Undergraduate Course Listing

BME – Biomedical Engineering

BME 3009. Biomedical Engineering (3). Prerequisites: BSC 2010, MAC 2312, and PHY 2048C. Corequisites: MAC 2313 and PHY 2049C. This course presents an introduction to the field of biomedical engineering, building on previous basic coursework in biological science, physics, and calculus. Topics in cell physiology and modeling, bioinstrumentation, biomaterials, tissue engineering, and bioimaging will be covered. The course will provide sophomore-level biomedical engineering students with both fundamentals and applications in contemporary biomedical science and engineering.

BME 4007. Biomedical Engineering (3). Prerequisites: ECH 3274L, ECH 3418, and ECH 4267. Corequisites: ECH 4404L, ECH 4504, and ECH 4604. This course offers an introduction to the field of biomedical engineering, with emphasis on the role of general engineering. Topics cover hemodynamics, human physiology, pharmacodynamics, artificial organs, biomaterials, biomechanics, and clinical engineering.

BME 4082. Biomedical Engineering Ethics (3). Prerequisite: Senior or graduate standing in biomedical engineering. This course is an introduction to the key theories, concepts, principles, and methodology relevant to the development of biomedical professional ethics. The student is facilitated in his/her development of a code of professional ethics through written work, class discussion, and case analysis.

BME 4403C. Quantitative Anatomy and Systems Physiology I (3). Prerequisites: ECH 3023, ECH 3024, and ECH3301, all with a grade of "C" or higher, as well as CHM 2211, PHY 2049C, and BSC 2010. Corequisites: ECH 3101, ECH3266, ECH 3854, EGM 3512, and CHM 4410. This is course, the first of a two-semester sequence, introduces engineering students to principles of anatomy and physiology of the human body. The lecture portion of the course focuses on relating fundamental biomedical engineering concepts to the human physiological system. The laboratory portion of the course involves a practical, in-depth study of the physical and chemical interrelationships in the form and function of all human anatomical and physiological subsystems.

BME 4404C. Quantitative Anatomy and Systems Physiology II (3). Prerequisites: BME 4403C, ECH 3101, ECH 3266, ECH 3854, EGM 3512, and CHM4410. Corequisites: ECH 3274L, ECH 3418, and ECH 4267. This course, the second in a two-semester sequence, introduces engineering students to principles of anatomy and physiology of the human body. The lecture portion of the course focuses on relating fundamental biomedical engineering concepts to the human physiological system. The laboratory portion of the course involves a practical, in-depth study of the physical and chemical interrelationships in the form and function of all human anatomical and physiological subsystems.

BME 4801. Biomedical Engineering Process Design I (3). Prerequisites: BCH 4053, BME 4404C, and ECH 3821. Corequisite: Senior standing. This is the first course of a two-semester sequence on the design of biomedical engineering processes and products. The first semester consists of introducing students to the principles of engineering economics and cost estimation techniques relating to principles of biomedical engineering design. Included is an introduction to computer-aided design calculations.

BME 4802. Biomedical Engineering Process Design II (3). Prerequisites: BCH 4053, BME 4403C, and BME 4801. Corequisite: Senior standing. This is the second course of a two-semester sequence on the design of biomedical engineering processes and products. The second term focuses on the actual design of a biomedical engineering process or product using computer-aided design calculations. This is the capstone senior design course in biomedical engineering. An individual design project is completed by each student.

BME 4904r. Undergraduate Research Project (1–3). Prerequisite: BME 4403C, CHM 4410, ECH 3101, ECH 3266, ECH 3854, a 3.0 GPA, and instructor permission. Corequisites: ECH 3274L, ECH 3418, and ECH 4267. This course involves the completion of an Honors Undergraduate Research Program (URP) for six hours with a minimum grade of "C". This program requires independent student research on a topic relevant to biomedical engineering and may be used to satisfy the Chemical Engineering Elective requirement. May be repeated to a maximum of six semester hours.

BME 4905r. Directed Individual Study (3). Prerequisite: department chair permission. This course offers a supervised program of study approved by the department chair. May be repeated within the same term to a maximum of twelve credit hours.

BME 4906r. Honors URP in Biomedical Engineering (1–3). Prerequisite: BME 4403C, CHM 4410, ECH 3101, ECH 3266, ECH 3854, a 3.2 GPA, and instructor permission. Corequisites: ECH 3274L, ECH 3418, and ECH 4267. This course involves the completion of an Honors Undergraduate Research Program (URP) for six hours with a minimum grade of "C". This program requires independent student research on a topic relevant to biomedical engineering and may be used to satisfy the Chemical Engineering Elective requirement. May be repeated to a maximum of six semester hours.

BME 4937r. Special Topics in Biomedical Engineering (3). Prerequisite: BME 4404C, ECH 3274L, ECH 3418, and ECH 4267. Corequisite: ECH 4504. Topics in this course emphasize recent developments in the field of biomedical engineering. Selected readings are assigned by the instructor. Structure of the course varies by instructor and topic, but generally involve lectures and a final project on a topic in biomedical engineering. May be repeated within the same term to a maximum of twelve semester hours.

ECH – Chemical Engineering

ECH 2050. Engineering Communications (2). Prerequisite: ENC 1101. Corequisite: EGN 1004L. This course includes techniques for effective oral communication in settings most frequently encountered by the practicing engineer. Speaking skills are applied in informal presentations, formal presentations, and interviews.

ECH 3023. Mass and Energy Balances I (3). Prerequisites: BSC 2010, CHM 1046, and MAC 2312. Corequisites: CHM 2210, MAC 2313, and PHY 2048C. This course covers mass and energy balances related to chemical process systems and measurements, as well as to the development of problem-solving methodologies in mass and energy balances.

ECH 3024. Mass and Energy Balances II (3). Prerequisites: CHM 2210, ECH 3023, MAC 2313, and PHY 2048C. Corequisites: ECH 3301 and PHY 2049C. This course is the second in a two-part series introducing the general concepts of chemical engineering. Applications of mass and energy balances are extended to include reactive systems, systems undergoing phase changes, and transient processes. MATLAB is used to demonstrate the use of a structured programming language for material and energy balances.

ECH 3101. Chemical Engineering Thermodynamics (3). Prerequisites: ECH 3023, ECH 3024, and ECH 3301, all with a grade of "C" or higher, as well as PHY 2049C. Corequisites: CHM 4410, ECH 3854, ECH 3266, and EGM 3512. This course exposes students to the basics of classical and solution thermodynamics, forming a link between the mass and energy balance courses and separations.

ECH 3266. Transport Phenomena I (3). Prerequisites: ECH 3023, ECH 3024, and ECH 3301, all with a grade of "C" or higher, as well as PHY 2049C. Corequisites: CHM 4410, ECH 3101, ECH 3854, and EGM 3512. This course examines integral balance equations for conservation of momentum, energy, and mass. Topics include: application to chemical processes involving fluid flow and heat and mass transfer; estimation of friction factors and of heat and mass transfer coefficients; pump selection and sizing; piping network analysis; and design of heat exchangers.

ECH 3274L. Transport Phenomena Lab (3). Prerequisites: CHM 4410, ECH 3101, ECH 3266, and ECH 3854. Corequisites: ECH 3418 and ECH 4267. This course enables students to design and conduct experiments on fluid mechanics and heat transfer; analyze and interpret data; apply spreadsheets, statistical methods, and process models; as well as gain proficiency in operating basic chemical-engineering equipment and instruments. Emphasis is placed on safety, professionalism, teamwork, and oral/written communication.

ECH 3301. Process Analysis and Design (4). Prerequisite: MAC 2312. Corequisites: ECH 3023 and MAC 2313. This course examines the development and analysis of process models for systems that arise in chemical-engineering applications.

ECH 3330. Statistical Approach to Process Improvement (3). Prerequisite: Completion of the academic requirements through the sophomore year in chemical engineering or in other engineering disciplines. This course covers ways to apply statistical process control and methods of planned experimentation to the design of products and processes, as well as to continuous quality improvement. Topics covered include control charts; process-capability studies; loss functions; acceptance sampling; design of experiments for screening studies and response-surface modeling; and analysis of variance. The course also introduces case studies in chemical processes, food engineering, and health care.

ECH 3418. Separations Processes (3). Prerequisites: ECH 3101, ECH 3266, ECH 3854, and CHM 4410. Corequisites: ECH 3274L and ECH 4267. This course examines the principles of equilibrium and transport-controlled separations. Topics include analysis and design of stagewise and continuous separation processes, including distillation, absorption, extraction, filtration, and membrane separations.

ECH 3854. Chemical Engineering Computations (4). Prerequisites: PHY 2040C and a grade of "C-" or better in ECH 3023, ECH 3024, and ECH 3301. Corequisites: ECH 3101, ECH 3266, EGM 3512, and CHM 4410. This course covers structured programming techniques, solutions of ordinary differential equations, as well as numerical techniques useful in the solution of chemical engineering processes, as follows: root-finding techniques, direct and iterative approaches for solving linear systems, linear and nonlinear regression, interpolation, numerical differentiation and integration, and statistical analysis of data.

ECH 3949r. Cooperative Work Experience (0). (S/U grade only.)

ECH 4267. Transport Phenomena II (3). Prerequisites: CHM 4410, ECH 3101, ECH 3266, and ECH 3854. Corequisites: ECH 3274L and ECH 3418. This is the second in a two-semester sequence on transport phenomena. Emphasis is on critical analytical and mathematical skills for analyzing and applying fundamental concepts in transport phenomena (including fluid

mechanics, heart transfer, and mass transfer), as well as on the analysis of similarities and differences among these three processes.

ECH 4323. Process Control (3). Prerequisites: ECH 4504 and ECH 4604. Corequisite: ECH 4615. A systematic introduction to dynamic behavior and automatic control of industrial processes. Synthesis of feedback control loops for linear systems and synthesis of control structures.

ECH 4323L. Process Control Lab (1). Prerequisites: ECH 4504 and ECH 4604. Corequisite: ECH 4615. This lab is comprised of experiments designed to illustrate and apply control theory, measurement techniques, calibration, tuning of controls, characterization of sensors, and control circuits.

ECH 4404L. Unit Operations Lab (3). Prerequisites: ECH 3274L, ECH 3418, and ECH 4267. Corequisites: ECH 4504 and ECH 4604. This course involves preparing experimental plans and doing experimental work with unit operations equipment to meet specific objectives. Emphasis is on computer data analysis and on oral communication skills.

ECH 4504. Kinetics and Reactor Design (3). Prerequisites: ECH 3274L, ECH 3418, and ECH 4267. This course covers the following topics: homogeneous and heterogeneous reaction kinetics; analysis of batch, mixed, plug, and recycle reactors; analysis of multiple reactions and multiple reactors; reactor temperature control; and catalytic reactor design.

ECH 4604. Chemical Engineering Process Design I (4). Prerequisites: ECH 3274L, ECH 3418, and ECH 4267. Corequisites: ECH 4404L, ECH 4504, and ECO 2023. This is the first course in a two-semester sequence on the analysis, synthesis, and design of chemical processes, preparing students for engineering practice. Students integrate knowledge from prior courses with process economics, computer-aided design, engineering standards, and realistic constraints to solve open-ended process problems.

ECH 4615. Chemical Engineering Process Design II (3). Prerequisites: ECH 4504 and ECH 4604. Corequisites: ECH 4323 and ECH 4323L. The second in a two-semester sequence on the analysis, synthesis, and design of chemical processes, this course prepares students for engineering practice. Students integrate knowledge from prior courses with process economics, computer-aided design, engineering standards, and realistic constraints to the design of chemical-process facilities.

ECH 4743. Bioengineering (3). Prerequisites: ECH 3274L, ECH 3418, and ECH 4267. Corequisites: ECH 4404L, ECH 4504, and ECH 4604. Introduction to the major principles of the life sciences (microbiology, biochemistry, biophysics, genetics) that are important for biotechnological applications. Extension of the chemical engineering principles of kinetics, reactor design, heat and mass transport, thermodynamics, process control, and separation processes to important problems in bioengineering.

ECH 4781. Chemical Engineering--Environmental (3). Prerequisites: ECH 3274L, ECH 3418, and ECH 4267. Corequisites: ECH 4404L, ECH 4504, and ECH 4604. Introduction to applications of environmental engineering from a chemical engineering perspective. Thermodynamics, stoichiometry, chemical kinetics, transport phenomena, and physical chemistry are utilized in addressing pollution control and prevention processes. Analysis of particle phenomena, including aerosols and colloids. Applications of fundamentals to analyze gas and liquid waste treatment processes.

ECH 4800C. Distilled Spirits Processing and Properties (3). Prerequisites: Completion of sophomore-year academic requirements in chemical engineering, other engineering discipline, or in a related science; and instructor permission. This course involves the production of a distilled-

spirit sample at a commercial facility, followed by an in-depth chemical analysis of the product through the use of sophisticated instrumentation located at a university chemistry laboratory in Scotland. This intensive course takes place over a two week period in which students are instructed in the operational procedure of the plant and given hands-on involvement in an actual production run. Lecture and laboratory sessions following the production run focus on a detailed chemical and physical analysis of the distilled spirit sample using spectroscopic, chromatographic, and NMR techniques.

ECH 4823. Polymer Science and Engineering (3). Prerequisites: ECH 3274L, ECH 3418, and ECH 4267. Corequisites: ECH 4404L, ECH 4504, and ECH 4604. This course offers an introduction to different types of polymers and their physical properties. Topics include major synthetic paths and reaction kinetics, properties of macromolecules in solution, methods of molecular weight determination, and the role of phase transitions in amorphous and crystalline polymers.

ECH 4824. Chemical Engineering--Materials (3). Prerequisites: ECH 3274L, ECH 3418, and ECH 4267. Corequisites: ECH 4404L, ECH 4504, and ECH 4604. Introduction to materials science and engineering from a chemical engineering perspective. Fundamentals of engineering materials, including polymers, metals, and ceramics are studied. Emphasis is placed on the strong interrelationship between materials structure and composition, synthesis and processing, and properties and performance.

ECH 4825. Polymer Process Engineering (3). Prerequisites: ECH 3274L, ECH 3418, and ECH 4267. Corequisites: ECH 4404L, ECH 4504, and ECH 4604. This course explores polymeric systems, interrelationships between material properties, processing conditions, and final properties with an emphasis on viscoelastic rheological behavior of polymer melts, concentrated solutions, and the relationship to the processing operations.

ECH 4904r. Undergraduate Research Project in Chemical Engineering (1–3). Prerequisites: CHM 4410, ECH 3101, ECH 3266, ECH 3854, a 3.0 GPA, and instructor permission. Corequisites: ECH 3274L, ECH 3418, and ECH 4267. This course involves the completion of an Honors Undergraduate Research Program (URP) for six hours with a minimum grade of "C". This program requires independent student research on a topic relevant to biomedical engineering and may be used to satisfy the Chemical Engineering Elective requirement. May be repeated to a maximum of six semester hours.

ECH 4905r. Directed Individual Study (1–3). Prerequisite: Permission of department chair. This is a supervised program of study. May be repeated to a maximum of twelve semester hours.

ECH 4906r. Honors--URP in Chemical Engineering (1–3). Prerequisites: BME 4403C, CHM 4410, ECH 3101, ECH 3266, ECH 3854, a 3.2 GPA, and instructor permission. Corequisites: ECH 3274L, ECH 3418, and ECH 4267. This course involves the completion of an Honors Undergraduate Research Program (URP) for six hours with a minimum grade of "C". This program requires independent student research on a topic relevant to biomedical engineering and may be used to satisfy the Chemical Engineering Elective requirement.

ECH 4937r. Special Topics in Chemical Engineering (3). Prerequisites: ECH 3274L, ECH 3418, and ECH 4267. Corequisite: ECH 4504. This course covers selected topics in chemical engineering with emphasis on contemporary developments in the field. May be repeated within the same term to a maximum of twelve semester hours.

EGN – General Engineering

EGN 3032. Engineering Ethics (3). Prerequisite: EGN 1004L. This course introduces the key theories, concepts, principles, and methodology relevant to the development of professional engineering ethics. Students are guided in their development of a code of professional ethics through written work, class discussion, and case analysis.