Chemistry, BS

Learning Outcomes
The Department of Chemistry is committed to maintaining excellence in teaching and mentoring, and to providing the maximum educational benefit to each chemistry graduate. The desired outcomes will prepare students for success in graduate or professional school, industry or government employment, and a wide variety of career choices.

The graduate with a bachelor’s degree in chemistry will be able to use the knowledge and skills obtained in the program to demonstrate the following.

Knowledge and Understanding of Chemistry
Graduates will be able to demonstrate:

- mastery of major concepts, theoretical principles, and experimental findings in chemistry;
- an understanding of the relationship between molecular structure and physical/chemical properties;
- an understanding of the relationship between the microscopic, macroscopic, and symbolic descriptions of matter and the changes it undergoes; and
- an understanding of the conditions that affect stability and factors that control rates of change.

Laboratory Skills
Graduates will be able to:

- assess chemical and procedural hazards involved in laboratory work;
- use strategies to minimize the risks associated with laboratory work;
- maintain a clearly organized laboratory notebook;
- use a variety of synthetic techniques;
- use instrumentation and laboratory techniques to separate, purify, identify, quantify, and characterize chemical species; and
- use computers as tools for data acquisition, management, and analysis.

Scientific Thinking
Graduates will be able to:

- pose scientific questions with a clear hypothesis;
- plan and carry out scientific investigations;
- analyze data in order to make inferences about chemical and physical behavior and properties, and construct scientific arguments to support conclusions;
- use scientific theory and/or interpretations of experimental results to explain chemical phenomena;
- use mathematics and computational thinking to understand and predict chemical behavior;
- identify and quantify uncertainties in measurements and limitations in methods; and
- use graphs, diagrams, and other models to communicate chemical information.

Chemical Information Skills
Graduates will be able to:

- use modern library search tools to locate and retrieve chemical information;
- read, analyze, and critically evaluate journal articles; and
- reference and cite chemical literature appropriately using designated citation styles.

Professional Skills
Graduates will be able to:

- report scientific findings in oral presentations in a clear and organized fashion using appropriate visual tools;
- report on experimental work and scientific findings in written reports;
- communicate results of scientific work to nontechnical audiences;
- work collaboratively with peers to plan and conduct experiments, interpret chemical information, and solve problems; and
- engage in responsible and ethical scientific conduct.

Requirements
The Bachelor of Science with a major in chemistry requires a minimum of 120 s.h., including 69 s.h. of work for the major (20 s.h. in foundation chemistry courses, 27 s.h. in advanced chemistry, and 22 s.h. in supporting coursework). Students must earn at least 20 s.h. in advanced chemistry courses at the University of Iowa. They must maintain a grade-point average of at least 2.00 in all courses for the major and in all UI courses for the major. Students also must complete the College of Liberal Arts and Sciences GE CLAS Core.

The BS degree with a major in chemistry is certified by the American Chemical Society (ACS) when a biochemistry course is included. An ACS-approved program offers a broad-based and rigorous chemistry education that provides students with the intellectual, experimental, and communication skills to become effective scientific professionals in chemical and related fields. The program also provides all the prerequisites for graduate work in chemistry or biochemistry and in other biomedical areas with a molecular focus.

Courses in the chemistry major have prerequisites, so they must be taken in the correct order. Advanced chemistry courses are built on the chemistry foundation courses. Most advanced courses are taught only once a year. Students should consult their academic advisors and plan their course schedules carefully. They should take CHEM:2021 Fundamentals of Chemical Measurements during the first semester of the second year.

Students may not use a course to fulfill more than one requirement.

The BS with a major in chemistry requires the following coursework.

Chemistry Foundation Courses
Students complete the following foundation courses.
## Chemistry, BS

### Course #  Title  Hours
All of these:  
CHEM:1110 & CHEM:1120  
Chemistry Laboratory  8  
CHEM:2021  
Fundamentals of Chemical Measurements  3  
One of these sequences:  
CHEM:2210 & CHEM:2220  
Chemistry Laboratory  6  
CHEM:2230 & CHEM:2240  
Organic Chemistry Laboratory  6  
CHEM:2410  
Organic Chemistry Laboratory  3  
CHEM:2420  
Organic Chemistry Laboratory  3  

### Advanced Chemistry Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
</table>
| All of these:  
CHEM:3110 & CHEM:3120  
CHEM:3250  
CHEM:3430  
CHEM:3440  
CHEM:3530  
CHEM:4270  
CHEM:4431 & CHEM:4432  | Equilibria and Electrochemistry - Separations  6  
Inorganic Chemistry  3  
Analytical Measurements  3  
Physical Measurements  3  
Inorganic Chemistry Laboratory  3  
Advanced Inorganic Chemistry  3  
Chemical Thermodynamics - Quantum Mechanics and Chemical Kinetics  6  |

### Mathematics Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
</table>
| All of these:  
MATH:1550 & MATH:1560 | Engineering Mathematics I: Single Variable Calculus - Multivariable Calculus  8  |
| MATH:1850 & MATH:1860 | Calculus I-II (preferred)  8  |

### Introductory Physics Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
</table>
| All of these:  
PHYS:1511 & PHYS:1512 | College Physics I-II  8  |
| PHYS:1611 & PHYS:1612 | Introduction to Physics I-II (preferred)  8  |

### Science Electives and Research Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
</table>
| All of these:  
CHEM:3994 | Undergraduate Research  1-4  |

### Advanced science elective courses

### ACS Certification Requirement

Students who want an ACS-certified degree complete one of these optional courses (also in the "Science Electives and Research Courses" list).

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMB:3110</td>
<td>Biochemistry  3</td>
<td></td>
</tr>
<tr>
<td>BMB:3120</td>
<td>Biochemistry and Molecular Biology I  3</td>
<td></td>
</tr>
<tr>
<td>BMB:3130</td>
<td>Biochemistry and Molecular Biology II  3</td>
<td></td>
</tr>
</tbody>
</table>

### Teacher Licensure

Students interested in teaching in elementary and/or secondary schools should seek admission to the Teacher Education Program (TEP) in the College of Education.

To qualify for licensure in secondary teaching, students in the TEP complete a degree in education as well as a related College of Liberal Arts and Sciences degree. See Apply on the College of Education website for details on requirements and deadlines for applying to the College of Education and about TEP choices of majors leading to licensure.

### Honors

#### Honors in the Major

Majors are able to graduate with departmental honors. Students must maintain a cumulative University of Iowa grade-point average (GPA) of at least 3.33, as required by the College of Liberal Arts and Sciences; additionally, students must maintain a 3.33 cumulative GPA in the major, a GPA set by the Department of Chemistry.

Students also must complete an undergraduate research project acceptable to their research advisor and must write an honors thesis based on their research. They are encouraged but not required to present their research at local and regional meetings and to publish their results in professional journals.

### University of Iowa Honors Program

In addition to honors in the major, students have opportunities for honors study and activities through membership in the University of Iowa Honors Program. Visit Honors at Iowa to learn about the university's honors program.

Membership in the UI Honors Program is not required to earn honors in the chemistry major.

### Financial Support

#### Scholarships and Awards

A number of awards and scholarships are available to chemistry majors, including the American Institute of Chemists Award, the Undergraduate Award in Analytical
Chemistry, the Chemistry Alumni Awards (one each for a sophomore, a junior, and a senior), the Merck Index Award, and the Viksnins, Harris & Padys PLLP Award.

Chemistry majors also may apply for the Donald J. and Margaret Burton Scholarship, E. David Cater Scholarship, and Russell K. Simms Scholarship.

For more information, visit Undergraduate Scholarships and Awards on the Department of Chemistry website.

### Academic Plans

#### Four-Year Graduation Plan

The following checkpoints list the minimum requirements students must complete by certain semesters in order to stay on the university's Four-Year Graduation Plan. Courses in the major are those required to complete the major; they may be offered by departments other than the major department.

Courses in the chemistry major have prerequisites, so they must be taken in the correct order. Most advanced courses are taught only once a year. Students should consult their academic advisors and plan their course schedules carefully. They should take CHEM:2021 Fundamentals of Chemical Measurements during the first semester of the second year. Typical chemistry course schedules and a regression list are available at Undergraduate Program in Chemistry on the Department of Chemistry website.

**Before the third semester begins:** math through MATH:1550 Engineering Mathematics I: Single Variable Calculus or MATH:1850 Calculus I; CHEM:1110 Principles of Chemistry I and CHEM:1120 Principles of Chemistry II, or equivalent coursework.


**Before the seventh semester begins:** six more courses in the major and at least 90 s.h. earned toward the degree.

**Before the eighth semester begins:** three more courses in the major.

**During the eighth semester:** enrollment in all remaining coursework in the major, all remaining GE CLAS Core courses, and a sufficient number of semester hours to graduate.

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### Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

### Chemistry, BS

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Any Semester</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GE CLAS Core: Sustainability</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td><strong>First Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM:1110</td>
<td>Principles of Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>MATH:1850</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>RHET:1030 or ENGL:1200</td>
<td>Rhetoric or The Interpretation of Literature</td>
<td>3 - 4</td>
</tr>
<tr>
<td>GE CLAS Core: Diversity and Inclusion</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>CSI:1600</td>
<td>Success at Iowa</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Hours 16-17</strong></td>
</tr>
<tr>
<td><strong>Second Year</strong></td>
<td></td>
<td></td>
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<tr>
<td>Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM:2021</td>
<td>Fundamentals of Chemical Measurements</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:2230</td>
<td>Organic Chemistry I for Majors</td>
<td>3</td>
</tr>
<tr>
<td>PHYS:1611</td>
<td>Introductory Physics I</td>
<td>4</td>
</tr>
<tr>
<td>GE CLAS Core: World Languages Second Level</td>
<td>Proficiency or elective course</td>
<td>4 - 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Hours 14-15</strong></td>
</tr>
<tr>
<td><strong>Spring</strong></td>
<td></td>
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</tr>
<tr>
<td>CHEM:2240</td>
<td>Organic Chemistry II for Majors</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:2420</td>
<td>Organic Chemistry Laboratory for Majors</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:3250</td>
<td>Inorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>GE CLAS Core: Historical Perspectives</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>GE CLAS Core: World Languages Third Level</td>
<td>Proficiency or elective course</td>
<td>4 - 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Hours 16-17</strong></td>
</tr>
<tr>
<td><strong>Third Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Any Semester</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM:3530</td>
<td>Inorganic Chemistry Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:4270</td>
<td>Advanced Inorganic Chemistry</td>
<td>3</td>
</tr>
</tbody>
</table>
CHEM:4431 Chemical Thermodynamics 3
GE CLAS Core: International and Global Issues  d  3
GE CLAS Core: World Languages Fourth Level Proficiency or elective course  e  4-5

| Hours | 16-17 |

**Spring**
CHEM:4432 Quantum Mechanics and Chemical Kinetics 3
PHYS:1612 Introductory Physics II 4
Major: science elective or research  i  3
GE CLAS Core: Literature, Visual, and Performing Arts  d  3

| Elective course  j  3 |

| Hours | 16 |

**Fourth Year**

**Fall**
CHEM:3110 Equilibria and Electrochemistry  g  3
CHEM:3440 Physical Measurements  h  3
BMB:3110 Biochemistry  i, k  3
GE CLAS Core: Social Sciences  d  3

| Elective course  j  3 |

| Hours | 14-15 |

**Spring**
CHEM:3120 Spectroscopy and Separations 3
CHEM:3430 Analytical Measurements  h  3
GE CLAS Core: Values and Culture  d  3

| Elective course  j  3 |

| Elective course  j  3 |

| Degree Application: apply on MyUI before deadline (typically in February for spring, September for fall)  l |

| Hours | 15 |

| Total Hours | 122-129 |

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a. Sustainability must be completed by choosing a course that has been approved for Sustainability AND for one of these General Education areas: Natural Sciences; Quantitative and Formal Reasoning; Social Sciences; Historical Perspectives; International and Global Issues; Literary, Visual, and Performing Arts; or Values and Culture.
b. Enrollment in chemistry courses requires completion of a placement exam.
c. Enrollment in math courses requires completion of a placement exam.
d. GE CLAS Core courses may be completed in any order unless used as a prerequisite for another course. Students should consult with an advisor about the best sequencing of courses.
e. Students who have completed four levels of a single language or two levels of two different languages in high school or college have satisfied the GE CLAS Core World Languages requirement. Students who have completed three levels of a single language may complete a fourth-level course in the same language or may choose an approved World Language and Cultural Exploration course. Enrollment in world languages courses requires a placement exam, unless enrolling in a first-semester-level course. Contact your academic advisor or CLAS Undergraduate Programs Office with questions concerning the World Languages requirement.
f. Students should take CHEM:2021 during the first semester of the second year.
g. Typically this course is offered in fall semesters only. Check MyUI for course availability since offerings are subject to change.
h. Typically this course is offered in spring semesters only. Check MyUI for course availability since offerings are subject to change.
i. Students are required to complete 6 s.h. in science electives and research toward the major; refer to the General Catalog for list of approved courses.
j. Students may use elective courses to earn credit towards the total s.h. required for graduation or to complete a double major, minors, or certificates.
k. Students who want an ACS certified degree must complete one of these optional courses: BMB:3110 or BMB:3120.
l. Please see Academic Calendar, Office of the Registrar website for current degree application deadlines. Students should apply for a degree for the session in which all requirements will be met. For any questions on appropriate timing, contact your academic advisor or Degree Services.