CHEMICAL ENGINEERING, B.S.

Begin Campus: Any Penn State Campus
End Campus: University Park

Program Description
Chemical Engineering is one of the most versatile professions—you’ll find Chemical Engineers employed in a broad array of industries ranging from pharmaceutical and biotechnical companies to semiconductor manufacturing to start-up companies converting the latest laboratory discoveries to large-scale commercial production. Chemical Engineers work with catalysts to develop new ways to manufacture medicines and plastics; they develop control systems that enable the safe production of products from semiconductors to household soap; they design chemical and petroleum plants; they research the effects of artificial organs on blood flow; and they develop the equipment and processes necessary for advances in biotechnology. While chemistry emphasizes the facts and principles of science, chemical engineering emphasizes its practical application for the development of new products and processes.

The undergraduate program in Chemical Engineering provides students with fundamental skills in problem solving, analysis, and design, along with hands-on experience in practical applications. The curriculum builds upon the traditional foundation in the chemical and energy-related industries and introduces new material in the life sciences, polymers, and environmental fields.

What is Chemical Engineering?
Chemical engineers draw extensively on a strong foundation in the chemical, physical, and biological sciences. They focus on the processes involved in making new products or treating the environment, such as pharmaceuticals, plastics, alternative fuels, therapeutic proteins, and artificial organs. Chemical engineering is a broad discipline that encompasses many different scientific principles in engineering and technology. Chemical engineers apply the principles of chemistry, biology, and physics to solve problems involving the production of chemicals, fuel, drugs, food and energy solutions.

You Might Like This Program If...

- You want to solve some of today's most critical global issues involving food, energy, pharmaceutical drugs and environmental sustainability using the principles of chemistry, biology, physics and technology.
- You enjoy supervising the design of chemical reactions for energy production or human development.
- Designing the equipment and processes needed to efficiently create viable products out of raw materials appeals to you.

Entrance to Major
This program currently has administrative enrollment controls. Administrative Enrollment Controls are initiated when limitations of space, faculty, or other resources in a major prevent accommodating all students who request them. Students must follow the administrative enrollment controls that are in effect for the semester that they enter the university.

First-Year Students Entering Summer 2020, Fall 2020, Spring 2021
In order to be eligible for entrance to this major, students must satisfy the following requirements:

- 29-55 graded Penn State credits (excludes transfer and AP credits)
- completed with a grade of C or better: CHEM 110, EDSGN 100, MATH 140, MATH 141, PHYS 211
- earned a minimum cumulative grade-point average (GPA) of 3.20

Students Who Entered Prior to Summer 2020
Students who entered the University from Summer 2018 through Spring 2020 should view the administrative enrollment controls in the appropriate Undergraduate Bulletin archive (http://bulletins.psu.edu/undergraduate/archive/). Students who entered the University prior to the summer 2018 semester should view the administrative enrollment controls for the semester that they entered the university (http://advising.psu.edu/entrance-major-requirements/) on the Academic Advising Portal.

Degree Requirements
For the Bachelor of Science degree in Chemical Engineering, a minimum of 133 credits is required:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>45</td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>115</td>
</tr>
</tbody>
</table>

27 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GN courses; 6 credits of GQ courses; 3 credits of GS courses; 9 credits of GWS courses.

General Education
Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (http://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program/) section of the Bulletin and consult your academic adviser.

The Keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

Foundations (grade of C or better is required.)
- Quantification (GQ): 6 credits
- Writing and Speaking (GWS): 9 credits

Knowledge Domains
- Arts (GA): 6 credits
- Health and Wellness (GHW): 3 credits
- Humanities (GH): 6 credits
- Social and Behavioral Sciences (GS): 6 credits
- Natural Sciences (GN): 9 credits
Integrative Studies (may also complete a Knowledge Domain requirement)
- Inter-Domain or Approved Linked Courses: 6 credits

University Degree Requirements
First Year Engagement
All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

Cultures Requirement
6 credits are required and may satisfy other requirements
- United States Cultures: 3 credits
- International Cultures: 3 credits

Writing Across the Curriculum
3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits
A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work
Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition
The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80)). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major
To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44).

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMB 251</td>
<td>Molecular and Cell Biology I</td>
<td>3</td>
</tr>
<tr>
<td>CHE 230</td>
<td>Computational Tools for Chemical Engineering</td>
<td>1</td>
</tr>
<tr>
<td>CHE 300</td>
<td>Professional Development Seminar</td>
<td>1</td>
</tr>
<tr>
<td>CHE 340</td>
<td>Introduction to Biomolecular Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CHE 452</td>
<td>Chemical Process Safety</td>
<td>3</td>
</tr>
<tr>
<td>CHE 470</td>
<td>Design of Chemical Plants</td>
<td>3</td>
</tr>
<tr>
<td>CHE 480W</td>
<td>Chemical Engineering Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 111</td>
<td>Experimental Chemistry I</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 112</td>
<td>Chemical Principles II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Experimental Chemistry II</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 212</td>
<td>Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 457</td>
<td>Experimental Physical Chemistry</td>
<td>2</td>
</tr>
<tr>
<td>MATH 231</td>
<td>Calculus of Several Variables</td>
<td>2</td>
</tr>
<tr>
<td>MATH 251</td>
<td>Ordinary and Partial Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 212</td>
<td>General Physics: Electricity and Magnetism</td>
<td>4</td>
</tr>
</tbody>
</table>

Prescribed Courses: Require a grade of C or better
- CHE 210 Introduction to Material Balances: 3 credits
- CHE 220 Introduction to Chemical Engineering Thermodynamics: 3 credits
- CHE 320 Phase and Chemical Equilibria: 3 credits
- CHE 330 Process Fluid Mechanics: 3 credits
- CHE 350 Process Heat Transfer: 3 credits
- CHE 410 Mass Transfer Operations: 3 credits
- CHE 430 Chemical Reaction Engineering: 3 credits
- CHEM 110 Chemical Principles I: 3 credits
- EDSGN 100 Introduction to Engineering Design: 3 credits
- ENGL 202C Effective Writing: Technical Writing: 3 credits
- MATH 140 Calculus With Analytic Geometry I: 4 credits
- MATH 141 Calculus with Analytic Geometry II: 4 credits
- PHYS 211 General Physics: Mechanics: 4 credits

Additional Courses
- Select 1 credit of First-Year Seminar: 1 credit
- Select one of the following: 3 credits
  - ECON 14 Principles of Economics
  - ECON 102 Introductory Microeconomic Analysis and Policy
  - ECON 104 Introductory Macroeconomic Analysis and Policy

Additional Courses: Require a grade of C or better
- CAS 100A Effective Speech: 3 credits
  - or CAS 100B Effective Speech: 3 credits
- ENGL 15 Rhetoric and Composition: 3 credits
  - or ENGL 30 Honors Freshman Composition: 3 credits

Supporting Courses and Related Areas
- Select 3 credits of physical chemistry from departmental list: 3 credits
- Select 3 credits of materials elective from departmental list: 3 credits
- Select 6 credits in 400-level chemical engineering electives from departmental list: 6 credits
- Select 3 credits of approved engineering electives from departmental list: 3 credits
- Select 6 credits of professional electives from departmental list: 6 credits

1 Students may substitute 6 credits of ROTC for part of this requirement in consultation with department.

Program Educational Objectives
The undergraduate program in chemical engineering at Penn State has been designed so that students can identify and pursue their personal
and professional goals while obtaining a strong foundation in the principles and practice of chemical engineering. The program aims to produce graduates who will attain one or more of the following:

- Careers as practicing chemical engineers in traditional chemical and energy-related industries as well as in expanding areas of materials, environmental, pharmaceutical, and biotechnology industries.
- Advanced degrees in chemical engineering (or a related technical discipline), medicine, law, or business.
- Positions that provide the technical, educational, business, and/or political leadership needed in today's rapidly changing, increasingly technological, global society.

**Student Outcomes**

Student outcomes describe what students are expected to know and be able to do by the time of graduation. The Chemical Engineering program is designed to enable students to:

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. 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. Communicate effectively with a range of audiences
4. 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. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.

**Academic Advising**

The objectives of the university's academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and out-of class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The advisee's unit of enrollment will provide each advisee with a primary academic adviser, the information needed to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy/)

**University Park**

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**Suggested Academic Plan**

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2020-21 academic year. To access previous years’ suggested academic plans, please visit the archive (http://bulletins.psu.edu/undergraduate/archive/) to view the appropriate Undergraduate Bulletin edition (Note: the archive only contain suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin).

**Chemical Engineering, University Park Campus**

The course series listed below provides only one of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an Academic Requirements or What If report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

If you are starting at a campus other than the one this plan is ending at, please refer to: http://advising.engr.psu.edu/degree-requirements/academic-plans-by-major.aspx

**First Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Spring Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 100 (or First Year Seminar)</td>
<td>1</td>
<td>CHEM 112 (GN)</td>
</tr>
<tr>
<td>CHEM 110 (GN)</td>
<td>3</td>
<td>CHEM 111 (GN)</td>
</tr>
<tr>
<td>ECON 102 or 104 (GS)</td>
<td>3</td>
<td>MATH 141 (GQ)</td>
</tr>
<tr>
<td>EDSGN 100</td>
<td>4</td>
<td>MATH 140 or 140E (GQ)</td>
</tr>
</tbody>
</table>

Total 15 Credits

**Second Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Spring Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 210</td>
<td>3</td>
<td>CHEM 112 (GN)</td>
</tr>
<tr>
<td>MATH 231</td>
<td>2</td>
<td>CHEM 212 (GN)</td>
</tr>
<tr>
<td>MATH 251</td>
<td>4</td>
<td>CHEM 111 (GN)</td>
</tr>
<tr>
<td>PHYS 212 (PHYS 212L &amp; PHYS 212R (GN))</td>
<td>4</td>
<td>CHEM 121</td>
</tr>
<tr>
<td>General Education Course</td>
<td>3</td>
<td>General Education Course</td>
</tr>
<tr>
<td>General Education Course</td>
<td>3</td>
<td>General Education Course</td>
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</tbody>
</table>

Total 16.5 Credits

**Third Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Spring Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMB 251 or MICRB 251</td>
<td>3</td>
<td>CAS 100A or 100B (GWS)</td>
</tr>
<tr>
<td>CHE 320</td>
<td>3</td>
<td>CHEM 300</td>
</tr>
<tr>
<td>CHE 330</td>
<td>3</td>
<td>CHEM 340</td>
</tr>
<tr>
<td>Professional Elective</td>
<td>3</td>
<td>CHEM 350</td>
</tr>
<tr>
<td>General Education Course</td>
<td>3</td>
<td>CHEM 457</td>
</tr>
<tr>
<td>General Education Course</td>
<td>3</td>
<td>Physical Chemistry Elective</td>
</tr>
</tbody>
</table>

Total 16.5 Credits
College Notes:

- CHE 210 & CHE 220: The Department of Chemical Engineering requires that students complete both MATH 231 and MATH 251 before taking CHE 210. Please plan accordingly if you cannot take both MATH 251 & MATH 231 before the 4th semester. Courses require a grade of 'C' or better before enrolling in the next higher course.
- CHE Elective: Select from department list.
- Engineering Elective: Select from department list. However, some courses on the department list may be controlled by the department that is offering the course and will not be able to be scheduled. Students who complete the Cooperative Education Program may substitute 3 co-op credits for an engineering elective.

Career Paths

Careers

Graduates go onto careers in technical roles across a wide variety of industries, including in chemical production, fuels and energy technology, microelectronics, consumer goods, pharmaceuticals, biotechnology, materials, design and construction, food processing, environmental health, and safety industries. Students take roles in large and small companies as engineers in production, process development, product development, process automation, among others, as well as consulting and sales positions.

Opportunities for Graduate Studies

Our undergraduate curriculum prepares students for graduate studies at the master’s or doctoral level in chemical engineering and related engineering and science fields. Fundamental classwork as well as computational and experimental research experiences help students progress towards graduate studies, and eventual research positions in industry, academia, and national laboratories. Graduates are trained to be independent researchers with the ability to solve some of today’s most challenging real-world issues. As trained problem solvers, students completing the chemical engineering bachelor of science degree also progress to further studies in medicine and business.

Professional Resources

- American Institute of Chemical Engineers (AIChe) (http://sites.psu.edu/aiche/)
- Chemical Engineering Graduate Student Association (http://chegsa.psu.edu)
- Omega Chi Epsilon - Chemical Engineering Honors Society (https://sites.psu.edu/oxe/home/)

Accreditation

The baccalaureate program in Chemical Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

MORE INFORMATION ABOUT ABET ACCREDITATION (http://www.abet.org)
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