

## BIOLOGICAL ENGINEERING • BE

- 1250 Introduction to Engineering Methods (2) F** 6 hrs. lab. Fundamentals of engineering design; presentation of an engineering design; graphical expression of engineering design using computer-aided drafting.
- 1252 Biology in Engineering (2) S** Prereq.: credit or registration in BIOL 1201. 1 hr. lecture; 3 hrs. lab. Effect of variability and constraints of biological systems on engineering problem solving and design; engineering units; engineering report writing; oral report presentation; laboratory demonstration of biological engineering analysis.
- 2307 Elements of Landscape Construction (3) F,S** Prereq.: MATH 1015 or 1022. 2 hrs. lecture; 3 hrs. lab. Theory and use of tape, level, transit, plane table, and compass; principles of area and volume calculations, land slope, drainage grades, legal land descriptions, and topographic mapping.
- 2350 Experimental Methods for Engineers (3) S** Prereq.: BE 2352. 2 hrs. lecture; 3 hrs. lab. Introduction to experimental methods, technical report writing, and instrumentation for engineering applications; measurement of temperature, pressure, flow, strain, and vibration in biological products; microprocessor data loggers and computer data acquisition systems.
- 2352 Quantitative Biology in Engineering (3) F** Prereq.: BE 1252. 2 hrs. lecture; 3 hrs. lab. Characterization of biological phenomena in engineering design; relationships among parameters using linear and nonlinear statistical expressions; case studies of engineering design solutions.
- 3249 Engineering Practice I (3) Su only** Prereq.: consent of instructor. Pass-fail grading. A minimum of six weeks full-time employment in an industry participating in the summer program. Selected engineering problems in an industrial environment.
- 3250 Engineering Practice II (3) Su only** Prereq.: consent of instructor. Pass-fail grading. A minimum of six weeks full-time employment in an industry participating in the summer program. Selected engineering problems in an industrial environment.
- 3290 Professionalism for Biological Engineers (2)** Prereq.: Grad of "C" or better in CE 2450. Ethical standards, technical communication, goal setting, professionalism and professional organizations, safety and risk, team dynamics, and proposal preparation.
- 3320 Mechanical Design for Biological Engineering (3)** Prereq.: CE 3400; credit or registration in CE 2460 or ME 3133. 2 hrs. lecture; 3 hrs. lab. Term project in mechanical design. Philosophy of mechanical design for biological engineering; materials for construction; frame design; power transmission.
- 3340 Process Design in Biological Engineering (3) S** Prereq.: EE 2950, CE 2200, and credit or registration in ME 3333. 2 hrs. lecture; 3 hrs. lab. Design applications in biological engineering using the engineering sciences of fluid mechanics and thermodynamics; electrical machines and controls.
- 3371 Irrigation Fundamentals and Management (3)** Prereq.: consent of instructor. For majors in agriculture, design, and natural sciences. Cannot be used to fulfill College of Engineering requirements. Turf, landscaping, and other horticultural applications of irrigation; design of irrigation systems from water source to application and uptake by plants; covers typical irrigation application techniques from sprinkler to micro; friction loss in system components; irrigation scheduling; and auditing/troubleshooting irrigation system performance.
- 3381 Nonpoint Source Pollution Engineering (3)** Prereq.: BE 2352 and EVEG 3110. 2 hrs. lecture; 3 hrs. lab. Water quality criteria and regulations for the agricultural community; production, treatment, and disposal of agricultural and food processing wastes; management of agricultural nutrients; nonpoint source pollution; bi-product utilization; land application; wetland restoration; stream sampling and analysis; re-aeration studies and modeling.
- 3400 Environmental Engineering II (3) F,S** Prereq.: CHEM 2060 (2261), EVEG 2000. See EVEG 3400.
- 3989 Special Projects in Biological Engineering (1-4) F,S,Su** Prereq.: consent of instructor. May be taken for a max. of 6 hrs. of credit. Library research, experimental and/or theoretical investigation, and written report in form of engineering report.
- 4290 Senior Engineering Design and Professionalism (2) F** Prereq.: BE 3290. Students work in teams to develop a detailed design to address a technical problem that the team chose in BE 3290. Activities include developing measurable design objectives and a product design specification, creating multiple design solutions, evaluating design solutions, and communicating a detailed design.
- 4292 Senior Engineering Design Laboratory (2) S** Prereq.: BE 4290. 6 hrs. lab. Engineering principles used to complete the project set forth in the design outline submitted in BE 4290; design project completion.
- 4303 Engineering Properties of Biological Materials (3) V** Prereq.: MATH 2065 and credit or registration in CE 3400. 2 hrs. lecture; 3 hrs. lab. Engineering properties, including rheology, friction, mechanical damage, texture, and thermal, optical, and electrical properties.
- 4323 Biomechanics for Engineers (3) V** Prereq.: CE 2450. 2 hrs. lecture; 3 hrs. lab. Also offered as IE 4465. Mechanical behavior of the human musculoskeletal system and component tissue when physical work is performed; engineering mechanics applied to the activities; fundamental knowledge of human anatomy and physiology; workplace design.
- 4332 Molecular Methods in Biological Engineering (3) V** Prereq.: BIOL 2083, BE 2350, and credit or registration in BE 4303. Fundamentals of the theory and applications of quantitative molecular techniques used in biological engineering research and design.
- 4340 Food and Bioprocess Engineering (3) V** Prereq.: BE 2352; credit or registration in BE 3340. 2 hrs. lecture; 3 hrs. lab. Design and analysis of systems for processing biological materials, with emphasis on food; topics include biotechnology, fluid flow, thermodynamics, and transport phenomena in food and bioprocessing; unit operations, including freezing, extraction, drying, and aseptic processing.
- 4341 Biological Reactor Systems Design (3) S** Prereq.: BIOL 2051 and BE 4352. 2 hrs. lecture; 3 hrs. lab. Microbial and biochemical principles used in design of biological reactors for biotransformation; metabolic output and cellular production; design of batch and continuous flow reactors utilizing microbial kinetic models; attached and suspended growth systems and eucaryotic and procaryotic cells.
- 4342 Sugar Process Engineering (3)** Prereq.: EE 2950, CE 2200 or ME 3834 or CHE 3101, ME 2334 or 3333 or CHE 3172. Processes used in the manufacture of raw and refined sugar; application of scientific and engineering principles to unit operations of evaporation, crystallization, extraction, solids handling and drying, centrifuging, clarification, and steam and power generation.
- 4347 Sugar Factory Design (3)** Prereq.: credit or registration in BE 4342. 2 hrs. lecture; 3 hrs. lab. P and I diagrams for sugar processes and instrumentation/control strategies; detailed process design of heat transfer equipment, fluid flow systems including non-Newtonian flow, prime mover requirements, steam and power use, and reticulation, materials handling systems, utility systems, and materials of construction.
- 4352 Transport Phenomena in Biological Engineering (3) F** Prereq.: BE 2352, BIOL 2051; credit or registration in CE 2200 and ME 3333. Introduction to biological kinetics; time-temperature substrate-dependent growth and death of biological organisms; heat and mass transfer in engineering design and analysis; principles of material and energy balances in reactor design.
- 4360 Mobile Fluid Power Control (3)** Prereq.: ME 3834 or equivalent. 2 hrs. lecture; 3 hrs. lab. Theory and design of hydraulic systems and basic components; power steering, hydrostatic transmissions, electrohydraulic servovalves, manual and automatic control applications.
- 4362 Agricultural Precision Systems (3)** 2 hrs. lecture; 3 hrs. lab. Principles and applications of geospatial technologies supporting precision agriculture/farming and planning for natural resource data management.
- 4380 Aquacultural Engineering (3) F** Prereq.: senior standing. Engineering principles applied to aquacultural systems; water chemistry; fluid mechanics; aquacultural pumping plants; fish pond design; recirculating aquacultural systems; water filtration; disinfection; aeration and degassing.
- 4383 Natural Resource Engineering (3) F** Prereq.: CE 2200. Engineering analysis and design of natural resource control systems, including open channels, vegetated waterways, terraces, water control structures, spillways, reservoirs, flood control, surface water quality, and wetlands.
- 4989 Independent Study in Biological Engineering (1-4) F,S,Su** Prereq.: senior standing. Written engineering report required. May be taken for a max. of 6 sem. hrs. of credit when topics vary. Biological engineering practice; library research, experimental and/or theoretical investigation.
- 7301 Similitude in Biological Engineering Research (3) V** Prereq.: graduate standing. Determination of pertinent quantities in a research project, Buckingham  $\pi$  theorem, theory and systematic calculation of dimensionless numbers, similarity and distortion in model studies, research project design, and prediction equations.
- 7304 Advanced Natural Resource Engineering (3) V** Prereq.: BE 4383. Advanced topics in statistical hydrology, flow theory, evapotranspiration, transport of pollutants, drainage, irrigation, erosion, sediment transport, and sedimentation applied to rural fields and watersheds.
- 7306 Agricultural Systems Engineering (3) V** Prereq.: BE 4292 or equivalent. Applications of systems approaches to engineering problems in agriculture; queuing theory; modeling and simulation; linear programming; decision support systems and expert systems.
- 7340 Advanced Food Engineering and Biotechnology (3) V** Prereq.: BE 4340. Design and modeling of food and bioprocessing systems; application of advanced thermodynamic principles and transport phenomena with emphasis on numerical techniques in the design, analysis, and modeling of food systems; focus on current research topics in food engineering and food biotechnology.
- 7350 Advanced Instrumentation and Control for Biological Systems (3) V** Prereq.: BE 2350 and MATH 2065. 2 hrs. lecture; 3 hrs. lab. Theory of measurement and feedback integrated with applied design work with biological systems; focus areas include: aquaculture, precision farming, environmental applications, bioprocess, and biomedical measurement and control concepts.
- 7352 Advanced Transport Phenomena in Biological Engineering (3) V** Prereq.: BE 4352. Transient heat and mass transfer in biological materials and systems; mathematics describing active and passive cellular transport; emphasis on numerical solution techniques for heat and mass flow in nonideal, heterogenous systems, including kinetic and thermodynamic considerations.
- 7361 Biological Reactor Systems for Agricultural Waste Treatment (3) V** Prereq.: BE 4341. Design of biological reactor systems for treatment of agricultural wastes; utilizing and developing kinetic models for suspended and attached-growth cultures; characterization of agricultural wastes and wastewaters; consideration of nutrient recovery, pathogen survival, odor reduction, and by-product recovery goals.
- 7381 Advanced Aquacultural Engineering (3) V** Prereq.: BE 4380. Advanced topics in aquacultural aeration, oxygenation, disinfection of aquacultural systems, and aquacultural wastewater characterization; integration with traditional agricultural production.
- 7500 Seminar (1)** Prereq.: graduate standing in engineering. Only 1 sem. hr. of credit will be allowed toward the degree. Pass-fail grading.

**7909 Advanced Topics in Biological Engineering (1-4) F,S,Su** *Prereq.: consent of instructor. May be taken for a max. of 6 hrs. of credit when topics vary. One or more phases of advanced biological engineering practice.*

**8000 Thesis Research (1-12 per sem.)** *"S"/"U" grading.*

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