CHEMICAL ENGINEERING, B.S.

Begin Campus: Any Penn State Campus

End Campus: University Park

Program Description

Not all options are available at every campus. Contact the campus you are interested in attending to determine which options are offered.

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 2018, Fall 2018, Spring 2019

In order to be eligible for entrance to this major, students must satisfy the following requirements:

- 40-59 cumulative credits (credits completed at Penn State for which a quality letter grade was earned)
- completed with a grade of C or better: CHEM 110, MATH 140, MATH 141, MATH 250 or MATH 251, PHYS 211, and PHYS 212
- earned a minimum of 3.20 cumulative GPA

Students Who Entered Prior to Summer 2018

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:

Requirement	Credits
General Education	45
Requirements for the Major	115

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).

Code	Title	Credits
Prescribed Courses		
BMB 251	Molecular and Cell Biology I	3
CHE 230	Computational Tools for Chemical Engineering	1
CHE 300	Professional Development Seminar	1
CHE 340	Introduction to Biomolecular Engineering	3
CHE 452	Chemical Process Safety	3
CHE 470	Design of Chemical Plants	3
CHE 480W	Chemical Engineering Laboratory	3
CHEM 111	Experimental Chemistry I	1
CHEM 112	Chemical Principles II	3
CHEM 113	Experimental Chemistry II	1
CHEM 210	Organic Chemistry I	3
CHEM 212	Organic Chemistry II	3
CHEM 213	Laboratory in Organic Chemistry	2
CHEM 457	Experimental Physical Chemistry	2
EDSGN 100	Introduction to Engineering Design	3
ENGL 202C	Effective Writing: Technical Writing	3
MATH 231	Calculus of Several Variables	2
Prescribed Courses: Require a grade of C or better		
CHE 210	Introduction to Material Balances	3
CHE 220	Introduction to Chemical Engineering Thermodynamics	3
CHE 320	Phase and Chemical Equilibria	3
CHE 330	Process Fluid Mechanics	3
CHE 350	Process Heat Transfer	3
CHE 410	Mass Transfer Operations	3
CHE 430	Chemical Reaction Engineering	3
CHEM 110	Chemical Principles I	3
MATH 140	Calculus With Analytic Geometry I	4
MATH 141	Calculus with Analytic Geometry II	4
MATH 251	Ordinary and Partial Differential Equations	4
PHYS 211	General Physics: Mechanics	4
PHYS 212	General Physics: Electricity and Magnetism	4
Additional Courses		
Select 1 credit of First-Year Seminar		1
CAS 100A	Effective Speech	3
or CAS 100B	Effective Speech	
ENGL 15	Rhetoric and Composition	3
or ENGL 30	Honors Freshman Composition	
Select one of the following:		3
ECON 14	Principles of Economics	
ECON 102	Introductory Microeconomic Analysis and Policy	
ECON 104	Introductory Macroeconomic Analysis and Policy	
Supporting Courses and Related Areas		
Select 3 credits of physical chemistry from departmental list		3
Select 3 credits of materials elective from departmental list		3
Select 6 credits in 400-level chemical engineering electives from departmental list		6
Select 3 credits of approved engineering electives from departmental list		3
Select 6 credits of professional electives from department list [1]		6

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

Program Educational Objectives

The educational objectives of the undergraduate program in Chemical Engineering are specifically designed to produce graduates who will be able to:

1. identify and pursue their personal and professional goals using the foundation provided by the breadth of educational opportunities in chemical and biomolecular engineering offered at Penn State

2. pursue careers as practicing chemical engineers in traditional chemical and energy-related universities as well as in expanding areas of materials, environmental, biomedical, and biotechnology
3. apply their broad chemical engineering education--including their problem solving, analytical, design, research, and communication skills--in industry, government agencies, financial institutions, consulting firms, educational institutions, business, law, and medicine
4. provide the technical, educational, business, and 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

Chemical Engineering - Ending at 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 here:

http://advising.engr.psu.edu/degree-requirements/academic-plans-by-major.aspx

First Year

Fall	Credits	Spring	Credits
CHE 100 (or First Year Seminar)[†]	1	CHEM 112 (GN)	3
CHEM 110 (GN)[*#†]	3	CHEM 113 (GN)	1
CHEM 111 (GN)	1	ENGL 15, 30, or ESL 15 (GWS)	3
ECON 102 or 104 (GS)[†]	3	MATH 141 or 141E (GQ)[*‡#†]	4
EDSGN 100	3	PHYS 211 (PHYS 211L and PHYS 211R (GN))[*#†]	4
MATH 140 or 140E (GQ)[*‡#†]	4	General Education Course[†]	3
	15		18

Second Year

Fall	Credits	Spring	Credits
CHEM 210	3	CHE 210[*]	3
MATH 231	2	CHE 220[*]	3
MATH 251[*#]	4	CHE 230	1
PHYS 212 (PHYS 212L & PHYS 212R (GN))[*#†]	4	CHEM 212	3
General Education Course[†]	3	CHEM 213	2
		General Education Course[†]	3
		General Education Course (GHW)[†]	1.5
	16		16.5

Third Year

Fall	Credits	Spring	Credits
BMB 251 or MICRB 251	3	CAS 100A or 100B (GWS)[‡†]	3
CHE 320[*]	3	CHE 300	1
CHE 330[*]	3	CHE 340	3
Professional Elective	3	CHE 350[*]	3
General Education Course[†]	3	CHEM 457	2
General Education Course[†]	3	Physical Chemistry Elective	3
		General Education Course (GHW)[†]	1.5
	18		16.5

Fourth Year

Fall	Credits	Spring	Credits
CHE 410[*]	3	CHE 470	3

CHE 430*	3	CHE 480W	3
CHE 452	3	Chemical Engineering Elective	3
ENGL 202C (GWS)‡†	3	Materials Elective	3
Chemical Engineering Elective	3	Professional Elective	3
Engineering Elective	3		
	18		15

Total Credits 133

* Course requires a grade of C or better for the major

‡ Course requires a grade of C or better for General Education

Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

College Note

CH E 210 & CH E 220: The Department of Chemical Engineering requires that students complete both MATH 231 and MATH 251 before taking CH E 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.

CH E 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.

Health and Physical Activity Elective: Students who complete the ROTC Program may substitute 3 ROTC credits for the GHW requirement and 3 ROTC credits for a professional elective.

Professional Elective: The six (6) credits of Professional Elective courses are required and should help you toward your career goals. These courses must generally be at the 200 level or above. Students who complete the ROTC Program may substitute 3 ROTC credits for the GHW requirement and 3 ROTC credits for a professional elective.

This course offered at University Park in fall semester only:

- CH E 452

This course offered at University Park in spring semester only:

- CH E 300

Career Paths

Careers

Microelectronics, manufacturing, creating pharmaceuticals, healthcare, design and construction, pulp and paper, food processing, specialty chemicals, biotechnology, environmental health and safety industries.

MORE INFORMATION ABOUT POTENTIAL CAREER OPTIONS FOR GRADUATES OF THE CHEMICAL ENGINEERING PROGRAM (http://career.engr.psu.edu)

Opportunities for Graduate Studies

Our programs cover a wide spectrum of research areas that encompass both computational and experimental research approaches. Graduates are trained to be independent researchers with the ability to solve some of today's most challenging real-world issues. In addition, our enjoy ultramodern research facilities including the 275,600 square-foot Millennium Science Complex, home of the Materials Characterization Lab and The Huck Institutes of the Life Sciences.

MORE INFORMATION ABOUT OPPORTUNITIES FOR GRADUATE STUDIES (http://www.che.psu.edu/grad)

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)

Contact

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