Chemical Engineering Concentrations

Future chemical engineers conceive and solve problems on a range of scales (nano, micro and macro). They bring new tools and insights from research and practice in other disciplines: molecular biology, chemistry, solid-state physics, materials science, and electrical engineering. They also make increasing use of computers, artificial intelligence and expert systems in problem solving, in product and process design, and in manufacturing. Chemical engineering can be viewed as the engineering discipline with the strongest tie to the molecular sciences and therefore is an integral part of multidisciplinary research efforts.

To allow students an opportunity to gain in-depth knowledge in specialized areas and to prepare them for diverse career opportunities, we provide five concentrations:

- **Bioengineering**
- **Chemical Process Engineering**
- **Environmental Engineering**
- **Materials Processing**
- **Semiconductor Manufacturing**

Students choose three advanced chemistry courses and two technical electives. In addition to these courses, the projects in the last design course (CBE 494L) and the last laboratory course (CBE 419L) provide opportunities to gain experience in the chosen concentration.

**Advanced Chemistry and Science Electives:** A minimum of 9 credit hours of advanced chemistry and/or biology, selected from among CHEM **302, **311, **312, 421, *431, 471; BIOL 201; or other approved courses depending upon the student’s area of concentration. One semester of CHEM **312 is required for all concentrations.

**Technical Electives:** Students have the opportunity to take 6 credit hours of technical electives. Three (3) credit hours must be engineering courses within the department or the School of Engineering. The other 3 credit hours may be taken outside of the School of Engineering, but must be a logical part of the concentration.
Bioengineering

Since biological and medical systems involve complex chemical and physical processes, chemical engineering is a natural professional background for bioengineering applications. Bioengineering is an interdisciplinary field that combines the tools and methods of engineering to address challenges in the health sciences and in basic research. Bioengineers strive to understand biological systems, from molecules to whole organisms, from a quantitative and analytical perspective. Because of this in-depth study, bioengineers are uniquely qualified to work at the interface between living and non-living systems, enhancing our ability to measure, image, repair, or replace physiological substances or processes. Training in bioengineering prepares students for graduate school or industry, and is an excellent preparation for professional programs (medicine, dentistry, nursing, pharmacy). Career opportunities for bioengineers at the undergraduate level include the biosensor, pharmaceutical and medical device industries as well as positions in hospitals, federal labs, and environmental agencies.

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<thead>
<tr>
<th>Advanced Chemistry and Science Electives</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>BIOL 201L Molecular and Cell Biology</td>
<td>4</td>
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<tr>
<td>CHEM 302 Organic Chemistry II</td>
<td>3</td>
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<tr>
<td>CHEM 312 Physical Chemistry II</td>
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Chemical Process Engineering

The Chemical Process Engineering concentration is designed to provide maximum flexibility for students to pursue career opportunities in a wide range of industries as a process engineer. Historically, many chemical process engineers have found employment in the petroleum or chemical industries, and many still do. However, chemical engineers with a strong process engineering foundation are in increasing demand in many other technology areas, including pharmaceuticals, semiconductors and electronic materials, and environmental or “green” engineering. This concentration builds on the traditional process engineering emphasis, allowing the technical electives to be chosen by the student in consultation with his adviser to fit the interests or professional goals of the student.

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<td>CHEM **311 Physical Chemistry I</td>
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Environmental Engineering

The chemical engineer with a concentration in Environmental Engineering is prepared to enter a field of growing importance. This field deals with treatment of waste to reduce its volume, to recover recyclable resources and to prepare appropriately for long-term disposal. Interesting applications exist in atmospheric discharge control and clean-up, bio-treatable water decontamination, soil remediation, and nuclear byproduct handling. Increasingly, chemical engineers are required to develop new processes to minimize byproduct and waste generation, and achieve higher energy efficiencies.

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Materials Processing

The Materials Processing concentration is designed to add additional emphasis in inorganic materials, polymeric, or biological materials, depending on the students interest. Students who are interested in working in the realm of high technology materials, biomedical materials, or nanotechnology should choose this concentration. These rapidly developing fields are expected to provide many job opportunities in the next decade. New materials are currently being developed whose properties depend strongly on their microstructure, nanostructure and processing history. Materials included in this category are advanced ceramics, polymers, composites, photonics, superconductors, semiconductors, and recording media. This concentration provides flexibility for students interested in inorganic or organic materials technology.

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<tr>
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<tr>
<td>CHEM 312</td>
<td>Physical Chemistry II</td>
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<tr>
<td>CHEM 431-or-CHEM 471</td>
<td>Advanced Inorganic Chemistry</td>
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<tr>
<td>CHEM 471-or-CHEM 471</td>
<td>Adv T: Polymer Science</td>
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<td>Adv T: Chemistry and Physics at the Nanoscale</td>
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Semiconductor Manufacturing

There is an increasing demand for chemical engineers in high technology oriented semiconductor manufacturing companies like Intel, Motorola, IBM, etc. This concentration is designed to prepare the student in the fundamental unit operations used in semiconductor manufacturing (oxidation, diffusion, lithography, plasma etch, CVD, ion implant and metalization) and statistical methods used extensively in the industry to optimize the performance of these unit operations. The continuing revolution occurring in computer technology virtually insures there is a strong future demand for engineers with the background needed for semiconductor manufacturing. The goal of this concentration is to introduce students to the specific chemical engineering tools used in micro-chip fabrication.

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<td>CHEM *431</td>
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<tr>
<td>ECE **371</td>
<td>Materials and Devices</td>
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Advanced Chemistry and Science Electives

Technical Electives