

Chemical Engineering, B.S.

Program Educational Objectives and Student Outcomes

Program Educational Objectives

Graduates of the Carnegie Mellon Chemical Engineering Bachelor of Science program will achieve the following professional accomplishments within a few years of completing the program:

1. advancing in a professional career or a graduate or professional education program
2. established a reputation for seeking challenges and excelling in applying the skills they learned as chemical engineers to solve complex problems as part of their professional responsibilities
3. established a reputation for pursuing their professional responsibilities in an ethical manner that respects the principles of safety, inclusivity, and sustainability
4. established a reputation for excellence in team and interdisciplinary efforts, which includes seeking leadership opportunities and embracing diverse perspectives

Student Outcomes

Students who complete the Bachelor of Science in Chemical Engineering at Carnegie Mellon University will acquire:

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

The department offers a number of special programs for students majoring in Chemical Engineering. In addition to the additional majors offered by the College of Engineering such as: Biomedical Engineering (BME), Engineering Design, Innovation & Entrepreneurship (EDIE), and Engineering & Public Policy (EPP), students may choose from a variety of minors in technical areas offered by the College of Engineering. Undergraduate research projects are also available in the areas of: air quality and climate, autonomous and data-driven sciences, biotechnology and pharmaceutical engineering, catalysis and surface science, energy, decarbonization, and sustainability, process systems engineering and soft materials and complex fluids. The department offers the Chemical Engineering Summer Scholars (ChESS) program to support undergraduate research within the department. Students may participate in study abroad programs during their Junior year. In addition to the University Study Abroad programs, the department provides its own exchange programs with: RWTH Aachen in Germany, Imperial College in London, Great Britain, Universidad Nacional del Litoral in Argentina, and Yonsei University in Seoul, Korea. A summer exchange program in Dortmund, Germany is also available. Finally, qualified students may enroll in our Master of Chemical Engineering program. This degree is typically completed in the fifth year. However, depending on the number of advanced placement courses and course load at Carnegie Mellon, this degree could be awarded during the B.S. graduation, or after one additional semester.

Curriculum

Minimum units required for B.S. in Chemical Engineering

388

The program in chemical engineering within the Department of Chemical Engineering is accredited by the Engineering Accreditation Commission of ABET, <https://www.abet.org>, under the commission's General Criteria and Program Criteria for Chemical, Biochemical, Biomolecular, and Similarly Named Engineering Programs.

First Year

Fall		Units
21-120	Differential and Integral Calculus	10
76-xxx	Designated Writing/Expression Course	9
99-101	Core@CMU	3
06-100	Introduction to Chemical Engineering ^A	12
09-105	Introduction to Modern Chemistry I	10
		44

Spring		Units
21-122	Integration and Approximation	10
xx-xxx	Introductory Engineering Elective (other than ChE)	12
33-141	Physics I for Engineering Students	12
xx-xxx	General Education Course	9
		43

A For those students who have not taken 06-100 as one of the two Introductory Engineering Electives, 06-100 should be taken in the Fall Semester of the Sophomore year. The General Education Course normally taken during that semester may be postponed until the Junior year. These students should consult with their advisor as soon as possible. 21-120 Differential and Integral Calculus is a corequisite for 06-100 Intro to ChemE. If enrolled in 21-090 Pre-Calculus in the fall of the first year, students should enroll in a different intro to engineering course in the fall and take 06-100 Intro to ChemE in the spring concurrently with 21-120.

Spring		Units
21-122	Integration and Approximation	10
xx-xxx	Introductory Engineering Elective (other than ChE)	12
33-141	Physics I for Engineering Students	12
xx-xxx	General Education Course	9
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Second Year

Fall		Units
21-254	Linear Algebra and Vector Calculus for Engineers	11
06-222	Sophomore Chemical Engineering Seminar	1
06-223	Chemical Engineering Thermodynamics	12
09-106	Modern Chemistry II	10
xx-xxx	Computer Sci./Physics II ^B	10-12
xx-xxx	General Education Course	9
39-210	Experiential Learning I	0
		53-55

Spring		Units
06-261	Fluid Mechanics	9
06-262	Mathematical Methods of Chemical Engineering	9
09-221	Laboratory I: Introduction to Chemical Analysis	12
xx-xxx	Physics II/Computer Sci. ^B	12-10
xx-xxx	General Education Course	9
39-220	Experiential Learning II	0
		51-49

B Computer Science/Physics II: Students should complete 15-110 Principles of Computing or 15-112 Fundamentals of Programming and Computer Science as well as 33-142 Physics II for Engineering and Physics Students by the end of the Sophomore year. The recommended sequence is 33-141 /33-142 for engineering students, however, 33-151/ 33-152 will also meet the CIT Physics requirement.

At the end of the Sophomore year, a student should have completed the following required basic science and computer science courses:

09-105	Introduction to Modern Chemistry I	10
09-106	Modern Chemistry II	10
09-221	Laboratory I: Introduction to Chemical Analysis	12
15-110	Principles of Computing	10-12
or 15-112	Fundamentals of Programming and Computer Science	
33-141	Physics I for Engineering Students	12
33-142	Physics II for Engineering and Physics Students	12
99-101	Core@CMU	3

Third Year

Fall		Units
06-310	Molecular Foundations of Chemical Engineering	9
06-323	Heat and Mass Transfer	9
06-324	Computational Optimization and Machine Learning for Chemical Engineering	12
09-217	Organic Chemistry I	9-10
or 09-219	Modern Organic Chemistry	
xx-xxx	General Education Course	9
39-310	Experiential Learning III	0
		48-49

Spring		Units
06-361	Unit Operations of Chemical Engineering	9
06-362	Ethics and Safety for Chemical Engineering	2
06-363	Transport Process Laboratory	9
06-364	Chemical Reaction Engineering	9
xx-xxx	Advanced Science or Mathematics Elective ^{C/D}	9
xx-xxx	Unrestricted Elective	9
xx-xxx	General Education Course	9
		56

C Advanced Science or Mathematics Elective. Students must take any one technical course offered by the Departments of Biological Sciences, Chemistry, Physics, or Mathematical Sciences for at least 9 units at the 200-level or above, or one of the following: 06-607 Physical Chemistry of Colloids and Surfaces, 06-609 Physical Chemistry of Macromolecules, or 36-220 Engineering Statistics and Quality Control. Students may petition to count other courses. This elective can be completed in any semester that fits into the student's schedule.

D Students pursuing Chemical Engineering with an Additional Major in Engineering and Public Policy will take 36-220 as their Advanced Science or Mathematics elective.

Fourth Year

Fall		Units
06-421	Chemical Process Systems Design	12
06-423	Unit Operations Laboratory	9
xx-xxx	Unrestricted Elective	9
xx-xxx	Unrestricted Elective	9
xx-xxx	General Education Course	9
		48

Spring		Units
06-463	Chemical Product Design ^E	9
06-464	Chemical Engineering Process Control	9
xx-xxx	Unrestricted Elective	9
xx-xxx	Unrestricted Elective	9
xx-xxx	General Education Course	9
		45

E The 06-463 Chemical Product Design requirement is waived for BME Additional Major students completing 42-401 Foundations of Biomedical Engineering Design (6 units, fall) AND 42-402 Biomedical Engineering Design Project (9 units, spring).

Notes:

1. In addition to the graduation requirement of an overall QPA of 2.0 (not counting the First Year), the Department of Chemical Engineering requires a cumulative QPA of 2.0 in all chemical engineering courses (all those numbered 06-xxx).
2. Minimum number of units required for graduation: 388.
3. All mathematics (21-xxx) courses required for the engineering degree taken at Carnegie Mellon must have a minimum grade of C in order to be counted toward the graduation requirement for the BS engineering degree.
4. A minimum grade of C must be achieved in any required mathematics (21-xxx) course that is a pre-requisite for the next higher level required mathematics (21-xxx) course.
5. Overloads are permitted only for students maintaining a QPA of 3.5 or better during the preceding semester.
6. Electives: To obtain a Bachelor of Science degree in Chemical Engineering, students must complete 06-100 and one other Introductory Engineering Elective. There are also five Unrestricted Electives.
7. Undergraduate Research: Independent research projects are available by arrangement with a faculty advisor. Many students conduct these research projects for elective credit by enrolling in 06-150 First Year Research Project, 06-200, 06-300, or 06-400 (First Year, Sophomore, Junior, or Senior Research Projects) or 39-500 Honors Research Project for eligible Seniors.
8. Advanced undergraduates may also take Chemical Engineering graduate courses (600 or 700 level) as electives.