# Bachelor of Science in Chemical Engineering

Chemical engineering is one of the most broadly-based engineering disciplines. Its field of practice covers the development, design, and control of processes and products that involve molecular change, both chemical and biological, and the operation of such processes. Because many of the products that sustain and improve life are produced by carefully designed and controlled molecular changes, the chemical engineer serves in a wide variety of industries. These industries range from chemical and energy companies to producers of all types of consumer and specialty products, pharmaceuticals, textiles, polymers, advanced materials, and solid-state and biomedical devices.

Careers are available in industry, government, consulting, and education. Areas of professional work include research and development, operations, technical service, product development, process and plant design, market analysis and development, process control, and pollution abatement.

The chemical engineering degree program prepares students for professional practice in chemically related careers after the bachelor's degree or an advanced degree. Chemical engineering graduates are expected to attain the following capabilities at or within a few years of graduation: apply the fundamentals of science and engineering to solve important chemical engineering problems in industry, government or academic settings; communicate effectively and demonstrate the interpersonal skills required to lead and/or participate in multidisciplinary projects; apply life-long learning to meet professional and personal goals of their chosen profession, including graduate study; articulate and practice professional, ethical, environmental and societal responsibilities, and value different global and cultural perspectives. To meet the program objective, the faculty has designed a rigorous, demanding, and state-of-the-art curriculum that integrates lectures and laboratory experience in basic science, mathematics, engineering science, engineering design, and the liberal arts.

## ABET Student Outcomes:

a. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
b. 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
c. an ability to communicate effectively with a range of audiences
d. 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
e. an ability to function effectively on a team whose members together provide leadership, crate a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
f. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
g. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

## Portable Computing Devices

Students entering chemical engineering are required to have a laptop computer at their disposal. Laptops do not need to be brought to campus on a daily basis, but individual courses may require that a laptop be brought to certain lectures, labs, and/or exams. Minimum requirements for the laptop are listed on the department's website.

## Curriculum

Course requirements are divided into three categories: lower-division courses in the major, upper-division courses in the major, and other required courses. Enrollment in some upper-division Chemical Engineering courses requires completion of eight hours of lower-division Chemical Engineering coursework (Chemical Engineering 210, 317 and 319) and 11 hours of non-Chemical Engineering coursework (Chemistry 328M, 128K, 353, Physics 303L and 105N) in the major, while earning a grade of *C-* or better in each course. In addition, each student must complete the University's Core Curriculum. In some cases, a course required for the Bachelor of Science in Chemical Engineering may also be counted toward the core curriculum; these courses are identified below.

In the process of fulfilling engineering degree requirements, students must also complete coursework to satisfy the following flag requirements: one independent inquiry flag, one course with a quantitative reasoning flag, one ethics flag, one global cultures flag, one cultural diversity in the United States flag, and two writing flags. The independent inquiry flag, the quantitative reasoning flag, the ethics flag, and the two writing flags are carried by courses specifically required for the degree; these courses are identified below. Courses that may be used to fulfill flag requirements are identified in the Course Schedule.

| Requirements | | Hours |
|---|---|---|
| **Chemical Engineering Courses** | | |
| CHE 210 | Introduction to Computing | 2 |
| CHE 253K | Applied Statistics | 2 |
| CHE 253M | Measurement, Control, and Data Analysis Laboratory | 2 |
| CHE 264 | Chemical Engineering Process and Projects Laboratory (writing flag) | 2 |
| CHE 317 | Introduction to Chemical Engineering Analysis | 3 |
| CHE 319 | Transport Phenomena | 3 |
| CHE 322 | Thermodynamics | 3 |
| CHE 338 | Biochemical Engineering | 3 |
| CHE 348 | Numerical Methods in Chemical Engineering and Problem Solving | 3 |
| CHE 350 | Chemical Engineering Materials | 3 |
| CHE 354 | Transport Processes | 3 |
| CHE 360 | Process Control | 3 |
| CHE 363 | Separation Processes and Mass Transfer | 3 |
| CHE 372 | Chemical Reactor Analysis and Design | 3 |
| CHE 473K | Process Design and Operations (independent inquiry flag) | 4 |
| **Chemistry** | | |
| CH 302 | Principles of Chemistry II (part II science and technology; quantitative reasoning flag) | 3 |
| CH 204 | Introduction to Chemical Practice (quantitative reasoning flag) | 2 |

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|---|---|---|
| CH 128K | Organic Chemistry Laboratory | 1 |
| CH 328M | Organic Chemistry I | 3 |
| CH 353 | Physical Chemistry I (quantitative reasoning flag) | 3 |
| **Mathematics** | | |
| M 408C | Differential and Integral Calculus (mathematics; quantitative reasoning flag) | 4 |
| M 408D | Sequences, Series, and Multivariable Calculus | 4 |
| M 427J | Differential Equations with Linear Algebra (quantitative reasoning flag) | 4 |
| M 427L | Advanced Calculus for Applications II | 4 |
| **Physics** | | |
| PHY 105M | Laboratory For Physics 302K, 303K, and 317K | 1 |
| PHY 105N | Laboratory For Physics 302L, 303L, and 317L | 1 |
| PHY 303K | Engineering Physics I (part I science and technology; quantitative reasoning flag) | 3 |
| PHY 303L | Engineering Physics II (part I science and technology; quantitative reasoning flag) | 3 |
| **Rhetoric and Writing** | | |
| RHE 306 | Rhetoric and Writing (English composition) | 3 |
| **Other Required Courses** | | |
| Approved technical focus area electives in engineering | | 6 |
| Approved technical focus area electives | | 6 |
| CH 128L | Organic Chemistry Laboratory | 1 |
| CH 328N | Organic Chemistry II | 3 |
| CH 153K | Physical Chemistry Laboratory (writing flag) | 1 |
| E S 333T | Engineering Communication (Major) [E, Wr] | 3 |
| **Chemistry elective with a laboratory experience (not an online course) chosen from** | | **4** |
| CH 431 | Inorganic Chemistry | |
| CH 354 & CH 154K | Quantum Chemistry and Spectroscopy and Physical Chemistry Laboratory | |
| CH 354L & CH 154K | Physical Chemistry II and Physical Chemistry Laboratory | |
| CH 455 | Fundamentals of Analytical Chemistry | |
| BCH 369 & CHE 177K | Fundamentals of Biochemistry and Undergraduate Research Project | |
| BCH 369 & CHE 177L | Fundamentals of Biochemistry and Undergraduate Research Project | |
| CH 354 & CHE 177K | Quantum Chemistry and Spectroscopy and Undergraduate Research Project | |
| CH 354 & CHE 177L | Quantum Chemistry and Spectroscopy and Undergraduate Research Project | |
| **Remaining Core Curriculum Courses** | | |
| E 316L | British Literature [1] | 3 |
| or E 316M | American Literature | |
| or E 316N | World Literature | |
| or E 316P | Masterworks of Literature | |
| American and Texas government [2] | | 6 |
| American history [2] | | 6 |
| Visual and performing arts [3] | | 3 |
| Social and behavioral sciences [3] | | 3 |
| UGS 302 | First-Year Signature Course [4] | 3 |
| or UGS 303 | First-Year Signature Course | |

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1. Some sections of the English humanities courses (E 316L, 316M, 316N, 316P) carry a global cultures or cultural diversity flag.

2. Some sections carry a cultural diversity flag.

3. Some sections carry a global cultures and/or cultural diversity flag.

4. In UGS 302, all sections carry a writing flag. In UGS 303, some sections carry a writing flag.

| | |
|---|---|
| **Total Hours** | **129** |

## Honors Program

Chemical engineering students who are in the Engineering Honors Program and maintain a grade point average of at least 3.50 may take the honors research course, Chemical Engineering 679H. In this course the student performs research over two consecutive semesters under the supervision of a faculty member, makes two oral presentations, and writes a thesis. Chemical Engineering 679H may be used to fulfill either the approved area electives requirement or the approved area electives in chemical engineering requirement.

## Technical Option Areas

Because of the broad training in natural sciences and engineering received by the chemical engineer, opportunities are provided for students also to develop particular talents and interests in one or two areas of emphasis. Each student must complete 12 semester hours in one of the following areas or six semester hours in each of two areas. These courses must include at least two engineering courses, of which one must be in Chemical Engineering. If two technical option areas are selected, then two courses from each technical option area should be completed. The technical area courses should be discussed with a faculty advisor during faculty advising for the next registration period. The courses listed in each area do not constitute a complete list of technical option area courses but illustrate the types of courses that are generally suitable for a given area. A list of suggested complementary biology, physics, mathematics, and chemistry electives for each of the technical option areas is available from the Chemical Engineering Undergraduate Office and published on the departmental Web page.

Students who are interested in seeking an advanced degree in chemical engineering are encouraged to discuss their plans with the graduate advisor or another faculty member. They should also inquire about undergraduate research positions in the department.

For all areas, CHE 325L and 377K may be counted as chemical engineering electives. Chemical Engineering 377K may be counted only once toward the degree.

## Area 1, Process Systems and Product Engineering

The chemical process industry is one of the most advanced in the applications of modern design and control techniques and computer technology. Competence in design, economics, fault detection, optimization, control, and simulation is essential in this industry. Chemical engineers are also frequently involved in the development of new consumer and specialty products, an assignment that requires not only technical skills but also an understanding of the principles of successful marketing and quality control. Chemical engineering courses in this technical focus area cover topics such as optimization and statistical quality control, while courses in mechanical engineering and electrical engineering deal with both theory and applications in statistics, computer control, economic analysis, and operations research.

Chemical Engineering 341, *Design for Environment*
Chemical Engineering 342, *Chemical Engineering Economics and Business Analysis*
Chemical Engineering 356, *Optimization: Theory and Practice*
Chemical Engineering 376K, *Process Evaluation and Quality Control*
Chemical Engineering 379, *Topics in Chemical Engineering**
Electrical and Computer Engineering 370K, *Computer Control Systems*
Electrical and Computer Engineering 379K*
Architectural Engineering 323K, *Project Management and Economics*
Mechanical Engineering 335, *Engineering Statistics*
Mechanical Engineering 348F, *Advanced Mechatronics II*
Mechanical Engineering 353, *Engineering Finance*
Mechanical Engineering 366L, *Operations Research Models*
Marketing 320F, *Foundations of Marketing*
Upper-division mathematics course

*Approved topics

## Area 2, Materials Engineering

Advances in technology and improvements in our quality of life are linked to the development, processing, and manufacture of engineering materials. Materials span the spectrum from "hard" to "soft" materials and include metals, ceramics, semiconductors, and polymers; all are prepared in carefully controlled chemical processes. These materials are used technologically in objects such as catalysts, fuel cells, microelectronic devices, membranes, solar cells, and high-performance plastics. With advancements in analytical probes and modeling, our understanding of materials has become increasingly more molecular and the traditional boundaries between disciplines have faded to the extent that this is a truly interdisciplinary area. Chemical engineers can assume a creative role in this area when provided with the appropriate fundamentals and applications background.

Chemical Engineering 322M, *Molecular Thermodynamics*
Chemical Engineering 323, *Chemical Engineering for Micro- and Nanofabrication*
Chemical Engineering 355, *Introduction to Polymers*
Chemical Engineering 379*
Chemistry 341, *Special Topics in Laboratory Chemistry*
Chemistry 354, *Quantum Chemistry and Spectroscopy*
Chemistry 354L, *Physical Chemistry II*
Chemistry 367L, *Macromolecular Chemistry*
Chemistry 376K, *Advanced Analytical Chemistry*
Electrical and Computer Engineering 339, *Solid-State Electronic Devices*
Mechanical Engineering 349, *Corrosion Engineering*
Mechanical Engineering 359, *Materials Selection*
Mechanical Engineering 374S, *Solar Energy Systems Design*
Physics 338K, *Electronic Techniques*
Physics 355, *Modern Physics and Thermodynamics*
Physics 375S, *Introductory Solid-State Physics*

*Approved topics

## Area 3, Environmental Engineering

Chemical engineers are uniquely qualified to contribute to the solution of environmental problems and to design processes and products that minimize environmental hazards. From pollution prevention by process optimization, to new understanding of chemical processes that occur in the environment, to new materials for advanced catalysts and carbon-free energy sources, chemical engineers are creating the "green" technologies needed to sustain the planet.

Chemical Engineering 341, *Design for Environment*
Chemical Engineering 357, *Technology and Its Impact on the Environment*
Chemical Engineering 359, *Energy Technology and Policy*
Chemical Engineering 376K, *Process Evaluation and Quality Control*
Chemical Engineering 379*
Civil Engineering 341, *Introduction to Environmental Engineering*
Civil Engineering 342, *Water and Wastewater Treatment Engineering*
Civil Engineering 364, *Design of Wastewater and Water Treatment Facilities*

Civil Engineering 369L, *Air Pollution Engineering*
Civil Engineering 370K, *Environmental Sampling and Analysis*
Mechanical Engineering 374S, *Solar Energy Systems Design*
Mechanical Engineering 379M, *Topics in Mechanical Engineering*

*Approved topics

## Area 4, Biochemical, Biomolecular, and Biomedical Engineering

### Track A: Cellular and Bioprocess Engineering

Chemical engineers are developing innovative solutions to practical problems in biotechnology and in the biochemical, pharmaceutical, and life science industries. This track is designed to prepare students for a career or research in the areas of applied cellular engineering and bioprocess engineering in the chemicals and pharmaceutical industry. Chemical engineering and elective courses are available that cover chemical engineering principles applied to biological systems and the fundamentals of biomolecular, cellular, and metabolic processes. This track is also suitable for students interested in biofuels.
Chemical Engineering 339, *Introduction to Biochemical Engineering*
Chemical Engineering 339P, *Introduction to Biological Physics*
Chemical Engineering 379*
Biochemistry 369, *Fundamentals of Biochemistry*
Biochemistry 370, *Physical Methods of Biochemistry*
Biology 325, *Genetics*
Biology 326R, *General Microbiology*
Biology 355, *Microbial Biochemistry*
*Approved topics

### Track B: Biomedical Engineering

This track is designed to prepare students for careers in the biomedical and pharmaceutical industries that deal with medical systems or improvement of health treatment alternatives. This is also a natural track to be followed by students who plan to attend medical school. Chemical engineering courses and electives are available that cover the application of chemical engineering principles to the design of new medical and therapeutic devices, as well as to the understanding of physiological processes.

Chemical Engineering 339, *Introduction to Biochemical Engineering*
Chemical Engineering 339P, *Introduction to Biological Physics*
Chemical Engineering 339T, *Cell and Tissue Engineering*
Chemical Engineering 355, *Introduction to Polymers*
Chemical Engineering 379*
Biology 320, *Cell Biology*
Biology 325, *Genetics*
Biology 326R, *General Microbiology*
Biology 365S, *Human Systems Physiology*
Biomedical Engineering 352, *Engineering Biomaterials*
Biomedical Engineering 353, *Transport Phenomena in Living Systems*
Biomedical Engineering 365R, *Quantitative Engineering Physiology I*
Biochemistry 369, *Fundamentals of Biochemistry*
Electrical and Computer Engineering 374K, *Biomedical Electronic Instrument Design*
Mechanical Engineering 354, *Introduction to Biomechanical Engineering*

*Approved topics

## Area 5, Energy Technologies

The need for energy sustainability and new energy technologies provides some of the most significant scientific and engineering challenges that face society. Chemical engineers are uniquely qualified to address these issues and contribute new solutions to the problem. Technologies include solar energy utilization in the form of photovoltaics, biofuels and solar fuels; new and more efficient ways to extract fossil fuels from existing reservoirs; alternative power sources like wind, geothermal, and nuclear. Policy is also an important and active area that involves chemical engineers. Chemical engineering and other elective courses are available that teach fundamentals of energy technology and policy.

Chemical Engineering 323, *Chemical Engineering for Micro- and Nanofabrication*
Chemical Engineering 339, *Introduction to Biochemical Engineering*
Chemical Engineering 341, *Design for Environment*
Chemical Engineering 355, *Introduction to Polymers*
Chemical Engineering 357, *Technology and Its Impact on the Environment*
Chemical Engineering 359, *Energy Technology and Policy*
Chemical Engineering 379*
Civil Engineering 341, *Introduction to Environmental Engineering*
Electrical and Computer Engineering 339, *Solid-State Electronic Devices*
Mechanical Engineering 374S, *Solar Energy Systems Design*
Mechanical Engineering 379M, *Topics in Mechanical Engineering*
Petroleum and Geosystems Engineering 430, *Drilling and Well Completions*

*Approved topics

## Area 6, Engineering Economics and Business Leadership

Chemical engineers who understand the economic and policy issues faced by modern chemical and materials companies are needed to solve the challenges of modern industry. Globalization, sustainability, safety and modern labor practices, intellectual property protection, and the process of innovation are all issues facing modern industry. This focus area is designed to prepare students for business leadership in a technical arena.

Chemical Engineering 342, *Chemical Engineering Economics and Business Analysis*
Chemical Engineering 356, *Optimization: Theory and Practice*
Chemical Engineering 379, *Topics in Chemical Engineering**
Architectural Engineering 323K, *Project Management and Economics*
Economics 304K, *Introduction to Microeconomics*
Economics 304L, *Introduction to Macroeconomics*
Economics 328, *Industrial Organization*
Economics 339K, *International Trade and Investment*
Economics 351K, *Current Issues in Business Economics*
International Business 378, *International Business Operations*
Mechanical Engineering 353, *Engineering Finance*
Mechanical Engineering 366L, *Operations Research Models*
Marketing 320F, *Foundations of Marketing*
Marketing 460, *Information and Analysis*
Science, Technology, and Society 332, *The Nanotechnology and Science Revolution*

*Approved topics