BIOSYSTEMS AND AGRICULTURAL ENGINEERING

The Department of Biosystems and Agricultural Engineering (BAE) is administered jointly by the Ferguson College of Agriculture and the College of Engineering, Architecture and Technology. Students interested in a degree in Biosystems Engineering can enroll through either college at which time they will be assigned an advisor in Biosystems Engineering. The degree is accredited by the Engineering Accreditation Commission of ABET (see www.abet.org (http://www.abet.org/)) under criteria for biological engineering and similarly named programs.

Biosystems engineers are professionals who create and adapt engineering knowledge and technologies for the efficient and effective production, processing, storage, handling and distribution of food, feed, fiber and other biological products, while at the same time providing for a quality environment and preserving and protecting natural resources. Biosystems engineers directly address problems and opportunities related to food, water, energy and the environment—all of which are critical to the quality of life in our society. Subject-matter specialization is provided through the following five undergraduate option areas: general, bioprocessing and food processing, environment and natural resources, machine systems and pre-medical.

The Biosystems Engineering program is a comprehensive engineering program that includes math, physical and biological sciences, basic engineering sciences and specialty areas. The first two years focus on the underlying biological, physical, chemical and mathematical principles of engineering, supplemented by appropriate general education courses in English, social sciences and humanities. The next two years builds systematically upon the scientific knowledge acquired in the early courses and students have the opportunity to focus on the option areas listed above.

Biosystems engineering courses integrate engineering sciences, physical sciences, and biological sciences, and teach students to address real-world challenges. With the guidance of experienced faculty, students work both as individuals and in teams to design creative solutions to complex problems. The coursework is specifically sequenced and interrelated to provide design experience at each level, leading to progressively more complex, open-ended problems. The coursework incorporates the social and economic aspects of technical problems, and stresses the responsibilities of engineering professionals to behave ethically and promote occupational and public safety. The program culminates in senior year design courses in which students integrate the analysis, synthesis and other abilities they have developed throughout the earlier portions of their study into a capstone experience. At this point, students are able to design components, systems and processes that meet specific requirements, including such pertinent societal considerations as ethics, safety, environmental impact and aesthetics. The students have also developed and displayed the ability to conduct experiments essential to specific studies and to analyze the experimental results that lead to meaningful conclusions.

An integral part of this education continuum—from basic science through comprehensive engineering design—is learning experiences that facilitate the students' abilities to function effectively in both individual and team environments. Moreover, the program provides every graduate with adequate learning experiences to develop effective written and oral communication skills. State-of-the-art computational tools are introduced and used as a part of their problem-solving experiences. Finally, the students' experience in solving ever-more-challenging problems enables them to continue to learn independently throughout their professional careers.

The Biosystems Engineering program verifies that our students possess core engineering knowledge and capability by requiring students to take the Fundamentals of Engineering exam, which is an important step toward becoming a professional engineer. All candidates for the BS degree in Biosystems Engineering must take the Fundamentals of Engineering exam prior to receiving their degree.

The overall objective of the undergraduate Biosystems Engineering degree program is to provide the comprehensive education necessary to prepare students for successful, productive and rewarding careers in engineering for agricultural, food and biological systems.

Within a few years of graduation, Biosystems Engineering program graduates will become top professionals, managers or leaders in a wide variety of industries and organizations involved with biosystems engineering, where they apply discovery, problem solving, and leadership skills for the benefit of their organization and the society at large.

A wide variety of employment opportunities are available for biosystems engineers in industry, public service and education. Some of these opportunities include positions in governmental agencies, consulting engineering firms, and agricultural and food equipment industries. Biosystems engineers are employed throughout the U.S. as well as internationally.

Courses

BAE 1011 Introduction to Biosystems Engineering
Description: Introduction to the Biosystems Engineering discipline; use of computers in solving engineering problems; and the application of computer software in engineering analysis and reporting. Previously offered as BAE 1012.
Credit hours: 1
Contact hours: Lab: 2 Contact: 2
Levels: Undergraduate
Schedule types: Lab
Department/School: Biosystems & Ag Eng

BAE 1022 Experimental Methods in Biosystems Engineering
Prerequisites: BAE 1012 or consent of instructor.
Description: An introduction to the basics of instrumentation, measurement techniques, and data analysis, with an emphasis on written communication skills. Lecture and laboratory exercises that address measurement principles, including accuracy, precision and error analysis.
Credit hours: 2
Contact hours: Lecture: 1 Lab: 2 Contact: 3
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 2013 Computational Methods in Biosystems Engineering
Description: Introduction to computer-based methods applied to biosystems and agricultural engineering problems. Application of spreadsheet tools and programming methods to solve engineering problems. Course previously offered as BAE 2012.
Credit hours: 3
Contact hours: Lecture: 2 Lab: 2 Contact: 4
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 3013 Heat and Mass Transfer in Biological Systems
Prerequisites: ENSC 3233, MATH 2233.
Description: Mechanisms of heat and mass transfer, with specific applications in transport processes of biological systems. Introduction to steady state and transient heat conduction and convection, radiation, diffusion, simultaneous heat and mass transfer.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 3023 Instruments and Controls
Prerequisites: ENSC 2613, MATH 2233.
Description: Design of control and instrumentation systems, including sensor and actuator principles, interface electronics, system identification, modeling, and performance specification. Applications in biological and agricultural systems. Design project required.
Credit hours: 3
Contact hours: Lecture: 2 Lab: 2 Contact: 4
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 3033 Advanced Biology and Material Science of Biomaterials
Prerequisites: BIOL 1114 or (BIOL 1113 and BIOL 1111) or PBIO 1404, PHYS 2014, MATH 2144.
Description: Building on basic biology and engineering fundamentals to characterize properties of biological materials such as moisture content and water movement, rheology, electromagnetic response, thermal properties, conveyance requirements, psychometric interactions and heating/cooling response. Course previously offered as BAE 2022 and BAE 2023.
Credit hours: 3
Contact hours: Lecture: 2 Lab: 2 Contact: 4
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 3113 Biological Applications in Engineering
Prerequisites: BAE 2012, BIOL 1114 or (BIOL 1113 and BIOL 1111), ENSC 2213, 3233, MATH 2233 or concurrent enrollment.
Description: Introduction to engineering applications of biological processes. Technologies covered include fermentation systems, enzyme kinetics, wastewater treatment and bioremediation.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 3213 Energy and Power in Biosystems Engineering
Prerequisites: Completion or concurrent enrollment in ENSC 2213, ENSC 2613, ENSC 3233.
Description: Analysis and design of energy generation, transmission, and utilization in the production and processing of biological materials.
Credit hours: 3
Contact hours: Lecture: 2 Lab: 2 Contact: 4
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 3223 Principles of Agriculture and Off-Road Machinery
Prerequisites: Completion or concurrent enrollment in ENSC 3233, ENSC 2613 and SOIL 2124.
Description: Principles of design, function, operation, testing and application of agricultural and off-road equipment and systems. Vehicle and implement system dynamics and hitching, and plant and soil interaction with machines. Machinery evaluation and standardized test procedures emphasizing safe and efficient performance of modern farm and off-road equipment.
Credit hours: 3
Contact hours: Lecture: 2 Lab: 2 Contact: 4
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 3313 Natural Resources Engineering
Prerequisites: BAE 2023, STAT 2013, and ENSC 3233 or concurrent enrollment.
Description: Principles and practices of engineering analysis and design applied to hydrology, water quality, erosion and sedimentation, air quality, irrigation and animal waste management. Course previously offered as BAE 3323.
Credit hours: 3
Contact hours: Lecture: 2 Lab: 3 Contact: 5
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 4001 Professional Practice in Biosystems Engineering
Prerequisites: Concurrent enrollment in BAE 4012.
Description: Preparation for professional practice through case studies about ethics, legal liability, safety, and societal issues. Practical professional communications experience.
Credit hours: 1
Contact hours: Contact: 1 Other: 1
Levels: Undergraduate
Schedule types: Discussion
Department/School: Biosystems & Ag Eng

BAE 4010 Special Topics in Biosystems Engineering
Description: New and emerging areas of study in Biosystems Engineering. Offered for variable credit, 1-4 credit hours, maximum of 8 credit hours.
Credit hours: 1-4
Contact hours: Lecture: 1-4 Contact: 1-4
Levels: Undergraduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 4012 Senior Engineering Design Project I
Prerequisites: Completion or concurrent enrollment in ENSC 2143, BAE 3013, BAE 3023, BAE 3213, BAE 4001.
Description: Team work on professional level design projects, using design procedures to develop specifications, propose alternative solutions, consider external constraints, develop drawings or plans, construct, test and evaluate designs.
Credit hours: 2
Contact hours: Lecture: 1 Lab: 2 Contact: 3
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 4023 Senior Engineering Design Project II
Prerequisites: BAE 4001, BAE 4012. BAE 4023 must be taken the immediate semester after completion of BAE 4012.
Description: Second of two-semester sequence of senior design courses. Course previously offered as BAE 4022.
Credit hours: 3
Contact hours: Lecture: 1 Lab: 4 Contact: 5
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 4043 In-Vehicle Networking for Off-Road and Heavy Duty Systems
Prerequisites: BAE 3023.
Description: Analysis of in-vehicle network systems and associated design issues. Introduction to CAN-based networking, serial and parallel communications, sensor interfacing, computer control of external devices, and comprehensive coverage of ISO 11783 and BAE J1939.
Credit hours: 3
Contact hours: Lecture: 1 Lab: 4 Contact: 5
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 4213 Precision Agriculture
Prerequisites: MATH 1513, senior standing.
Description: Introduction to the concepts of precision agriculture including analysis of spatial variability, relationships of fertility and crop response, geographical information systems, variable rate technology, optical sensing, global positioning systems, and yield monitoring. Case studies included for detailed analyses. Same course as SOIL 4213. May not be used for Degree Credit with BAE 5223.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 4224 Machinery for Production and Processing
Prerequisites: ENSC 2143.
Description: Analysis and design of machine components and machine systems for production and processing of biological materials. Component failure theory and analysis. Assembly and design of mechanical elements. Course previously offered as BAE 4223. May not be used for Degree Credit with BAE 5224.
Credit hours: 4
Contact hours: Lecture: 4 Contact: 4
Levels: Undergraduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 4283 Bioprocess Engineering
Prerequisites: BAE 3013, BAE 3113 or consent of instructor, ENSC 3233.
Description: Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up and downstream processing. Same course as CHE 4283. May not be used for Degree Credit with BAE 5283.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 4314 Design Hydrology
Prerequisites: BAE 3033, ENSC 3233, and STAT 4033 or STAT 4073, or concurrent.
Description: Basic principles of surface and groundwater hydrology and their application in engineering problems. The hydrologic cycle, weather and hydrology, precipitation, evaporation, transpiration, subsurface waters, stream flow hydrographs, hydrologic and hydraulic stream routing, probability of hydrologic events and application of hydrologic models. Laboratory component will emphasize the application of hydrologic and hydraulic models and the quantification of hydrologic and hydraulic parameters. Course previously offered as BAE 4313. May not be used for degree credit with BAE 5314.
Credit hours: 4
Contact hours: Lecture: 3 Lab: 2 Contact: 5
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 4323 GIS for Water Resources
Prerequisites: ENSC 2113 or GEOG 4203 or LA 4453 or NREM 2083.
Description: Various aspects of GIS applications in water resources, including spatial coordinate systems, acquisitioning water resources GIS data, water resources data management and processing, physiographic terrain analysis and mapping, river and watershed networks, National Hydrography Dataset (NHD), and Arc Hydro. May not be used for degree credit with BAE 5323.
Credit hours: 3
Contact hours: Lecture: 2 Lab: 2 Contact: 4
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 4324 Water Quality Engineering
Prerequisites: MATH 2233; BAE 2013; CHEM 1414 or CHEM 1515; or consent of instructor.
Description: Assessment of water quality, water and wastewater treatment, as well as point and nonpoint source pollution processes. Additional topics include principles of environmental chemistry, water body assessment, and integrated watershed management. May not be used for Degree Credit with BAE 5374.
Credit hours: 4
Contact hours: Lecture: 3 Lab: 3 Contact: 6
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 4343 Environmental Contaminant Fate and Transport
Prerequisites: BAE 4324 or consent of instructor.
Description: Physical, chemical, and biological processes that govern the environmental fate and transport of contaminants in natural systems including soil, water, and air. Topics include conceptual and mathematical models describing transport processes, mass balance, chemical equilibria and kinetics, and modelling. May not be used for degree credit with BAE 5343.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 4400 Special Problems
Description: Investigations in specialized areas of biosystems engineering. Offered for variable credit, 1-4 credit hours, maximum of 8 credit hours.
Credit hours: 1-4
Contact hours: Contact: 1-4 Other: 1-4
Levels: Undergraduate
Schedule types: Independent Study
Department/School: Biosystems & Ag Eng

BAE 4413 Food Engineering
Prerequisites: BAE 3013 and ENSC 3233, ENSC 2213.
Description: Analysis and design of various unit operations in food processing including thermal processing, drying, evaporation, freezing, processing non-Newtonian fluids and quality changes during processing. Course previously offered as BAE 4423. May not be used for Degree Credit with BAE 5443.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 5000 Master's Research and Thesis
Prerequisites: Consent of major professor.
Description: Research and thesis writing. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.
Credit hours: 1-6
Contact hours: Contact: 1-6 Other: 1-6
Levels: Graduate
Schedule types: Independent Study
Department/School: Biosystems & Ag Eng

BAE 5010 Advanced Topics in Biosystems Engineering
Prerequisites: Graduate standing or consent of instructor.
Description: New and emerging areas of study in Biosystems Engineering. Offered for variable credit, 1-4 credit hours, maximum of 8 credit hours.
Credit hours: 1-4
Contact hours: Lecture: 1-4 Contact: 1-4
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 5030 Problems in Biosystems Engineering and Agricultural Technology
Prerequisites: Consent of instructor.
Description: Problems associated with biosystems engineering and agricultural technology. Offered for variable credit, 1-6 credit hours, maximum of 9 credit hours.
Credit hours: 1-6
Contact hours: Contact: 1-6 Other: 1-6
Levels: Graduate
Schedule types: Independent Study
Department/School: Biosystems & Ag Eng

BAE 5213 Renewable Energy Engineering
Prerequisites: ENSC 2213, ENSC 3233 or consent of instructor.
Description: Renewable technologies such as solar, wind, geothermal, hydroelectric, and biomass to generate energy for electricity, heating, transportation, and other uses.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 5223 Precision Agriculture
Prerequisites: MATH 1513.
Description: Introduction to the concepts of precision agriculture including analysis of spatial variability, relationships of fertility and crop response, geographical information systems, variable rate technology, optical sensing, global positioning systems, and yield monitoring. Case studies included for detailed analyses. May not be used for degree credit with BAE 4213.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 5224 Machinery for Production and Processing
Prerequisites: ENSC 2143.
Description: Analysis and design of machine components and machine systems for production and processing of biological materials. Component failure theory and analysis. Assembly and design of mechanical elements. May not be used for degree credit with BAE 4224.
Credit hours: 4
Contact hours: Lecture: 4 Contact: 4
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 5243 Biological Conversion for Advanced Biofuels
Prerequisites: ENSC 2213.
Description: Fundamental principles and applications of converting biomass to advanced biofuels. Focus will be on biological processes, fermentor design and operation, product recovery and emerging fuels.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 5283 Advanced Bioprocess Engineering
Prerequisites: Consent of instructor.
Description: Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up and downstream processing. Same course as CHE 5283.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 5313 Watershed Modeling
Prerequisites: BAE 4313 or equivalent.
Description: A computer modeling course with an emphasis on chemical and physical processes governing nonpoint source pollution (nitrogen, phosphorus, sediment) at the basin scale. The laboratory use of state-of-the-art models applied to a variety of agricultural systems. "Hands on" use of comprehensive hydrologic water quality models that utilize spatial data in a geographic information system. Models and parameter uncertainty, digital data sources, parameter estimation and model testing, calibration and validation. For students with advanced personal computer skills.
Credit hours: 3
Contact hours: Lecture: 1 Lab: 6 Contact: 7
Levels: Graduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 5314 Design Hydrology
Prerequisites: BAE 2023 and ENSC 3233, and STAT 4033 or STAT 4073, or concurrent.
Description: Basic principles of surface and groundwater hydrology and their application in engineering problems. The hydrologic cycle, weather and hydrology, precipitation, evaporation, transpiration, subsurface waters, stream flow hydrographs, hydrologic and hydraulic stream routing, probability of hydrologic events and application of hydrologic models. Laboratory component will emphasize the application of hydrologic and hydraulic models and the quantification of hydrologic and hydraulic parameters. Course previously offered as BAE 4313. May not be used for degree credit with BAE 4314.
Credit hours: 4
Contact hours: Lecture: 3 Lab: 2 Contact: 5
Levels: Graduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 5323 GIS for Water Resources
Prerequisites: ENSC 2113 or GEOG 4203 or LA 4453 or NREM 2083.
Description: Various aspects of GIS applications in water resources, including spatial coordinate systems, acquisitioning water resources GIS data, water resources data management and processing, physiographic terrain analysis and mapping, river and watershed networks, National Hydrography Dataset (NHD), and Arc Hydro. May not be used for degree credit with BAE 4323.
Credit hours: 3
Contact hours: Lecture: 2 Lab: 2 Contact: 4
Levels: Graduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 5324 Modeling and Design in Storm Water and Sediment Control
Prerequisites: BAE 4313 or equivalent.
Description: Analysis and design of storm water, sediment and water quality systems with a focus on application to urban areas and developments in the urban-rural fringe. Advanced concepts in hydrologic modeling with kinematics, diffusion and dynamic modeling of flow; soil erosion, sediment transport and sediment control; storm water quality modeling and the impact of best management practices. In laboratories, use of hydrologic, sediment, and water quality models in analysis and design for real-world problems.
Credit hours: 4
Contact hours: Lecture: 3 Lab: 3 Contact: 6
Levels: Graduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 5333 Applied Water Resources Statistics
Prerequisites: STAT 5013 or equivalent.
Description: Applied statistical methods for hydrologists, engineers, and environmental scientists for analysis of environmental data. Parametric and nonparametric methods and exploratory data analysis applied to observed environmental data sets. Laboratory exercises emphasize hands-on application of statistical problems to reinforce concepts.
Credit hours: 3
Contact hours: Lecture: 2 Lab: 3 Contact: 5
Levels: Graduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 5343 Environmental Contaminant Fate and Transport
Prerequisites: BAE 4324 or consent of instructor.
Description: Physical, chemical, and biological processes that govern the environmental fate and transport of contaminants in natural systems including soil, water, and air. Topics include conceptual and mathematical models describing transport processes, mass balance, chemical equilibria and kinetics, and modeling. May not be used for degree credit with BAE 4343.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 5353 Environmental and Ecological Risk Assessment
Prerequisites: Graduate standing.
Description: Process and methodologies associated with human, environmental and ecological risks. Will quantify uncertainty in human perturbation, management, and restoration of environmental and ecological processes. Course available online only through AG*IDEA consortium.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 5374 Water Quality Engineering
Prerequisites: Graduate standing.
Description: Assessment of water quality, water and wastewater treatment, as well as point and nonpoint source pollution processes. Additional topics include principles of environmental chemistry, water body assessment and integrated watershed management. May not be used for degree credit with BAE 4324.
Credit hours: 4
Contact hours: Lecture: 3 Lab: 3 Contact: 6
Levels: Graduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 5413 Advanced Data Acquisition and Control
Prerequisites: BAE 3023 or equivalent.
Description: Principles and operation of commercial instruments and data acquisition systems used in biological, environmental, and agricultural applications. Hands-on projects that will improve system design, development and programming skills. Introduction of advanced topics including machine vision, spectroscopy, and data communication networks.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 5423 Food Rheology
Prerequisites: ENSC 3233.
Description: Characterization and analysis of the rheological properties of food products. Focus on measurement techniques and equipment, including tube and rotational type instruments, with specific applications in food processing.
Credit hours: 3
Contact hours: Lecture: 2 Lab: 2 Contact: 4
Levels: Graduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Biosystems & Ag Eng

BAE 5433 Biosensors
Prerequisites: PHYS 2114 and CHEM 3053 or equivalent.
Description: Principles and applications of biosensors in food analysis, disease diagnostics, and environmental monitoring. Emphasis on conceptual design and characterization of biosensors. Introduction to recent advances in biodetection using nanotechnology.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 5443 Food Engineering
Prerequisites: BAE 3013 and ENSC 3233, ENSC 2213.
Description: Analysis and design of various unit operations in food processing including thermal processing, drying, evaporation, freezing, processing non-Newtonian fluids and quality changes during processing. May not be used for degree credit with BAE 4413.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 5501 Seminar
Description: Discussion of current literature with special emphasis on research and experimental techniques. Graded on a pass-fail basis.
Credit hours: 1
Contact hours: Contact: 1 Other: 1
Levels: Graduate
Schedule types: Discussion
Department/School: Biosystems & Ag Eng

BAE 6000 Doctoral Research and Dissertation
Prerequisites: Approval by the student's advisory committee.
Description: Research and doctoral dissertation preparation. Offered for variable credit, 1-10 credit hours, maximum of 42 credit hours.
Credit hours: 1-10
Contact hours: Contact: 1-10 Other: 1-10
Levels: Graduate
Schedule types: Independent Study
Department/School: Biosystems & Ag Eng

BAE 6101 Teaching Practicum in Biosystems Engineering
Prerequisites: One semester of doctoral study in Biosystems Engineering, or consent of instructor; International students must pass the ITA exam.
Description: Philosophies and techniques of resident and non-resident teaching, including experiences in preparation, presentation, and evaluation of lectures, laboratories, extension or continuing education programs. Course previously offered as BAE 6100.
Credit hours: 1
Contact hours: Contact: 1 Other: 1
Levels: Graduate
Schedule types: Independent Study
Department/School: Biosystems & Ag Eng

BAE 6213 Advanced Biomass Thermochemical Conversion
Prerequisites: ENSC 2213.
Description: Advanced study, evaluation, and application of thermochemical conversion pathways in biofuel production. Specific topics include biomass gasification, pyrolysis, liquefaction, and heterogeneous catalysis. Course available online only through AG*IDEA consortium. Course previously offered as BAE 6100.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 6313 Stochastic Methods in Hydrology
Prerequisites: CIVE 5843, STAT 4033.
Description: Stochastic and statistical hydrologic analyses of surface water and groundwater systems. Analysis of urban and rural drainage and detention systems. Same course as CIVE 6843.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 6333 Fluvial Hydraulics
Prerequisites: BAE 3013 or equivalent.
Description: Principles of sediment detachment and transport in fluvial systems. Design of stable channels and flow resistance relationships for sediment-laden flows.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 6343 Ground Water Contaminant Transport
Prerequisites: SOIL 5583 or CIVE 5913 or GEOL 5453.
Description: Principles of solute and multiphase transport in soils and ground water. Effects of advection, diffusion, dispersion, degradation, volatilization and adsorption. Relationships between laboratory and field scale transport. Contamination by nonaqueous phase liquids.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 6503 Similitude in Research
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Biosystems & Ag Eng

BAE 6520 Problems in Soil and Water Engineering
Prerequisites: Consent of instructor.
Description: Consent of instructor. Problems associated with erosion control, drainage, flood protection and irrigation. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.
Credit hours: 2-6
Contact hours: Contact: 2-6 Other: 2-6
Levels: Graduate
Schedule types: Independent Study
Department/School: Biosystems & Ag Eng

BAE 6540 Prob Farm Power & Mach
Prerequisites: Consent of instructor.
Description: Literature review and analytical studies of selected farm power and machinery problems. Written report required. Offered for variable credit, 2-6 credit hours, maximum of 6 credit hours.
Credit hours: 2-6
Contact hours: Contact: 2-6 Other: 2-6
Levels: Graduate
Schedule types: Independent Study
Department/School: Biosystems & Ag Eng

BAE 6580 Problems in Transport Processes
Prerequisites: Consent of instructor.
Description: Literature review and analysis of heat and mass transport and interval diffusion in biological materials. Transport phenomena at interfaces, thermal and cryogenic processing, drying, packed and fluidized bed systems. Thermal and moisture control processing affecting quality of food products. Written report required. Offered for variable credit, 2-6 credit hours, maximum of 6 credit hours.
Credit hours: 2-6
Contact hours: Contact: 2-6 Other: 2-6
Levels: Graduate
Schedule types: Independent Study
Department/School: Biosystems & Ag Eng

BAE 6610 Adv Research & Study
Prerequisites: Approval by the student's advisory committee.
Description: Research and study at the doctoral level on the topic related to the student's doctoral program and field of interest. Offered for variable credit, 1-10 credit hours, maximum of 20 credit hours.
Credit hours: 1-10
Contact hours: Contact: 1-10 Other: 1-10
Levels: Graduate
Schedule types: Independent Study
Department/School: Biosystems & Ag Eng

Undergraduate Programs

- Biosystems Engineering: Bioprocessing & Food Processing, BSBE (http://catalog.okstate.edu/engineering-architecture-technology/biosystems-agricultural-engineering/bioprocessing-food-processing-bsbe/)
- Biosystems Engineering: Biosystems Engineering, BSBE (http://catalog.okstate.edu/engineering-architecture-technology/biosystems-agricultural-engineering/biosystems-engineering-general-option-bsbe/)
- Biosystems Engineering: Environmental and Natural Resources, BSBE (http://catalog.okstate.edu/engineering-architecture-technology/biosystems-agricultural-engineering/environmental-natural-resources-bsbe/)
- Biosystems Engineering: Machine Systems & Agricultural Engineering, BSBE (http://catalog.okstate.edu/engineering-architecture-technology/biosystems-agricultural-engineering/machine-systems-agricultural-engineering-bsbe/)
- Biosystems Engineering: Pre-Medical, BSBE (http://catalog.okstate.edu/engineering-architecture-technology/biosystems-agricultural-engineering/pre-medical-bsbe/)

Graduate Programs

BAE Graduate Programs

The Department of Biosystems and Agricultural Engineering offers Master of Science and Doctor of Philosophy degrees in Biosystems Engineering. Specific research areas include Machine System Engineering, Bioprocessing and Biotechnology, Food Engineering, and Environment & Natural Resources.

BAE provides excellent laboratory and computer facilities for students to explore research and design in such areas as bioprocessing and food engineering, machine vision, sensor and control technology, waste management and utilization, hydrology, water quality, porous media flow, and intelligent systems for agricultural machine design and production.

Research projects are supported by the Oklahoma Agricultural Experiment Station and by state, federal and private grants and contracts. Well-trained faculty members, many of whom are registered professional engineers with research, consulting and design experience, guide the graduate students' activities and plan programs to meet students' needs.

Graduate students design experiments and special equipment to conduct their work. They are expected to demonstrate, by supporting research or by design, the ability to identify a problem, define alternatives, propose a solution, organize a design or an experimental investigation, manage the project to completion, analyze and interpret data, and report the results through peer-reviewed papers and professional presentations.

Graduate Admission Requirements

Admission is competitive based on GPA(s) from previous degree(s), TOEFL/IELTS (for international students), statement of interests, experience, and recommendations. The GRE is not required, but often considered for graduate assistantship.

Minimum BAE Program Requirements

- Previous Degree:
  - An undergraduate degree in Biosystems Engineering or other Engineering from an ABET accredited or equivalent program (ABET Accredited Programs).
  - Students with undergraduate degrees in other disciplines or closely related fields, such as chemistry, physics, mathematics, biological science, agricultural sciences, and environmental sciences are also invited to apply to the BAE graduate program. Such applications are evaluated on an individual basis. Completion of additional credit hours of undergraduate course (such as engineering sciences and advanced biology) may be required before a BAE graduate Plan of Study is developed.
- Grade Point Average (GPA): GPA $\geq$ 3.0 (on a 4.0 scale). Equivalent grades are required from an international university.

Prior research and publication experience for a Ph.D. application are preferred.

Degree Requirements

Each graduate student follows an approved plan of study and is supervised by his/her advisory committee. The Plan of Study is designed to satisfy the individual goals of the student, while conforming to the general requirements of the BAE Department and the Graduate College.

Master of Science Degree – Thesis Option

MS students with a Thesis Option will complete a thesis reporting original research. Thirty (30) credit hours are required for the degree, which consists of 23 credits of coursework (including 9 credits of BAE courses), one (1) credit of BAE 5501, BAE Graduate Seminar, and six (6) credits of satisfactory research hours (BAE 5000).

Master of Science Degree – Non-Thesis Option with a Formal Format

MS students with a Non-Thesis Option and a Formal Report should complete a total of 32 credit hours, which consist of at least 28 credits of coursework (including 6 credits of BAE courses), one (1) credit of BAE 5501, BAE Graduate Seminar, and 1-3 credits of BAE 5000, Thesis Research.

Master of Science Degree – Non-Thesis Option

MS students with a Non-Thesis Option are required to complete a total of thirty-two (32) credit hours of coursework (including six credits of BAE courses and one credit of BAE 5501, BAE Graduate Seminar).

Doctor of Philosophy Degree (Ph.D.) – After MS Option

Ph.D. students are required to take a minimum total of 44 credit hours beyond an MS degree. This includes a minimum of 30 credits of BAE 6000 Thesis Research and 14 credits of coursework. The coursework is required to include at least 6 credits of BAE courses, including one (1) credit of BAE 6101,Teaching Practicum, and one (1) credit of BAE 5501, BAE Graduate Seminar.

Doctor of Philosophy Degree (Ph.D.) – After BS Option

Ph.D. students are required to take a minimum 74 credits beyond a BS degree. This includes a minimum of 36 credits of BAE 6000, Thesis Research, and 38 credits of coursework. The coursework should include at least six (6) credit hours of BAE courses, including one (1) credit hour of BAE 6101, Teaching Practicum and two (2) credit hours of BAE 5501, BAE Graduate Seminar.

Faculty

Mari S. Chinn, PhD—Professor and Department Head, AT&T Professorship in Engineering
Professor, Orville L. and Helen Buchanan Endowed Chair: Danielle Bellmer, PhD
Director, Capital Projects for CASNR/Assistant Director, Oklahoma Agricultural Experiment Station: Randy L. Raper, PhD, PE
Professors: Hasan Atiyeh, PhD, PE; Danielle D. Bellmer, PhD; Timothy J. Bowser, PhD, PE; Nurhan Dunford, PhD, PE; Ajay Kumar, PhD, PE; Yu Mao, PhD; Randal K. Taylor, PhD, PE; Ning Wang, PhD, PE
Associate Professors: Robert Scott Frazier, PhD, PE; Douglas W. Hamilton, PhD, PE; John Long, PhD, PE; Ali Mirchi, PhD
Assistant Professors: Sumon Datta, PhD; Keighobad Jafarzadegan, PhD; Kiranmayi Mangalgiri, PhD; Kevin Moore, PhD, MBA, CSP; Jeffrey Sadler, PhD
Assistant Extension Specialist: Wesley Lee, MS
Teaching Assistant Professor: Sara Alian, PhD
Adjunct Professors: Jason Vogel, PhD, PE
Adjunct Associate Professors: Krushna Patil, PhD; Derek Whitelock, PhD
Adjunct Assistant Professor: Sherry L. Hunt, PhD