BIOLOGICAL SYSTEMS ENGINEERING (BSEN)

BSEN 818 Tissue Engineering
Crosslisted with: BSEN 418
Prerequisites: BSEN 416/816 or equivalent
Notes: Uses case studies to demonstrate clinical implementation of engineered tissues.
Description: Introduction to engineering biological substitutes that can restore, maintain or improve organ function in therapy of diseases. Engineering methods and principles to design tissues and organs, cell and tissue biology, tissue growth and development, biomaterial scaffolds, growth factor and drug delivery, scaffold-cell interactions, and bioreactors.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 822 Pollution Prevention: Principles and Practices
Crosslisted with: BSEN 422, CIVE 422, CIVE 822
Prerequisites: Permission.
Description: Introduction to pollution prevention (P2) and waste minimization methods. Practical applications to small businesses and industries. Legislative and historical development of P2 systems analysis, waste estimation, P2 methods, P2 economics, and sources of P2 information.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 841 Animal Waste Management
Crosslisted with: AGEN 441, AGEN 841, BSEN 441
Prerequisites: Senior standing.
Description: Characterization of wastes from animal production. Specification and design of collection, transport, storage, treatment, and land application systems. Air and water pollution, regulatory and management aspects.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 844 Biomass and Bioenergy Engineering
Crosslisted with: BSEN 444
Prerequisites: Senior/graduate standing in engineering; BIOC 401 or 431
Description: Engineering processes for biomass conversion and bioenergy production. Topics include biomass chemistry, conversion reactions, current and emerging bioenergy technologies, feedstock logistics, life cycle assessment. Analysis of primary research literature required for graduate credit.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
BSEN 845 Bioprocess Engineering
Crosslisted with: BSEN 445
Prerequisites: BSEN 344 or CHME 333
Description: Engineering topics related to processing of biological materials into valuable products. Enzyme kinetics, microbial kinetics, application of enzymes in industrial processes, bioreactor design, equipment scale-up, gas transfer in reactors and bioseparations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL

BSEN 846 Unit Operations of Biological Processing
Crosslisted with: BSEN 446, AGEN 446, AGEN 846
Prerequisites: AG/BSE 225; and AGEN/BSE 344
Description: Application of heat, mass, and momentum transport in analysis and design of unit operations for biological and agricultural materials. Evaporation, drying, distillation, extraction, leaching, thermal processing, membrane separation, centrifugation, and filtration.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: SPRING
Prerequisite for: BSEN 935

BSEN 853 Irrigation and Drainage Systems Engineering
Crosslisted with: AG/BSE 453, AG/BSE 853
Prerequisites: CIVE 310 or MECH 310; AGEN 344 or BSE 344.
Description: Analytical and design consideration of evapotranspiration, soil moisture, and water movement as related to irrigation and drainage systems; analysis and design of components of irrigation and drainage systems including water supplies, pumping plants, sprinkler systems, and center pivots.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: AG/BSE 854

BSEN 855 Nonpoint Source Pollution Control Engineering
Crosslisted with: BSEN 455, CIVE 455, CIVE 855
Prerequisites: BSEN 321/CIVE 321 or BSE 355; AG/BSE 350 or CIVE 352 as prerequisite or parallel.
Description: Identification, characterization, and assessment of nonpoint source pollutants; transport mechanisms and remediation technologies; design methodologies and case studies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: FALL

BSEN 858 Groundwater Engineering
Crosslisted with: BSEN 458, CIVE 458, CIVE 858
Prerequisites: CIVE 352 or AG/BSE 350 or BSE 350
Description: Application of engineering principles to the movement of groundwater. Analysis and design of wells, well fields, and artificial recharge. Analysis of pollutant movement.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 860 Instrumentation and Controls
Crosslisted with: AG/BSE 460, AG/BSE 860, BSE 460
Prerequisites: ECEN 211 or ECEN 215 or AG/BSE 260
Description: Analysis and design of instrumentation and controls for agricultural, biological, and biomedical applications. Theory of basic sensors and transducers, analog and digital electrical control circuits, and the interfacing of computers with instruments and controls. LabVIEW Programming. Emphasis on signal analysis and interpretation for improving system performance.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: FALL

BSEN 868 Wetlands
Crosslisted with: BIOS 458, NRES 468, NRES 868, WATS 468, BSE 468
Prerequisites: CHEM 109A and 109L and CHEM 110A and 110L, or CHEM 105A and 105L and CHEM 106A and 106L; Junior or Senior Standing.
Notes: Offered even-numbered calendar years.
Description: Physical, chemical and biological processes that occur in wetlands; the hydrology and soils of wetland systems; organisms occurring in wetlands and their ecology wetland creation, delineation, management and ecotoxicology.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Grade Pass/No Pass Option
Course and Laboratory Fee: $40

BSEN 879 Hydroclimatology
Crosslisted with: NRES 479, METR 479, WATS 479, BSE 479, NRES 879, METR 879
Prerequisites: NRES 208 or METR 100 or METR/NRES 370
Notes: Offered spring semester of even-numbered calendar years.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 889 Seminar I
Crosslisted with: AG/BSE 889
Description: Introduction into departmental and campus resources, professionalism, preparation and delivery of presentations, technical writing, and additional topics as arranged by enrolled students.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Grade Pass/No Pass Option
BSEN 892 Special Topics
Crosslisted with: BSEN 492
Prerequisites: Permission
Description: Subject matter in emerging areas of Biological Systems Engineering not covered in other courses within the curriculum. Topics, activities, and delivery methods vary.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Graded

BSEN 896 Special Problems
Crosslisted with: AGEN 896
Prerequisites: Permission
Description: Investigation and written report on engineering problems not covered in sufficient depth through existing courses. Topic varies by semester.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Grade Pass/No Pass Option

BSEN 897 Masters Project
Crosslisted with: AGEN 897, AGST 897
Prerequisites: Admission to M.S. in Agricultural and Biological Systems Engineering or M.S. in Agricultural Systems Technology, and permission of major advisor
Notes: Intended for students who are pursuing an Option II or III master's degree in Agricultural and Biological Systems Engineering, or Agricultural Systems Technology.
Description: Conception, design, development, and completion of a project that requires data collection, synthesis, analysis of results, and the development of a final written report that will be defended in the final oral examination.
Credit Hours: 3-6
Min credits per semester: 3
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Pass No-Pass

BSEN 898 Internship
Crosslisted with: AGEN 898
Prerequisites: Permission
Notes: Students required to write an internship report of their creative accomplishments after completion of the internship. Students may spend up to nine months at the cooperating partner's workplace.
Description: Solution of engineering or management problems through a non-academic experience within the private sector or a government agency. The experience entails all or some of the following: research, design, analysis, and testing on an engineering problem. A plan, which documents how the individual will demonstrate creativity during the internship must be approved prior to the internship.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Grade Pass/No Pass Option

BSEN 899 Masters Thesis
Prerequisites: Admission to masters degree program and permission of major advisor
Credit Hours: 1-10
Min credits per semester: 1
Max credits per semester: 10
Max credits per degree: 99
Grading Option: Pass No-Pass

BSEN 910 Delivery of Nucleic Acids
Prerequisites: Graduate Standing
Description: Engineering methods and principles to design delivery systems that can transfer nucleic acids to mammalian cells, including viral, non-viral and physical techniques, and review of applications including vaccines and gene therapies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL

BSEN 912 Advanced Ultrasound Imaging
Prerequisites: BSEN 311 or ELEC 304 Engineering design and analysis of medical ultrasound applications
Description: Beamforming, diffraction, wave space, scattering, imaging. Interactions of mechanical energy and tissue. Linear and phased arrays. Doppler estimation of blood flow velocity. Tumor and cyst characterization. Other modern research topics in medical ultrasound.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 918 Analysis of Engineering Properties of Biological Materials
Prerequisites: BSEN 846 or equivalent
Description: Current and relevant mechanical, rheological, thermal, electrical, and optical properties as related to the engineering of processing, storage, handling, and utilization systems for biological materials are selected for analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 919 Agricultural Waste Management
Crosslisted with: AGEN 941
Prerequisites: Permission
Description: aerobic, anaerobic, and physical-chemical treatment, energy recovery and protein synthesis processes for high-strength organic materials; agricultural applications including composting, ammonia stripping, nitrification, denitrification, and land disposal of organic and chemically treated materials.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 920 Delivery of Nucleic Acids
Prerequisites: Graduate Standing
Description: Engineering methods and principles to design delivery systems that can transfer nucleic acids to mammalian cells, including viral, non-viral and physical techniques, and review of applications including vaccines and gene therapies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL

BSEN 921 Advanced Ultrasound Imaging
Prerequisites: BSEN 311 or ELEC 304 Engineering design and analysis of medical ultrasound applications
Description: Beamforming, diffraction, wave space, scattering, imaging. Interactions of mechanical energy and tissue. Linear and phased arrays. Doppler estimation of blood flow velocity. Tumor and cyst characterization. Other modern research topics in medical ultrasound.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 923 Analysis of Engineering Properties of Biological Materials
Prerequisites: BSEN 846 or equivalent
Description: Current and relevant mechanical, rheological, thermal, electrical, and optical properties as related to the engineering of processing, storage, handling, and utilization systems for biological materials are selected for analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 924 Agricultural Waste Management
Crosslisted with: AGEN 941
Prerequisites: Permission
Description: aerobic, anaerobic, and physical-chemical treatment, energy recovery and protein synthesis processes for high-strength organic materials; agricultural applications including composting, ammonia stripping, nitrification, denitrification, and land disposal of organic and chemically treated materials.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
BSEN 942 Antimicrobial Resistance from a One Health Perspective
Prerequisites: Graduate Standing
Description: Covers the fundamentals of antimicrobial resistant development, transmission, and risks to humans, animals and the environment delivered by experts in One Health fields (interconnection between people, animals, and their shared environment). Exposed to a variety of perspectives on the highly complex problem of AMR and the spectrum of the challenges and the opportunities of multidisciplinary efforts to address it. Expected to work together with their peers across the country to review and develop research-based resources and methods for communicating scientific information about AMR to non-academic audiences.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded
Offered: SPRING

BSEN 943 Bioenvironmental Engineering
Prerequisites: MATH 821
Description: An engineer analysis of livestock, their environment and the interaction between the two; mathematical models, heat transfer, energy balances, environmental measurements, physiological measurements, calorimetry.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 951 Advanced Mathematical Modeling in Biological Engineering
Prerequisites: No prerequisite specified
Description: Advanced mathematical modeling techniques and applications. Specific topics from current literature and vary depending on research interests.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 954 Turbulent Transfer in the Atmospheric Surface Layer
Crosslisted with: NRES 954
Prerequisites: MATH 821; MECH 310 or NRES 808 or BIOS 857; or equivalent
Notes: Offered spring semester of odd-numbered calendar years.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 957 Modeling Vadose Zone Hydrology
Crosslisted with: AGEN 957, CIVE 957, GEOL 957
Prerequisites: MATH 221/821 or equivalent. AGEN/BSEN 350 or NRES 453/853 or equivalent.
Notes: Typically offered spring semester in even years.
Description: Principles and modeling of fluid flow and solute transport in the vadose zone. Topics include hydraulic properties of variably saturated media, application of Darcy’s Law in variably saturated media, hydrologic and transport processes in the vadose zone, and solution of steady and unsteady flow problems using numerical techniques including finite element methods. Contemporary vadose zone models will be applied to engineering flow and transport problems. Review and synthesis of classic and contemporary research literature on vadose zone hydrology will be embedded in the course.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: SPRING

BSEN 989 Seminar II
Crosslisted with: AGEN 989
Description: Developing a graduate program, orientation to research, grant and research proposal preparation, experimental design and analysis, manuscript preparation and review, preparations and delivery of technical presentations, and research management.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Grade Pass/No Pass Option

BSEN 998 Advanced Topics
Crosslisted with: AGEN 998
Prerequisites: Permission
Description: Individual study in advanced engineering topics that are not covered in regular course work or thesis. Topic varies by term.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Grade Pass/No Pass Option

BSEN 999 Doctoral Dissertation
Prerequisites: Admission to doctoral degree program and permission of supervisory committee chair
Credit Hours: 1-24
Min credits per semester: 1
Max credits per semester: 24
Max credits per degree: 99
Grading Option: Pass No-Pass