BIOLOGICAL ENGINEERING (BIEN)

BIEN 2810 (3) Biology for Engineers
Develops a basic understanding of the science of biology, including an introduction to the disciplines of biochemistry, cell organization, metabolism, genetics, genomics, molecular biology, recombinant DNA technology and evolution. Provides a basic introduction to several key techniques used in biological engineering laboratories. Uses examples of complex and creative structures engineered by natural processes. Formerly CHEN 2820.
Requisites: Requires prereq or coreq course of CHEN 1201 or CHEN 1211 or CHEM 1113 or MCEN 1024 (minimum grade C-). Restricted to College of Engineering (ENGRU) undergraduates and IUT On Track applicants only.

BIEN 2840 (1-4) Independent Study
Available to sophomores with approval of Department of Chemical and Biological Engineering. Subject arranged to fit needs of student.
Repeatable: Repeatable for up to 6.00 total credit hours.

BIEN 3800 (3) Fundamentals of Biotechnology
Surveys the five areas of modern biotechnology (human, industrial, agricultural, animal, environmental), highlighting engineering principles in biology in all five areas. Delves into how biology is used to create useful materials and medicines. Imparts a working knowledge of synthetic DNA technology, including recombinant DNA, genome editing, DNA synthesis, and DNA sequencing.
Requisites: Requires prerequisite courses of BIEN 2810 or MCDB 1150 or EBIO 1220 and APPM 1350 or MATH 1300 and CHEN 1201 or CHEN 1211 or CHEM 1113 or MCEN 1024 (all minimum grade C-).

BIEN 3840 (1-4) Independent Study
Available to juniors with approval of the Department of Chemical and Biological Engineering. Subject arranged to fit needs of the student.
Repeatable: Repeatable for up to 6.00 total credit hours.

BIEN 4010 (2) Biological Engineering Senior Thesis 1
Provides an opportunity for advanced students to conduct exploratory research in biological engineering.
Requisites: Restricted to College of Engineering (ENGRU) undergraduates only.

BIEN 4020 (2) Biological Engineering Senior Thesis 2
Continuation of BIEN 4010.
Requisites: Requires prerequisite course of BIEN 4010 (minimum grade C-). Restricted to College of Engineering students only.

BIEN 4520 (3) Biological Process and Product Design
Provides a team-based capstone design experience for biological engineering students. The design synthesis activities, the considerations of numerous options, and the practical application of the fundamentals all need to be integrated from first year courses through to this senior design course. The sequence provides a culmination for all previous chemical and biological engineering courses (transport processes, thermodynamics, reaction kinetics, unit operations, etc.). Students are expected to know the basics of fluids, heat transfer, bioseparations, and reactor engineering (kinetics). In BIEN 4520, students will be exposed to design of equipment used for separations and reactions. Students will be taught how to select process units and interconnect them in an overall process flowsheet with the primary goal being to find the optimal design conditions for the best possible design scenario among various conceptualized alternatives. With the exception of cost estimation, process economics, heat integration, se
Requisites: Requires prerequisite courses of CHEN 3010 and BIEN 4820 and BIEN 4830 and BIEN 3800 or MCDB 2150 (all minimum grade C-). Restricted to College of Engineering majors only.

BIEN 4530 (2) Biological Engineering Design Project
This is the 2nd course in the team-based capstone biodesign sequence of classes. Projects are sponsored by industry and student design teams collaborate with industrial consultants. Projects consider biological process and product design with emphasis on economic analysis. Deliverables include an oral mid-project design review, a final oral presentation and a final written design report.
Requisites: Requires prerequisite course of BIEN 4520 (minimum grade C-). Restricted to College of Engineering majors only.

BIEN 4801 (3) Pharmaceutical Biotechnology
Focuses on the engineering needed to bring therapeutic products derived from living organisms (e.g., proteins, peptides, DNA, RNA) from the production plant to the patient. Covers the challenges of keeping these products "active" as they are stored, shipped, and administered to patients. Formerly CHEN 4801.
Requisites: Requires prerequisite courses of CHEN 3320 and prerequisite or corequisite courses of BIEN 4830 or CHEN 4330 (all minimum grade C-). Restricted to College of Engineering majors only.

BIEN 4802 (3) Tissue Engineering
Tissue engineering demonstrates enormous potential for improving human health. This course explores principles of tissue engineering, drawing upon diverse fields such as cell biology, material science, and chemical and biological engineering. Current and developing methods of tissue engineering, as well as specific applications will be discussed in the context of these principles. The course will involve review of current literature within this developing field, as well as focus on translational concepts of tissue engineering.
Equivalent - Duplicate Degree Credit Not Granted: BIEN 5802
Requisites: Requires prerequisite course of BIEN 2810 or MCDB 1150 or EBIO 1210 and EBIO 1220 and prerequisite or corequisite of BIEN 4520 or CHEN 4520 or BMEN 4010 (minimum grade C-). Restricted to College of Engineering students only.

BIEN 4803 (3) Metabolic Engineering
Introduces basic concepts in metabolic engineering and explores modern approaches in metabolic and strain engineering. Application areas that will be discussed will include the use of metabolic engineering approaches in biofuels and biorefining as well as biopharmaceutical production. Formerly CHEN 4803.
Equivalent - Duplicate Degree Credit Not Granted: BIEN 5803
Requisites: Requires prerequisite course of BCHM 4611 (minimum grade C-). Restricted to College of Engineering majors only.

BIEN 4804 (3) Protein and Enzyme Engineering
This course reviews various applications of protein and enzyme engineering and covers key concepts in protein and enzyme design, including protein structure-function relationships; rational and evolutionary engineering approaches; genetic code expansion; cell-free protein synthesis; computational design; and biophysical methods for protein characterization. Additionally, students gain valuable experience reading, analyzing, and interpreting research results from scientific literature, as well as drafting an original research proposal.
Equivalent - Duplicate Degree Credit Not Granted: BIEN 5804
Requisites: Requires prerequisite courses of CHEN 3320 and BIEN 2810 and BCHM 4611 (minimum grade C-). Restricted to College of Engineering undergraduates only.

BIEN 4805 (3) Biomaterials
Provides an overview of biomaterials. Covers major classes of materials used in medical applications, properties, degradation mechanisms, and characterization methods, foreign body response, methods to control physiological response to biomaterial surfaces, biocompatibility, biomaterials used in soft and hard tissue replacements, drug delivery devices and tissue engineering, and design criteria for developing a material for a given biological application.
Requisites: Requires prerequisite courses of BIEN 2810 or MCDB 1150 or EBIO 1220 and CHEN 3320 and CHEM 3311 (all minimum grade C-). Restricted to College of Engineering students only.
Recommended: Prerequisite CHEM 3331.

BIEN 4806 (3) Immunoengineering
Examines the fundamentals of immunology and covers engineering approaches to study and control immune reactions and their applications in therapy and diagnostics for infectious disease, cancer, allergy, and autoimmune disease.
Equivalent - Duplicate Degree Credit Not Granted: BIEN 5806
Requisites: Requires prerequisite course of BIEN 2810 and prerequisite or corequisite of CHEN 4330 or BIEN 4830 or BMEN 3010 (minimum grade C-). Restricted to College of Engineering students only.

BIEN 4810 (3) Biological Engineering Laboratory
Involves planning and execution of chemical engineering experiments on mass transfer operations, bioseparations, and biological reactors. Interprets experimental data with theoretical principles and statistical analysis. Emphasizes communication with written memos, full reports and oral presentations.
Requisites: Requires prerequisite courses of BIEN 2810 or MCDB 1150 or (EBIO 1210 and EBIO 1220) and CHEN 3010 and BIEN 4820 and BIEN 4830 (all minimum grade C-). Restricted to College of Engineering majors only.

BIEN 4820 (3) Biochemical Separations
Lect. and lab. Presents purification methods, mass transfer coefficients, problems specific to biologicals, and scale-up of processes. Also covers chromatography, phase extraction, supercritical fluids, sedimentation, precipitation, electrophoresis, dialysis, affinity techniques, cell separation, application of separations to bioreactors, and comparison of batch and continuous processes. Formerly CHEN 4820.
Requisites: Requires prerequisite course of CHEN 3210 and prereq or coreq of CHEN 4330 or BIEN 4830 (all minimum grade C-). Restricted to College of Engineering majors only.

BIEN 4830 (3) Biokinetics and Reactor Design
Introduces chemical kinetics, chemical reactor design, and biological kinetics. Involves mass and energy balances for steady-state and transient reactor systems. Also covers residence time distribution, mass transfer, catalytic reactions, multiple steady states in reactors, enzyme kinetics, metabolic networks, and cell growth kinetics.
Requisites: Requires prerequisite courses of CHEN 3320 and CHEN 3210 and (CHEN 4521 or CHEM 4531) (all minimum grade C-). Restricted to College of Engineering majors only.

BIEN 4838 (1-3) Special Topics in Biological Engineering
Examines a special topic in Biological Engineering.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Requisites: Restricted to College of Engineering (ENGRU) undergraduates only.

BIEN 4840 (1-4) Independent Study
Available to seniors with approval of Chemical and Biological Engineering department. Subject arranged to fit needs of student.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

BIEN 5802 (3) Tissue Engineering
Tissue engineering demonstrates enormous potential for improving human health. This course explores principles of tissue engineering, drawing upon diverse fields such as cell biology, material science, and chemical and biological engineering. Current and developing methods of tissue engineering, as well as specific applications will be discussed in the context of these principles. The course will involve review of current literature within this developing field, as well as focus on translational concepts of tissue engineering.
Equivalent - Duplicate Degree Credit Not Granted: BIEN 4802
Requisites: Restricted to graduate students only.

BIEN 5803 (3) Metabolic Engineering
Introduces basic concepts in metabolic engineering and explores modern approaches in metabolic and strain engineering. Application areas that will be discussed will include the use of metabolic engineering approaches in biofuels and biorefining as well as biopharmaceutical production.
Equivalent - Duplicate Degree Credit Not Granted: BIEN 4803
Requisites: Requires prerequisite courses of APPM 2360 and BCHM 4611 (all minimum grade C-). Restricted to graduate students only.

BIEN 5804 (3) Protein and Enzyme Engineering
This course reviews various applications of protein and enzyme engineering and covers key concepts in protein and enzyme design, including protein structure-function relationships; rational and evolutionary engineering approaches; genetic code expansion; cell-free protein synthesis; computational design; and biophysical methods for protein characterization. Additionally, students gain valuable experience reading, analyzing, and interpreting research results from scientific literature, as well as drafting an original research proposal.
Equivalent - Duplicate Degree Credit Not Granted: BIEN 4804
Requisites: Requires prerequisite courses of CHEN 3320 and BIEN 2810 and BCHM 4611 (minimum grade C-). Restricted to graduate students only.
Grading Basis: Letter Grade

BIEN 5806 (3) Immunoengineering
Examines the fundamentals of immunology and covers engineering approaches to study and control immune reactions and their applications in therapy and diagnostics for infectious disease, cancer, allergy, and autoimmune disease.
Equivalent - Duplicate Degree Credit Not Granted: BIEN 4806
Requisites: Restricted to graduate students only.

BIEN 5838 (1-3) Special Topics in Biological Engineering
Graduate-selected topics courses offered upon demand.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Requisites: Restricted to graduate students only.