Courses

BSEN 2210 ENGINEERING METHODS FOR BIOLOGICAL SYSTEMS (2) LEC. 1. LAB. 3. Pr. (ENGR 1110 or ENGR 1113) and (PHYS 1600 or PHYS 1607) or Departmental approval. Introduction to experimental design methodology, basic engineering design and problem solving methodology for Biological Engineering. Visualization skills, computer-aided 3-D solid modeling of parts, 3-D assembly of solid part geometries, computation of mass properties, 2-D engineering drawings, engineering design process, safety, tools and fabrication processes and design, and hands-on shop fabrication of semester project.

BSEN 2240 BIOLOGICAL AND BIOENVIRONMENTAL HEAT AND MASS TRANSFER (3) LEC. 3. Pr. (MATH 2630 or MATH 2637) and (PHYS 1600 or PHYS 1607) and P/C ENGR 2010. Basic principles of heat and mass transfer with special applications to biological and environmental systems. Introduction to steady state and transient heat conduction. Convection, radiation, diffusion, simultaneous heat and mass transfer, and generation and depletion of heat and mass in biological systems.

BSEN 3210 MECHANICAL POWER FOR BIOSYSTEMS (3) LEC. 2. LAB. 3. Pr. ENGR 2010 and MATH 2650 and P/C ENGR 2350. Basic engineering analysis, synthesis, and design concepts applied to power sources, mobile equipment, and machinery applications for agricultural, forestry, and natural resource systems.

BSEN 3230 NATURAL RESOURCE CONSERVATION ENGINEERING (3) LEC. 2. LAB. 3. Pr. BSEN 3310. Departmental approval. Engineering analysis applied to natural resource systems. Design principles and practices in rainfall-runoff relationships, soil erosion and its prediction and control, hydraulic structures, and open channel hydraulics.

BSEN 3240 PROCESS ENGINEERING IN BIOSYSTEMS (3) LEC. 2. LAB. 3. Pr. BSEN 2240. Departmental approval. Theory and application of process operations in biological, food and agricultural systems. Heat transfer, fluid flow, thermal processing, evaporation, psychrometrics, refrigeration, drying freezing.

BSEN 3260 ENGINEERING FOR PRECISION AGRICULTURE AND FORESTRY (3) LEC. 2. LAB. 3. Pr. ELEC 3810 and MATH 2650. Departmental approval. Engineering aspects of spatial technologies applied to agricultural and forest production. Data collection in the field using GPS and use of field data in site specific applications. Fall.

BSEN 3310 HYDRAULIC TRANSPORT IN BIOLOGICAL SYSTEMS (4) LEC. 3. LAB. 3. Pr. (ENGR 2050 or ENGR 2053) and MATH 2650 or Departmental approval. Fluid properties, Non-Newtonian fluids and biological systems, Fluid statics, Energy equation, mass and momentum balance, pipe flow for Newtonian and Non-Newtonian fluids, dimensional analysis, compressible flows.

BSEN 3510 AGRICULTURAL POWER AND MACHINERY FUNDAMENTALS (3) LEC. 2. LAB. 3. Pr. MATH 1130 or MATH 1133. Power unit fundamentals with emphasis on diesel and small gasoline engines; mechanics of operation, safety, use, and adjustment of machines used for horticultural and agronomic crop production; and precision agriculture principles and technology.

BSEN 3530 AGRICULTURAL PRODUCTION AND PROCESSING FACILITY TECHNOLOGY (3) LEC. 3. Pr. MATH 1130 or MATH 1133. Fundamental requirements for the design and operation of agricultural production and processing facilities.

BSEN 3560 TURF SYSTEMS IRRIGATION DESIGN (3) LEC. 3. Pr. MATH 1130 or MATH 1133. Irrigation system design for turf-based systems including residential lawns, commercial properties, athletic fields, and golf courses. Irrigation scheduling and water demand are presented to provide management capabilities.

BSEN 3610 INSTRUMENTATION AND CONTROLS FOR BIOLOGICAL SYSTEMS (3) LEC. 2. LAB. 3. Pr. MATH 2650 and BSEN 2210. Departmental approval. Understanding of fundamentals of electrical circuits, sensing and sensors, simple digital electronics, analog measurement circuits, introductory digital signal processing, computer data acquisition.

BSEN 4210 IRRIGATION SYSTEM DESIGN (3) LEC. 2. LAB. 3. Pr. BSEN 3230. Departmental approval. Theory and design of irrigation systems for the application of water and wastewater including surveying techniques for system design. Systems include solid-set, traveler, center-pivot, and trickle. Fall.

BSEN 4240 BULK BIOLOGICAL SOLIDS BEHAVIOR AND PROCESSING (3) LEC. 2. LAB. 3. Pr. BIOL 1020 and STAT 2510. The course is designed to enable students to develop fundamental understanding of the properties of bulk biological solids and how these properties influence the behavior and processability of bulk solids.
BSEN 4250 HYDRAULIC CONTROL SYSTEMS DESIGN (3) LEC. 2. LAB. 3. Pr. BSEN 3310 or Departmental approval. Principles of energy transfer by means of fluid power. Design of hydraulic control systems using prime movers, valves, actuators, and accessories. Spring.

BSEN 4300 PROFESSIONAL PRACTICE IN BIOSYSTEMS ENGINEERING (2) LEC. 1. LAB. 3. Pr. BSEN 3230 and ENGR 2070 or Departmental approval. This course focuses on issues related to the professional practice of biological engineering including preparing students for transition to careers as professional engineers.

BSEN 4310 ENGINEERING DESIGN FOR BIOSYSTEMS (3) LEC. 1. LAB. 6. Pr. BSEN 4300. Departmental approval. Capstone design course in biosystems engineering emphasizing teamwork, communication, safety engineering, and economic analysis to complete an engineering design project. Spring.

BSEN 4960 SPECIAL PROBLEMS IN BIOSYSTEMS ENGINEERING (1-4) AAB/IND. Departmental approval. Faculty supervision of individual student investigations of specialized problems in biosystems engineering. May be repeated with change in problem. Course may be repeated with change in topics.

BSEN 4967 HONORS SPECIAL PROBLEMS (1-3) IND. Pr. Honors College. Course may be repeated for a maximum of 3 credit hours.

BSEN 4970 SPECIAL TOPICS IN BIOSYSTEMS ENGINEERING (1-4) LEC. Departmental approval. Individual or small group study of a specialized area in biosystems engineering. Course may be repeated for a maximum of 12 credit hours.

BSEN 4980 UNDERGRADUATE RESEARCH (2-4) IND. Departmental approval. Directed research in the area of specialty within the department. Course may be repeated for a maximum of 4 credit hours.

BSEN 4997 HONORS THESIS (1-3) IND. Pr. Honors College. Course may be repeated for a maximum of 3 credit hours.

BSEN 5220 GEOSPATIAL TECHNOLOGIES IN BIOSYSTEMS (3) LEC. 2. LAB. 3. Pr. STAT 2510 or STAT 2513 or STAT 2610 or STAT 3010 or CSES 2040 or CSES 2043 or AGRN 2040 or AGRN 2043 or Departmental approval. Geopatial technologies including GPS, GIS, and remote sensing systems applied to biosystems. Collecting, managing, and analyzing spatial data for agricultural and forest systems. Spring.

BSEN 5230 WASTE MANAGEMENT AND UTILIZATION FOR BIOSYSTEMS (3) LEC. 2. LAB. 3. Pr. CHEM 1040 and BIOL 3200 and P/C BSEN 3230. Introduction to animal waste management problems of confined production systems, and characterization of animal waste types. Design of biological treatment and processing systems. Departmental approval. May count either BSEN 5230 or BSEN 6230.

BSEN 5250 DETERMINISTIC MODELING FOR BIOSYSTEMS (3) LEC. 3. LAB. 2. Pr. MATH 2650 and ELEC 3810 and (ENGR 2350 or MECH 2110) or Departmental approval. Modeling of biosystems, methods to deal with complexity, and validation tools. Spring.

BSEN 5260 RENEWABLE ENERGY IN BIOSYSTEMS PROCESS OPERATIONS (3) LEC. 2. LAB. 3. Pr. BSEN 3310. Application and use of renewable energy in biological, food, forest and agricultural systems including bioenergy, solar energy, wind power and geothermal. Departmental approval. May count either BSEN 5260 or BSEN 6260.

BSEN 5270 METABOLIC ENGINEERING FOR BIOPROCESS (3) LEC. 3. Pr. BIOL 3200 and CHEM 1040. Or with the consent of the instructor. Introduction of basic principles of bioprocess engineering and metabolic engineering, to prepare engineers and scientists for biotechnology and bioeconomy industries.

BSEN 5280 LIFE-CYCLE ASSESSMENT FOR BIOLOGICAL SYSTEMS (3) LEC. 2. LAB. 3. Pr. BSEN 2240. Departmental approval. This course introduces the concept of life cycle assessment (LCA) in the context of biological engineering. Examples will include LCA applications to engineered biological systems and other engineering processes and products.

BSEN 5450 COMMERCIAL POULTRY & LIVESTOCK HOUSING (3) LEC. 2. LAB. 3. An introduction to the basic design, operation, and maintenance of modern commercial animal housing systems. Emphasis will be placed on poultry and swine systems with elements of dairy and beef when applicable.

BSEN 5510 ECOLOGICAL ENGINEERING (3) LEC. 3. Pr. BSEN 3230. Ecological engineering non-point source transport of nutrients, sediment, pesticides, pathogens, and chemicals from agricultural, forestry, and urban activities. Departmental approval. May count either BSEN 5510 or BSEN 6510.
**BSEN 5520 WATERSHED MODELING (3)** LEC. 3. Pr. BSEN 5510. Modeling of non-point source pollution at watershed scale using Soil and Water Assessment Tool model including underlying processes that control movement of pollutants. Departmental approval. May count either BSEN 5520 or BSEN 6520.

**BSEN 5540 BIOMASS AND BIOFUELS ENGINEERING (3)** LEC. 2. LAB. 3. Pr. CHEM 1040 and MATH 2650 and BSEN 3310. This course introduces the various processes and engineering principles in converting biomass into biofuels and chemicals. The focus will be on thermochemical and biochemical conversion platforms. May count either BSEN 5540 or BSEN 6540.

**BSEN 5550 PRINCIPLES OF FOOD ENGINEERING TECHNOLOGY (4)** LEC. 3. LAB. 3. Pr. (MATH 1130 or MATH 1133 or MATH 1150 or MATH 1153 or MATH 1610 or MATH 1613 or MATH 1617) and (PHYS 1000 or PHYS 1007) or PHYS 1500 or (PHYS 1600 or PHYS 1607). Engineering concepts and unit operations used in processing food products. Fall.

**BSEN 5560 SITE DESIGN FOR BIOSYSTEMS (3)** LEC. 2. LAB. 3. Pr. BSEN 3230. Development of student skills in computer-aided site design and restoration by using rural and urban best management practices to reduce environmental impacts. Departmental approval. May count either BSEN 5560 or BSEN 6560.

**BSEN 6220 GEOSPATIAL TECHNOLOGIES IN BIOSYSTEMS (3)** LEC. 2. LAB. 3. Departmental approval. Geospatial technologies including GPS, GIS, and remote sensing systems applied to biosystems. Collecting, managing, and analyzing spatial data for agricultural and forest systems. Spring.

**BSEN 6230 WASTE MANAGEMENT AND UTILIZATION FOR BIOSYSTEMS (3)** LEC. 2. LAB. 3. Pr. CHEM 1040 or CHEM 1041. Departmental approval. Coreq. BSEN 3230. Introduction to the animal waste management problems of confined production systems and characterization of animal waste types. Design of biological treatment and processing systems.

**BSEN 6250 DETERMINISTIC MODELING FOR BIOSYSTEMS (3)** LEC. 2. LAB. 3. Pr. MATH 2650 and ELEC 3810 and (ENGR 2350 or MECH 2110) or Departmental approval. Modeling of biosystems, methods to deal with complexity, and validation tools. Spring.

**BSEN 6260 RENEWABLE ENERGY IN BIOSYSTEMS PROCESS OPERATIONS (3)** LEC. 2. LAB. 3. Pr. BSEN 3310. Departmental approval. Application and use of renewable energy in biological, food forest and agricultural systems including biomass and bioenergy, solar energy, wind power and geothermal.

**BSEN 6270 METABOLIC ENGINEERING FOR BIOPROCESS (3)** LEC. 3. Department/instructor approval. An introduction of basic principles of bioprocess engineering and metabolic engineering, to prepare engineers and scientists for biotechnology and bioeconomy industries. May count either BSEN 5270 or BSEN 6270.

**BSEN 6280 LIFE-CYCLE ASSESSMENT FOR BIOLOGICAL SYSTEMS (3)** LEC. 2. LAB. 3. Pr. BSEN 2240. Departmental approval. This course introduces the concept of life cycle assessment (LCA) in the context of biological engineering. Examples will include LCA applications to engineered biological systems and other engineering processes and products.

**BSEN 6450 COMMERCIAL POULTRY AND LIVESTOCK HOUSING (3)** LEC. 2. LAB. 3. An introduction to the basic design, operation, and maintenance of modern commercial animal housing systems. Emphasis will be placed on poultry and swine systems with elements of dairy and beef when applicable.

**BSEN 6510 ECOLOGICAL ENGINEERING (3)** LEC. 3. Pr. BSEN 3230. Departmental approval. The course introduces students to ecological engineering non-point source transport of nutrients, sediment, pesticides, pathogens, and chemicals from agricultural, forestry, and urban activities.

**BSEN 6520 WATERSHED MODELING (3)** LEC. 3. Departmental approval. The course covers modeling of non-point source pollution at the watershed scale using Soil and Water Assessment Tool model including underlying processes that control movement of pollutants.

**BSEN 6540 BIOMASS AND BIOFUELS ENGINEERING (3)** LEC. 2. LAB. 3. This course introduces the various processes and engineering principles in converting biomass into biofuels and chemicals. The focus will be on thermochemical and biochemical conversion platforms. May count either BSEN 5540 or BSEN 6540.

**BSEN 6550 PRINCIPLES OF FOOD ENGINEERING TECHNOLOGY (4)** LEC. 3. LAB. 3. Pr. (MATH 1130 or MATH 1133) and (PHYS 1000 or PHYS 1007). Engineering concepts and unit operations used in processing food products. Fall.

**BSEN 6560 SITE DESIGN FOR BIOSYSTEMS (3)** LEC. 2. LAB. 3. Pr. BSEN 3230. Departmental approval. The course is designed to develop student skills in computer-aided site design and restoration by using rural and urban best management practices to reduce environmental impacts.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>LECs</th>
<th>LAB.</th>
<th>Prerequisites</th>
<th>Departmental Approval</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>BSEN 7016</td>
<td>QUANTITATIVE AGRICULTURAL REMOTE SENSING</td>
<td>3</td>
<td>3</td>
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<td>Theory and application of remote sensing to quantifying soil and vegetation characteristics, with emphasis on agriculture but also relevant to natural biosystems.</td>
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<tr>
<td>BSEN 7020/7026</td>
<td>SITE-SPECIFIC TECHNOLOGIES FOR AGRICULTURE AND FORESTRY SYSTEMS</td>
<td>3</td>
<td>2</td>
<td>3</td>
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<td></td>
<td>Departmental approval. Introduction to advanced concepts of off-highway vehicle equipment for use in agricultural and forestry production with emphasis on site-specific management (Precision Agriculture/Forestry). The course will overview new concepts and technologies for equipment usage and technologies applied for site-specific crop management.</td>
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<tr>
<td>BSEN 7050</td>
<td>SOIL DYNAMICS OF TILLAGE AND TRACTION</td>
<td>3</td>
<td>3</td>
<td></td>
<td>CIVL 4300 and CSES 7590</td>
<td></td>
<td>Analyses and measurements of soil reactions as affected by physical properties of soil when subjected to forces imposed by tillage implements and traction devices.</td>
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<tr>
<td>BSEN 7110/7116</td>
<td>FUNDAMENTALS OF INSTRUMENTATION FOR BIOLOGICAL SYSTEMS</td>
<td>3</td>
<td>2</td>
<td>3</td>
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<td>Departmental approval. Students will gain an understanding of the fundamentals of sensing and sensors, simple digital electronics and measurement circuits, introductory digital signal processing, and computer data acquisition. They will be required to build and test instrumentation to collect data on biological systems that might include fluid flow, pressure, force, or other transducers.</td>
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<tr>
<td>BSEN 7120</td>
<td>STOCHASTIC MODELING FOR BIOSYSTEMS</td>
<td>3</td>
<td>3</td>
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<td>CIVL 3020</td>
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<td>Departmental approval. Solving problems in biosystems engineering and related fields by modeling data with probability distributions, spatial statistics, autoregressive models, Monte-Carlo simulation, and reliability methods.</td>
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<tr>
<td>BSEN 7136</td>
<td>GIS APPLICATIONS IN PRECISION AGRICULTURE</td>
<td>1</td>
<td>1</td>
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<td>Departmental approval. Exploration of geographic information systems (GIS) and its applications in precision agriculture. Topics include file structure and formatting, interfacing with precision agriculture equipment, georeferencing maps, merging and clipping farm data, data field calculations, designing management zones, variable rate prescriptions, and basic data analysis.</td>
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<tr>
<td>BSEN 7216</td>
<td>BIOMASS TO RENEWABLE ENERGY PROCESSES</td>
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<td>3</td>
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<td>(CHEM 2070 or CHEM 2077) and (CHEM 2080 or CHEM 2087) or CHEM 5180 and BIOL 3200</td>
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<td>Departmental approval. This will introduce fundamental principles and practical applications of biomass-to-renewable energy processes.</td>
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<tr>
<td>BSEN 7220</td>
<td>RENEWABLE ENERGY SYSTEMS DESIGN, ANALYSIS AND APPLICATIONS</td>
<td>3</td>
<td>3</td>
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<td>Understanding of the basic principles, applications, modeling, energetic and economic analysis of renewable energy resources namely solar, biomass, wind, hydropower and geothermal. Design of renewable energy systems.</td>
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<tr>
<td>BSEN 7240</td>
<td>BULK SOLIDS STORAGE, HANDLING AND TRANSPORTATION</td>
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<td>Sampling of particulate materials, bulk solids characterization, flow properties, particle and bulk solid flow, dynamics of fluid/solids systems, hydraulic and pneumatic conveyor design, storage bin and hopper design and geometry, safety issues.</td>
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<tr>
<td>BSEN 7260</td>
<td>ADVANCED UNIT OPERATIONS IN BIOSYSTEMS ENGINEERING</td>
<td>3</td>
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<td>The course is an advance analysis of the unit operations used to process and enhance the value of biological materials.</td>
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<tr>
<td>BSEN 7280</td>
<td>FOOD THERMAL PROCESSING</td>
<td>3</td>
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<td>Departmental approval. Insight of technologies and approaches used in food thermal processing for commercial purposes. Application of fundamentals of heat transfer, thermo-bacteriology, physical and chemical kinetics of food, and plant layout.</td>
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<td>BSEN 7310</td>
<td>NONPOINT SOURCE POLLUTION</td>
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<td>Departmental approval. Non-point source (NPS) transport of nutrients, sediment, pesticides, and pathogens from agricultural, forestry, and urban activities. Basic concepts of pollutant transport through soils and with overland flow. Evaluation, management, and prevention of non-point pollution of surface and groundwater.</td>
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<tr>
<td>BSEN 7320</td>
<td>NON-POINT SOURCE POLLUTION MODELING</td>
<td>3</td>
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<td>BSEN 7310 or Departmental approval. Non-point source (NPS) modeling of nutrients, sediment, pesticides, and pathogens from agricultural, forestry, and urban activities. Underlying processes (climate, hydrology, nutrients and pesticides, erosion, channel), land cover/plants best management practices. Sensitivity and uncertainty analyses.</td>
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<tr>
<td>BSEN 7330</td>
<td>SOIL-PLANT-ENVIRONMENT SYSTEM DESIGN</td>
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<td>Study of systems that incorporate plant uptake of nutrients and/or heavy metals for remediation of soil-based contaminants. Design applications of environmental remediation include constructed wetlands, drip irrigation of wastewater effluent, disposal of municipal sludge, and phytoremediation of contaminants in shallow groundwater.</td>
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</table>
BSEN 7350 ENGINEERING ANALYSIS OF LAKES AND RESERVOIRS (3) LEC. 3. Departmental approval. Knowledge and understanding of the causes, impacts, and methods of restoring water quality impairments, with emphasis placed on impounded water bodies and perennial streams.

BSEN 7366 INTEGRATING AUTOCAD CIVIL3D & GIS (3) LEC. 3. Departmental approval. Accessing and importing GIS data into C3D. Exporting C3D objects to GIS for subsequent manipulation and display. Emphasis on applications in environmental engineering projects such as stream restoration and wetland design.

BSEN 7376 WATERSHED MONITORING & ASSESS (3) LEC. 3. Departmental approval. Knowledge and understanding of the causes, impacts, and methods of restoring water quality impairments, with emphasis placed on impounded water bodies and perennial streams.

BSEN 7366 INTEGRATING AUTOCAD CIVIL3D & GIS (3) LEC. 3. Departmental approval. Accessing and importing GIS data into C3D. Exporting C3D objects to GIS for subsequent manipulation and display. Emphasis on applications in environmental engineering projects such as stream restoration and wetland design.

BSEN 7376 WATERSHED MONITORING & ASSESS (3) LEC. 3. Departmental approval. Accessing and importing GIS data into C3D. Exporting C3D objects to GIS for subsequent manipulation and display. Emphasis on applications in environmental engineering projects such as stream restoration and wetland design.

BSEN 7516 INTRODUCTION TO LAND AND WATER ENGINEERING (3) LEC. 3. This course aims at equipping students with the engineering tools and knowledge needed for advanced courses in land and water engineering.

BSEN 7526 INTRODUCTION TO FLUVIAL GEOMORPHOLOGY (3) LEC. 3. Pr. BSEN 3230. This course provides an overview of stream geomorphology as it relates to natural stream physical processes.

BSEN 7536 DRAINMOD (3) LEC. 3. Pr. BSEN 3230. This course presents the principles of water movement and fate in shallow water table systems and application of the drainage water management model DRAINMOD to a wide variety of problems.

BSEN 7616 AGRICULTURAL WASTE MANAGEMENT (3) LEC. 3. This course covers principles of managing, handling, treating and applying animal and poultry manures and organic byproducts from an engineering perspective. Departmental approval.

BSEN 7626 STORMWATER BMP DESIGN (3) LEC. 3. Pr. BSEN 3230. Departmental approval. This course is designed to introduce students to several innovative stormwater practices including stormwater wetlands, bioretention, green roofs, permeable pavement, cisterns, and others.

BSEN 7636 STREAM RESTORATION STRUCTURE RISK AND FAILURE ASSESS (1) LEC. 1. Pr. BSEN 3230. Departmental approval. Critical thinking about the use of various stream restoration structures an providing the tools needed to investigate further into failure analysis and risk assessment.

BSEN 7646 OPEN CHANNEL HYDRAULICS (3) LEC. 3. Pr. BSEN 3310. Departmental approval. Theory and application of hydraulics in open channels with an emphasis on natural systems (natural streams and rivers).

BSEN 7666 WETLANDS DESIGN AND RESTORATION (3) LEC. 3. Departmental approval. Fundamental understanding of hydrology, soils and ecology of natural wetland systems to serve as the basis of designing wetland systems for water treatment and restoring degraded natural wetlands.

BSEN 7900 SPECIAL PROBLEMS IN BIOSYSTEMS ENGINEERING (1-4) IND. Departmental approval. Faculty supervision of individual student investigations of advanced specialized problems in biosystems engineering at the graduate level. Pr., Course may be repeated with change in topics.

BSEN 7950 SEMINAR (1) SEM. SU. Reviews and discussions of research techniques, current scientific literature, and recent developments in biosystems engineering. Course may be repeated for a maximum of 12 credit hours.

BSEN 7970 SPECIAL TOPICS IN BIOSYSTEMS ENGINEERING (1-4) IND. Departmental approval. Individual or small group study of an advanced specialized area in biosystems engineering at the graduate level. Pr., Course may be repeated with change in topics.

BSEN 7990 RESEARCH AND THESIS (1-10) MST. Course may be repeated with change in topic.

BSEN 8990 RESEARCH AND DISSERTATION (1-12) DSR.