

# BACHELOR OF SCIENCE (BS) DEGREE WITH A MAJOR IN CHEMISTRY

## Program Learning Outcomes for the BS Degree with a Major in Chemistry

Upon completing the BS degree with a major in Chemistry, students will be able to:

1. Demonstrate understanding of and proficiency with: the structure, bonding, spectroscopy, and reactivity of organic compounds and functional groups; curved-arrow formalism to describe reaction mechanisms; and the synthesis of organic compounds.
2. Demonstrate understanding of and proficiency with: thermochemical principles, acid-base and redox reactions; structure of simple solids and construction of molecular orbital diagrams (group theory); and survey of main group chemistry.
3. Demonstrate understanding of: the principles of quantum mechanics and applications to atomic and molecular structure and spectroscopy; classical and basic statistical thermodynamics and applications to equilibrium physico-chemical systems; and kinetics of gas phase processes and chemical reactions.
4. Understand and apply the scientific method and research skills, and be able to communicate scientific findings.
5. Design, conduct, record, and analyze chemical experiments, while practicing responsible and ethical scientific conduct.

## Requirements for the BS Degree with a Major in Chemistry

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 BS degree with a major in Chemistry must complete:

- A minimum of 24-28 courses, depending on course selection, (69 credit hours) to satisfy major requirements.
- A minimum of 120 credit hours to satisfy degree requirements.
- A minimum of 14-16 courses, depending on course selection, (39 credit hours) at the 300-level or above.
- The requirements for one area of specialization (see below for areas of specialization). The BS degree with a major in Chemistry offers four areas of specialization:
  - [Biological and Medicinal Chemistry](#) (p. 2), **or**
  - [Inorganic Chemistry and Inorganic Materials](#) (p. 2), **or**
  - [Organic Chemistry](#) (p. 3), **or**
  - [Physical and Theoretical Chemistry](#) (p. 3).

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/>)). 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 Chemistry		69
Total Credit Hours Required for the BS Degree with a Major in Chemistry		120

## Degree Requirements

Code	Title	Credit Hours
<b>Core Requirements</b>		
General Chemistry <sup>1</sup>		
CHEM 121 & CHEM 123	GENERAL CHEMISTRY I and GENERAL CHEMISTRY LABORATORY I	4
Select 1 from the following:		4
CHEM 122 & CHEM 124	GENERAL CHEMISTRY II and GENERAL CHEMISTRY LABORATORY II	
CHEM 201 & CHEM 205	ADVANCED TOPICS IN GENERAL CHEMISTRY and ADVANCED TOPICS IN GENERAL CHEMISTRY LABORATORY	
Chemistry Foundation Courses		
BIOS 301	BIOCHEMISTRY I <sup>2</sup>	3
Select 1 from the following:		3
CHEM 211 & CHEM 213	ORGANIC CHEMISTRY I and ORGANIC CHEMISTRY DISCUSSION I	
CHEM 219	ORGANIC CHEMISTRY I HONORS	
CHEM 301	PHYSICAL CHEMISTRY I	3
CHEM 302	PHYSICAL CHEMISTRY II	3
CHEM 330	ANALYTICAL CHEMISTRY	3
CHEM 360	INORGANIC CHEMISTRY	3
Mathematics <sup>3</sup>		
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 212	MULTIVARIABLE CALCULUS <sup>4</sup>	3
Physics		
Select 1 from the following: <sup>5</sup>		4
PHYS 101 & PHYS 103	MECHANICS (WITH LAB) and MECHANICS DISCUSSION	
PHYS 111	HONORS MECHANICS (WITH LAB)	
PHYS 125	GENERAL PHYSICS (WITH LAB)	
Select 1 from the following: <sup>6</sup>		4
PHYS 102 & PHYS 104	ELECTRICITY & MAGNETISM (WITH LAB) and ELECTRICITY AND MAGNETISM DISCUSSION	
PHYS 112	HONORS ELECTRICITY & MAGNETISM (WITH LAB)	
PHYS 126	GENERAL PHYSICS II (WITH LAB)	
Advanced Laboratories		
Select 3 courses from the following:		6
BIOS 311	EXPERIMENTAL BIOCHEMISTRY	
CHEM 365	ORGANIC CHEMISTRY LAB	

CHEM 366	INORGANIC CHEMISTRY LAB	
CHEM 367	MATERIALS CHEMISTRY LAB	
CHEM 368	CHEMICAL MEASUREMENT LAB	
Research		
Select 8 credit hours from the following:		8
CHEM 391	RESEARCH FOR UNDERGRADUATES <sup>7</sup>	
CHEM 491	RESEARCH FOR UNDERGRADUATES <sup>7</sup>	
CHEM 492	UNDERGRADUATE HONORS RESEARCH <sup>7</sup>	
CHEM 493	UNDERGRADUATE HONORS RESEARCH <sup>7</sup>	
CHEM 700	TEACHING PRACTICUM <sup>8</sup>	
<b>Area of Specialization</b>		
Select 1 from the following Areas of Specialization (see Areas of Specialization below):		12
Biological and Medicinal Chemistry		
Inorganic Chemistry and Inorganic Materials		
Organic Chemistry		
Physical and Theoretical Chemistry		
<b>Total Credit Hours Required for the Major in Chemistry</b>		<b>69</b>
Additional Credit Hours to Complete Degree Requirements *		20
University Graduation Requirements ( <a href="https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/">https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/</a> ) *		31
<b>Total Credit Hours</b>		<b>120</b>

### 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> CHEM 111 may be substituted for CHEM 121; CHEM 113 may be substituted for CHEM 123; CHEM 112 may be substituted for CHEM 122; CHEM 114 may be substituted for CHEM 124.

<sup>2</sup> Chemistry students may enroll in BIOS 301 without the prerequisite BIOS 201. Requests to waive the prerequisite course are approved by the course instructor. Students should contact the course instructor for more information.

<sup>3</sup> Though not required, MATH 211 **is strongly recommended** for students planning to specialize in Physical and Theoretical chemistry or planning to pursue graduate studies. Additionally, the Department of Mathematics may, after consultation with students concerning their previous math preparation, recommend that a student be placed into a higher level math course than that for which the student has received official credit. The Department of Chemistry will accept this substitution of the math classes upon a written confirmation of the substitution from the Department of Mathematics and upon the student's successful completion of the higher level math course.

<sup>4</sup> MATH 221 and MATH 222 may substitute for MATH 212.

<sup>5</sup> The Chemistry department has determined that credit awarded for PHYS 141 *CONCEPTS IN PHYSICS I* is not eligible for meeting the requirements of the Chemistry major.

<sup>6</sup> The Chemistry department has determined that credit awarded for PHYS 142 *CONCEPTS IN PHYSICS II* is not eligible for meeting the requirements of the Chemistry major.

<sup>7</sup> Enrollment in each of these courses requires permission of the course instructor. *Students are expected to complete CHEM 391 before the end of their junior year; permission will not normally be granted for students in their final year of undergraduate study.*

<sup>8</sup> If CHEM 700 is selected as a Research course, it may only be taken for up to 2 credit hours.

## Areas of Specialization

To fulfill the remaining Chemistry major requirements, students must complete advanced work that satisfies the requirements of one area of specialization as listed below. A student may, working with their chemistry major advisor and with the approval of the Director of the Undergraduate Program, propose a course of study in another specialization. Such proposed areas of specialization must have course and laboratory experiences comparable to those of the areas of specialization listed below.

Additionally, a double specialization can be earned by completing the requirements for two specialties. For double specialization, only two advanced lecture courses may count towards both specializations. The remaining two advanced courses in each specialization must be unique (i.e., double specialization requires six advanced lecture courses, and triple specialization require eight). A NanoChemistry specialization can be added to any of the standard areas of specialization by adding two nanoscience courses.

### Area of Specialization: Biological and Medicinal Chemistry

Students must complete a minimum of 4 courses (12 credit hours) as listed below to satisfy the requirements for the area of specialization in Biological and Medicinal Chemistry.

Code	Title	Credit Hours
Select 1 from the following:		3
CHEM 313 & CHEM 314	ORGANIC CHEMISTRY II and ORGANIC CHEMISTRY DISCUSSION II	
CHEM 320	ORGANIC CHEMISTRY II HONORS	
BIOS 302	BIOCHEMISTRY II	3
<b>Advanced Coursework in Chemistry</b>		
Select 2 courses from the following: <sup>1</sup>		6
Any lecture course between CHEM 400 and CHEM 489		
Any lecture course between CHEM 495 and CHEM 699		
<b>Total Credit Hours</b>		<b>12</b>

### Area of Specialization: Inorganic Chemistry and Inorganic Materials

Students must complete a minimum of 4 courses (12 credit hours) as listed below to satisfy the requirements for the area of specialization in Inorganic Chemistry and Inorganic Materials.

Code	Title	Credit Hours
CHEM 475	PHYSICAL METHODS IN INORGANIC CHEMISTRY	3
CHEM 495 or CHEM 496	TRANSITION METAL CHEMISTRY or ADVANCED INORGANIC CHEMISTRY	3
<b>Advanced Coursework in Chemistry</b>		

Select 2 courses from the following: <sup>1</sup>		6
Any lecture course between CHEM 400 and CHEM 489		
Any lecture course between CHEM 495 and CHEM 699		
<b>Total Credit Hours</b>		<b>12</b>

### Area of Specialization: Organic Chemistry

Students must complete a minimum of 4 courses (12 credit hours) as listed below to satisfy the requirements for the area of specialization in Organic Chemistry.

Code	Title	Credit Hours
Select 1 from the following:		3
CHEM 313 & CHEM 314	ORGANIC CHEMISTRY II and ORGANIC CHEMISTRY DISCUSSION II	
CHEM 320	ORGANIC CHEMISTRY II HONORS	
CHEM 401	ADVANCED ORGANIC CHEMISTRY	3
<b>Advanced Coursework in Chemistry</b>		
Select 2 courses from the following: <sup>1</sup>		6
BIOS 302	BIOCHEMISTRY II	
Any lecture course between CHEM 400 and CHEM 489		
Any lecture course between CHEM 495 and CHEM 699		
<b>Total Credit Hours</b>		<b>12</b>

### Area of Specialization: Physical and Theoretical Chemistry

Students must complete a minimum of 4 courses (12 credit hours) as listed below to satisfy the requirements for the area of specialization in Physical and Theoretical Chemistry.

Code	Title	Credit Hours
CHEM 420	CLASSICAL AND STATISTICAL THERMODYNAMICS	3
CHEM 430	QUANTUM CHEMISTRY	3
Select 1 course from the following:		3
CHEM 415	CHEMICAL KINETICS AND DYNAMICS	
CHEM 531	ADVANCED QUANTUM CHEMISTRY	
CHEM 559	SPECTROSCOPY AT THE SINGLE MOLECULE/PARTICLE LIMIT	
Select 1 course (for at least 3 credit hours) from MATH or PHYS course offerings at the 400-level or above		3
<b>Total Credit Hours</b>		<b>12</b>

### Footnotes and Additional Information

<sup>1</sup> For purposes of this requirement, "advanced coursework" includes chemistry lecture courses at the 400-level or higher (courses in Rice's course catalog that have a course type listed as "lecture"). CHEM 313 & CHEM 314, CHEM 320 or BIOS 302 count as "advanced coursework" for purposes of this requirement. Courses in other departments at the 400-level or higher with substantial chemistry content may count toward this requirement with approval of the Director of the Undergraduate Program.

## Policies for the BS Degree with a Major in Chemistry

### Program Restrictions and Exclusions

Students pursuing the BS Degree with a Major in Chemistry should be aware of the following program restriction:

- As noted in [Majors, Minors, and Certificates \(https://ga.rice.edu/undergraduate-students/academic-opportunities/majors-minors-certificates/\)](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 BS Degree with a Major in Chemistry may not additionally pursue the BA Degree with a Major in Chemistry.

### 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. The Office of Academic Advising maintains the university's official list of 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 their academic program's transfer credit advisor when considering transfer credit possibilities.

### Departmental Transfer Credit Guidelines

Students pursuing the major in Chemistry should be aware of the following departmental transfer credit guidelines:

- Requests for transfer credit will be considered by the program director (and/or the program's official transfer credit advisor) on an individual case-by-case basis. Please see the *Transfer Credit* tab on the [department website \(https://chemistry.rice.edu/transfer-credit/\)](https://chemistry.rice.edu/transfer-credit/) for more information.

### Additional Information

For additional information, please see the Chemistry website: <https://chemistry.rice.edu>

## Opportunities for the BS Degree with a Major in Chemistry

### 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.

### Honors Research Program in Chemistry

The Chemistry Honors Research Program is a suite of courses (CHEM 492/CHEM 493) offering the opportunity for a rigorous two-semester "capstone" individual research project in Chemistry. This immersive program is intended to give students a first-hand experience of a career in research. Students interested in graduate school are strongly encouraged to apply. Students having completed previous independent research (as CHEM 391 and/or CHEM 491) in an off-campus laboratory in the Texas Medical Center are eligible to apply to perform honors research in that laboratory. The honors research courses (CHEM 492

and CHEM 493) function as a pair and must all be taken in the same academic year. Registration for CHEM 492 requires a commitment to register for CHEM 493.

Students who complete the Chemistry Honors Research Program are given primary consideration for the Distinction in Research and Creative Work (<https://ga.rice.edu/undergraduate-students/honors-distinctions/university/>), a university honor for select undergraduates, carefully selected by the department and granted at commencement, which appears on the transcript and diploma.

#### **Chemistry Honors Research Program Components**

- CHEM 492: Fall semester, 5 credit hours. For approved students only, requires a formal application and recommendation of a faculty research advisor. Requirements include at least 15 hours of laboratory research per week and regular written and/or oral progress reports.
- CHEM 493: Spring semester, 5 credit hours. Requirements include at least 15 hours of laboratory research per week and a formal thesis.
- Applications may be submitted to the course instructor, February 1 – August 1. Students are encouraged to apply early.

#### **Additional Information**

For additional information, please see the Chemistry website: <https://chemistry.rice.edu>