CHEMICAL ENGINEERING, BS

for the degree of Bachelor of Science in Chemical Engineering (Specialized Curriculum)

The first two years of the Chemical Engineering curriculum provide a strong foundation in basic sciences through Physics, Mathematics, Chemistry, an introduction to what Chemical Engineers do, and the fundamental basis of Chemical Engineering (Mass and Energy Balances and Thermodynamics.) In the third year, students delve deeper into more specialized Chemistry courses such as Physical and Analytical Chemistry, while exploring fundamental Chemical Engineering courses such as Momentum Transfer, Separations, and Reactor Design. The Senior year incorporates all of this learning through high level technical electives, Process Control, Capstone Lab, and Capstone Design courses. It is through the lab and design class that students apply everything they have learned in previous Chemical Engineering courses to real-world team projects and presentations.

The standard Chemical Engineering curriculum provides a strong fundamental understanding of Chemical Engineering and is designed to prepare students for careers in industries spanning the areas of energy, chemical processing, food, semiconductor processing, personal care products, specialized fibers and materials.

As an alternative, the Department of Chemical and Biomolecular Engineering provides a *Bachelor of Science in Chemical Engineering* degree with a concentration in Biomolecular Engineering. The Biomolecular Engineering concentration builds upon the traditional principles of chemical engineering, but specializes in biological and biotechnological systems in order to better prepare students who are interested in or seek employment in the food, pharmaceutical, and biotechnology industries.

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Graduation Requirements

Minimum hours required for graduation: 129 hours.

A grade point average of 2.5 or higher in all courses required for the major earned on the UIUC campus is required in order to be accepted by the department as juniors and seniors.

University Requirements

Minimum of 40 hours of upper-division coursework, generally at the 300- or 400-level. These hours can be drawn from all elements of the degree. Students should consult their academic advisor for additional guidance in fulfilling this requirement.

The university and residency requirements can be found in the Student Code (https://studentcode.illinois.edu/article3/part8/3-801/) (§ 3-801) and in the Academic Catalog (http://catalog.illinois.edu/general-information/degree-general-education-requirements/).

General Education Requirements

Follows the campus General Education (Gen Ed) requirements (https://courses.illinois.edu/gened/DEFAULT/DEFAULT/). Some Gen Ed requirements may be met by courses required and/or electives in the program.

Code	Title	Hours
Composition I		4-6
Advanced Composition		3
fulfilled by CHBE 431		
Humanities & the Arts (6 hours)		6
Natural Sciences & Technology (6 hours)		6
fulfilled by CHEM 202 and CHEM 204, or CHEM 102 and CHEM 104; and PHYS 211, PHYS 212		
Social & Behavioral Sciences (6 hours)		6
Cultural Studies: Non-Western Cultures (1 course)		3
Cultural Studies: US Minority Cultures (1 course)		3
Cultural Studies: Western/Comparative Cultures (1 course)		3
Quantitative Reasoning (2 courses, at least one course must be Quantitative Reasoning I)		6-10
fulfilled by MATH 220 or MATH 221; and MATH 231, MATH 241, MATH 285, PHYS 211, PHYS 212, CS 101		
Language Requirement (Completion of the third semester or equivalent of a language other than English is required.)		0-15

Orientation and Professional Development

These courses introduce opportunities and resources the college, department, and curriculum offers students. They also provide background on the Chemical Engineering curriculum, what chemical engineers do, and the skills to work effectively and successfully in the engineering profession.

Code	Title	Hours
CHBE 121	CHBE Profession	1
For non-first-year students, CHBE 121 can be replaced with 1 hour of credit from Technical Elective List 1 or List 2. (Ref List 1 and List 2 below.)		
ENG 100	Grainger Engineering Orientation Seminar	1
Total Hours		**2**

Foundational Mathematics and Science

These courses stress the basic mathematical and scientific principles upon which the engineering discipline is based.

Code	Title	Hours
Select one group of courses (Accelerated or General Chemistry)		10-12
CHEM 202	Accelerated Chemistry I	
& CHEM 203	and Accelerated Chemistry Lab I	
& CHEM 204	and Accelerated Chemistry II	
& CHEM 205	and Accelerated Chemistry Lab II	
OR		

CHEM 102 & CHEM 103 & CHEM 104 & CHEM 105 & CHEM 222 & CHEM 223	General Chemistry I and General Chemistry Lab I and General Chemistry II and General Chemistry Lab II and Quantitative Analysis Lecture and Quantitative Analysis Lab	
MATH 221	Calculus I (MATH 220 may be substituted. MATH 220 is appropriate for students with no background in calculus. 4 or 5 credit hours count towards the degree.)	4
MATH 231	Calculus II	3
MATH 241	Calculus III	4
MATH 257	Linear Algebra with Computational Applications	3
or MATH 415	Applied Linear Algebra	
MATH 285	Intro Differential Equations	3
or MATH 441	Differential Equations	
PHYS 211	University Physics: Mechanics	4
PHYS 212	University Physics: Elec & Mag	4
PHYS 214	Univ Physics: Quantum Physics	2
Total Hours		**37-39**

Chemical Engineering Technical Core

These courses stress fundamental concepts and basic laboratory techniques that comprise the common intellectual understanding of chemical engineering and chemical science.

Code	Title	Hours
CHBE 221	Principles of CHE	3
CHBE 321	Thermodynamics	4
CHBE 421	Momentum and Heat Transfer	4
CHBE 422	Mass Transfer Operations	4
CHBE 424	Chemical Reaction Engineering	3
CHBE 430	Unit Operations Laboratory	4
CHBE 431	Process Design	4
CHBE 440	Process Control and Dynamics	3
CHEM 236	Fundamental Organic Chem I	4
CHEM 237	Structure and Synthesis	2
CHEM 315	Instrumental Chem Systems Lab	2
Students must register in one of the Chemical Engineering-specific CHEM 315 lab sections.		
CHEM 420	Instrumental Characterization	2
CHEM 442	Physical Chemistry I	4
CS 101	Intro Computing: Engrg & Sci	3
CHBE 411	Probability and Statistics for ChBE	3-4
or IE 300	Analysis of Data	
or STAT 400	Statistics and Probability I	
Total Hours		**49-50**

Note: An optional Biomolecular Engineering concentration can be elected. See* Chemical Engineering: Biomolecular Engineering, BS *(http://catalog.illinois.edu/undergraduate/las/chemical-engineering-bs/biomolecular-engineering/). Those who do not elect the optional concentration are required to take the coursework below.

Chemical Engineering Technical Core (cont.)

Code	Title	Hours
CHEM 436	Fundamental Organic Chem II	3
or MCB 450	Introductory Biochemistry	
Total Hours for Chemical Engineering Technical Core		**52-53**

Chemical Engineering Technical Electives

These courses stress the rigorous analysis and design principles practiced in the major subdisciplines of chemical engineering, embodied in the standard chemical engineering program and biomolecular engineering concentration.

Code	Title	Hours
Select 18 credit hours from List 1 and List 2, with specific requirements noted below.		
Note: A maximum of 10 credit hours of undergraduate research may be counted toward Technical Elective credit.		
Two 400-level ChBE courses from List 1, with not more than 3 hours being CHBE 497 or CHBE 499		6
One Additional 400-level course from List 1		3
Two Additional courses from List 1		6
One Additional 400-level course from List 1 or List 2		3
Total Hours for Chemical Engineering Technical Electives		**18**
LIST 1		
Any 400-level ChBE Course, excluding ChBE core courses CHBE 411, CHBE 421, CHBE 422, CHBE 424, CHBE 430, CHBE 431, and CHBE 440		
ABE 436	Renewable Energy Systems	
ABE 483	Engineering Properties of Food Materials	
ABE 488	Bioprocessing Biomass for Fuel	
ATMS 420	Atmospheric Chemistry	
BIOE 476	Tissue Engineering	
CEE 320	Construction Engineering	
CEE 330	Environmental Engineering	
CEE 350	Water Resources Engineering	
CEE 421	Construction Planning	
CEE 422	Construction Cost Analysis	
CEE 437	Water Quality Engineering	
CEE 440	Fate Cleanup Environ Pollutant	
CEE 442	Environmental Engineering Principles, Physical	
CEE 443	Env Eng Principles, Chemical	
CEE 450	Surface Hydrology	
CEE 452	Hydraulic Analysis and Design	
CHBE 297	Individual Study Sophomores	
CHBE 397	Individual Study for Juniors	
CS 357	Numerical Methods I	
CS 411	Database Systems	

CS 427	Software Engineering I
CS 440	Artificial Intelligence
CS 446	Machine Learning
CS 450	Numerical Analysis
CS 498	Special Topics
ECE 304	Photonic Devices
ECE 313	Probability with Engrg Applic
ECE 333	Green Electric Energy
ECE 380	Biomedical Imaging
ECE 416	Biosensors
ECE 444	IC Device Theory & Fabrication
ECE 481	Nanotechnology
ECE 490	Introduction to Optimization
ME 400	Energy Conversion Systems
ME 471	Finite Element Analysis
ME 482	Musculoskel Tissue Mechanics
ME 483	Mechanobiology
ME 487	MEMS-NEMS Theory & Fabrication
MSE 304	Electronic Properties of Matls
MSE 307	Materials Laboratory I
MSE 308	Materials Laboratory II
MSE 401	Thermodynamics of Materials
MSE 402	Kinetic Processes in Materials
MSE 403	Synthesis of Materials
MSE 406	Thermal-Mech Behavior of Matls
MSE 420	Ceramic Materials & Properties
MSE 441	Metals Processing
MSE 450	Polymer Science & Engineering
MSE 457	Polymer Chemistry
MSE 458	Polymer Physics
MSE 460	Electronic Materials I
MSE 470	Design and Use of Biomaterials
MSE 473	Biomolecular Materials Science
MSE 474	Biomaterials and Nanomedicine
MSE 480	Surfaces and Colloids
MSE 487	Materials for Nanotechnology
MSE 489	Matl Select for Sustainability
NPRE 201	Energy Systems
NPRE 402	Nuclear Power Engineering
NPRE 412	Nuclear Power Econ & Fuel Mgmt
NPRE 441	Radiation Protection
NPRE 442	Radioactive Waste Management
NPRE 457	Safety Anlys Nucl Reactor Syst
NPRE 461	Probabilistic Risk Assessment
NPRE 470	
NPRE 475	
NPRE 480	Energy and Security
SE 411	Reliability Engineering
TAM 211	Statics
TAM 251	Introductory Solid Mechanics
TAM 461	Cellular Biomechanics

LIST 2

ABE 425	Engrg Measurement Systems
ABE 430	Project Management
ABE 497	Independent Study
ABE 498	Special Topics
ANSC 445	Statistical Methods
ANSC 450	Comparative Immunobiology
ATMS 421	Earth Systems Modeling
BADM 461	Tech, Eng, & Mgt Final Project
BIOC 446	Physical Biochemistry
CEE 407	Airport Design
CEE 497	Independent Study
CEE 498	Special Topics
CHEM 436	Fundamental Organic Chem II
CHEM 437	Organic Chemistry Lab
CHEM 444	Physical Chemistry II
CHEM 445	Physical Principles Lab I
CHEM 483	Solid State Structural Anlys
CHEM 497	Individual Study Senior
CPSC 414	Forage Crops & Pasture Ecology
CPSC 415	Bioenergy Crops
CPSC 418	Crop Growth and Management
CPSC 419	Midwest Agricultural Practices
CPSC 453	Principles of Plant Breeding
FSHN 414	Food Chemistry
FSHN 418	Food Analysis
FSHN 426	Biochemical Nutrition I
FSHN 428	Community Nutrition
FSHN 460	Food Processing Engineering
FSHN 465	Principles of Food Technology
FSHN 471	Food & Industrial Microbiology
FSHN 480	Basic Toxicology
FSHN 481	Food Processing Unit Operations I
FSHN 483	Food Processing Unit Operations II
GEOL 450	Investigating the Earth's Interior
GEOL 451	Environmental Geophysics
GEOL 454	Introduction to Seismology
GEOL 470	Introduction to Hydrogeology
IB 451	Conservation Biology
IS 467	Ethics and Policy for Data Science
MATH 402	Non Euclidean Geometry
MATH 413	Intro to Combinatorics
MATH 417	Intro to Abstract Algebra
MATH 442	Intro Partial Diff Equations
MATH 446	Applied Complex Variables
MATH 461	Probability Theory
MATH 487	Advanced Engineering Math
MCB 408	Immunology
MCB 424	Microbial Biochemistry
MCB 436	Global Biosecurity
MCB 450	Introductory Biochemistry
MCB 462	Integrative Neuroscience
MSE 497	Independent Study

MSE 498	Special Topics
NPRE 483	Seminar on Security
NPRE 498	Special Topics
NRES 488	Soil Fertility and Fertilizers
PHYS 435	Electromagnetic Fields I
PHYS 470	Subatomic Physics
SE 400	Engineering Law
STAT 410	Statistics and Probability II
STAT 420	Methods of Applied Statistics
STAT 430	Topics in Applied Statistics
STAT 440	Statistical Data Management
UP 406	Urban Ecology
UP 430	Urban Transportation Planning

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This sample sequence is intended to be used only as a guide for degree completion. All students should work individually with their academic advisors to decide the actual course selection and sequence that works best for them based on their academic preparation and goals. Enrichment programming such as study abroad, minors, internships, and so on may impact the structure of this four-year plan. Course availability is not guaranteed during the semester indicated in the sample sequence.

Students must fulfill their Language Other Than English requirement by successfully completing a third level of a language other than English. For more information, see the corresponding section on the* Degree and General Education Requirements page *(http://catalog.illinois.edu/general-information/degree-general-education-requirements/).

****The sample sequence below assumes that the student has placed into the Accelerated Chemistry courses.***

First Year	
First Semester	**Hours**
ENG 100	1
CHEM 202	3
CHEM 203	2
MATH 221 (MATH 220 may be substituted)	4
General Education course (Choose a Humanities course with Cultural Studies designation)	3

General Education course (Choose Social & Behavioral Sciences course) or Composition I	3
	16

Total Hours 16

First Year

Second Semester	**Hours**
CHBE 121	1
CHEM 204	3
CHEM 205	2
MATH 231	3
PHYS 211	4
Composition I or General Education course (Choose a Social & Behavioral Sciences course)	4
	17

Total Hours 17

Second Year

First Semester	**Hours**
CHBE 221	3
MATH 241	4
PHYS 212	4
CHEM 236	4
CHEM 237	2
	17

Total Hours 17

Second Year

Second Semester	**Hours**
CHBE 321	4
MATH 285 or 441	3
MATH 257 or 415	3
CS 101	3
PHYS 214	2
	15

Total Hours 15

Third Year

First Semester	**Hours**
CHBE 421	4
CHEM 315	2
CHBE 411, IE 300, or STAT 400	3
CHEM 420	2
CHEM 442	4
	15

Total Hours 15

Third Year

Second Semester	**Hours**
CHBE 422	4
CHBE 424	3
CHEM 436 or MCB 450	3
Language Other Than English (3rd level)	4
Technical Elective (CHBE 400-level)	3
	17

Total Hours 17

Fourth Year

First Semester	**Hours**
CHBE 430	4
CHBE 440	3
Technical Elective (CHBE 400-level)	3
Technical Elective (400-level, List 1 or 2)	3
Technical Elective (400-level, List 1)	3
	16

Total Hours 16

Fourth Year

Second Semester	**Hours**
CHBE 431	4
Technical Elective (List 1)	3
Technical Elective (List 1)	3
General Education course (Choose a Social & Behavioral Sciences course with Cultural Studies designation)	3
General Education course (Choose Humanities course with Cultural Studies designation)	3
	16

Total Hours 16

Total Hours: 129

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Student learning outcomes are based on learning outcomes in line with the ABET accreditation process.

Chemical Engineering graduates will have:

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.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

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Chemical & Biomolecular Engineering (https://chbe.illinois.edu/)

Chemical & Biomolecular Engineering faculty (https://chbe.illinois.edu/directory/)
SCS Academic Advising (https://scs.illinois.edu/academics/advising/)

College of Liberal Arts and Sciences (https://las.illinois.edu/)

Overview of College Admissions & Requirements: Liberal Arts & Sciences (http://catalog.illinois.edu/schools/las/)