BIOLOGICAL SYSTEMS ENGINEERING (BSE)

BSE 1 – COOPERATIVE EDUCATION PROGRAM
1 credit.

Full-time off-campus work experience which combines classroom theory with practical knowledge of operations to provide a background upon which to base a professional career.
Requisites: Consent of instructor
Course Designation: Workplace - Workplace Experience Course
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2025

BSE 170 – PRODUCT DESIGN PRACTICUM
2 credits.

Work in small groups to design, fabricate, and test a device that solves a real world problem. Includes retrieval techniques, specification writing, methods for enhancing creativity, selection methodologies, safety engineering, sustainability in design, shop safety, fabrication equipment and techniques, and oral and written communication.
Requisites: Declared in Biological Systems Engineering BS or classified as Pre-Biological Systems Engineering
Repeatable for Credit: No
Last Taught: Spring 2023
Learning Outcomes: 1. Work effectively in teams by creating a collaborative and inclusive environment, establishing goals and meeting objectives
Audience: Undergraduate

2. Practice oral and written communication
Audience: Undergraduate

3. Demonstrate safe use of engineering fabrication equipment and techniques and general shop safety procedures
Audience: Undergraduate

4. Generate a functional design prototype based on working through the engineering design process steps
Audience: Undergraduate

BSE 249 – ENGINEERING PRINCIPLES FOR BIOLOGICAL SYSTEMS
3 credits.

Applications of basic engineering principles such as mass and energy balances, psychrometric heat and mass transfer and fluid flow to problems encountered in agricultural and biological systems including grain conditioning, fruit and vegetable storage, food processing, animal housing, and environmental control.
Requisites: MATH 217 or 221
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Describe the definitions and relationships between material properties of biological materials, such as bulk density, moisture content, and porosity.
Audience: Undergraduate

2. Employ dimensional analysis to check the correctness of physical relations and to convert the value of a physical quantity in one system to the value in another.
Audience: Undergraduate

3. Describe the definitions and relationships among the thermodynamic properties such as internal energy, enthalpy, and entropy for pure materials and air-water mixtures.
Audience: Undergraduate

4. Employ energy and material balances in the analysis of batch and continuous as well as reactive and nonreactive processes.
Audience: Undergraduate

5. Use psychometric charts to design heating, cooling, and drying systems for biological materials.
Audience: Undergraduate

BSE 270 — INTRODUCTION TO COMPUTER AIDED DESIGN
3 credits.

Introduction to computer aided design (CAD) concepts and techniques, including two- and three-dimensional drawing presentation, methods of graphic communication and design synthesis. Specific topics include parametric solid modeling, part design, survey data and surface construction, orthographic drawings, dimensioning rules and drawing standards, assemblies, and animation.
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Demonstrate knowledge about fundamentals of computer aided design (CAD) concepts and techniques that include two- and three-dimensional graphical presentations
Audience: Undergraduate

2. Create CAD parts, assemblies, and engineering drawings
Audience: Undergraduate

3. Apply the methods of graphic communication rules which include Geometric Dimensioning and Tolerancing (GD&T)
Audience: Undergraduate

4. Present data, design synthesis, and production methods in engineering graphics
Audience: Undergraduate

5. Apply the proper and efficient use of the latest engineering design and analysis tools
Audience: Undergraduate

BSE 289 — HONORS INDEPENDENT STUDY
1-2 credits.

Research work for Honors students under direct guidance of a faculty member in an area of Biological Systems Engineering. Students are responsible for arranging the work and credits with the supervising instructor.
Requisites: Consent of instructor
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions

BSE 299 — INDEPENDENT STUDY
1-3 credits.

Research work for students under direct guidance of a faculty member in an area of Biological Systems Engineering. Students are responsible for arranging the work and credits with the supervising instructor.
Requisites: Consent of instructor
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2024

BSE 301 — LAND INFORMATION MANAGEMENT
3 credits.

An introduction to land information management through the principles of geospatial technologies and methods for analysis and interpretation of geospatial data. Includes both the basic land surveying technology and advanced remote observation of land resources by airborne and space-based sensors.
Requisites: MATH 113, 114, or 217
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Describe basic geospatial concepts and engineering principles applicable to the acquisition and management of land information.
Audience: Undergraduate

2. Apply an engineer's level and total station instrument for land surveying.
Audience: Undergraduate

3. Identify important resources, and retrieve, interpret, analyze and critique information for use in solving geospatial engineering problems and conducting basic land information investigations.
Audience: Undergraduate

4. Apply the remote sensing techniques and geospatial data processing tools for land information management.
Audience: Undergraduate

5. Communicate effectively through engagement during in-class discussions.
Audience: Undergraduate

BSE 308 — CAREER MANAGEMENT FOR ENGINEERS
1 credit.

Develop engineering career and life skills in time management, housing selection, financial management, the job search process, professional networking, branding and social media presence, professional development and professional society membership, leadership, professional ethics, and registration/licensure. Understand future trends in digital technology, climate change, diversity, and sustainability and how they affect career opportunities in the engineering field.
Requisites: None
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2025
Learning Outcomes: 1. Identify the basic personal financial management skills#necessary for early-career engineers, including preparing for costs such as#housing, healthcare, and transportation.#
Audience: Undergraduate

2. Recognize and implement select improvement strategies in the areas of interpersonal skills, communication, and social media facility to build personal and professional networks and create a "brand" as an engineer.#
Audience: Undergraduate

3. Identify and explain the benefits of direct involvement in one's engineering professional society/organization, including building ongoing professional relationships and pursuing ongoing professional development and lifelong learning.
Audience: Undergraduate

4. Explain the processes and professional benefits associated with completing the FE (Fundamentals of Engineering) exam and becoming a PE (Professional Engineer).
Audience: Undergraduate

5. Apply the Engineering Code of Ethics to specific cases and scenarios that present ethical challenges for engineers around decision making, product safety, economic tradeoffs, sustainability, and other issues.
Audience: Undergraduate

6. Provide examples of the importance of understanding diversity (gender, ethnicity, culture, etc.) as a practicing engineer as it relates to working on an engineering team and best serving a global customer base.#
Audience: Undergraduate

7. Develop a long-range,#comprehensive career plan that includes goal setting, plans for lifelong learning, personal financial management/ decision making, and#other factors,#synthesizing the semester's class content.
Audience: Undergraduate

8. Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts. (ABET Outcome 4)
Audience: Undergraduate

9. Acquire and apply new knowledge as needed, using appropriate learning strategies. (ABET Outcome 7)
Audience: Undergraduate

10. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. (ABET Outcome 2)
Audience: Undergraduate

BSE 310 — PROJECT ECONOMICS & DECISION ANALYSIS
3 credits.

Evaluation techniques for research, development engineering projects. Covers the time value of money and other cash-flow concepts, capital budgeting, economic practices and techniques used to evaluate and optimize decisions, and research development project portfolio management techniques.
Requisites: MATH 113, 114, or (MATH 171 and 217)
Course Designation: Breadth - Social Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Define the terminology used in project economic analysis
Audience: Undergraduate

2. Describe time-value-of-money and discounting concepts
Audience: Undergraduate

3. Apply the criteria for making economic-based decisions
Audience: Undergraduate

4. Analyze before-tax and after-tax cash flows
Audience: Undergraduate

5. Explain economic risk analysis techniques
Audience: Undergraduate

6. Demonstrate capability to use a spreadsheet program in solving economic problems
Audience: Undergraduate

7. Estimate costs and perform an economic analysis in support of a research or engineering project
Audience: Undergraduate

8. Describe techniques used to manage company project portfolios
Audience: Undergraduate

9. Develop engineering economic problem-solving techniques similar to those in the Engineering Economics portion of the Fundaments of Engineering exam
Audience: Undergraduate

BSE/AN SCI 344 – DIGITAL TECHNOLOGIES FOR ANIMAL MONITORING
3 credits.

Introduces key concepts of sensor technology used for livestock and companion animal monitoring and veterinary medicine. Describes applications of Artificial Intelligence (AI) systems for livestock animals and veterinary medicine, including animal monitoring, computer-aided diagnosis, and optimized farm management decisions.
Requisites: (MATH 112, 114, 171, or placement into MATH 221) or graduate/professional standing
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Explain what precision livestock is and why it is needed
Audience: Undergraduate

2. Demonstrate familiarity with data science and artificial intelligence principles as applied to agricultural systems and veterinary medicine
Audience: Undergraduate

3. Describe the current sensor sensing technologies used in livestock and companion animals
Audience: Undergraduate

4. Explain principles and applications of sensor technology applied to animals
Audience: Undergraduate

5. Identify artificial intelligence applications in veterinary medicine
Audience: Undergraduate

6. Evaluate the major ethical concerns associated with Artificial Intelligence for agriculture
Audience: Undergraduate

BSE 349 – QUANTITATIVE TECHNIQUES FOR BIOLOGICAL SYSTEMS
3 credits.

Principles of how energy and materials are utilized in Cells, organisms and ecosystems. Mass transfer, heat and energy balances applied to cell metabolism, plants, and ecosystems. Quantification of biological processes to allow manipulation for human benefit.
Requisites: MATH 222, (CHEM 104, 109, or 116), and (BOTANY/BIOLOGY/ZOOLOGY 151, ZOOLOGY 153, ZOOLOGY/BIOLOGY 101, BOTANY/BIOLOGY 130, MICROBIO 101, or ENVIR ST/BOTANY/ZOOLOGY 260)
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Identify and analyze how energy and materials enter and are utilized by cells, organisms, and ecosystems using engineering concepts including material and energy balances, redox balance, and the first and second laws of thermodynamics.
Audience: Undergraduate

2. Mathematically model important biological processes including enzyme kinetics and microbial growth and be able to quantitatively assess how interactions between biological characteristics and the environment affect system performance.
Audience: Undergraduate

3. Recognize the basic types of plants and their ecosystems and be able to describe the ways in which plants interact with their environment and how that interaction can be manipulated to achieve desired outcomes.
Audience: Undergraduate

4. Describe the ways in which all living creatures interact with each other and their environment on the local, regional, and global scale and to consider how the activities of people can affect the sustainability of these interactions.
Audience: Undergraduate

BSE 364 — ENGINEERING PROPERTIES OF FOOD AND BIOLOGICAL MATERIALS
3 credits.

Study of various physical, mechanical, thermal and other properties of food and biological materials. Importance of such property values on the design and operation of various food and bioprocess engineering systems.
Requisites: (BSE 249 or CBE 250) and (M E 361 or CBE 310)
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Describe the engineering properties of food and biomaterials, including physical, rheological, thermal, aerodynamic and hydrodynamic, and electromagnetic properties
Audience: Undergraduate

2. Explain moisture and water activity and their impacts on the properties and processing of food and biomaterials
Audience: Undergraduate

3. Demonstrate the importance and applications of the engineering properties in agricultural systems
Audience: Undergraduate

4. Analyze how the environmental conditions and the composition and structure of biomaterials affect the engineering properties
Audience: Undergraduate

5. Interpret the designs, working principles, experimental setups. and operations of the instruments/devices for measuring/determining the engineering properties
Audience: Undergraduate

6. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (ABET Outcome 1)
Audience: Undergraduate

7. Develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions (ABET Outcome 6)
Audience: Undergraduate

BSE 365 — MEASUREMENTS AND INSTRUMENTATION FOR BIOLOGICAL SYSTEMS
3 credits.

Principles of instrumentation and measurement systems, analysis of experimental data, electronic components, instrumentation for measuring various parameters of biological systems (e.g., temperature, force, flow).
Requisites: Declared in Biological Systems Engineering or Environmental Engineering BS
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Describe the calibration and measurement process.
Audience: Undergraduate

2. Design systems for the acquisition, analysis, and communication of measured data.
Audience: Undergraduate

3. Describe the principles of operation and limitations of common engineering instruments and sensors.
Audience: Undergraduate

4. Implement measures to minimize electromagnetic interference and noise in measurements.
Audience: Undergraduate

5. Select and use position, velocity, force, torque, temperature, pressure, and fluid flow sensors.
Audience: Undergraduate

6. Display enhanced problem solving skills involving electronics and instrumentation.
Audience: Undergraduate

7. Display improved communications skills both written (lab reports) and oral (presentation).
Audience: Undergraduate

8. Display enhanced teamwork skills.
Audience: Undergraduate

9. Select and/or utilize the most appropriate methodologies and practices.
Audience: Graduate

BSE/ENVIR ST 367 — RENEWABLE ENERGY SYSTEMS
3 credits.

Learn about the state-of-the-art in renewable energy applications including biomass for heat, electric power and liquid fuels as well as geo-energy sources such as wind, solar, and hydro power. Practice engineering calculations of power and energy availability of renewable energy sources and learn about requirements for integrating renewable energy sources into production, distribution and end-use systems.
Requisites: MATH 112, 114, 217, placement into MATH 221, or graduate/professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Calculate energy and power production for renewable energy systems
Audience: Both Grad & Undergrad

2. Determine renewable resource availability and impact on energy infrastructure
Audience: Both Grad & Undergrad

3. Design and assess the technical and economic feasibility of renewable energy systems
Audience: Both Grad & Undergrad

4. Explain the social, economic, and/or environmental dimensions of the sustainability challenge(s) of renewable energy systems.
Audience: Both Grad & Undergrad

5. Produce comprehensive renewable energy project analysis.
Audience: Graduate

BSE/CIV ENGR/SOIL SCI 372 — ON-SITE WASTE WATER TREATMENT AND DISPERSAL
2 credits.

On-site treatment and dispersal of waste water from homes, commercial sources and small communities. Sources, pretreatment units, nutrient removal units, constructed wetlands, surface and soil dispersal systems, recycle and reuse systems, regulations, alternative collection systems.
Requisites: CHEM 103, 109, or 115
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Identify, formulate, solve complex wastewater management and engineering problems by applying engineering and science principles to design a complete residential onsite wastewater treatment system.
Audience: Undergraduate

2. Use engineering design to produce wastewater management solutions that meet treatment goals with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
Audience: Undergraduate

3. Communicate effectively with the instructor and other students during in-class discussions.
Audience: Undergraduate

4. Recognize ethical and professional responsibilities in onsite wastewater management and engineering situations and make informed design assumptions/judgments, which must consider the impact of wastewater management solutions in global, economic, environmental, and societal context.
Audience: Undergraduate

5. Analyze and interpret data related to wastewater flow, source, and characteristics, soil/site characteristics, and use engineering judgement to select appropriate design solutions.
Audience: Undergraduate

6. Acquire and apply new knowledge regarding advanced treatment processes for residential wastewater treatment.
Audience: Undergraduate

BSE 375 — SPECIAL TOPICS
1-4 credits.

Specialized subject matter of current interest to undergraduate students.
Requisites: None
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2024

BSE 380 — INTRODUCTORY DATA SCIENCE FOR THE AGRICULTURAL AND LIFE SCIENCES
3 credits.

Agricultural and life scientists need to creatively apply physical, chemical, and biological principles to address technical, business, and environmental challenges. Many of these challenges involve numerical analyses, including the interpretation of large datasets. The fundamentals of computer coding using numerical software will be taught, using real-world data science challenges from the agricultural and life sciences.
Requisites: (CHEM 103, 109, or 115) and (MATH 112, 114, 217 or placement into MATH 211 or 221)
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Analyze agricultural and life sciences data using computer code
Audience: Undergraduate

2. Import data from multiple formats into numeric software for analysis
Audience: Undergraduate

3. Perform fundamental statistical analyses and basic data interpretation
Audience: Undergraduate

4. Write code to create graphical displays of data and model simulations
Audience: Undergraduate

5. Critique and improve data presentation with ethics and inclusivity in mind
Audience: Undergraduate

6. Work as an individual and in teams to solve data science challenges
Audience: Undergraduate

7. Create scientific workflows for automated data import, analysis, and presentation
Audience: Undergraduate

BSE 399 — COORDINATIVE INTERNSHIP/COOPERATIVE EDUCATION
1-8 credits.

An internship under the guidance of a faculty or instructional academic staff member in BSE and internship site supervisor. Students are responsible for arranging the work and credits with the faculty or instructional academic staff member and the internship site supervisor.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Workplace - Workplace Experience Course
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2024

BSE 400 — STUDY ABROAD IN BIOLOGICAL SYSTEMS ENGINEERING
1-6 credits.

Provides an area equivalency for courses taken on Madison Study Abroad Programs that do not equate to existing UW courses. Enrollment in a UW-Madison resident study abroad program
Requisites: None
Repeatable for Credit: Yes, unlimited number of completions

BSE 405 — ARTIFICIAL INTELLIGENCE IN AGRICULTURE
3 credits.

Provides an understanding of how cutting-edge Artificial Intelligence (AI) technologies revolutionize and optimize various aspects of the agricultural sector. Covers topics related to advanced sensors for data acquisition, data processing and visualization, and machine learning models to inform agricultural decision making. Introduces both theoretical concepts and practical insights into real-world AI implementation in agriculture.
Requisites: BSE 380, COMP SCI 220, 300, or graduate/professional standing
Course Designation: Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Apply advanced sensing and computing techniques and modern engineering tools for intelligent agricultural system design
Audience: Undergraduate

2. Apply basic machine learning models and engineering principles to solve digital agriculture problems
Audience: Undergraduate

3. Identify important resources to retrieve, interpret, analyze, and critique information for use in solving problems in digital agriculture
Audience: Undergraduate

4. Deliver presentations to an audience of peers discussing the development of machine learning models and interpretation of modeling results
Audience: Undergraduate

BSE 460 – BIOREFINING: ENERGY AND PRODUCTS FROM RENEWABLE RESOURCES
3 credits.

Concepts, processes, status quo and future direction of biorefining for production of energy (fuels), chemicals and materials from biomass, with emphases on chemical, biological and engineering aspects of the biorefining.
Requisites: (CHEM 104 or 109) and (CHEM 341 or 343), or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Identify the opportunities and challenges of energy, chemicals, and materials from biomass
Audience: Both Grad & Undergrad

2. Describe chemical composition, anatomical structure, and physical & chemical properties of lignocellulosic biomass and their effect on biomass processing and conversion
Audience: Both Grad & Undergrad

3. Evaluate the technologies and processes and their working principles for producing liquid biofuels, such as corn ethanol, cellulose ethanol, biodiesel, and other alternative fuels.
Audience: Both Grad & Undergrad

4. Outline representative platform chemicals derivable from biomass, such as furfural, HMF, levulinic acid, lactic acid, xylitol, and sorbitol, and their production technologies and reaction chemistry
Audience: Both Grad & Undergrad

5. Compare the production of fibers, pulp & paper, and biobased materials from lignocellulosic biomass
Audience: Both Grad & Undergrad

6. Develop mass balance for a process to convert biomass to fuel, chemical, or material.
Audience: Both Grad & Undergrad

7. Design a process to produce a target product (fuel, chemical, or material)
Audience: Both Grad & Undergrad

8. Synthesize the historical and current research on a select topic in biorefining and generate evidence-based predictions regarding the future direction of the topic.
Audience: Graduate

BSE 461 – FOOD AND BIOPROCESSING OPERATIONS
3 credits.

Principles of mechanics, fluid dynamics, and heat and mass transfer as applied to food and bioprocessing operations. Specific focus on unit operations and equipment associated with the products key to Wisconsin industries including pulp and paper, dairy products, ethanol, forage, and grain.
Requisites: (BSE 249 or CBE 250), (CIV ENGR 310, CBE 320, or M E 363), or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Describe bioprocessing operations (e.g., food processing and biofuels)
Audience: Both Grad & Undergrad

2. Develop mass and energy balances on unit operations (e.g., heat exchangers, evaporators, dryers, filters)
Audience: Both Grad & Undergrad

3. Develop a series of unit operations to perform the desired transformations of mass and energy in bioprocessing operations
Audience: Both Grad & Undergrad

4. Stimulate a system or process to determine impact of theoretical changes and conduct virtual experiments to optimize components or system
Audience: Both Grad & Undergrad

5. Consider the effect of public health, safety, and welfare, as well as global, culture, social, environmental, and economic factors on process design
Audience: Both Grad & Undergrad

6. Design a system to meet the operational and regulatory demands of food and bioprocessing plants
Audience: Graduate

BSE 464 – HEAT AND MASS TRANSFER IN BIOLOGICAL SYSTEMS
3 credits.

Introduction to heat and mass transfer fundamentals, including transport mechanisms of conduction, convection, radiation, diffusion and evaporation. Development of governing equations and boundary conditions with application to living systems, controlled environments, water systems, and food processing. Introduction to, and application of, finite-difference and finitevolume methods, including computational fluid dynamics (CFD).
Requisites: (M E 361 or CBE 310) and (M E 363, CBE 320, or CIV ENGR 310)
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Demonstrate knowledge about fundamental heat and mass transfer modes
Audience: Undergraduate

2. Identify governing equations, boundary conditions, and initial conditions
Audience: Undergraduate

3. Analyze the interrelationships among conduction, convection, radiation, and mass diffusion
Audience: Undergraduate

4. Demonstrate knowledge about the significance of theoretical, computational, and experimental approaches to solve heat and mass transfer problems
Audience: Undergraduate

5. Apply heat and mass transfer concepts and principles to real-world agricultural, environmental, and biosystems problems
Audience: Undergraduate

BSE 472 – SEDIMENT AND BIO-NUTRIENT ENGINEERING AND MANAGEMENT
3 credits.

Hydrologic, biologic and engineering applications in the design and management of sediment and bio-nutrient control systems.
Requisites: Junior standing
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Identify, formulate, and solve complex water, sediment, and manure management, and engineering problems by applying engineering and science principles to design water control, erosion control, and nutrient management systems.
Audience: Undergraduate

2. Apply engineering design to produce water, sediment, and manure management solutions that meet agricultural production needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
Audience: Undergraduate

3. Communicate effectively with the instructor and other students during in-class discussions.
Audience: Undergraduate

4. Recognize ethical and professional responsibilities in water, sediment, and manure management, and engineering situations and make informed design assumptions/judgments, which must consider the impact of soil & water conservation and manure management solutions in global, economic, environmental, and societal context.
Audience: Undergraduate

5. Function effectively on a team to accomplish assigned tasks.
Audience: Undergraduate

6. Analyze and interpret data related to rainfall and runoff, soil characteristics, tillage practices, and manure characteristics and use engineering judgement to select appropriate design solutions.
Audience: Undergraduate

7. Acquire and apply new knowledge relate to sustainable agricultural production systems that can protect and preserve soil and water resources while maintaining agricultural productivity.
Audience: Undergraduate

BSE 473 — WATER MANAGEMENT SYSTEMS
3 credits.

Engineering and management applications of soil–plant–water relationships applied to water management systems and efficient water use.
Requisites: MATH 217, 221, or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Identify, formulate and solve complex water management and engineering problems by applying hydrologic, biologic, and engineering principles applicable to the design of efficient water management systems and components.
Audience: Both Grad & Undergrad

2. Apply engineering design to produce water management solutions that meet agricultural production needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
Audience: Both Grad & Undergrad

3. Communicate effectively through engagement during in-class discussions
Audience: Both Grad & Undergrad

4. Recognize ethical and professional responsibilities in water management and engineering situations and make informed judgements, which must consider the impact of water management solutions in global, economic, environmental, and societal context
Audience: Both Grad & Undergrad

5. Explain the social, economic, and/or environmental dimensions of the sustainability challenge of water use
Audience: Both Grad & Undergrad

6. Analyze the causes of and solutions for the sustainability challenge of clean water and efficient use of water
Audience: Both Grad & Undergrad

7. Identify, evaluate, and synthesize contemporary literature on a specific water management issue
Audience: Graduate

BSE/M E 474 — FLUID POWER
3 credits.

Engineering principles of design and analysis of fluid power systems and fluid power components. Topics include hydraulic fluid properties, fluid flow and, positive displacement pumps, valves for pressure, flow, and directional control, linear and rotary actuators, accumulators, pressure compensation, load sensing, energy management and system efficiency.
Requisites: M E 363, CIV ENGR 310, CBE 320, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Analyze various positive displacement pumps for flow, pressure, power, and efficiency
Audience: Both Grad & Undergrad

2. Determine flow and pressure drop characteristics of spool-type and poppet-type proportional, on-off, and servovalves
Audience: Both Grad & Undergrad

3. Construct hydraulic system schematics and select components from a functional system description
Audience: Both Grad & Undergrad

4. Determine efficiency and design improvements for mobile and industrial hydraulic systems
Audience: Both Grad & Undergrad

5. Develop mathematical models of hydraulic system/components and solve using numerical techniques
Audience: Graduate

BSE/M E 475 — ENGINEERING PRINCIPLES OF AGRICULTURAL MACHINERY
3 credits.

Engineering design principles of machines for the production, processing and handling of crops for food, fuel, bio-mass and fiber. Environmental and biological factors that influence machine design and operation. Economic and capacity analysis of machines and systems.
Requisites: Declared in Biological Systems Engineering or Mechanical Engineering and (M E 240, E M A 202, PHYSICS 201, 207, or 247), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Identify and describe key operating and design principles, concepts, and methods related to agricultural field machinery
Audience: Both Grad & Undergrad

2. Calculate relevant quantities regarding the design and engineering of agricultural field machinery
Audience: Both Grad & Undergrad

3. Critically review results of engineering calculations to ensure answers are realistic
Audience: Both Grad & Undergrad

4. Choose, synthesize and effectively utilize appropriate ASABE engineering standards, methods, and concepts regarding agricultural field machinery
Audience: Both Grad & Undergrad

5. Hone skills in teamwork, oral and written communication, and problem solving
Audience: Both Grad & Undergrad

6. Critically review emerging technology and apply relevant concepts to current issues with agricultural field machinery
Audience: Both Grad & Undergrad

7. Demonstrate an ability to formulate, analyze, and independently solve advanced engineering problems
Audience: Graduate

BSE/M E 476 — ENGINEERING PRINCIPLES OF OFF-ROAD VEHICLES
3 credits.

Engineering design principles of heavy-duty vehicles intended for off-road use: fuels, engine cycles, engine principles and construction, clutches, mechanical and hydrostatic transmissions, final drives, traction systems, traction modeling, dynamic behavior, suspension systems and braking.
Requisites: (M E 361 or concurrent enrollment), (M E 240, E M A 202, PHYSICS 201, 207, or 247), and declared in Biological Systems Engineering or Mechanical Engineering or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Identify, formulate, and solve engineering problems related to off-road vehicle dynamics and mobility
Audience: Both Grad & Undergrad

2. Glean relevant data from the engineering research literature and technical data sheets, and specify appropriate components and systems in the application of off-road vehicle design
Audience: Both Grad & Undergrad

3. Perform an experiment on off-road vehicle systems, analyze and interpret data, and use engineering judgment to draw conclusions
Audience: Both Grad & Undergrad

4. Apply knowledge gained in the course to evaluate off-road vehicle design alternatives
Audience: Both Grad & Undergrad

5. Critically review off-road vehicle research
Audience: Graduate

BSE 508 — BIOLOGICAL SYSTEMS ENGINEERING DESIGN PRACTICUM I
2 credits.

Overview of the engineering design process including problem identification, information retrieval, specification writing, development and analysis of alternative solutions, selection methodology, product safety, standardization, scheduling and cost estimating. Develop design project proposals for real-world design problems.
Requisites: Declared in Biological Systems Engineering BS
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Develop design requirements for biological systems engineering design problems.
Audience: Undergraduate

2. Conduct technical reviews of engineering problems.
Audience: Undergraduate

3. Develop alternative solutions to biological systems engineering problems.
Audience: Undergraduate

4. Provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives as part of a team.
Audience: Undergraduate

BSE 509 — BIOLOGICAL SYSTEMS ENGINEERING DESIGN PRACTICUM II
3 credits.

Individual or team work on a biological systems engineering design project: problem identification, information retrieval, specification writing, development and analysis of alternative solutions, selection methodology.
Requisites: Senior standing and BSE 508
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
Audience: Undergraduate

2. Develop alternative solutions to biological systems engineering problems.
Audience: Undergraduate

3. Develop a model or prototype to evaluate an engineering design.
Audience: Undergraduate

4. Provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives as part of a team.
Audience: Undergraduate

5. Communicate effectively with a range of audiences.
Audience: Undergraduate

BSE 571 — SMALL WATERSHED ENGINEERING
3 credits.

Application of engineering principles to small, ungauged watershed analysis. Application of hydrologic and sedimentologic principles to upland watersheds for run-off and sediment control.
Requisites: MATH 222 or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Identify, formulate and solve complex hydrologic engineering problems by applying hydrologic, sedimentologic, and engineering principles applicable to the design of water and sediment control systems and components
Audience: Both Grad & Undergrad

2. Apply engineering design to produce water and sediment control solutions that meet regulatory requirements with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
Audience: Both Grad & Undergrad

3. Communicate technical information effectively
Audience: Both Grad & Undergrad

4. Recognize ethical and professional responsibilities in watershed engineering situations and make informed judgements, which must consider the impact of watershed engineering solutions in global, economic, environmental, and societal context
Audience: Both Grad & Undergrad

5. Demonstrate advanced application of hydrologic, sedimentologic, and/or engineering principles.
Audience: Graduate

BSE 681 — SENIOR HONORS THESIS
2-4 credits.

Individual study for undergraduate students in an Honors program completing a thesis in the area of Biological Systems Engineering, as arranged with a faculty member.
Requisites: Consent of instructor
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions

BSE 682 — SENIOR HONORS THESIS
2-4 credits.

Second semester of individual study for undergraduate students in an Honors program completing a thesis in the area of Biological Systems Engineering, as arranged with a faculty member.
Requisites: Consent of instructor
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: No

BSE 691 — SENIOR THESIS
2 credits.

Individual study for undergraduate students completing a thesis in the area of Biological Systems Engineering, as arranged with a faculty member.
Requisites: Consent of instructor
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

BSE 692 — SENIOR THESIS
2 credits.

Second semester of individual study for undergraduate students completing a thesis in the area of Biological Systems Engineering, as arranged with a faculty member.
Requisites: Consent of instructor
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2018

BSE 699 — SPECIAL PROBLEMS
1-4 credits.

Individual advanced work in an area of Biological Systems Engineering under the direct guidance of a faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

BSE 799 — PRACTICUM IN AGRICULTURAL ENGINEERING TEACHING
1-3 credits.

Hands-on teaching experience through working with a course instructor to improve pedagogical understanding. Guidance will be provided on such aspects as course planning, delivery, student supervision, and evaluation, etc.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025

BSE 875 — SPECIAL TOPICS
1-4 credits.

Specialized subject matter of current interest to graduate students.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2023

BSE 900 — SEMINAR
1 credit.

Provides an overview of research-related activities and resources available to graduate students in the department, college, and on campus. Includes library resources, statistical consulting, professional development, research proposal development, thesis writing, technical presentation, etc.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2024
Learning Outcomes: 1. Use departmental and campus resources to make academic progress (coursework and research) with their graduate degree program.
Audience: Graduate

2. Develop research questions related to their thesis research work.
Audience: Graduate

3. Develop skills to effectively review/critique scientific publications.
Audience: Graduate

4. Communicate technical information effectively using posters and oral presentations.
Audience: Graduate

BSE 901 — GRADUATE RESEARCH SEMINAR
1 credit.

Presentation, evaluation, and discussion of Biological Systems Engineering graduate student thesis and non-thesis research.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, for 10 number of completions
Last Taught: Spring 2025
Learning Outcomes: 1. Evaluate (in both verbal and written formats) the quality of professional or academic research presentations.
Audience: Graduate

2. Apply the principles of ethical and professional conduct.
Audience: Graduate

3. Analyze peer-reviewed research within a select subject area.
Audience: Graduate

4. Communicate field specific information effectively with a professional/academic audience.
Audience: Graduate

BSE 990 — RESEARCH
1-12 credits.

Independent laboratory research in preparation of a graduate thesis under supervision of a faculty member
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2025

BSE 999 — SPECIAL PROBLEMS
1-3 credits.

In-depth study of a research or design and development problem under the supervision of a faculty member.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2024