Chemical Engineering, BSE

The major in chemical engineering provides students with a comprehensive education at the forefront of technology, focusing on solving pressing societal issues. By emphasizing fundamental concepts, problem-solving skills, laboratory techniques, and effective communication, the program prepares graduates to tackle challenges in the areas of sustainability, climate change, environmental protection, energy, and health while driving innovation to create new sensors, advanced materials, and manufacturing processes.

Programs designed to lead to professional licensure are subject to federal regulations regarding informational disclosures. Please see Professional Licensure Disclosures by Program for further information.

Focus Areas

All BSE students complete a focus area within their chosen major. Students majoring in chemical engineering select from twelve pre-approved focus areas: biochemical engineering; business, chemical process engineering; computation, data science, and machine learning; energy and environment; entrepreneurship; oil and gas engineering; pharmaceuticals; polymers; pre-medicine; safety and health; and sustainability. Alternatively, students may develop an individualized custom focus area with approval from the department's curriculum committee.

Biochemical Engineering

This focus area allows students to choose from a selection of courses that combine concepts of biology, biochemistry, and engineering. Biochemical engineers leverage knowledge from these fields to manufacture biological products, including fermentation products and pharmaceuticals. Graduates often work in the biotechnology and pharmaceutical industries as production leaders or researchers.

Business

This focus area consists of eight courses from the Tippie College of Business. Students gain foundational business knowledge on topics including finance, economics, accounting, marketing, law, and management. Past students have successfully applied their integrated business and technical knowledge in various settings, including manufacturing plants, consulting, and corporate offices.

Chemical Process Engineering

Process engineering involves the design, optimization, and operation of systems that transform raw materials into valuable products. Process engineers work with a variety of products, including foods and beverages, electronic materials, metals, plastics, fuels, building materials, and pharmaceuticals. Given its broad scope, students can select from a wide range of engineering, math, and science courses, allowing for ample customization based on individual interests.

Computation, Data Science, and Machine Learning

This focus area is designed for students who wish to blend advanced computation and programming with their chemical engineering degree. It can accommodate introductory training in cyber-physical systems, remote sensing, advanced simulation, supply chain management, in silico chemistry and biology, bioinformatics, software design, next-generation controls, machine learning, and artificial intelligence.

Energy and Environment

Students passionate about environmental issues should consider this focus area. Courses prepare students to address environmental challenges and revolutionize energy systems. Topics include air and water pollution, climate change, clean and renewable energy, environmental regulations, and sustainable systems. Students in this focus area may want to consider the Certificate in Applied Climate Science and Energy Technology.

Entrepreneurship

This focus area focuses on succeeding in the world of startups, innovation, business ownership, and new products. It is well-suited for students intending to start and operate their own businesses, as well as those interested in managing innovation within existing companies. A wide range of electives allows students to tailor their business courses to their individual interests. Students in this area should consider the Technological Entrepreneurship Certificate.

Oil and Gas Engineering

Designed for students interested in pursuing careers in oil and gas engineering, this focus area explores foundational elements of chemistry, geology, petrochemical refining, and environmental science. The course plan includes recommendations from experienced advisors with petrochemical backgrounds. Often viewed as the birthplace of chemical engineering, the petroleum industry offers numerous challenging and lucrative opportunities for chemical engineers.

Pharmaceuticals

Chemical and biochemical engineering are central to the design, formulation, and manufacturing of pharmaceutical products. Students passionate about medical applications can aim their chemical engineering skills toward a career in pharmaceuticals by choosing this focus area. The curriculum includes courses on biology, drug delivery, and the mechanisms and chemistry of drug interactions, with options spanning multiple departments, including biomedical engineering, biochemistry and molecular biology, pharmacy, and pharmacology.

Polymers

This focus area enables students to study the development of chemical compounds through polymerization, including the combination of small molecules into engineered networks to produce valuable plastics and other advanced materials. The program is ideal for students who wish to design new materials and understand the relationship between molecular-scale structures and macroscopic-scale properties.

Pre-Medicine

Concepts of chemical engineering are naturally applicable to biological processes. This focus area allows students to apply these concepts to gain a deeper understanding of the atoms and molecules that comprise living organisms and the pathways through which they operate. This program is designed for students aiming to gain acceptance into post-graduate education in the medical field.

Safety and Health

This focus area prepares students to prevent incidents and accidents in chemical and pharmaceutical manufacturing, particularly those resulting from the unintentional release of hazardous materials and energy into the environment, and provide a safe and healthy workplace by preventing injuries and hazards in the workplace environment.

Sustainability

This focus area covers the most important and current topics in environmental science, societal impacts, energy usage, and natural systems. Courses prepare students to understand and discuss these topics as they relate to chemical engineering. This focus area is designed to dovetail with the University of Iowa Certificate in Sustainability.

Educational Objectives

The chemical engineering program produces graduates with a strong foundation of scientific and technical knowledge who are equipped with problem-solving, teamwork, and communication skills that will serve them throughout their careers, consistent with the following educational objectives. Within a few years following graduation, graduates will:

- attain careers as practicing chemical engineers in fields such as biomedical, biotechnology, chemical products, climate solutions, computation, energy, environmental engineering, food processing, pharmaceuticals, polymers/advanced materials, or semiconductors;
- pursue advanced studies in disciplines such as business, chemical engineering, computation, dentistry, environmental engineering, law, medicine, or pharmaceuticals; or
- assume professional leadership roles.

The following methods and strategies are used in the chemical engineering undergraduate program to achieve these program educational objectives. The department:

- fosters a unique and personalized undergraduate experience by leveraging the advantages of a small college atmosphere within a comprehensive liberal arts and research university;
- enriches the undergraduate experience through cultural diversity, international opportunities, and/or experiential learning;
- provides a solid foundation and understanding of the fundamental principles of mathematics, science, and engineering;
- provides students with experience in learning and applying tools and analyzing and interpreting data to solve theoretical and open-ended chemical engineering problems;
- provides students with opportunities to participate in collaborative teams;
- develops students' written and oral communication skills to a wide range of audiences;
- provides students with opportunities to design and conduct chemical engineering experiments and to design systems, components, and chemical processes to meet specific needs and constraints;
- provides a contemporary grounding in ethical and professional responsibility, including global, economic, environmental, safety, and societal impacts of engineering decisions; and
- instills the desire and the understanding of the need for lifelong learning.