BIOSYSTEMS AND AGRICULTURAL ENGINEERING

The Department of Biosystems and Agricultural Engineering 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 may initially enroll through either college, at which time they will be assigned a Biosystems Engineering advisor. The degree is accredited by the Engineering Accreditation Commission of ABET (see 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 science 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 build 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.

Students interested in a degree in Biosystems Engineering may initially enroll in the College of Engineering, Architecture and Technology or the College of Agricultural Sciences and Natural Resources. Through either college, they will be assigned a Biosystems Engineering advisor.

The Department of Biosystems and Agricultural Engineering offers programs leading to the Master of Science and Doctor of Philosophy degrees in Biosystems Engineering. These degrees emphasize research and development.

Excellent laboratory and computer facilities are available 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 designs, the ability to identify a problem, define alternatives, propose a solution, organize a design or an experimental investigation, manage the project to completion and report the results through peer-reviewed papers and professional presentations.

Admission Requirements

Admission to either the Master of Science or Doctor of Philosophy degree program requires graduation from an engineering curriculum accredited by the ABET Engineering Accreditation Commission, http://www.abet.org. Students without accredited degrees may be admitted provisionally and may be required to take additional courses. A student must be accepted
Degree Requirements

A candidate for the graduate degrees listed above follows an approved plan of study which must satisfy at least the minimum University requirements for that particular degree.

Courses

BAE 1012 Introduction to Biosystems Engineering
Prerequisites: Engineering major.
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.
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 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 Modeling in Biosystems Engineering
Prerequisites: MATH 2144; BIOL 1114 or BOT 1404.
Description: Introduction and modeling of various applications in biosystems and agricultural engineering. Case studies that emphasize the interface between engineering and biology in areas such as plant systems, industrial biological processes, sensor and control systems development, intelligent machine design, environmental remediation, water treatment systems and food processing. Use of a fourth generation programming language for solving engineering problems. Course previously offered as BAE 2012.
Credit hours: 3
Contact hours: Lecture: 3 Contact: 3
Levels: Undergraduate
Schedule types: Lecture
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: BAE 1022, BIOL 1114 or BOT 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, psychrometric 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, 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: BAE 1022, 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 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:** Completion or concurrent enrollment in BAE 4012, BAE 3013, BAE 3023.  
**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 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 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 4324 Water Quality Engineering
Prerequisites: BAE 4314 or CIVE 3843.
Description: Point and nonpoint source pollution processes, including transport mechanisms, and contaminant fate, control and remediation. Other topics include principles of ecological engineering, 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 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 4415 Special Topics: Bioprocess Engineering
Prerequisites: BAE 4413.
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 4443 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 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 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 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 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
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Description</th>
<th>Levels</th>
<th>Contact hours: Lecture: 3 Lab: 2 Contact: 5</th>
<th>Department/School</th>
<th>Schedule types: Lab, Lecture, Combined lecture and lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAE 5313</td>
<td>Watershed Modeling</td>
<td>BAE 4313 or equivalent.</td>
<td>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. &quot;Hands on&quot; 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.</td>
<td>Graduate</td>
<td>3 Contact hours: Lecture: 1 Lab: 6 Contact: 7</td>
<td>Biosystems &amp; Ag Eng</td>
<td>Lab, Lecture, Combined lecture and lab</td>
</tr>
<tr>
<td>BAE 5314</td>
<td>Design Hydrology</td>
<td>BAE 2023 and ENSC 3233, and STAT 4033 or STAT 4073, or concurrent.</td>
<td>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.</td>
<td>Graduate</td>
<td>4 Contact hours: Lecture: 3 Lab: 2 Contact: 5</td>
<td>Biosystems &amp; Ag Eng</td>
<td>Lab, Lecture, Combined lecture and lab</td>
</tr>
<tr>
<td>BAE 5324</td>
<td>Modeling and Design in Storm Water and Sediment Control</td>
<td>BAE 4313 or equivalent.</td>
<td>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.</td>
<td>Graduate</td>
<td>4 Contact hours: Lecture: 3 Lab: 3 Contact: 6</td>
<td>Biosystems &amp; Ag Eng</td>
<td>Lab, Lecture, Combined lecture and lab</td>
</tr>
<tr>
<td>BAE 5333</td>
<td>Applied Water Resources Statistics</td>
<td>STAT 5013 or equivalent.</td>
<td>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.</td>
<td>Graduate</td>
<td>3 Contact hours: Lecture: 2 Lab: 3 Contact: 5</td>
<td>Biosystems &amp; Ag Eng</td>
<td>Lab, Lecture, Combined lecture and lab</td>
</tr>
<tr>
<td>BAE 5343</td>
<td>Environmental Contaminant Transport</td>
<td>BAE 4313.</td>
<td>Conceptual and mathematical models for the transport of contaminants in natural systems with an emphasis on agricultural pollutants. Basic transport processes relevant to the three environmental media - air, water, and soil. Common features underlying pollutant transport.</td>
<td>Graduate</td>
<td>3 Contact hours: Lecture: 3 Contact: 3</td>
<td>Biosystems &amp; Ag Eng</td>
<td>Lecture</td>
</tr>
<tr>
<td>BAE 5353</td>
<td>Environmental and Ecological Risk Assessment</td>
<td>Graduate standing.</td>
<td>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.</td>
<td>Graduate</td>
<td>3 Contact hours: Lecture: 3 Contact: 3</td>
<td>Biosystems &amp; Ag Eng</td>
<td>Lab, Lecture, Combined lecture and lab</td>
</tr>
<tr>
<td>BAE 5374</td>
<td>Water Quality Engineering</td>
<td>BAE 4314 or CIVE 3843.</td>
<td>Point and nonpoint source pollution processes, including transport mechanisms, and contaminant fate, control and remediation. Other topics include principles of ecological engineering, water body assessment and integrated watershed management. May not be used for degree credit with BAE 4324.</td>
<td>Graduate</td>
<td>4 Contact hours: Lecture: 3 Lab: 3 Contact: 6</td>
<td>Biosystems &amp; Ag Eng</td>
<td>Lab, Lecture, Combined lecture and lab</td>
</tr>
<tr>
<td>BAE 5413</td>
<td>Advanced Instrumentation and Control Systems for Biological Applications</td>
<td>BAE 3023 or equivalent.</td>
<td>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.</td>
<td>Graduate</td>
<td>3 Contact hours: Lecture: 3 Contact: 3</td>
<td>Biosystems &amp; Ag Eng</td>
<td>Lecture</td>
</tr>
<tr>
<td>BAE 5433</td>
<td>Environmental Contaminant Transport</td>
<td>BAE 4313.</td>
<td>Conceptual and mathematical models for the transport of contaminants in natural systems with an emphasis on agricultural pollutants. Basic transport processes relevant to the three environmental media - air, water, and soil. Common features underlying pollutant transport.</td>
<td>Graduate</td>
<td>3 Contact hours: Lecture: 3 Contact: 3</td>
<td>Biosystems &amp; Ag Eng</td>
<td>Lab, Lecture, Combined lecture and lab</td>
</tr>
</tbody>
</table>
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  
**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  
**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  
**Department/School:** Biosystems & Ag Eng  

BAE 5501 Seminar  
**Description:** Discussion of current literature with special emphasis on research and experimental techniques.  
**Credit hours:** 1  
**Contact hours:** Contact: 1 Other: 1  
**Levels:** Graduate  
**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  
**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.  
**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:** Lab: 2 Contact: 3 Other: 1  
**Levels:** Graduate  
**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  
**Department/School:** Biosystems & Ag Eng  

BAE 6313 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  
**Department/School:** Biosystems & Ag Eng  

BAE 6333 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  
**Department/School:** Biosystems & Ag Eng  

BAE 6334 Ground Water Contaminant Transport  
**Prerequisites:** CIVE 5913 or ENSC 3233.  
**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  
**Department/School:** Biosystems & Ag Eng  

BAE 6501 Seminar  
**Description:** Discussion of current literature with special emphasis on research and experimental techniques.  
**Credit hours:** 1  
**Contact hours:** Contact: 1 Other: 1  
**Levels:** Graduate  
**Department/School:** Biosystems & Ag Eng  

BAE 6700 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  
**Department/School:** Biosystems & Ag Eng  

BAE 6711 Teaching Practicum in Biosystems Engineering  
**Prerequisites:** One semester of doctoral study in Biosystems Engineering, or consent of instructor.  
**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:** Lab: 2 Contact: 3 Other: 1  
**Levels:** Graduate  
**Department/School:** Biosystems & Ag Eng  

BAE 6713 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  
**Department/School:** Biosystems & Ag Eng  

BAE 6714 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  
**Department/School:** Biosystems & Ag Eng  

BAE 6715 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  
**Department/School:** Biosystems & Ag Eng  

BAE 6716 Ground Water Contaminant Transport  
**Prerequisites:** CIVE 5913 or ENSC 3233.  
**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  
**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: 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  
The Department of Biosystems and Agricultural Engineering offers programs leading to the Master of Science and Doctor of Philosophy degrees in Biosystems Engineering. These degrees emphasize research and development.  

Graduate Admission Requirements  
Admission to either the Master of Science or Doctor of Philosophy degree program requires graduation from an engineering curriculum accredited by the ABET Engineering Accreditation Commission, http://www.abet.org. Students without accredited degrees may be admitted provisionally and may be required to take additional courses. A student must be accepted by an advisor in the department prior to official admission to the graduate program.  

Excellent laboratory and computer facilities are available 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 designs, the ability to identify a problem, define alternatives, propose a solution, organize a design or an experimental investigation, manage the project to completion and report the results through peer-reviewed papers and professional presentations.  

Degree Requirements  
A candidate for the graduate degrees listed above follows an approved plan of study which must satisfy at least the minimum University requirements for that particular degree.  

Faculty  
John N. Veenstra, PhD, PE, BCEE—Professor and Department Head  
Professor Orville L. and Helen Buchanan Endowed Chair: Carol Jones, PhD, PE  
Regents Professor/Director, Biobased Products and Energy Center: Raymond L. Huhnke, PhD, PE  
Professor/Sarkey’s Professor/Assistant Director and State Program Leader, Agricultural Natural Resources, Oklahoma Cooperative Extension Service: Randal K. Taylor, PhD, PE  
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; Dan Thomas, PhD, PE; Ning Wang, PhD, PE; Paul Weckler, PhD, PE
Associate Professors: Robert Scott Frazier, PhD, PE; Douglas W. Hamilton, PhD, PE; John Long, PhD, PE; Yu Mao, PhD; Saleh Taghvaeian, PhD
Adjunct Associate Professor: Derek Whitelock, PhD
Assistant Professor: Ali Mirchi, PhD
Adjunct Assistant Professor: Sherry L. Hunt, PhD
Research Associate Professor: J.D. Carlson, PhD
Assistant Extension Specialist: Wesley Lee, MS
Teaching Assistant Professor: Sara Alian, PhD