

# CHEMICAL ENGINEERING: BIOMOLECULAR ENGINEERING, BS

for the degree of Bachelor of Science in Chemical Engineering, Biomolecular Engineering Concentration (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 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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For those students who are pursuing a B.S. Degree in Chemical Engineering, students can choose to earn a concentration in Biomolecular Engineering, as well. This concentration builds upon the traditional principles of chemical engineering but specializes in biological and biotechnological systems to better prepare students who are interested in or plan to seek employment in the food, pharmaceutical, and biotechnology industries.

## 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 fulfilled by CHBE 431	3
	Humanities & the Arts (6 hours)	6
	Natural Sciences & Technology (6 hours) fulfilled by CHEM 202 and CHEM 204, or CHEM 102 and CHEM 104; and PHYS 211, PHYS 212	6
	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) fulfilled by MATH 220 or MATH 221 and MATH 231, MATH 241, MATH 285, PHYS 211, PHYS 212, CS 101	6-10
	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 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.)	1
ENG 100	Grainger Engineering Orientation Seminar	1
<b>Total Hours</b>		<b>2</b>

## 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 & CHEM 203 & CHEM 204 & CHEM 205	Accelerated Chemistry I and Accelerated Chemistry Lab I and Accelerated Chemistry II 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 or MATH 415	Linear Algebra with Computational Applications Applied Linear Algebra	3
MATH 285 or MATH 441	Intro Differential Equations Differential Equations	3
PHYS 211	University Physics: Mechanics	4
PHYS 212	University Physics: Elec & Mag	4
PHYS 214	Univ Physics: Quantum Physics	2
<b>Total Hours</b>		<b>37-39</b>

### 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 or IE 300 or STAT 400	Probability and Statistics for ChBE Analysis of Data Statistics and Probability I	3-4
<b>Total Hours</b>		<b>49-50</b>

### Biomolecular Engineering Concentration Technical Core

Code	Title	Hours
MCB 450	Introductory Biochemistry	3
<b>Total Hours for Chemical Engineering with Biomolecular Concentration Technical Core</b>		<b>52-53</b>

### Biomolecular Engineering Concentration 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 major and biomolecular engineering concentration.

Code	Title	Hours
<b>Select 18 hours from Category A, Category B, List 1 and List 2, with specific requirements listed below.</b>		
Three Courses from Category A		9
Two Additional Courses from Category A or Category B		6
One additional 400-level course from List 1 or List 2		3

Note: A maximum of 9 hours of UG research credit in CHBE 497 or CHBE 499 may be applied to the total 18 hours of technical elective credit with only 3 of those hours allowed use for Category A requirements. Consult with your advisor to make sure that your research contains sufficient biomolecular content to count as Category A credit.

<b>Total Hours for Biomolecular Engineering Concentration Technical Electives</b>	<b>18</b>
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#### CATEGORY A

CHBE 471	Biochemical Engineering
CHBE 472	Techniques in Biomolecular Eng
CHBE 473	Biomolecular Engineering
CHBE 474	Metabolic Engineering
CHBE 475	Tissue Engineering
CHBE 476	Biotransport
CHBE 478	Bioenergy Technology
CHBE 497	Individual Study for Seniors
CHBE 499	Senior Thesis

#### CATEGORY B

ABE 436	Renewable Energy Systems
ABE 483	Engineering Properties of Food Materials
ABE 488	Bioprocessing Biomass for Fuel
BIOE 476	Tissue Engineering
ECE 467	Biophotonics
ECE 480	Magnetic Resonance Imaging
MSE 470	Design and Use of Biomaterials
MSE 473	Biomolecular Materials Science
MSE 474	Biomaterials and Nanomedicine
TAM 461	Cellular Biomechanics

#### LIST 1

Any 400-level CHBE courses, excluding CHBE core courses CHBE 411, CHBE 421, CHBE 422, CHBE 424, CHBE 430, CHBE 431, & CHBE 440.

ABE 436	Renewable Energy Systems
ABE 483	Engineering Properties of Food Materials
ABE 488	Bioprocessing Biomass for Fuel

ATMS 420	Atmospheric Chemistry	MSE 480	Surfaces and Colloids
BIOE 476	Tissue Engineering	MSE 487	Materials for Nanotechnology
CEE 320	Construction Engineering	MSE 489	Matl Select for Sustainability
CEE 330	Environmental Engineering	NPRE 201	Energy Systems
CEE 350	Water Resources Engineering	NPRE 402	Nuclear Power Engineering
CEE 421	Construction Planning	NPRE 412	Nuclear Power Econ & Fuel Mgmt
CEE 422	Construction Cost Analysis	NPRE 441	Radiation Protection
CEE 437	Water Quality Engineering	NPRE 442	Radioactive Waste Management
CEE 440	Fate Cleanup Environ Pollutant	NPRE 457	Safety Anlys Nucl Reactor Syst
CEE 442	Environmental Engineering Principles, Physical	NPRE 461	Probabilistic Risk Assessment
CEE 443	Env Eng Principles, Chemical	NPRE 470	
CEE 450	Surface Hydrology	NPRE 475	
CEE 452	Hydraulic Analysis and Design	NPRE 480	Energy and Security
CHBE 297	Individual Study Sophomores	SE 411	Reliability Engineering
CHBE 397	Individual Study for Juniors	TAM 211	Statics
CS 357	Numerical Methods I	TAM 251	Introductory Solid Mechanics
CS 411	Database Systems	TAM 461	Cellular Biomechanics
CS 427	Software Engineering I		
CS 440	Artificial Intelligence	<b>LIST 2</b>	
CS 446	Machine Learning	ABE 425	Engrg Measurement Systems
CS 450	Numerical Analysis	ABE 430	Project Management
CS 498	Special Topics	ABE 497	Independent Study
ECE 304	Photonic Devices	ABE 498	Special Topics
ECE 313	Probability with Engrg Applic	ANSC 445	Statistical Methods
ECE 333	Green Electric Energy	ANSC 450	Comparative Immunobiology
ECE 380	Biomedical Imaging	ATMS 421	Earth Systems Modeling
ECE 416	Biosensors	BADM 461	Tech, Eng, & Mgt Final Project
ECE 444	IC Device Theory & Fabrication	BIOC 446	Physical Biochemistry
ECE 481	Nanotechnology	CEE 407	Airport Design
ECE 490	Introduction to Optimization	CEE 497	Independent Study
ME 400	Energy Conversion Systems	CEE 498	Special Topics
ME 471	Finite Element Analysis	CHEM 436	Fundamental Organic Chem II
ME 482	Musculoskel Tissue Mechanics	CHEM 437	Organic Chemistry Lab
ME 483	Mechanobiology	CHEM 444	Physical Chemistry II
ME 487	MEMS-NEMS Theory & Fabrication	CHEM 445	Physical Principles Lab I
MSE 304	Electronic Properties of Matls	CHEM 483	Solid State Structural Anlys
MSE 307	Materials Laboratory I	CHEM 497	Individual Study Senior
MSE 308	Materials Laboratory II	CPSC 414	Forage Crops & Pasture Ecology
MSE 401	Thermodynamics of Materials	CPSC 415	Bioenergy Crops
MSE 402	Kinetic Processes in Materials	CPSC 418	Crop Growth and Management
MSE 403	Synthesis of Materials	CPSC 419	Midwest Agricultural Practices
MSE 406	Thermal-Mech Behavior of Matls	CPSC 453	Principles of Plant Breeding
MSE 420	Ceramic Materials & Properties	FSHN 414	Food Chemistry
MSE 441	Metals Processing	FSHN 418	Food Analysis
MSE 450	Polymer Science & Engineering	FSHN 426	Biochemical Nutrition I
MSE 457	Polymer Chemistry	FSHN 428	Community Nutrition
MSE 458	Polymer Physics	FSHN 460	Food Processing Engineering
MSE 460	Electronic Materials I	FSHN 465	Principles of Food Technology
MSE 470	Design and Use of Biomaterials	FSHN 471	Food & Industrial Microbiology
MSE 473	Biomolecular Materials Science	FSHN 480	Basic Toxicology
MSE 474	Biomaterials and Nanomedicine	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	Second Semester	Hours
ENG 100	1	CHBE 121	1
CHEM 202	3	CHEM 204	3
CHEM 203	2	CHEM 205	2
MATH 221 or 220	4	MATH 231	3
General Education course (choose Humanities Course with Cultural Studies designation)	3	PHYS 211	4
Composition I or General Education course (choose a Social & Behavioral Sciences course) or Composition I	4		
		17	16
Second Year			
First Semester	Hours	Second Semester	Hours
CHBE 221	3	CHBE 321	4
MATH 241	4	MATH 285 or 441	3
PHYS 212	4	PHYS 214	2
CHEM 236	4	MATH 257 or 415	3
CHEM 237	2	CS 101	3
		17	15
Third Year			
First Semester	Hours	Second Semester	Hours
CHBE 421	4	CHBE 422	4
CHBE 411, IE 300, or STAT 400	3	CHBE 424	3
CHEM 315	2	Technical Elective (400-level, List 1 or List 2)	3
CHEM 420	2	MCB 450	3
CHEM 442	4	Language Other Than English (3rd level)	4
		15	17
Fourth Year			
First Semester	Hours	Second Semester	Hours
CHBE 430	4	CHBE 431	4
CHBE 440	3	Technical Elective Course (Category A)	3
Technical Elective course (Category A)	3	Technical Elective course (Category A or Category B)	3
Technical Elective course (Category A)	3	Technical Elective course (Category A or Category B)	3

General Education course (choose a Humanities course with Cultural Studies designation)	3 General Education course (choose a Social & Behavioral Science Course with Cultural Studies designation)	3
	<b>16</b>	<b>16</b>
<b>Total Hours 129</b>		

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Upon completing this program, students are expected to be able 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.
8. An ability to analyze the chemistry and metabolism of macromolecules in biological processes and their relation to the regulation and processes of organisms, cells, and subcellular components.

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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/academic-units/>)