CHEMICAL ENGINEERING & BIOENGINEERING

CHEMICAL ENGINEERING

Chemical engineering is concerned with the analysis and design of processes that deal with the transfer and transformation of energy and material into products of high value. The practice of chemical engineering includes the conception, development, design, and application of physicochemical processes and their products; the development, design, construction, operation, control, and management of plants for these processes; and activities relating to public service, education, and research.

The curriculum prepares students for productive careers in industry or government and provides a foundation for graduate studies. The college's program emphasizes chemical engineering fundamentals while offering opportunities for focused study in Bioengineering, Energy, and Environmental Engineering.

Traditional employment areas in the chemical process industries include industrial chemicals, petroleum and petrochemicals, plastics, pharmaceuticals, metals, textiles, and food. Chemical engineers are also working in increasing numbers in the areas of energy engineering, pollution abatement, and biochemical and biomedical engineering; in addition, they are employed by many government laboratories and agencies as well as private industries and institutions.

Chemical Engineering Mission Statement

The Chemical Engineering program strives to prepare our students for productive careers in industry or government and also provides our students with a solid foundation for graduate studies. Our program emphasizes chemical engineering fundamentals while offering opportunities for focused studies in bioengineering, energy, and environmental engineering.

Chemical Engineering Program Educational Objectives

The program has the following major educational objectives with the expectation that our alumni will have successful careers in the many diverse areas of chemical engineering profession. Within a few years of obtaining a bachelor's degree in chemical engineering, we expect our graduates to have the following attributes:

(1) Depth: To be effective in applying chemical engineering principles in engineering practice or for advanced study in chemical engineering.

(2) Breadth: To have a productive career in the many diverse fields of chemical engineering such as bioengineering, energy and the environment, or in the pursuit of graduate education in disciplines such as Chemical Engineering, Medicine, Law or Business.

(3) Professionalism: To function effectively in the complex modern work environment with the ability to assume professional leadership roles.

Chemical Engineering Student Outcomes

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

(3) an ability to communicate effectively with a range of audiences.

(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

BIOENGINEERING

The Bioengineering program is tailored to students who want to use engineering principles to analyze problems and design solutions in the fields of healthcare, medicine and biology. It's a truly interdisciplinary program, with courses in both the College of Engineering and Physical Sciences and the College of Life Sciences and Agriculture.#Graduates from the bioengineering program solve problems at the interface of biology and engineering in the fields of biotechnology and pharmaceuticals, as well as medicine and biofuels.

The curriculum prepares students by providing a solid foundation of biology and engineering principles through challenging courses and hands-on learning opportunities in our state-of-the-art laboratories. Our faculty have a broad background in modeling physiological and biochemical processes, enzyme kinetics, synthetic biology, biomaterials and biosensor development and related topics such as tissue engineering. Elective courses let you adapt your program to prepare for medical school, other graduate studies or careers in biomanufacturing, biotechnology or biomedical engineering.

Bioengineering Mission Statement

Our Bioengineering program empowers students with broad preparation for pursuing careers related to biotechnology, biomedical and engineering fields.

Bioengineering Program Educational Objectives

The program has the following major educational objectives with the expectation that our alumni will have successful careers in the many diverse areas of bioengineering profession. #Within a few years of obtaining a bachelor's degree in bioengineering, we expect our graduates to have the following attributes:

(1) Depth:#To be effective in applying life science concepts and bioengineering principles in engineering practice or for advanced study.

(2) Breadth: To have productive careers in the many diverse areas of bioengineering or in pursuit of graduate studies in engineering, law, medicine or business.

(3) Professionalism:#To function effectively in the complex modern work environment with the ability to assume professional leadership roles.

Bioengineering Student Outcomes

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

(3) an ability to communicate effectively with a range of audiences.

(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

https://ceps.unh.edu/chemical-bioengineering

Programs

- Bioengineering Major (B.S.)
- Chemical Engineering Major (B.S.)
- Chemical Engineering Major: Bioengineering Option (B.S.)
- Chemical Engineering Major: Energy Option (B.S.)
- Chemical Engineering Major: Environmental Engineering Option (B.S.)

Courses

Chemical Engineering and Bioengineering (CHBE)

CHBE 400 - Chemical and Bioengineering Lectures
Credits: 1
Introduces the profession, the process engineer as designer and problem solver; and the goals of the chemical engineering/bioengineering curriculum. Lectures by faculty and practitioners. Introduction to computer skills, engineering ethics, safety, and careers in chemical engineering and bioengineering.
Equivalent(s): CHE 400
Grade Mode: Credit/Fail Grading

CHBE 410 - Energy and Environment
Credits: 4
Energy supply in this country and the world; conventional fuel reserves: coal, oil, natural gas; alternative sources: nuclear, solar, geothermal, et. Forecasts and strategies to meet needs. Environmental pollution, sources, and economic and environmental impacts. Methods for pollution control. Regulatory standards for environmental protection.
Attributes: Physical Science(Discovery)
Equivalent(s): CHE 410
Grade Mode: Letter Grading

CHBE 501 - Material Balances
Credits: 3
Systems of units; material balances and chemical reactions; gas laws; phase phenomena.
Equivalent(s): CHE 501
Grade Mode: Letter Grading

CHBE 502 - Energy Balances
Credits: 3
Energy and material balances for systems with and without chemical reactions; design case studies.
Attributes: Inquiry (Discovery)
Equivalent(s): CHE 502
Grade Mode: Letter Grading

CHBE 601 - Fluid Mechanics and Unit Operations
Credits: 3
Continuity, momentum, and energy equations; laminar and turbulent flow in pipes; rheology. Applications to flow in porous media, filtration, and fluidization.
Equivalent(s): CHE 601
Grade Mode: Letter Grading

CHBE 602 - Heat Transfer and Unit Operations
Credits: 3
Thermal properties of materials, steady-state and transient conduction and convection; radiation; applications to heat exchangers and process equipment.
Equivalent(s): CHE 602
Grade Mode: Letter Grading

CHBE 603 - Applied Mathematics for Chemical Engineers
Credits: 4
Mathematical modeling and analysis of chemical engineering problems. Analytical methods for firstand second-order differential equations; numerical solutions; series solutions; Bessel functions; Laplace transforms; matrix algebra. Interpretation and solution of partial differential equations. Lab.
Equivalent(s): CHE 603
Grade Mode: Letter Grading

CHBE 604 - Chemical Engineering Thermodynamics
Credits: 3
Volumetric and phase behavior of ideal and real gases and liquids; cycles; steady-flow processes; chemical equilibrium.
Equivalent(s): CHE 604
Grade Mode: Letter Grading

CHBE 612 - Chemical Engineering Laboratory I
Credits: 3
Selected experiments in fluid mechanics, heat transfer, and unit operations.
Attributes: Writing Intensive Course
Equivalent(s): CHE 612
Grade Mode: Letter Grading

CHBE 614 - Separation Processes
Credits: 3
Adsorption, Chromatography, Membrane Separations, Liquid-liquid Extraction and Crystallization.
Equivalent(s): CHE 614
Grade Mode: Letter Grading

CHBE 651 - Biotech Experience/Biomanufacturing
Credits: 4
Course begins by introducing students to the proteins and companies of biotechnology and to current good manufacturing practices.
For remainder of the course, students use cell culture of bacteria, mammalian and yeast cells to produce human proteins using the tools and manufacturing standards, operating procedures of biotechnology, including upstream and downstream processing of proteins, and quality control of protein production.
Equivalent(s): CHE 651
Mutual Exclusion: No credit for students who have taken BIOT 775.
Grade Mode: Letter Grading

CHBE 695 - Chemical Engineering Project
Credits: 1-4
Independent research problems carried out under faculty supervision.
Equivalent(s): CHE 695
Grade Mode: Letter Grading

CHBE 696 - Independent Study
Credits: 1-4
Permission of the adviser and department chairperson required; granted only to students having superior scholastic achievement.
Equivalent(s): CHE 696
Grade Mode: Letter Grading

CHBE 703 - Mass Transfer and Stagewise Operations
Credits: 3
Diffusion in gases, liquids, and solids; design and analysis of distillation, absorption, and other stagewise equipment and operations.
Equivalent(s): CHE 703
Grade Mode: Letter Grading

CHBE 705 - Fossil Fuels and Renewable Energy Sources
Credits: 4
Processing and refining of coal, crude oil, natural gas, tar sands and shale oil. Biomass co-combustion, biofuel extraction, impediments to widespread utilization. Exploration of environmental issues with energy generation and consumption. Lab.
Equivalent(s): CHE 705
Grade Mode: Letter Grading

CHBE 706 - Electrochemical Methods for Energy Applications
Credits: 4
Fundamentals and applications of thermodynamics of electrochemical processes; kinetics of electrochemical reactions; electrocatalysis basics and current technologies for batteries, supercapacitors and fuel cells.
Prerequisite(s): CHEM 683 with a minimum grade of D- and CHEM 684 with a minimum grade of D-.
Equivalent(s): CHE 706
Grade Mode: Letter Grading

CHBE 707 - Chemical Engineering Kinetics
Credits: 3
Use of laboratory data to design commercial reactors. Continuous, batch, plug-flow, and stirred-tank reactors for homogeneous and catalytic multiphase reactions.
Equivalent(s): CHE 707
Grade Mode: Letter Grading

CHBE 708 - Chemical Engineering Design
Credits: 4
Introduction to cost engineering. Application of acquired skills to design of chemical processes. Individual major design project required. Safety for industrial processes. Lab.
Attributes: Writing Intensive Course
Equivalent(s): CHE 708
Grade Mode: Letter Grading

CHBE 709 - Fundamentals of Air Pollution and Its Control
Credits: 4
The origin and fate of air pollutants. Fundamentals of atmospheric meteorology, chemistry, and dispersion phenomena. Control of air pollutants and the related equipment. Current issues. Lab.
Equivalent(s): CHE 709
Grade Mode: Letter Grading

CHBE 712 - Introduction to Nuclear Engineering
Credits: 4
Development of nuclear reactors; binding-energy; radioactivity; elements of nuclear reactor theory; engineering problems of heat transfer, fluid flow, materials selection, and shielding; environmental impacts.
Equivalent(s): CHE 712
Grade Mode: Letter Grading

CHBE 713 - Chemical Engineering Laboratory II
Credits: 3
Selected experiments in mass transfer, stagewise operations, thermodynamics, and kinetics.
Attributes: Writing Intensive Course
Equivalent(s): CHE 713
Grade Mode: Letter Grading

CHBE 714 - Chemical Sensors
Credits: 4
Interdisciplinary approach using thermodynamic, physical and surface chemistry, kinetic, electrochemical, and optical principles to analyze and design chemical sensors. Topics will include selectivity and sensitivity pf sensors, biosensors, electrochemical sensors, mass sensors, optical sensors, and multivariate sensors. Lab.
Prerequisite(s): MATH 527 with a minimum grade of D- and CHEM 405 with a minimum grade of D-.
Equivalent(s): CHE 714
Grade Mode: Letter Grading

CHBE 722 - Introduction to Microfluidics
Credits: 4
Fundamentals and applications of microfluidics; scaling laws; microfabrication technology; hydrodynamics and electrodynamics; interfacial phenomena; capillary effects and diffusion; microvalves; micropumps; lab-on-a-chip systems; biochips.
Prerequisite(s): CHBE 601 with a minimum grade of D-.
Equivalent(s): CHE 722
Grade Mode: Letter Grading

CHBE 725 - Cell Phenotyping and Tissue Engineering Laboratory
Credits: 4
Introduction to culture and phenotyping of mammalian cells (cell line models), with applications to bioengineering and biomedical sciences. Skills, techniques, and knowledge covered include sterile technique, cell culture, cell line models, cell proliferation, cell survival, cell migration, cell adhesion, and drug response. Inquiry-based team projects investigate cell proliferation, cell death, transfection, flow cytometry, 3D scaffolds, or cell imaging.
Prerequisite(s): BMS 503 with a minimum grade of D- and BMS 504 with a minimum grade of D-.
Equivalent(s): BENG 725
Grade Mode: Letter Grading

CHBE 744 - Corrosion
Credits: 4
Fundamentals of corrosion processes in industrial and environmental settings; thermodynamics, kinetics, and mass transport in local corrosion cells; protection by electrochemical, chemical, surface modification or barrier methods; instrumental methods in corrosion science. Lab.
Equivalent(s): CHE 744
Grade Mode: Letter Grading

CHBE 752 - Process Dynamics and Control
Credits: 4
Dynamic behavior of chemical engineering processes described by differential equations; feedback control concepts and techniques; stability analysis. Lab.
Equivalent(s): CHE 752
Grade Mode: Letter Grading

CHBE 755 - Computational Molecular Bioengineering
Credits: 4
Introduction to fundamental concepts in bioengineering with primary emphasis on understanding details of biomolecular structures integrated with molecular modeling, simulation, and visualization techniques. The course will introduce structural details of various biomolecules (proteins, nucleic-acids, sugars, and lipids), followed by concepts in thermodynamics and physical chemistry (such as intermolecular forces, energy, entropy, chemical potential, and Boltzmann's distribution), the applications of which will be discussed in the context of drug-receptor interactions, molecular recognition, biomolecular folding, enzyme catalysis, allosteric communication, diffusion, and transport. The laboratory will include training and learning about advanced simulation and visualization software engines. Preference will be given to bioengineering majors.
Equivalent(s): BENG 755
Grade Mode: Letter Grading

CHBE 761 - Biochemical Engineering
Credits: 4
Immobilized enzyme technology, microbial biomass production, transport phenomena in microbial systems, biological reactor design, process instrumentation and control, applications in separation and purification processes. Lab.
Equivalent(s): CHE 761
Grade Mode: Letter Grading

CHBE 762 - Biomedical Engineering
Credits: 4
Overview of the biomedical engineering through topical studies such as drug delivery and sensors. Discussion of modern engineering methods through primary research sources. Differential equations and statistics required prior to taking this course.
Attributes: Writing Intensive Course
Equivalent(s): BENG 762, CHE 762
Grade Mode: Letter Grading

CHBE 763 - Bioengineering Design I
Credits: 2
Bioengineering design course will cover safety, regulations and ethics for development of bioengineering devices and processes. Topics include product design, benchmarks, design team functioning, marketing and finances. Students will also learn about current Good Manufacturing Practices, process validation and intellectual property considerations. Students will produce the following documents during the course: preliminary design, materials and supplies list, project schedule and budget, innovation map, FDA approval plan.
Attributes: Writing Intensive Course
Equivalent(s): BENG 763
Grade Mode: Letter Grading

CHBE 764 - Bioengineering Design II
Credits: 4
Team based laboratory course focuses on developing the project planned in CHBE 763. Major report is due at mid-semester after first prototype is completed. A second report is due at the end of the semester to indicate improvements on initial design.
Attributes: Writing Intensive Course
Equivalent(s): BENG 764
Grade Mode: Letter Grading

CHBE 766 - Biomaterials
Credits: 4
Fundamental principles of biology and material science, along with latest topics in biomaterials research. Topics include cell biology, wound healing, host response to foreign materials, polymers, hydrogels, diffusion and methods of material characterization. Specific medical applications of biomaterials such as orthopedic and dental implants, heart valves, artificial blood vessels, cochlear and ophthalmic implants and tissue engineering. Laboratory. Students are expected to have some background in chemistry, mathematics, and high school biology.
Equivalent(s): BENG 766, CHE 766
Grade Mode: Letter Grading

Faculty

Chemical Engineering and Bioengineering Faculty