

Bachelor of Science in Chemical Engineering

B.S. in Chemical Engineering Program

Chemical engineering has grown out of a combination of chemistry and engineering associated with industrial processes. Today, it possesses a body of knowledge used in the synthesis, design testing, scale-up, operation, control, and optimization of processes that change the physical state or composition of materials. Chemical engineers have played central roles in the industrial development of materials that have had major social influence, such as the production of fuels and lubricants, fertilizer, synthetic fibers, and plastics. They will be centrally involved in reducing the polluting effects of certain byproducts and cleaning up unwanted residues from previous processes.

The first part of the program offers courses on the fundamental principles underlying the conversion of raw materials into a desired product by chemical and physical processes. Development of the concepts of engineering design begins with the application of fundamental principles to solve engineering problems in these courses and culminates in a series of senior-level design courses that require comprehensive integration of technical knowledge as well as consideration of economic, environmental, safety, and societal concerns. This experience is essential in preparing graduates for entry-level positions.

Educational Objective

The objective of the program is to prepare graduates for professional practice in industry, government, or post-undergraduate training in chemical engineering, medicine, and other related disciplines.

Professional Opportunities

Chemical engineers are concerned with the chemical processes that turn raw materials into valuable products. They serve industrial and other activities where processes occur in which materials undergo a chemical or physical change. Chemical engineers build a bridge between science and manufacturing, applying the principles of chemistry, biology and engineering to solve problems involving the production or use of chemicals. Chemical engineers typically work for manufacturing companies, environmental companies, health care and pharmaceuticals, petroleum industry, biotechnology, or consulting firms.

Undergraduate Admission to the School of Engineering

Admission to the KU School of Engineering (and its degree programs) is selective.

Students may be admitted to an engineering or computer science degree program (http://enr.ku.edu/sites/enr.drupal.ku.edu/files/docs/pdfs/Majors_and_Curriculum_Guide_2014_Online.pdf) as freshmen (first year) students, but all admissions, for both in-state and out-of-state students, are selective. Applications are judged on several factors, such as high school record, scores on national tests, academic record at college or university level, and trend of grades and more. High school transcripts and ACT scores (or equivalent SAT scores) are required.

Minimum Academic Standards for Admission

To be considered for admission to the School of Engineering, beginning first-year students must meet or exceed the following minimum standards:

- Must be admissible (<http://admissions.ku.edu/apply/requirements/usfreshmen>) to the University of Kansas by assured admissions or individual review **AND**
- Have a 3.0+ GPA **AND**
- Have a mathematics ACT score of 22 (or math SAT score of 540).

Important: Simply meeting these requirements won't guarantee admission to a School of Engineering degree program. Students who perform beyond these minimums will have a better probability of being admitted to their selected major.

Minimum Academic Standards for Direct Admission into Degree Program for incoming Freshmen

Students with a 26+ Math ACT (600+ Math SAT) or meet eligibility requirements for MATH 125 (Calculus I) (<http://catalog.ku.edu/liberal-arts-sciences/math/#undergraduatetext>) may be admitted directly into their chosen major, with the exception of those seeking admission into an EECS program. Electrical Engineering, Computer Science, Computer Engineering, and Interdisciplinary Computing students must have a 28+ Math ACT (640+ Math SAT) or eligibility for MATH 125 for direct admission.

First-Year General Engineering Program

Students with a 22-25 Math ACT (540-580 Math SAT) or meet eligibility requirements for Math 104 (Pre-Calculus) (<http://catalog.ku.edu/liberal-arts-sciences/math/#undergraduatetext>) are admitted to the School of Engineering First-Year Experience non-degree program for undergraduate students.

First-year Engineering students have one academic year (two semesters and one summer) to transition into a degree program. Admission to a degree program is possible after one of the following is met:

- Complete 12+ credit hours at KU, earn a "B" or higher in Math 104 (Pre-Calculus), earn a "C" or higher in all science and engineering courses, and earn a KU GPA of 2.5+ OR
- Earn a "C" or better in MATH 125 (Calculus I), earn a "C" or better in all science and engineering courses, and earn a KU GPA of 2.5+

Exploring Engineering

Students not admitted directly to the School of Engineering or their major but who are admissible to the university may be admitted to the College of Liberal Arts and Sciences as an Undecided student. They can later re-apply to the School of Engineering during the semester they are completing the admission requirements for transfer students.

Transfer Admission Standards

Applications from all transfer students, whether from other institutions or from other academic schools at the University of Kansas, are evaluated on a case-by-case basis. Transfer students must be admissible (<http://admissions.ku.edu/apply/requirements/ustransfer>) to KU **AND** have a cumulative college transferable grade-point average of 2.5+ to be considered. In addition, students must have grades of "C" or better in

those courses in math (must include MATH 125 Calculus I or equivalent), science, and engineering applicable to the engineering degree.

Students interested in the **Information Technology** program are admitted as juniors. They must have completed 60 hours of pre-requisite courses including foundational courses in math, science, and computer science and have a 2.5+ cumulative GPA or better. The Information Technology program resides at the Edwards Campus in Overland Park, KS. Click here (<http://edwardscampus.ku.edu/overview-bachelors-information-technology>) for more information.

Current KU Students admitted to other academic units may apply to the School of Engineering by completing a Change of School form (<http://engineering.ku.edu/forms>). This must be turned in to the School of Engineering Dean's Office by the appropriate deadlines indicated below.

Already Applied to KU, But Not Engineering?

Don't worry. It's not too late to change your mind if you've already applied to KU and selected a major outside the School of Engineering. If you think one of the 12 engineering or computer science majors is a better fit for your talents, you can still change your requested major — preferably before May 1 — and be considered for admission to the School of Engineering and all the benefits that go with it.

To update your application, visit Undergraduate Admissions (<http://admissions.ku.edu/update-your-application>) and click on "Change application term, major, mailing address, and/or email address."

Please contact a member of our recruitment team (studyengineering@ku.edu), 785-864-3881, if you have any difficulty.

Application Deadlines For New Freshman and Transfer Applicants

September 15	Priority deadline for current KU students to apply for spring admission to Engineering.
November 1	Final deadline for scholarship consideration for incoming freshmen planning to enter in fall or summer semesters.
December 1	Final deadline to apply for the Self Engineering Leadership Fellows Program for incoming freshmen
February 1	Final deadline for scholarship consideration for transfer students planning to enter in fall or summer semesters. Applications available for the Engineering Learning Community

February 15	Priority deadline for current KU students to apply for summer or fall admission to Engineering.
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May 1	Enrollment Deposit due.
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General Education Requirements

The **KU Core** is the university-wide curriculum that all incoming undergraduate students will complete as part of their degree requirements. It comprises three general education goals and three advanced education goals. Associated with each goal are one or more learning outcomes:

- GE 1.1, Goal 1, Outcome 1, Critical Thinking;
- GE 1.2, Goal 1, Outcome 2, Quantitative Literacy;
- GE 2.1, Goal 2, Outcome 1, Written Communication;
- GE 2.2, Goal 2, Outcome 2, Oral Communication;
- GE 3H, Goal 3, Outcome 1, Arts & Humanities;
- GE 3N Goal 3, Outcome 2, Natural Sciences;
- GE 3S Goal 3, Outcome 3, Social Sciences;
- AE 4.1, Goal 4, Outcome 1, Diversity;
- AE 4.2 Goal 4, Outcome 2 Culture;
- AE 5.1, Goal 5, Outcome 1, Social Responsibility & Ethics (course);
- AE 5.2, Goal 5, Outcome 2, Social Responsibility & Ethics (practice);
- AE 6.1, Goal 6, Outcome 1 and 2, Integration & Creativity.

Details of the KU Core can be found at kucore.ku.edu. Some required courses in the Chemical Engineering curricula satisfy a KU Core goal and/or outcome. For these courses, the goal/outcome code is given in parentheses after the course on the pages below. Where required courses do NOT specially satisfy KU Core goals (Goals GE 3H, GE 3S, AE 4.1, and AE 4.2) students must choose from a list of several courses to satisfy the required goals.

First- and Second-Year Preparation

Recommended enrollments for the first 2 years are as follows:

Freshman

Fall	Hours Spring	Hours
C&PE 111	1 ENGL 102 (KU Core GE 2.1)	3
ENGL 101 (KU Core GE 2.1)	3 MATH 126	4
CHEM 130 or 170 (KU Core GE 3N)	5 CHEM 135 or 175	5
MATH 125	4 PHSX 210	3
KU Core GE 3H, GE 3S, AE 4.1, or AE 4.2	3 PHSX 216	1
	C&PE 112	1
	16	17

Sophomore

Fall	Hours Spring	Hours
C&PE 211	4 C&PE 221	3
PHSX 212	3 C&PE 325	3
CHEM 330	3 MATH 127	4
CHEM 331	2 PHSX 236	1

MATH 220	3 ENGR Elective (See handbook for approved Engineering Electives)	3
MATH 290	2 Advanced Chemistry elective (See handbook for approved electives)	3
17		17

Total Hours 67

Bachelor of Science in Chemical Engineering Degree Requirements

Following are descriptions of the **General Program**, the **Biomedical** emphasis, the **Environmental** emphasis, the **Materials Science** emphasis, the **Petroleum** emphasis, and the **Premedical** emphasis.

1. Chemical Engineering students must earn a cumulative 2.0 GPA in C&PE 211, C&PE 221, and C&PE 325 in order to progress to C&PE 511, C&PE 512, C&PE 524, or C&PE 525. The cumulative GPA is calculated using the highest grade earned in each course.
2. Chemical Engineering students must earn a cumulative 2.0 GPA in C&PE 511, C&PE 512, C&PE 522, C&PE 524, and C&PE 525 in order to progress to C&PE 611, C&PE 613, C&PE 615, C&PE 616, C&PE 624, or C&PE 626. The cumulative GPA is calculated using the highest grade earned in each course.
3. Chemical Engineering students must attain a cumulative GPA of at least 2.0 in C&PE courses taken at KU for graduation with a B.S. degree in Chemical Engineering.

General Program

A total of 128 hours are required for the B.S. degree in Chemical Engineering. Students that are exempt from ENGL 101 based on ACT or SAT test score do not have to make up the 3 credit hours with another course. This exemption results in the total hours required for the B.S. degree in Chemical Engineering to be 125.

Code	Title	Hours
Chemical Engineering Courses		
C&PE 111	Introduction to the Chemical Engineering Profession	1
C&PE 112	Introduction to Chemical Engineering Profession II	1
C&PE 211	Material and Energy Balances	4
C&PE 221	Chemical Engineering Thermodynamics	3
C&PE 325	Numerical Methods and Statistics for Engineers	3
C&PE 511	Momentum Transfer	3
C&PE 512	Chemical Engineering Thermodynamics II	3
C&PE 522	Economic Appraisal of Chemical and Petroleum Projects (KU Core Goal 5)	2
C&PE 524	Chemical Engineering Kinetics and Reactor Design	3
C&PE 525	Heat and Mass Transfer	4
C&PE 611	Design of Unit Operations	3
C&PE 613	Chemical Engineering Design I (KU Core Goal 2.2, Goal 6)	4
C&PE 615	Introduction to Process Dynamics and Control	3
C&PE 616	Chemical Engineering Laboratory I (KU Core Goal 2.2)	3

C&PE 623	Chemical Engineering Design II	2
C&PE 624	Process Safety and Sustainability (KU Core Goal 5)	3
C&PE 626	Chemical Engineering Laboratory II (KU Core Goal 2.2)	3

Engineering Electives

A minimum of 3 hours of engineering elective must be taken within the Chemical Engineering department. A maximum of 6 hours may be taken in chemical engineering. At least 6 hours of engineering elective must be in engineering areas outside the department. You can consult with your advisor to find out commonly selected electives.

Basic Sciences

CHEM 170	Chemistry for the Chemical Sciences I	5
or CHEM 130	General Chemistry I	
CHEM 175	Chemistry for the Chemical Sciences II	5
or CHEM 135	General Chemistry II	
PHSX 210	General Physics I for Engineers (KU Core GE 1.1)	3
or PHSX 211	General Physics I	
PHSX 216	General Physics I Laboratory (KU Core AE 5)	1
PHSX 212	General Physics II	3
PHSX 236	General Physics II Laboratory	1

Advanced Chemistry

CHEM 330	Organic Chemistry I	3
CHEM 331	Organic Chemistry I Laboratory	2
CHEM 525	Physical Chemistry for Engineers	4

Advanced Science Electives

See approved list of Advanced Science Electives 6

Mathematics

MATH 125	Calculus I	4
MATH 126	Calculus II	4
MATH 127	Calculus III	4
MATH 220	Applied Differential Equations	3
MATH 290	Elementary Linear Algebra	2

General Education Component

Students with an initial term of Fall 2014 or later must meet the minimum requirements of the KU Core. Learn more about KU Core requirements at <http://kucore.ku.edu>

ENGL 101	Composition (KU Core GE 2.1 - Students that are exempt from ENGL 101 based on ACT or SAT test score do not have to make up the credit hours with another course.)	3
ENGL 102	Critical Reading and Writing (KU Core GE 2.2)	3
KU Core GE 3H		3
KU Core GE 3S		3
KU Core AE 4.1		3
KU Core AE 4.2	Students that satisfy AE 4.2 with an experience or by being an international student must make up the three credit hours with math, science, engineering, humanities, or social science credit.	3

Students completing the requirements described above will earn a Bachelor of Science in Chemical Engineering degree, also known as the general option. Within Chemical Engineering, students may also choose to complete an emphasis: Biomedical, Environmental, Materials Science, Premedical, or Petroleum. Students completing an emphasis are required to satisfy all the requirements for the Bachelor of Science degree in Chemical Engineering general option. In addition, each emphasis has

specific requirements for some of the engineering and advanced science electives. The coursework required for each emphasis is described below.

Biomedical Emphasis

Students completing an emphasis are required to satisfy all the requirements for the Bachelor of Science degree in Chemical Engineering general option. The following advanced science and engineering elective courses must be completed as part of the advanced science and engineering electives required for the Biomedical emphasis:

Code	Title	Hours
BIOL 150	Principles of Molecular and Cellular Biology (Counts towards Advanced Science elective)	4
BIOL 600 or BIOL 546	Introductory Biochemistry, Lectures (Counts towards Advanced Science elective) Mammalian Physiology	3
C&PE 656	Introduction to Biomedical Engineering (Counts towards Engineering Elective)	3
C&PE 651	Undergraduate Problems (recommended, not required; Counts towards Engineering Elective)	3

Environmental Emphasis

Students completing an emphasis are required to satisfy all the requirements for the Bachelor of Science degree in Chemical Engineering general option. The following engineering elective courses must be completed as part of the engineering electives required for the Environmental emphasis:

Code	Title	Hours
CE 477	Introduction to Environmental Engineering and Science (required)	3

9 hours of Environmental Engineering electives at 500 level or above. Typical classes include but are not limited to: CE 570, CE 571, CE 573, CE 772, or CE 774. Generally, Environmental Engineering electives will require CE 477 as a prerequisite.

Material Science Emphasis

Students completing an emphasis are required to satisfy all the requirements for the Bachelor of Science degree in Chemical Engineering general option. The following engineering elective courses must be completed as part of the engineering electives required for the Material Science emphasis:

Code	Title	Hours
Select 4 courses from the list below to satisfy the 12 hours of Engineering Electives required		
ARCE 350	Building Materials Science	3
AE 507	Aerospace Structures I	3
AE 510	Aerospace Materials and Processes	4
CE 310	Strength of Materials	4
CE 412	Structural Engineering Materials	3
CE 461	Structural Analysis	4
C&PE 655	Introduction to Semiconductor Processing	3
C&PE 657	Polymer Science and Technology	3
C&PE 751	Basic Rheology	3
C&PE 752	Tissue Engineering	3

C&PE 765	Corrosion Engineering	3
ME 306	Science of Materials	3
ME 311	Mechanics of Materials	3
ME 767	Molecular Biomimetics	3
CHEM 680/ C&PE 715/ BIOL 420/ PHSX 600/EPHX 600	Topics in Chemistry: _____ (Introduction to Nanotechnology)	3
C&PE 651	Undergraduate Problems ((By petition))	1-4
C&PE 661	Undergraduate Honors Research ((By petition))	3

The following courses can be used to satisfy the 6 hours of Advanced Science Electives but are not required:

PHSX 313	General Physics III	3
BIOL 150	Principles of Molecular and Cellular Biology	4
CHEM 400	Analytical Chemistry	3
CHEM 401	Analytical Chemistry Laboratory	2
CHEM 635	Instrumental Methods of Analysis	2
CHEM 636	Instrumental Methods of Analysis Laboratory	3
CHEM 660	Systematic Inorganic Chemistry	3

Petroleum Emphasis

The Petroleum emphasis in chemical engineering is distinct from the B.S. in Petroleum Engineering degree (see below). Students completing an emphasis are required to satisfy all the requirements for the Bachelor of Science degree in Chemical Engineering general option. The following advanced science and engineering elective courses must be completed as part of the advanced science and engineering electives required for the Petroleum emphasis:

Code	Title	Hours
GEOL 101 & GEOL 103	The Way The Earth Works and Geology Fundamentals Laboratory (counts towards Advanced Science requirement of Chemical Engineering BS)	5
C&PE 327	Reservoir Engineering (1 hour counts towards Advance Science Elective requirement, 3 hours counts towards Engineering Elective requirement)	4
C&PE 527	Reservoir Engineering II (counts towards Engineering Elective requirement)	4
Petroleum engineering elective		3
C&PE 117	Energy in the Modern World (Recommended instead of C&PE 111)	1
C&PE 127	Introduction to Petroleum Engineering Profession (Recommended instead of C&PE 111)	1

Premedical Emphasis

Students completing an emphasis are required to satisfy all the requirements for the Bachelor of Science degree in Chemical Engineering general option. Additional courses may be required by each specific medical school, and students should consult the medical school of interest to verify requirements for admission. The following advanced science courses must be completed as part of the advanced science electives required for the Premedical emphasis:

Code	Title	Hours
CHEM 335	Organic Chemistry II	3
BIOL 150	Principles of Molecular and Cellular Biology	4
BIOL 152	Principles of Organismal Biology	4
BIOL 600	Introductory Biochemistry, Lectures	3

The following courses may be required for admission into specific medical schools or be recommended for the MCAT. These classes are recommended but not required:

PSYC 104	General Psychology (KU Core GE 3S (recommended, not required))	3
SOC 104	Elements of Sociology (KU Core AE 4.1 (recommended, not required))	3
BIOL 350	Principles of Genetics (recommended, not required)	4
BIOL 416	Cell Structure and Function (recommended, not required)	3
BIOL 546	Mammalian Physiology (recommended, not required)	3

Credit for ROTC Courses

Only ROTC courses qualifying as engineering electives and humanities/social sciences may be used.

Departmental Honors

Students wishing to receive Departmental Honors in Chemical and Petroleum Engineering must apply to the Department in writing by September 1st for a December graduation or February 1st for a May graduation. The criteria for Departmental Honors are:

1. A cumulative 3.5 GPA in courses taken at KU
2. A cumulative 3.5 GPA in engineering courses taken at KU
3. Completion of an experience or an achievement that is deemed worthy of Departmental Honors. Examples of achievements include (not limited to):
 - a. Completion of 3 hours of C&PE 661 (Honors research) or equivalent with an A or B
 - b. Completion of Senior Thesis
 - c. Co-author on a publication – may require research advisor verification
 - d. Presentation at a National Conference – may require research advisor verification
 - e. Receiving an award for scholarly work – may require research advisor verification

The application must include:

- Completed application form
- Approximately 200-500 word statement of the achievement or experience that is worthy of Departmental Honors.

A departmental committee will review all applications and make the final decision on the awarding of Departmental Honors. Some applications may require verification from the research advisor. Students awarded Departmental Honors will be recognized at the end of the year banquet.