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:
   a. the structure, bonding, spectroscopy, and reactivity of organic compounds and functional groups;
   b. curved-arrow formalism to describe reaction mechanisms, and
   c. the synthesis of organic compounds.
2. Demonstrate understanding of and proficiency with:
   a. thermochemical principles, acid-base and redox reactions,
   b. structure of simple solids and construction of molecular orbital diagrams (group theory), and
   c. survey of main group chemistry.
3. Demonstrate understanding of:
   a. the principles of quantum mechanics and applications to atomic and molecular structure and spectroscopy,
   b. classical and basic statistical thermodynamics and applications to equilibrium physico-chemical systems, and
   c. kinetics of gas phase processes and chemical reactions.
4. 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/). 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 129 credit hours to satisfy degree requirements.
- A minimum of 60 credit hours outside of major requirements.
- A minimum of 14-16 courses, depending on course selection, (41 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. 2), 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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td></td>
<td>Total Credit Hours Required for the Major in Chemistry</td>
<td>69</td>
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<td></td>
<td>Total Credit Hours Required for the BS Degree with a Major in Chemistry</td>
<td>129</td>
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Degree Requirements

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td></td>
<td>Core Requirements</td>
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<tr>
<td></td>
<td>General Chemistry 1</td>
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<tr>
<td>CHEM 151 &amp; CHEM 153</td>
<td>HONORS CHEMISTRY I and HONORS CHEMISTRY LABORATORY I</td>
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<td>CHEM 152 &amp; CHEM 154</td>
<td>HONORS CHEMISTRY II and HONORS CHEMISTRY LABORATORY II</td>
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<td>Chemistry Foundation Courses</td>
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<tr>
<td>BIOC 301</td>
<td>BIOCHEMISTRY I 2</td>
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<td>CHEM 211 &amp; CHEM 213</td>
<td>ORGANIC CHEMISTRY I and ORGANIC CHEMISTRY DISCUSSION</td>
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<td>CHEM 301</td>
<td>PHYSICAL CHEMISTRY I</td>
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<td>CHEM 302</td>
<td>PHYSICAL CHEMISTRY II</td>
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<td>CHEM 330</td>
<td>ANALYTICAL CHEMISTRY</td>
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<td>CHEM 360</td>
<td>INORGANIC CHEMISTRY</td>
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<td>Mathematics 3</td>
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<td>MATH 101</td>
<td>SINGLE VARIABLE CALCULUS I</td>
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<td>or MATH 105</td>
<td>AP/OTH CREDIT IN CALCULUS I</td>
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<td>MATH 102</td>
<td>SINGLE VARIABLE CALCULUS II</td>
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<td>or MATH 106</td>
<td>AP/OTH CREDIT IN CALCULUS II</td>
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<td>MATH 212</td>
<td>MULTIVARIABLE CALCULUS 4</td>
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<td>Physics</td>
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<td>PHYS 101 &amp; PHYS 103</td>
<td>MECHANICS (WITH LAB) and MECHANICS DISCUSSION</td>
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<td>PHYS 111</td>
<td>HONORS MECHANICS (WITH LAB)</td>
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<td>PHYS 125</td>
<td>GENERAL PHYSICS (WITH LAB)</td>
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<td>PHYS 102 &amp; PHYS 104</td>
<td>ELECTRICITY &amp; MAGNETISM (WITH LAB) and ELECTRICITY AND MAGNETISM DISCUSSION</td>
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<td>PHYS 112</td>
<td>HONORS ELECTRICITY &amp; MAGNETISM (WITH LAB)</td>
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<td>PHYS 126</td>
<td>GENERAL PHYSICS II (WITH LAB)</td>
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<td>Advanced Laboratories</td>
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<td>BIOC 311</td>
<td>ADVANCED EXPERIMENTAL BIOSCIENCES</td>
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<td>CHEM 365</td>
<td>ORGANIC CHEMISTRY LAB</td>
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<td>CHEM 366</td>
<td>INORGANIC CHEMISTRY LAB</td>
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<td>CHEM 367</td>
<td>MATERIALS CHEMISTRY LAB</td>
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<td>CHEM 368</td>
<td>CHEMICAL MEASUREMENT LAB</td>
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Research
CHEM 391 RESEARCH FOR UNDERGRADUATES 5 3
Select 5 credit hours from the following: 5
CHEM 491 RESEARCH FOR UNDERGRADUATES
CHEM 492 UNDERGRADUATE HONORS RESEARCH
CHEM 493 UNDERGRADUATE HONORS RESEARCH
CHEM 700 TEACHING PRACTICUM 6

Area of Specialization
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

Total Credit Hours Required for the Major in Chemistry 69

University Graduation Requirements (https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/) 60

Total Credit Hours 129

Footnotes and Additional Information
* Includes coursework completed as distribution credit, FWIS, LPAP, upper-level, residency (hours taken at Rice), 60 hours outside of the major (if applicable), and any additional academic program requirements. The "hours outside of the major" requirement may include all of the above university requirements.
1 CHEM 121 or CHEM 111 may be substituted for CHEM 151; CHEM 123 or CHEM 113 may be substituted for CHEM 153; CHEM 122 or CHEM 112 may be substituted for CHEM 152; CHEM 124 or CHEM 114 may be substituted for CHEM 154.
2 Chemistry students may enroll in BIOC 301 without the prerequisite BIOC 201. Requests to waive the prerequisite course are approved by the course instructor. Students should contact the course instructor for more information.
3 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 a student concerning his/her 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 waiver of the math classes upon a written confirmation of the waiver from the Department of Mathematics and upon the student's successful completion of the higher level math course.
4 MATH 221 and MATH 222 may substitute for MATH 212.
5 CHEM 391 must be taken as part of the Research requirement and for at least 3 credit hours. Enrollment in CHEM 391 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.
6 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 his or her 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
CHEM 212 ORGANIC CHEMISTRY II 3
& CHEM 214 and ORGANIC CHEM DISCUSSION II
CHEM 320 ORGANIC CHEMISTRY II
BIOC 302 BIOCHEMISTRY II 3

Advanced Coursework in Chemistry
Select 2 courses from the following: 6
Any lecture course between CHEM 400 and CHEM 489
Any lecture course between CHEM 495 and CHEM 699

Total Credit Hours 12

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 TRANSITION METAL CHEMISTRY 3

Advanced Coursework in Chemistry
Select 2 courses from the following: 6
Any lecture course between CHEM 400 and CHEM 489
Any lecture course between CHEM 495 and CHEM 699

Total Credit Hours 12

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
CHEM 212 ORGANIC CHEMISTRY II 3
& CHEM 214 and ORGANIC CHEM DISCUSSION II
CHEM 320 ORGANIC CHEMISTRY II

Select 1 from the following:
Students pursuing the major in Chemistry should be aware of the Departmental Transfer Credit Guidelines. For Rice University's policy regarding transfer credit, see 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 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.

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/) (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/). 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, 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.