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 like to problem solve using chemistry and mathematics in critical global challenges in a variety of areas including pharmaceuticals, food, energy, environmental sustainability, medicine, law, and finance.
- You like to work with others to design processes and equipment to create chemical products safely and economically.

Entrance to Major

In order to be eligible for entrance to this major, students must satisfy the following requirements by the end of the semester during which the admission to major process is carried out.

- Completed 29-55 cumulative credits (credits completed at Penn State for which a quality letter grade was earned)
- Completed with a C or better the following courses: EDSGN 100, CHEM 110, MATH 140, MATH 141, and PHYS 211
- Attained at least a 2.6 cumulative grade point average

* In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

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.

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 (https://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
MATH 231	Calculus of Several Variables	2
MATH 251	Ordinary and Partial Differential Equations	4
PHYS 212	General Physics: Electricity and Magnetism	4
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
EDSGN 100	Cornerstone Engineering Design	3
ENGL 202C	Effective Writing: Technical Writing	3
MATH 140	Calculus With Analytic Geometry I	4
MATH 141	Calculus with Analytic Geometry II	4

PHYS 211	General Physics: Mechanics	4
Additional Courses		
Select 1 credit of First-Year Seminar		1
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	
Additional Courses: Require a grade of C or better		
CAS 100A	Effective Speech	3
or CAS 100B	Effective Speech	
ENGL 15	Rhetoric and Composition	3
or ENGL 30H	Honors Rhetoric and Composition	
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.

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 (https://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 and Inter-Domain courses do not meet this requirement.)

- **Quantification (GQ):** 6 credits
- **Writing and Speaking (GWS):** 9 credits

Breadth in the Knowledge Domains (Inter-Domain courses do not meet this requirement.)

- **Arts (GA):** 3 credits
- **Health and Wellness (GHW):** 3 credits
- **Humanities (GH):** 3 credits
- **Social and Behavioral Sciences (GS):** 3 credits
- **Natural Sciences (GN):** 3 credits

Integrative Studies

- **Inter-Domain Courses (Inter-Domain):** 6 credits

Exploration

- **GN,** may be completed with Inter-Domain courses: 3 credits
- **GA, GH, GN, GS, Inter-Domain courses.** This may include 3 credits of World Language course work beyond the 12th credit level or the requirements for the student's degree program, whichever is higher**:** 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 (https://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.

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 (https://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy/)

University Park

Stephanie Velegol
Acting Associate Department Head for Undergraduates, Teaching Professor
224 Chemical & Biomedical Engineering Building
University Park, PA 16802
814-865-4907
sbv1@psu.edu

Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2023-24 academic year. To access previous years' suggested academic plans, please visit the archive (https://bulletins.psu.edu/undergraduate/archive/) to view the appropriate Undergraduate Bulletin edition (*Note: the archive only contains suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin*).

Chemical Engineering, B.S. 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 to: 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, 30H, 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
CHE 210[*]	3	CHE 220[*]	3
CHEM 210	3	CHE 230	1
MATH 251	4	CHEM 212	3
PHYS 212 (PHYS 212L & PHYS 212R (GN))[†]	4	CHEM 213	2
General Education Course[†]	3	MATH 231	2
		General Education Course[†]	3
		General Education Course (GHW)[†]	1.5
	17		**15.5**

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	Engineering Elective	3
Chemical Engineering Elective	3	Professional Elective	3
Materials 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 Cultural Diversity 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.

General Education includes Foundations (GWS and GQ), Knowledge Domains (GHW, GN, GA, GH, GS) and Integrative Studies (Inter-domain) requirements. N or Q (Honors) is the suffix at the end of a course number used to help identify an Inter-domain course, but the inter-domain attribute is used to fill audit requirements. Foundations courses (GWS and GQ) require a grade of 'C' or better.

All incoming Schreyer Honors College first-year students at University Park will take ENGL 137H/CAS 137H in the fall semester and ENGL 138T/CAS 138T in the spring semester. These courses carry the GWS designation and satisfy a portion of that General Education requirement. If the student's program prescribes GWS these courses will replace both ENGL 15/ENGL 30H and CAS 100A/CAS 100B/CAS 100C. Each course is 3 credits.

College Notes:

- Please see the Chemical Engineering Advising Handbook (https://www.che.psu.edu/academics/undergraduate/handbook.aspx) for lists of courses for the CHE Elective, Engineering Elective, Professional Elective, Physical Chemistry Elective, and Materials 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.
- This course offered at University Park in spring semester only: CHE 300.

Career Paths

Our chemical engineering graduates work in various industries such as pharmaceuticals, food, cosmetics, specialty chemicals, and oil and gas. They also serve as consultants for various engineering applications including challenges in the environment. Chemical Engineers can go to graduate school to obtain a Ph.D. Some chemical engineers also chose to go to medical school or law school.

Careers

A chemical engineer might work on a team to improve a process for making a pharmaceutical drug to increase the supply and decrease the cost.

A chemical engineer might design a new material that will make our clothing more comfortable and functional.

A chemical engineer might develop a solution to pressing environmental problems like an oil spill or global climate change.

MORE INFORMATION ABOUT POTENTIAL CAREER OPTIONS FOR GRADUATES OF THE CHEMICAL ENGINEERING PROGRAM (https://www.che.psu.edu/academics/undergraduate/what-is-chemical-engineering.aspx)

Opportunities for Graduate Studies

Our students go on to graduate school and conduct research in topics including materials, energy, water treatment, biotechnology, and catalysis. Application of this research include: energy production and storage, large scale production of pharmaceuticals and vaccines, treatment of water and air, large scale production of affordable consumer products, and reduction of CO_2.

MORE INFORMATION ABOUT OPPORTUNITIES FOR GRADUATE STUDIES (https://www.che.psu.edu/academics/graduate/phd.aspx)

Professional Resources

- American Institute of Chemical Engineering (https://www.aiche.org)

Accreditation

The Bachelor of Science in Chemical Engineering at University Park is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the General Criteria and the Chemical, Biochemical, Biomolecular Engineering Program Criteria.

Professional Licensure/Certification

Many U.S. states and territories require professional licensure/certification to be employed. If you plan to pursue employment in a licensed profession after completing this program, please visit the Professional Licensure/Certification Disclosures by State (https://www.psu.edu/state-licensure-disclosures/) interactive map.

Contact

University Park

DEPARTMENT OF CHEMICAL ENGINEERING
121 Chemical & Biomedical Engineering Building
University Park, PA 16802
814-865-2574
cheundergrad@psu.edu

https://www.che.psu.edu