or testing techniques, but also corrective action that may be taken should undesirable results be obtained.

Prerequisite: BBS/FS 325 Introduction to Brewing Science and Technology

Typically offered in Fall only

FS 330 Science of Food Preparation (3 credit hours)

Basic elements of culinary practices are taught in conjunction with the scientific basis for how flavor, texture, and appearance of foods are created or maintained during food preparation.

Prerequisite: FS 201 and CH 101

Typically offered in Spring only

FS 331 Principles of Food and Bioprocess Engineering (4 credit hours)

Engineering concepts and their applications to the food and bioprocessing industries. Dimensions and units, mass and energy balances, fluid flow, heat transfer, refrigeration, freezing, psychrometrics, evaporation, dehydration, thermal processing, aseptic processing, alternative technologies (ohmic, microwave, radio frequency, infrared, high pressure, UV, pulsed electric field, ultrasonics, pulsed light, irradiation, ozone, cold atmospheric pressure plasma, supercritical fluids) in food and bioprocessing.

Prerequisite: PY 211 or PY 205 and PY 206

Typically offered in Spring only

FS 352 Introduction to Microbiological Food Safety Hazards (3 credit hours)

For non-science students. The course is designed to provide an introduction to the more prominent microbial foodborne safety hazards and their control. Lessons are provided on specific pathogens, their pathogenesis and transmission and the scientific basis for specific control options. In addition, the course provides up-to-date information on current "hot-topics" in food microbiology, including food safety regulations and emerging food safety issues. Course is offered to non-science majors. Students may not receive credit for both FS 352 and FS 405.

Typically offered in Fall and Spring

FS 354 Food Sanitation (3 credit hours)

Discussion of hygienic practices, requirements for sanitation programs, and modern sanitation practices in food processing facilities. At the end of this course, students will have the knowledge to develop and maintain a sanitation program.

Prerequisite: FS/ANS/PO 350 or equivalent HACCP industry experience

Typically offered in Fall and Spring

FS 401/NTR 501/FS 501/NTR 401 Advanced Nutrition and Metabolism (3 credit hours)

Nutritional biochemistry and physiology as it relates to establishment of nutrient requirements and Dietary Reference Intakes. Digestion, absorption, metabolism, storage, and excretion of nutrients and other markers of nutritional adequacy or excess with emphasis on micronutrients. Functions of nutrients, in bone muscle, blood, growth and development and communication. Credit will not be awarded for both NTR (FS) 401 and NTR (FS) 501.

Prerequisite: (NTR 301 or NTR 415) and (CH 221 or CH 220 or CH 225)

Typically offered in Fall only

FS 402/FS 502 Chemistry of Food and Bioprocessed Materials (4 credit hours)

The course focuses on the properties of biological molecules (e.g., proteins, enzymes lipids, carbohydrates and pigments) found in foods and pharmaceuticals. Basic elements of molecules, such as structure and reactive groups, are presented in regard to how they affect the properties of foods and pharmaceuticals. Reactions such as Maillard browning and lipid oxidation are discussed regarding mechanisms, products and controlling processes. Laboratory experiments emphasize basic concepts discussed in lecture and provide a practical working knowledge of select analytical equipment.

Prerequisite: CH 220 or 221 or 225

Typically offered in Fall only

FS 403 Analytical Techniques in Food & Bioprocessing Science (4 credit hours)

Principles, methods and techniques for quantitative physical and chemical analyses of food, nutraceutical, and pharmaceutical products. Results of analyses evaluated in terms of quality standards and governing regulations.

Prerequisite: FS 402

Typically offered in Spring only

FS 405/MB 405/FS 505/MB 505 Food Microbiology (3 credit hours)

Microorganisms of importance in foods and their metabolic activities. Source of microbial contamination during food production, processing and storage. Microbial spoilage; foods as vectors of human pathogens. Physical and chemical destruction of microorganisms in foods and the kinetics involved. Conversions of raw foods by microorganisms into food products. Microbiological standards for regulatory and trade purposes. Credit will not be given for both FS/MB 405 and FS/MB 505.

Prerequisite: MB 351

Typically offered in Spring only

FS 406/MB 406/FS 506/MB 506 Food Microbiology Lab (2 credit hours)

Laboratory experience to complement FS/MB 405 or FS/MB 505. Skills in detecting and quantitating microorganisms and their toxins in foods. Application of colony and direct microscopic counts, most probable numbers, enzyme immunoassays, nucleic acid probes, and computer modeling are used to understand the numbers and types of microorganisms or microbial end products in foods. Laboratory safety and oral and written reports are emphasized.

Typically offered in Fall only

FS 416/FS 516 Quality Control in Food and Bioprocessing (3 credit hours)

This course provides an overview of the principles of quality management, assurance and control in the food and bioprocessing industries. The objectives are for students to be able to identify government regulations, private industry standards, and customer expectations that are relevant to food and bioprocessing, apply root cause analysis methodologies, apply and evaluate control charts for monitoring process control for variables and attributes, conduct process capability analyses, apply statistical hypothesis testing, and design producer and/or customer-centered sampling plans. Lab activities alternate between guest speakers from industry and exercises in which students develop their abilities to apply computer programs to solve quality problems. Note: students may not earn credit for taking both FS 416 and FS 516.

Restriction: FS, Bioprocessing, PSC, ANS, and NT students. Others may enroll with permission from the instructor. Section 601 is restricted to true distance education students (not regular term students).

Typically offered in Fall only

FS 421/FS 521 Food Preservation (3 credit hours)

Food preservation methods. Emphasis on thermal, freezing, drying and fermentation processes and corresponding physical, chemical and organoleptic changes to products. Application of preservation schemes to the development of an overall processing operation.

Prerequisite: FS 231 and FS 405

Typically offered in Fall only

FS 426/BEC 426/BBS 526/FS 526/BEC 526/BBS 426 Upstream Biomanufacturing Laboratory (2 credit hours)

This course is an introduction to current food manufacturing practice (CGMP) as applied to the growth of microbial cells in bioreactors. Hands-on experience is obtained in the operation and control of 30 liter bioreactors to study agitation, oxygen transfer, cleaning, sterilization, media preparation and the growth of recombinant E. coli for protein production. Credit will not be awarded in both BBS 426 and BBS/FS 526. This is an eight week course.

Prerequisite: (MB 351 and FS 231) CHE/BEC 463

Typically offered in Fall and Spring

FS 427/BBS 427 Brewing Equipment, Controls and Operations (3 credit hours)

Modern commercial brewing is an equipment and utility intensive endeavor. Emphasis on efficiency, flexibility and sanitation has led to equipment and controls which have vastly improved the volume and consistency of brewery output while also improving safety and the quality of the working environment. In order to manage the transfer of material and energy in the brewing process, individual components within the brewing system, as well holistic function of the brewery environment have been adapted to maximize efficiency. Knowledge of the specific design and operation of these components within the overall system is crucial to the proper functioning of a brewery. The operation of individual components and processes within the brewery will be examined in terms of the physics and engineering principles driving their function. On completion, this course will provide sufficient knowledge of brewery equipment and operations to function successfully in an entry to mid-level position.

Corequisite: BBS 325 or FS 325

Typically offered in Spring only

FS 435/FS 535 Food Safety Management Systems (3 credit hours)

This course teaches students how to develop and implement food safety management systems. It begins with the Hazard Analysis and Critical Control Points (HACCP) system and then teaches the Hazard Analysis and Risk-Based Preventive Controls (HARPC) system. Students will learn the step-by-step process for developing and implementing food safety plans to ensure food products are safe and wholesome. Students will apply theoretical knowledge as they engage with case studies through interactive videos and virtual reality tours as they practice developing and auditing food safety plans.

Prerequisite: FS 250

Typically offered in Spring only

FS 444/FS 544 Food Ingredient Functionality (3 credit hours)

Structure determines Function. This course focuses on the applied skills regarding how to utilize chemistry knowledge to select proper ingredients and to construct targeted food structure and texture based on the considerations of processability, phase stability and consumer preferences. The course integrates key knowledge and skills involved in three topics: "food ingredient functionality", "polymer and colloidal properties in food systems", and "food rheology". Ingredient functionality is an essential aspect of product development. This course covers food ingredient functionalities in regards to construction of different food structures (sol, gel, emulsion and foam), stabilization of physical properties of processed foods, and control of food texture to meet processability and mouth-feel requirements. Food chemistry knowledge will be implemented to investigate and construct different processed food systems from common ingredients used in the food industry.

Prerequisite: Graduate Standing and FS 402 or FS 502

Typically offered in Spring only

FS 445/FS 545 Food Product Development (4 credit hours)

Mastering food product development is required for Food Scientists to meet the changing needs and desires of consumers. The food product developer must also consider several factors, including changing lifestyles, nutritional awareness, and technological advances. This course utilizes a team-based approach to guide students as they solve professional food science problems while developing novel food products. It focuses on the principles of food product development including idea, concept, and prototype development and presentation, formulation, manufacturing, packaging, product costs, pricing, quality, safety, and marketing. It involves the application of skills gained in food chemistry, formulation, ingredient technology, laws and regulations, quality, safety, sensory, and processing while emphasizing teamwork and effective communication.

R: Graduate Standing

Typically offered in Fall only

FS 453/FS 553 Food Laws and Regulations (3 credit hours)

Federal and state laws and regulations, and case law history affecting food production, processing, packaging, marketing, and distribution of food and food products. History of food law, enactment of laws and regulations, legal research, and regulatory agencies. Credit will not be given for both FS 453 and FS 553.

Prerequisite: Junior standing.

FS 462/HS 462/HS 562/FS 562 Postharvest Physiology (3 credit hours)

Preharvest and postharvest factors that affect market quality of horticultural commodities with an emphasis on technologies to preserve postharvest quality and extend storage life of fruits, vegetables and ornamentals.

Typically offered in Spring only

FS 471 Professionalism & Project Preparation in Food & Bioprocessing Science (1 credit hours)

Discipline-specific professional development: teamwork, problem-solving and communication skills. Resume and interview preparation. Experimental design, literature review, budgeting and planning in preparation for the FS 475 Problems and Design in Food and Bioprocessing Science capstone course.

P: FS 231 and Senior Standing in Food Science or Bioprocessing Science

Typically offered in Fall only

FS 475 Problems and Design in Food and Bioprocessing Science (4 credit hours)

Increasingly competitive national and international markets for safe, nutritious foods of high quality have created a need for professionals capable of integrating the science of food and biological systems with advanced manufacturing technologies. This team-based, project-driven capstone course challenges students to apply knowledge gained throughout their undergraduate career to solve problems, design products, and optimize processes related to food and bioprocessing sciences. Teams will draw on a wide range of basic and applied disciplines, including chemistry, microbiology, processing and engineering, statistics, food safety, sensory evaluation, regulatory issues, labeling, marketing, finance, and sustainability to successfully complete their projects. Students will work with mentors who have expertise related to team projects. To further develop communication skills, written and oral presentations will be required throughout the semester.

Prerequisite: FS 231, FS 402, FS 405 and BAE(BBS) 425 with Senior standing

Typically offered in Spring only

FS 481 Research Experience in Food and Bioprocessing Sciences (3 credit hours)

Students actively engage in a research initiative at the USDA-Agriculture Research Service Food Science Research Unit. Students become familiar with the settings of food science laboratories, conduct literature reviews, manage the basic scientific structure applied to problem solving, are introduced to experimental design and data processing and synthesis to solve complex problems, and understand the unpredictable nature of scientific research. At the end of the course, students will be able to structure an informative public presentation on the results of the study and present their findings to diverse audiences. As part of the learning process students will acquire and/or further develop selected laboratory techniques associated with basic microbiology and chemistry. Course limited to rising juniors and seniors in good standing. Sophomores would need instructor approval to join the course.

Restriction: Juniors and Seniors Only

Typically offered in Summer only

This course is offered alternate odd years

FS 492 Professional Internship Experience in Food Science (1-3 credit hours)

A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by the student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing

Typically offered in Fall, Spring, and Summer

FS 493 Research Experience in Food Science (1-3 credit hours)

This course provides an opportunity for students to gain real-world experience in a scientific research program. A minimum of 42 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Undergraduate Teaching Coordinator for Food Science prior to the start of the experience. To gain approval, a student must submit the completed FS 493 contract and have it approved by his/her research supervisor, academic advisor and the FS 493 coordinator. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.

Prerequisite: Sophomore standing

Typically offered in Fall, Spring, and Summer

FS 494 Teaching Experience in Food Science (1-3 credit hours)

This course provides an opportunity for students to gain teaching experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Undergraduate Teaching Coordinator for Food Science prior to the start of the experience. To gain approval, a student must submit the completed FS 494 contract and have it approved by his/her experience supervisor, academic advisor and the undergraduate teaching coordinator/course instructor. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.

Typically offered in Fall, Spring, and Summer

FS 495 Special Topics in Food Science (1-3 credit hours)

Offered as needed to present materials not normally available in regular course offerings or for offering new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

FS 501/NTR 401/FS 401/NTR 501 Advanced Nutrition and Metabolism (3 credit hours)

Nutritional biochemistry and physiology as it relates to establishment of nutrient requirements and Dietary Reference Intakes. Digestion, absorption, metabolism, storage, and excretion of nutrients and other markers of nutritional adequacy or excess with emphasis on micronutrients. Functions of nutrients, in bone muscle, blood, growth and development and communication. Credit will not be awarded for both NTR (FS) 401 and NTR (FS) 501.

Prerequisite: (NTR 301 or NTR 415) and (CH 221 or CH 220 or CH 225)

Typically offered in Fall and Summer

FS 502/FS 402 Chemistry of Food and Bioprocessed Materials (4 credit hours)

The course focuses on the properties of biological molecules (e.g., proteins, enzymes lipids, carbohydrates and pigments) found in foods and pharmaceuticals. Basic elements of molecules, such as structure and reactive groups, are presented in regard to how they affect the properties of foods and pharmaceuticals. Reactions such as Maillard browning and lipid oxidation are discussed regarding mechanisms, products and controlling processes. Laboratory experiments emphasize basic concepts discussed in lecture and provide a practical working knowledge of select analytical equipment.

Prerequisite: CH 220 or 221 or 225

Typically offered in Fall only

FS 505/MB 505/FS 405/MB 405 Food Microbiology (3 credit hours)

Microorganisms of importance in foods and their metabolic activities. Source of microbial contamination during food production, processing and storage. Microbial spoilage; foods as vectors of human pathogens. Physical and chemical destruction of microorganisms in foods and the kinetics involved. Conversions of raw foods by microorganisms into food products. Microbiological standards for regulatory and trade purposes. Credit will not be given for both FS/MB 405 and FS/MB 505.

Prerequisite: MB 351

Typically offered in Spring only

FS 506/MB 506/FS 406/MB 406 Food Microbiology Lab (2 credit hours)

Laboratory experience to complement FS/MB 405 or FS/MB 505. Skills in detecting and quantitating microorganisms and their toxins in foods. Application of colony and direct microscopic counts, most probable numbers, enzyme immunoassays, nucleic acid probes, and computer modeling are used to understand the numbers and types of microorganisms or microbial end products in foods. Laboratory safety and oral and written reports are emphasized.

Typically offered in Fall only

FS 516/FS 416 Quality Control in Food and Bioprocessing (3 credit hours)

This course provides an overview of the principles of quality management, assurance and control in the food and bioprocessing industries. The objectives are for students to be able to identify government regulations, private industry standards, and customer expectations that are relevant to food and bioprocessing, apply root cause analysis methodologies, apply and evaluate control charts for monitoring process control for variables and attributes, conduct process capability analyses, apply statistical hypothesis testing, and design producer and/or customer-centered sampling plans. Lab activities alternate between guest speakers from industry and exercises in which students develop their abilities to apply computer programs to solve quality problems. Note: students may not earn credit for taking both FS 416 and FS 516.

Restriction: FS, Bioprocessing, PSC, ANS, and NT students. Others may enroll with permission from the instructor. Section 601 is restricted to true distance education students (not regular term students).

Typically offered in Fall only

FS 520/FSA 520 Pre-Harvest Food Safety (3 credit hours)

Dairy, beef, swine, poultry, and seafood modules: production, government regulation of products, use of antimicrobials in production, and the emergence of resistant human pathogens. Field fruit and vegetable crops section: hazards in food including pesticide residues and philosophy and practice of organic farming and public's perception of food and biotechnology.

Typically offered in Fall only

FS 521/FS 421 Food Preservation (3 credit hours)

Food preservation methods. Emphasis on thermal, freezing, drying and fermentation processes and corresponding physical, chemical and organoleptic changes to products. Application of preservation schemes to the development of an overall processing operation.

Prerequisite: FS 231 and FS 405

Typically offered in Fall only

FS 522 Food Packaging (3 credit hours)

This course deals with the history of packaging, types of packages, and packaging equipment, factors involved in choice of package, aseptic packaging, shelf-life studies, modified atmospheric packaging, active packaging, packaging for e-commerce, automatic identification and data capture, closures, seal integrity, tamper evidence, graphic design & printing, distribution, labeling, environmental issues, regulatory agencies and stipulations, new frontiers in packaging, and packaging resources. Restricted to students enrolled in (or degree received) in the Food Bioprocessing and Nutrition Sciences Program or a closely related program such as the Biological & Agricultural Engineering Program.

Typically offered in Spring only

This course is offered alternate odd years

FS 526/BEC 526/BBS 426/FS 426/BEC 426/BBS 526 Upstream Biomanufacturing Laboratory (2 credit hours)

This course is an introduction to current food manufacturing practice (CGMP) as applied to the growth of microbial cells in bioreactors. Hands-on experience is obtained in the operation and control of 30 liter bioreactors to study agitation, oxygen transfer, cleaning, sterilization, media preparation and the growth of recombinant E. coli for protein production. Credit will not be awarded in both BBS 426 and BBS/FS 526. This is an eight week course.

Prerequisite: (MB 351 and FS 231) CHE/BEC 463

Typically offered in Fall and Spring

FS 530/FSA 530 Post-Harvest Food Safety (3 credit hours)

Background on the current issues and developments associated with post-harvest food safety, including biological, chemical, and physical food safety hazards. Additionally, regulations governing food safety and consumer perceptions.

Prerequisite: MB 351/352

Typically offered in Fall only

FS 535/FS 435 Food Safety Management Systems (3 credit hours)

This course teaches students how to develop and implement food safety management systems. It begins with the Hazard Analysis and Critical Control Points (HACCP) system and then teaches the Hazard Analysis and Risk-Based Preventive Controls (HARPC) system. Students will learn the step-by-step process for developing and implementing food safety plans to ensure food products are safe and wholesome. Students will apply theoretical knowledge as they engage with case studies through interactive videos and virtual reality tours as they practice developing and auditing food safety plans.

Prerequisite: FS 250

Typically offered in Spring only

FS 540/FSA 540 Food Safety and Public Health (3 credit hours)

Issues and developments related to the relationship between food safety and public health, including emerging foodborne pathogens; virulence and pathogenicity; foodborne toxins; epidemiological techniques used in the investigation of foodborne disease; rapid detection methods; and quantitative microbial risk assessment in food safety.

Prerequisite: MB 351/352

Typically offered in Spring only

FS 544/FS 444 Food Ingredient Functionality (3 credit hours)

Structure determines Function. This course focuses on the applied skills regarding how to utilize chemistry knowledge to select proper ingredients and to construct targeted food structure and texture based on the considerations of processability, phase stability and consumer preferences. The course integrates key knowledge and skills involved in three topics: "food ingredient functionality", "polymer and colloidal properties in food systems", and "food rheology". Ingredient functionality is an essential aspect of product development. This course covers food ingredient functionalities in regards to construction of different food structures (sol, gel, emulsion and foam), stabilization of physical properties of processed foods, and control of food texture to meet processability and mouth-feel requirements. Food chemistry knowledge will be implemented to investigate and construct different processed food systems from common ingredients used in the food industry.

Prerequisite: Graduate Standing and FS 402 or FS 502

Typically offered in Spring only

FS 545/FS 445 Food Product Development (4 credit hours)

Mastering food product development is required for Food Scientists to meet the changing needs and desires of consumers. The food product developer must also consider several factors, including changing lifestyles, nutritional awareness, and technological advances. This course utilizes a team-based approach to guide students as they solve professional food science problems while developing novel food products. It focuses on the principles of food product development including idea, concept, and prototype development and presentation, formulation, manufacturing, packaging, product costs, pricing, quality, safety, and marketing. It involves the application of skills gained in food chemistry, formulation, ingredient technology, laws and regulations, quality, safety, sensory, and processing while emphasizing teamwork and effective communication.

R: Graduate Standing

Typically offered in Fall only

FS 550 Food Industry Study Tour (2 credit hours)

The Food Industry Study Tour is designed to give students a behind the scenes look into the food processing industry. This week-long trip, will allow students to travel throughout North Carolina and the Southeast region, touring various meat, dairy, seafood, produce, cereal, snack food, beverage, and candy production facilities. The class trip will run 5-6 days during the week of Spring Break holiday. Enrollment is limited and subject to the permission of the instructor.

Typically offered in Spring only

FS 553/FS 453 Food Laws and Regulations (3 credit hours)

Federal and state laws and regulations, and case law history affecting food production, processing, packaging, marketing, and distribution of food and food products. History of food law, enactment of laws and regulations, legal research, and regulatory agencies. Credit will not be given for both FS 453 and FS 553.

Prerequisite: Junior standing.

FS 554/NTR 554 Lactation, Milk, and Nutrition (3 credit hours)

Nutritional properties of milk as a high-quality food with nutritional diversity. Principles of physiology, biochemistry and cell biology in the mammary gland. Procedures of milk production and milk collection for milk quality and nutrition. Human lactation vs. that of domestic animals. Impacts of biotechnology and food safety on dairy production. Credit will not be given for both ANS 454 and 554.

Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421

Typically offered in Spring only

This course is offered alternate even years

FS 555/NTR 555 Exercise Nutrition (3 credit hours)

Metabolism of macro- and micronutrients as affected by exercise and physical activity. Effects of dietary patterns, specific foods, dietary supplements and ergogenic aids on sports performance. Reading and discussion of current literature and individual or group projects.

Prerequisite: NTR 400/500

Typically offered in Spring only

This course is offered alternate odd years

FS 557/NTR 557 Nutraceuticals and Functional Foods (3 credit hours)

This course evaluates the weight of evidence from peer-reviewed scientific literature relating food bioactives, whole foods, and diets to disease prevention, athletic performance, and cognitive development/enhancement. Data are viewed in the context of processing effects, global food and supplement regulations, as well as commercial marketing claims. Key concepts include dose-response, signal transduction, and the use of advanced technologies such as genomics, proteomics and metabolomics. Students will work in teams to develop and write a critical review manuscript suitable for publication.

Typically offered in Fall only

FS 558/NTR 558/TOX 558 Food Toxicology (3 credit hours)

This course evaluates the weight of evidence from peer-reviewed scientific literature relating the presence of chemical or biological toxins, whether naturally occurring or man-made in the food system to health outcomes. Toxicological data are viewed in the context of processing effects, global food and supplement regulations, as well as commercial marketing claims and sustainability. Key concepts include dose-response, phase I and phase II metabolism, signal transduction, and the use of advanced technologies such as genomics, proteomics, and metabolomics. Students will work in teams to develop and write a critical review manuscript suitable for publication.

Prerequisite: Graduate standing or advanced undergraduate students enrolled in Food Science, Nutrition, or Toxicology majors.

Typically offered in Fall only

This course is offered alternate even years

FS 562/FS 462/HS 462/HS 562 Postharvest Physiology (3 credit hours)

Preharvest and postharvest factors that affect market quality of horticultural commodities with an emphasis on technologies to preserve postharvest quality and extend storage life of fruits, vegetables and ornamentals.

Typically offered in Spring only

FS 567 Sensory Analysis of Foods (3 credit hours)

Techniques of sensory analysis and data interpretation, a crucial aspect of food science research and marketing both at the academic and industrial levels. Fundamental and applied aspects of sensory analysis of foods, including human senses, descriptive analysis, scaling, consumer testing and sensory-instrumental relationships.

Prerequisite: Statistics 511

Typically offered in Spring only

FS 580/FSA 580 Professional Development and Ethics in Food Safety (1 credit hours)

Professional development and ethics related to food safety. Food safety communications to lay-audiences and the media; the ethical frontier between science/policy and science/profit. Planned student and faculty presentations as well as guest lectures on current topical issues.

Prerequisite: FSA 520 or FSA 530 or FS 540

Typically offered in Spring only

FS 591 Special Problems In Food Science (1-6 credit hours)

Analysis of scientific, engineering and economic problems of current interest in foods. Problems designed to provide training and experience in research.

Prerequisite: Graduate standing or Senior standing

Typically offered in Fall, Spring, and Summer

FS 592 Special Research Projects in Food Science (1-6 credit hours)

Typically offered in Spring only

FS 620 Special Problems In Food Science (1-6 credit hours)

Analysis of scientific, engineering and economic problems of current interest in foods. Problems designed to provide training and experience in research.

Prerequisite: Graduate standing or Senior standing

Typically offered in Fall, Spring, and Summer

FS 623 Special Research Problems In Food Science (1-6 credit hours)

Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy.

Typically offered in Spring only

FS 685 Master's Supervised Teaching (1-3 credit hours)

Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student

Typically offered in Fall and Spring

FS 690 Master's Examination (1-9 credit hours)

For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student

Typically offered in Fall and Spring

FS 693 Master's Supervised Research (1-9 credit hours)

Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student

Typically offered in Fall, Spring, and Summer

FS 695 Master's Thesis Research (1-9 credit hours)

Thesis research.

Prerequisite: Master's student

Typically offered in Fall, Spring, and Summer

FS 696 Summer Thesis Research (1 credit hours)

For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student

Typically offered in Summer only

FS 699 Master's Thesis Preparation (1-9 credit hours)

For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student

Typically offered in Fall, Spring, and Summer

FS 725/MB 725 Fermentation Microbiology (3 credit hours)

Fermentation bioprocessing and characteristics, function and ecology of responsible microorganisms. Fermentative activities, growth responses and culture interactions related to metabolism, physiology and genetics of lactic acid bacteria and selected yeasts and molds. Current developments in starter culture technology and genetics; application to food and industrial fermentations.

Prerequisite: BCH 451, MB 351

Typically offered in Spring only

This course is offered alternate years

FS 741 Thermal Processing of Foods (3 credit hours)

Fluid flow, heat transfer, food preservation, kinetics of chemical, microbiological, and enzymatic reactions, decimal reduction time, pasteurization, sterilization, cook value, process lethality, canning of foods, thermal process evaluation, quality considerations, optimization, shelf-life studies, thermal processing equipment, hot-fill, extended shelf-life products, heat exchanger design, pumps, sanitation, aseptic processing, minimal processing, NFPA bulletins, alternative processing technologies, regulatory issues, HACCP.

Prerequisite: FS 231

Typically offered in Spring only

This course is offered alternate odd years

FS 780 Seminar In Food Science (1 credit hours)

Preparation and presentation of scientific papers, progress reports and research and special topics of interest in foods.

Typically offered in Fall and Spring

FS 791 Special Problems in Food Science (1-6 credit hours)

Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy. Credits Arranged.

Typically offered in Fall, Spring, and Summer

FS 792 Special Research Projects in Food Science (1-6 credit hours)

Credits Arranged

Typically offered in Fall only

FS 820 Special Problems In Food Science (1-6 credit hours)

Analysis of scientific, engineering and economic problems of current interest in foods. Problems designed to provide training and experience in research.

Prerequisite: Graduate standing or Senior standing

Typically offered in Fall, Spring, and Summer

FS 823 Special Research Problems In Food Science (1-6 credit hours)

Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy.

Typically offered in Spring only

FS 885 Doctoral Supervised Teaching (1-3 credit hours)

Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student

Typically offered in Fall and Spring

FS 890 Doctoral Preliminary Exam (1-9 credit hours)

For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student

Typically offered in Fall and Spring

FS 893 Doctoral Supervised Research (1-9 credit hours)

Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student

Typically offered in Fall, Spring, and Summer

FS 895 Doctoral Dissertation Research (1-9 credit hours)

Dissertation research.

Prerequisite: Doctoral student

Typically offered in Fall, Spring, and Summer

FS 896 Summer Dissertation Research (1 credit hours)

For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student

Typically offered in Summer only

FS 899 Doctoral Dissertation Preparation (1-9 credit hours)

For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student

Typically offered in Fall, Spring, and Summer