

# BACHELOR OF SCIENCE IN CHEMICAL ENGINEERING (BSCHE) DEGREE

The program leading to the Bachelor of Science in Chemical Engineering (BScHE) is accredited by the Engineering Accreditation Commission of ABET, <https://www.abet.org>, under the General Criteria and the Chemical, Biochemical, Biomolecular and Similarly Named Engineering Criteria.

## Program Learning Outcomes (Student Outcomes) for the BScHE Degree

Upon completing the BScHE degree, students will be able to demonstrate:

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.

## Program Educational Objectives for the BScHE Degree

Within 3 to 5 years of graduation, graduates with a Bachelor of Science in Chemical Engineering (BScHE) degree are expected to be:

1. Graduate students, professionals, and entrepreneurs who are moving towards leadership positions as exemplary members of the global workforce; and
2. Professionals who practice their societal, environmental, and ethical responsibilities.

## Requirements for the BScHE Degree

For general university requirements, see [Graduation Requirements \(https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/\)](https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/). Students pursuing the BScHE degree must complete:

- A minimum of 95 credit hours to satisfy major requirements.
- A minimum of 127 credit hours to satisfy degree requirements.
- A minimum of 16 courses (48 credit hours) taken at the 300-level or above.

- The requirements for one area of specialization (see below for areas of specialization). When students declare the major (<https://ga.rice.edu/undergraduate-students/academic-opportunities/majors-minors-certificates/#text>) in Chemical Engineering (associated with the BScHE degree), students must additionally identify and declare one of five areas of specialization, either in:
  - **Biomolecular Engineering** (p. 2), **or**
  - **Computational Engineering** (p. 3), **or**
  - **Energy/Sustainability** (p. 3), **or**
  - **Materials/Nanotechnology** (p. 3), **or**
  - **Engineering Breadth** (p. 4) (Engineering Breadth is an area of specialization comprised of electives from a mix of engineering disciplines).

Because of the common core requirements, it is possible for students to change their area of specialization at any time, even after initially declaring the major. To do so, please contact the [Office of the Registrar \(registrar@rice.edu\)](mailto:registrar@rice.edu).

The courses listed below satisfy the requirements for this major. In certain instances, courses not on this official list may be substituted upon approval of the major's academic advisor, or where applicable, the department's Director of Undergraduate Studies. (Course substitutions must be formally applied and entered into Degree Works by the major's [Official Certifier \(https://registrar.rice.edu/facstaff/degreeworks/officialcertifier/\)](https://registrar.rice.edu/facstaff/degreeworks/officialcertifier/).) Students and their academic advisors should identify and clearly document the courses to be taken.

### Summary

Code	Title	Credit Hours
Total Credit Hours Required for the Major in Chemical Engineering		95
Total Credit Hours Required for the BScHE Degree		127

### Degree Requirements

Code	Title	Credit Hours
<b>Core Requirements</b>		
Chemistry		
CHEM 121 or CHEM 111	GENERAL CHEMISTRY I AP/OTH CREDIT IN GENERAL CHEMISTRY I	3
CHEM 123 or CHEM 113	GENERAL CHEMISTRY LABORATORY I AP/OTH CREDIT IN GENERAL CHEMISTRY LAB I	1
CHEM 122 or CHEM 112	GENERAL CHEMISTRY II AP/OTH CREDIT IN GENERAL CHEMISTRY II	3
CHEM 124 or CHEM 114	GENERAL CHEMISTRY LABORATORY II AP/OTH CREDIT IN GENERAL CHEMISTRY LAB II	1
CHEM 211 & CHEM 213	ORGANIC CHEMISTRY I and ORGANIC CHEMISTRY DISCUSSION I	3
CHEM 301	PHYSICAL CHEMISTRY I	3
Mathematics and Computational Applied Mathematics and Operations Research		
MATH 101 or MATH 105	SINGLE VARIABLE CALCULUS I AP/OTH CREDIT IN CALCULUS I	3
MATH 102 or MATH 106	SINGLE VARIABLE CALCULUS II AP/OTH CREDIT IN CALCULUS II	3

MATH 211	ORDINARY DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA	3
MATH 212	MULTIVARIABLE CALCULUS <sup>1</sup>	3
CMOR 220	INTRODUCTION TO ENGINEERING COMPUTATION	3
Physics		
Select 1 from the following: <sup>2</sup>		4
PHYS 101 & PHYS 103	MECHANICS (WITH LAB) and MECHANICS DISCUSSION	
PHYS 111	HONORS MECHANICS (WITH LAB)	
Select 1 from the following: <sup>3</sup>		4
PHYS 102 & PHYS 104	ELECTRICITY & MAGNETISM (WITH LAB) and ELECTRICITY AND MAGNETISM DISCUSSION	
PHYS 112	HONORS ELECTRICITY & MAGNETISM (WITH LAB)	
Chemical and Biomolecular Engineering Core Courses		
CHBE 243	CHEMICAL ENGINEERING LAB I	2
CHBE 301	CHEMICAL ENGINEERING FUNDAMENTALS	3
CHBE 305	APPLIED MATHEMATICS AND NUMERICAL METHODS FOR CHEMICAL ENGINEERS II	3
CHBE 310	FUNDAMENTALS OF BIOMOLECULAR ENGINEERING	3
CHBE 344	CHEMICAL ENGINEERING LAB II	2
CHBE 350	PROCESS SAFETY IN CHEMICAL ENGINEERING	1
CHBE 390	CHEMICAL KINETICS AND REACTOR DESIGN	3
CHBE 401	TRANSPORT PHENOMENA I	3
CHBE 402	TRANSPORT PHENOMENA II	3
CHBE 403	DESIGN FUNDAMENTALS	4
CHBE 404	CHEMICAL ENGINEERING DESIGN	4
CHBE 410	APPLIED BIOMOLECULAR ENGINEERING	3
CHBE 411	THERMODYNAMICS I	3
CHBE 412	THERMODYNAMICS II	3
CHBE 443	CHEMICAL ENGINEERING LAB III	3
CHBE 470	PROCESS DYNAMICS AND CONTROL	3

**Area of Specialization**

Select 1 from the following Areas of Specialization (see Areas of Specialization below): 12

Biomolecular Engineering	
Computational Engineering	
Energy/Sustainability	
Materials/Nanotechnology	
Engineering Breadth	

**Total Credit Hours Required for the Major in Chemical Engineering** 95

Additional Credit Hours to Complete Degree Requirements \* 1

University Graduation Requirements (<https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/>) \* 31

**Total Credit Hours** 127

**Footnotes and Additional Information**

\* **Note:** University Graduation Requirements include 31 credit hours, comprised of Distribution Requirements (Groups I, II, and III), FWIS, and LPAP coursework. In some instances, courses satisfying FWIS or distribution requirements may additionally meet other requirements, such as the Analyzing Diversity (AD) requirement, or some of the student's declared major, minor, or certificate requirements. **Additional Credit Hours to Complete Degree Requirements** include general electives, coursework completed as upper-level, residency (hours taken at Rice), and/or any other additional academic program requirements.

<sup>1</sup> MATH 221 and MATH 222 may substitute for MATH 212.

<sup>2</sup> The Chemical and Biomolecular Engineering department has determined that credit awarded for PHYS 141 *CONCEPTS IN PHYSICS I* is not eligible for meeting the requirements of the Chemical Engineering major.

<sup>3</sup> The Chemical and Biomolecular Engineering department has determined that credit awarded for PHYS 142 *CONCEPTS IN PHYSICS II* is not eligible for meeting the requirements of the Chemical Engineering major.

**Areas of Specialization**

Students must complete the requirements as listed for one of the following areas of specialization for the BChE degree program. A minimum of 4 courses (minimum of 12 credit hours) must be taken from one of the areas of specialization as listed below.

**Please Note:** The following list of approved courses can be used to satisfy the requirements of the area of specialization. Courses not on the list may be taken upon approval of the academic advisor. Students and their academic advisors should identify and clearly document the courses to be taken.

**Area of Specialization: Biomolecular Engineering**

To fulfill the BChE degree requirements, students pursuing the Biomolecular area of specialization must complete:

- 1 course (3 credit hours) from the area of specialization Core Requirement
- 3 courses (9 credit hours) from the area of specialization Elective Requirements

Code	Title	Credit Hours
------	-------	--------------

**Core Requirement**

CHBE 415	SEPARATION TECHNOLOGIES FOR CHEMICAL AND BIOMOLECULAR PROCESSES	3
----------	---	---

**Elective Requirements**

Select 3 courses from the following: 9

BIOS 201	INTRODUCTORY BIOLOGY I	
BIOS 301	BIOCHEMISTRY I	
BIOE 321	CELLULAR ENGINEERING	
BIOE 330	BIOREACTION ENGINEERING	
BIOE 370	BIOMATERIALS	

BIOE 372	BIOMECHANICS	
BIOE 420 / CHBE 420	TRANSPORT PHENOMENA IN BIOENGINEERING	
BIOE 422	GENE THERAPY	
BIOE 464	EXTRACELLULAR MATRIX	
BIOE 508 / SSPB 503	SYNTHETIC BIOLOGY	
BIOE 620 / CHBE 620	TISSUE ENGINEERING	
<b>Total Credit Hours</b>		<b>12</b>

**Area of Specialization: Computational Engineering**

To fulfill the BScHE degree requirements, students pursuing the Computational Engineering area of specialization must complete:

- 1 course (3 credit hours) from the area of specialization Core Requirement
- 3 courses (9 credit hours) from the area of specialization Elective Requirements

Code	Title	Credit Hours
<b>Core Requirement</b>		
CHBE 415	SEPARATION TECHNOLOGIES FOR CHEMICAL AND BIOMOLECULAR PROCESSES	3
<b>Elective Requirements</b>		
<i>Select 3 courses from the following:</i>		
CMOR 302	MATRIX ANALYSIS	
CMOR 360	INTRODUCTION TO OPERATIONS RESEARCH AND OPTIMIZATION	
CMOR 410	MODELING MATHEMATICAL PHYSICS	
CMOR 415 / ELEC 488 / NEUR 415	THEORETICAL NEUROSCIENCE: FROM CELLS TO LEARNING SYSTEMS	
CMOR 416 / ELEC 489 / NEUR 416	NEURAL COMPUTATION	
CMOR 430	ITERATIVE METHODS FOR SYSTEMS OF EQUATIONS AND UNCONSTRAINED OPTIMIZATION	
CMOR 435 / MATH 435	DYNAMICAL SYSTEMS	
CMOR 441	LINEAR AND INTEGER PROGRAMMING	
CMOR 518	APPLICATIONS IN COMPUTATIONAL MATHEMATICS	
<b>Total Credit Hours</b>		<b>12</b>

**Area of Specialization: Energy/Sustainability**

To fulfill the BScHE degree requirements, students pursuing the Energy/Sustainability area of specialization must complete:

- 1 course (3 credit hours) from the Core Requirement
- 3 courses (9 credit hours) from the area of specialization Elective Requirements

Code	Title	Credit Hours
<b>Core Requirement</b>		
CHBE 415	SEPARATION TECHNOLOGIES FOR CHEMICAL AND BIOMOLECULAR PROCESSES	3
<b>Elective Requirements</b>		
<i>Select 3 courses from the following:</i>		
CEVE 302 / ENGI 302	SUSTAINABLE DESIGN	
CEVE 307 / ENST 307 / EEPS 307	ENERGY AND THE ENVIRONMENT	
CEVE 310	PRINCIPLES OF ENVIRONMENTAL ENGINEERING	
CEVE 314 / BIOE 365 / GLHT 314	SUSTAINABLE WATER PURIFICATION FOR THE DEVELOPING WORLD	
CEVE 401	CHEMISTRY FOR ENVIRONMENTAL ENGINEERING AND SCIENCE	
CEVE 434	FATE AND TRANSPORT OF CONTAMINANTS IN THE ENVIRONMENT	
CEVE 484 / STAT 484	ENVIRONMENTAL RISK ASSESSMENT & HUMAN HEALTH	
CEVE 518	ENVIRONMENTAL HYDROGEOLOGY	
CEVE 535	PHYSICAL CHEMICAL PROCESSES FOR WATER QUALITY CONTROL	
CHBE 405	TECHNOECONOMIC ANALYSIS AND ENGINEERING DECISION TOOLS	
CHBE 468	INDUSTRIAL CHEMICAL PROCESSES AND THE ENERGY TRANSITION	
CHBE 570	INDUSTRIAL CATALYSIS AND PETROCHEMICAL PROCESSES	
EEPS 448	EXPLORATION GEOPHYSICS	
EEPS 465	ROCK DEFORMATION AND RHEOLOGY	
EEPS 484	DECISION MAKING AND ECONOMICS IN THE ENERGY INDUSTRY	
EEPS 486	PETROLEUM INDUSTRY ECONOMICS AND MANAGEMENT	
<b>Total Credit Hours</b>		<b>12</b>

**Area of Specialization: Materials/Nanotechnology**

To fulfill the BScHE degree requirements, students pursuing the Materials/Nanotechnology area of specialization must complete:

- 1 course (3 credit hours) from the area of specialization Core Requirement
- 3 courses (9 credit hours) from the area of specialization Elective Requirements

Code	Title	Credit Hours
<b>Core Requirement</b>		
CHBE 415	SEPARATION TECHNOLOGIES FOR CHEMICAL AND BIOMOLECULAR PROCESSES	3
<b>Elective Requirements</b>		

Select 3 courses from the following: 9

BIOE 431	BIOMATERIALS APPLICATIONS
CHBE 594 / MSNE 594	PROPERTIES OF POLYMERS
MSNE 211	INTRODUCTION TO MATERIALS SCIENCE FOR ENGINEERS
MSNE 302	MATERIALS PROCESSING AND NANOMANUFACTURING
MSNE 401	THERMODYNAMICS IN MATERIALS SCIENCE
MSNE 402	MECH PROPERTIES OF MATERIALS
MSNE 406	PHYSICAL PROPERTIES OF SOLIDS
MSNE 411	MATERIALS CHARACTERIZATION FROM NANO TO MACRO
MSNE 415	CERAMICS AND GLASSES
MSNE 433	COMPUTATIONAL MATERIALS MODELING
MSNE 435	CRYSTALLOGRAPHY & DIFFRACTION
MSNE 523	PROPERTIES, SYNTHESIS AND DESIGN OF COMPOSITE MATERIALS

**Total Credit Hours** 12

### Area of Specialization: Engineering Breadth

To fulfill the BChE degree requirements, students pursuing the Engineering Breadth area of specialization must complete:

- 1 course (3 credit hours) from the area of specialization Core Requirement
- 3 courses (9 credit hours) from the area of specialization Elective Requirements

Code	Title	Credit Hours
------	-------	--------------

#### Core Requirement

CHBE 415	SEPARATION TECHNOLOGIES FOR CHEMICAL AND BIOMOLECULAR PROCESSES	3
----------	---	---

#### Elective Requirements

Select 3 courses from at least 3 categories below: <sup>1</sup> 9

##### Basic Science

BIOS 201	INTRODUCTORY BIOLOGY I
CHEM 330	ANALYTICAL CHEMISTRY
CHEM 360	INORGANIC CHEMISTRY
EEPS 334	THE EARTH LABORATORY
EEPS 340	GLOBAL BIOGEOCHEMICAL CYCLES
PHYS 202	MODERN PHYSICS

##### Environmental Engineering Courses

CEVE 310	PRINCIPLES OF ENVIRONMENTAL ENGINEERING
CEVE 311 / MECH 311	MECHANICS OF SOLIDS AND STRUCTURES
CEVE 434	FATE AND TRANSPORT OF CONTAMINANTS IN THE ENVIRONMENT

##### Materials Science Engineering Courses

MSNE 211	INTRODUCTION TO MATERIALS SCIENCE FOR ENGINEERS
MSNE 402	MECH PROPERTIES OF MATERIALS
MSNE 406	PHYSICAL PROPERTIES OF SOLIDS
MSNE 594 / CHBE 594	PROPERTIES OF POLYMERS

##### Bioengineering Courses

BIOE 370	BIOMATERIALS
BIOE 372	BIOMECHANICS
BIOE 420 / CHBE 420	TRANSPORT PHENOMENA IN BIOENGINEERING
CHBE 640	METABOLIC ENGINEERING

##### Sustainability and Energy Courses

CEVE 302 / ENGI 302	SUSTAINABLE DESIGN
CEVE 307 / ENST 307 / EEPS 307	ENERGY AND THE ENVIRONMENT
CHBE 450	PETROLEUM PHASE BEHAVIOR AND FLOW ASSURANCE

##### Computational Applied Mathematics and Operations Research Course

CMOR 302	MATRIX ANALYSIS
----------	-----------------

##### Other Approved Engineering Course(s)

ELEC 261	INTRODUCTION TO PHYSICAL ELECTRONICS I
----------	--

**Total Credit Hours** 12

### Footnotes and Additional Information

<sup>1</sup> A maximum of 3 credit hours for CHBE 495, CHBE 498, or CHBE 499 may replace 3 credit hours of any of the discipline electives above, but not the Core Requirement.

## Policies for the BChE Degree

### Program Restrictions and Exclusions

Students pursuing the BChE degree should be aware of the following program restriction:

- As noted in *Majors, Minors, and Certificates* (<https://ga.rice.edu/undergraduate-students/academic-opportunities/majors-minors-certificates/>), under *Declaring Majors, Minors and Certificates*, students may not obtain both a BA and a BS in the same major. Students pursuing the Bachelor of Science in Chemical Engineering (BChE) Degree may not additionally pursue the BA Degree with a Major in Chemical Engineering.

### Transfer Credit

For Rice University's policy regarding transfer credit, see [Transfer Credit \(https://ga.rice.edu/undergraduate-students/academic-policies-procedures/transfer-credit/\)](https://ga.rice.edu/undergraduate-students/academic-policies-procedures/transfer-credit/). Some departments and programs have additional restrictions on transfer credit. Requests for transfer credit must be approved for Rice equivalency by the designated transfer credit advisor for the appropriate academic department offering the Rice equivalent course (corresponding to the subject code of the course content). The Office of Academic Advising maintains the university's official list of [transfer credit advisors \(https://oaa.rice.edu/advising-network/transfer-credit-advisors/\)](https://oaa.rice.edu/advising-network/transfer-credit-advisors/) on their website: <https://oaa.rice.edu>. Students are encouraged to meet with the applicable transfer credit

advisor as well as their academic program director when considering transfer credit possibilities.

### Additional Information

For additional information, please see the Chemical and Biomolecular Engineering website: <https://chbe.rice.edu/>.

## Opportunities for the BSChE Degree

### Academic Honors

The university recognizes academic excellence achieved over an undergraduate's academic history at Rice. For information on university honors, please see [Latin Honors \(https://ga.rice.edu/undergraduate-students/honors-distinctions/university/\)](https://ga.rice.edu/undergraduate-students/honors-distinctions/university/) (*summa cum laude*, *magna cum laude*, and *cum laude*) and [Distinction in Research and Creative Work \(https://ga.rice.edu/undergraduate-students/honors-distinctions/university/\)](https://ga.rice.edu/undergraduate-students/honors-distinctions/university/). Some departments have department-specific Honors awards or designations.

### Fifth-Year Master's Degree Option for Rice Undergraduate Students

In certain situations and with some terminal master's degree programs, Rice students have an option to pursue a master's degree by adding an additional fifth year to their four years of undergraduate studies.

Advanced Rice undergraduate students in good academic standing typically apply to the master's degree program during their junior or senior year. Upon acceptance, depending on course load, financial aid status, and other variables, they may then start taking some required courses of the master's degree program. A plan of study will need to be approved by the student's undergraduate major advisor and the master's degree program director.

As part of this option and opportunity, Rice undergraduate students:

- must complete the requirements for a bachelor's degree and the master's degree independently of each other (i.e. no course may be counted toward the fulfillment of both degrees).
- should be aware there could be financial aid implications if the conversion of undergraduate coursework to that of graduate level reduces their earned undergraduate credit for any semester below that of full-time status (12 credit hours).
- more information on this *Undergraduate - Graduate Concurrent Enrollment* opportunity, including specific information on the registration process can be found [here \(https://ga.rice.edu/undergraduate-students/academic-opportunities/undergraduate-graduate-concurrent-enrollment/\)](https://ga.rice.edu/undergraduate-students/academic-opportunities/undergraduate-graduate-concurrent-enrollment/).

Rice undergraduate students completing studies in science and engineering may have the option to pursue the Master of Chemical Engineering (MChE) degree. For additional information, students should contact their undergraduate major advisor and the MChE chair of the department graduate studies committee.

### Additional Information

For additional information, please see the Chemical and Biomolecular Engineering website: <https://chbe.rice.edu/>.