Chemistry

Majors:

- Bachelor of Arts, Chemistry (p. 1)
- Bachelor of Science, Biochemistry (p. 2)
- Bachelor of Science, Chemistry (p. 4)
- Bachelor of Science, Medicinal-Pharmaceutical Chemistry (p. 5)

Minor:

- Chemistry (p. 6)

The B.S. in Chemistry (BS-CHM) program is approved by the American Chemical Society for the training of professional chemists, and provides students with the opportunity to perform an original research project under the direction of a faculty mentor. BS-CHM majors electing to perform research typically select their faculty mentor and project during the first term of their junior year. The research project may be conducted over the entire senior year, but is more commonly conducted over a ten-week period during the summer following the junior year. In either case, the project culminates in the senior year with enrollment in CHM 498, the submission of an acceptable thesis, and the presentation of a seminar in CHM 490. Additional research work to a maximum total of six semester hours may be elected provided the work extends beyond two semesters.

The B.S. in Biochemistry (BCM) program prepares students for careers in the biochemical and life sciences. BCM majors may elect to conduct an original research project in biochemistry or a related chemical subdiscipline. In all other respects these biochemically-related research projects are identical to those detailed for the BS-CHM program above.

The B.S. in Medicinal-Pharmaceutical Chemistry (MCM) program is designed for students pursuing careers in medicine, pharmacy or forensic chemistry, and provides a focused preparation in the analysis and synthesis of compounds of pharmacological significance. MCM majors may elect to conduct an original research project, typically in synthetic or analytical chemistry. In all other respects these research projects are identical to those detailed for the BS-CHM program above.

The B.A. in Chemistry (BA-CHM) program prepares students for a wide range of interdisciplinary professions, and consists of a curriculum in which the traditional B.S. curriculum has been modified, most notably in mathematics, physics, and advanced chemistry. The BA-CHM program is accordingly somewhat flexible, and affords students a wide selection of courses in the humanities and social sciences. BA-CHM majors are free to choose courses which prepare them for careers in medicine, dentistry, optometry, veterinary medicine, biochemistry, education, law, and other professions which require a science background.

A minor in chemistry consists of twenty semester hours. Typically these consist of 8 credit hours of general chemistry (CHM 123, 123L, 124, 124L), 8 credit hours of organic chemistry (CHM 313, 313L, 314, 314L), 3 credit hours of physical chemistry (CHM 302, 303 or 304), and one credit hour in basic molecular spectroscopy (CHM 317). Of these, the physical chemistry course is the only requirement.

Faculty

David Johnson, Chairperson
Professors Emeriti: Fratini, Keil, Knachel, Morrow, Singer
Professor: Benin, S. Swavey
Associate Professors: Church, Crosson, Johnson, Lopper, Masthay
Assistant Professors: J. Beagle, Biffinger, Erb, Mammana

Bachelor of Arts, Chemistry (CHM) minimum 124 hours

Common Academic Program (CAP) 1

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HST 103</td>
<td>The West &amp; the World</td>
<td>12 cr.</td>
</tr>
<tr>
<td>REL 103</td>
<td>Introduction to Religious and Theological Studies</td>
<td>0-3 cr.</td>
</tr>
<tr>
<td>PHL 103</td>
<td>Introduction to Philosophy</td>
<td></td>
</tr>
<tr>
<td>ENG 100</td>
<td>Writing Seminar I</td>
<td></td>
</tr>
<tr>
<td>ENG 200</td>
<td>Writing Seminar II</td>
<td></td>
</tr>
<tr>
<td>CMM 100</td>
<td>Principles of Oral Communication</td>
<td></td>
</tr>
</tbody>
</table>

Mathematics 3 cr. hrs.

Social Science 3 cr. hrs.

Natural Sciences 5 cr. hrs.

Crossing Boundaries up to 12 cr. hrs.

Faith Traditions

Practical Ethical Action

Inquiry 6

Integrated Advanced Study

Philosophy and/or Religious Studies (6 cr. hrs.)

Historical Studies (3 cr. hrs.) 7

Diversity and Social Justice 8

Major Capstone 9

0-6 cr. hrs.
The credit hours listed reflect what is needed to complete each CAP component. However, they should not be viewed as a cumulative addition to a student's degree requirements because many CAP courses are designed to satisfy more than one CAP component (e.g., Crossing Boundaries and Advanced Studies) and may also satisfy requirements in the student's major.

1. May be completed with ASI 110 and ASI 120 through the Core Program.
2. May be completed with ENG 100A and ENG 100B, by placement.
3. May be completed with ENG 114 or ENG 198 or ASI 120.
4. Must include two different disciplines and at least one accompanying lab.
5. U.S. History AP and CLEP credit will not satisfy this requirement.
6. May be completed with ASI 110 and ASI 120 through the Core Program. U.S. History AP and CLEP credit will not satisfy this requirement.
7. May not double count with First-Year Humanities Commons, Second-Year Writing, Oral Communication, Social Science, Arts, or Natural Sciences CAP components, but may double count with courses taken to satisfy other CAP components and/or courses taken in the student's major.
8. The course or experience is designed by faculty in each major; it may, or may not, be assigned credit hours.

Liberal Studies Curriculum

Creative and Performing Arts (May include CAP Arts) 3
L2 Proficiency (Proficiency in a language other than English) 0-11
Mathematics (Satisfies CAP Mathematics) 9
MTH 148 & MTH 149 Introductory Calculus and Introductory Calculus II
MTH 367 Statistical Methods I
Natural Sciences (Applies to CAP Natural Science) 8
PHY 201 & 201L College Physics I and College Physics Laboratory I
PHY 202 & 202L General Physics and General Physics Laboratory
Social Sciences (Includes CAP Social Science) 12

Major Requirements 1

CHM 123 & 123L General Chemistry and General Chemistry Laboratory 4
CHM 124 & 124L General Chemistry and General Chemistry Laboratory 4
CHM 201 & 201L Quantitative Analysis and Quantitative Analysis Laboratory 4
CHM 302 Physical Chemistry 3-6
or CHM 303 Physical Chemistry and Physical Chemistry 3
CHM 313 & 313L Organic Chemistry and Organic Chemistry Laboratory 4
CHM 314 & 314L Organic Chemistry and Organic Chemistry Laboratory 4
CHM 480 Professional Practices Seminar 1
CHM 490 Seminar IV (Satisfies CAP Major Capstone) 1
Select four courses from: 2 10-13

Bachelor of Science, Biochemistry (BCM) minimum 120 hours

Common Academic Program (CAP) 1

First-Year Humanities Commons 2 12 cr. hrs.
HST 103 The West & the World 12 cr. hrs.
REL 103 Introduction to Religious and Theological Studies 12 cr. hrs.
PHL 103 Introduction to Philosophy 12 cr. hrs.
ENG 100 Writing Seminar I 3 0-3 cr. hrs.
ENG 200 Writing Seminar II 3 cr. hrs.
CMM 100 Principles of Oral Communication 3 cr. hrs.
Mathematics 3 cr. hrs.
Social Science 3 cr. hrs.

SSC 200 Social Science Integrated 3 cr. hrs.
### Arts
- 3 cr. hrs.

### Natural Sciences
- 7 cr. hrs.

### Crossing Boundaries
- Up to 12 cr. hrs.

### Faith Traditions
- Practical Ethical Action
- Inquiry

### Advanced Study
- Philosophy and/or Religious Studies (6 cr. hrs.)
- Historical Studies (3 cr. hrs.)

### Diversity and Social Justice
- 3 cr. hrs.

### Major Capstone
- 0-6 cr. hrs.

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1. The credit hours listed reflect what is needed to complete each CAP component. However, they should not be viewed as a cumulative addition to a student’s degree requirements because many CAP courses are designed to satisfy more than one CAP component (e.g., Crossing Boundaries and Advanced Studies) and may also satisfy requirements in the student's major.

2. May be completed with ASI 110 and ASI 120 through the Core Program.

3. May be completed with ENG 100A and ENG 100B, by placement.

4. May be completed with ENG 114 or ENG 198 or ASI 120.

5. Must include two different disciplines and at least one accompanying lab.

6. U.S. History AP and CLEP credit will not satisfy this requirement.

7. May be completed with ASI 110 and ASI 120 through the Core Program. U.S. History AP and CLEP credit will not satisfy this requirement.

8. May not double count with First-Year Humanities Commons, Second-Year Writing, Oral Communication, Social Science, Arts, or Natural Sciences CAP components, but may double count with courses taken to satisfy other CAP components and/or courses taken in the student’s major.

9. The course or experience is designed by faculty in each major; it may, or may not, be assigned credit hours.

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### CPS 132
- Computer Programming for Engineering & Science

### MTH 168
- Analytic Geometry & Calculus I (Satisfies CAP Mathematics)

### MTH 169
- Analytic Geometry & Calculus II

### MTH 218
- Analytic Geometry & Calculus III

### PHY 206
- General Physics I - Mechanics

### PHY 207
- General Physics II - Electricity & Magnetism

### PHY 210L
- General Physics Laboratory I

Select courses from:

- BIO 312: General Genetics
- BIO 314: Plant Biology
- BIO 403: Physiology I
- BIO 404: Physiology II
- BIO 411: General Microbiology
- BIO 427: Immunology
- BIO 440: Cell Biology
- BIO 462: Molecular Biology
- BIO 466: Biology of Infectious Disease
- CHM 404: Special Topics in Physical Chemistry
- CHM 412: Intermediate Organic Chemistry
- CHM 415 & 415L: Analytical Chemistry and Analytical Chemistry Laboratory
- CHM 417: Inorganic Chemistry
- CHM 418L: Inorganic Chemistry Laboratory
- CHM 426: Biosynthetic Organic Chemistry
- CHM 427: Medicinal Chemistry
- CHM 497: Research Seminar
- CHM 498 & CHM 499: Research & Thesis

### Major Requirements

1. Satisfies CAP Natural Science

#### Year 1
- BIO 151 & 151L: Concepts of Biology I: Cellular & Molecular Biology and Concepts of Biology Laboratory I: Cellular & Molecular Biology
- BIO 152: Concepts of Biology II: Evolution & Ecology
- CHM 123 & 123L: General Chemistry and General Chemistry Laboratory
- CHM 124 & 124L: General Chemistry and General Chemistry Laboratory

#### Year 2
- CHM 201 & 201L: Quantitative Analysis and Quantitative Analysis Laboratory
- CHM 313 & 313L: Organic Chemistry and Organic Chemistry Laboratory
- CHM 314 & 314L: Organic Chemistry and Organic Chemistry Laboratory

#### Year 3
- BIO Elective and Laboratory

#### Year 4
- CHM 303 & 303L: Physical Chemistry and Physical Chemistry Laboratory
- CHM 304: Physical Chemistry
- CHM 451: General Biochemistry I
- CHM 452: General Biochemistry II
- CHM 462L: Biochemistry Laboratory
- CHM 495: Introduction to Research Seminar

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### Science Breadth Requirements

- CPS 132: Computer Programming for Engineering & Science
- MTH 168: Analytic Geometry & Calculus I (Satisfies CAP Mathematics)
- MTH 169: Analytic Geometry & Calculus II
- MTH 218: Analytic Geometry & Calculus III
- PHY 206: General Physics I - Mechanics
- PHY 207: General Physics II - Electricity & Magnetism
**Bachelor of Science, Chemistry (CHM) minimum 120 hours**

### Common Academic Program (CAP)  
1. **First-Year Humanities Commons**  
   - HST 103 The West & the World  
   - REL 103 Introduction to Religious and Theological Studies  
   - PHL 103 Introduction to Philosophy  
   - ENG 100 Writing Seminar I  
   - Second-Year Writing Seminar  
   - ENG 200 Writing Seminar II  
   - Oral Communication  
   - CMM 100 Principles of Oral Communication  

### Mathematics  
- CPS 132 Computer Programming for Engineering & Science  
- MTH 168 Analytic Geometry & Calculus I (Satisfies CAP Mathematics)  
- MTH 169 Analytic Geometry & Calculus II  
- MTH 218 Analytic Geometry & Calculus III  

### Social Science  
- SSC 200 Social Science Integrated  

### Arts  
- 3 cr. hrs.  

### Natural Sciences  
- 7 cr. hrs.  

### Crossing Boundaries  
- up to 12 cr. hrs.  

### Faith Traditions  
### Practical Ethical Action  
### Inquiry  
### Integrative  
### Advanced Study  
- Philosophy and/or Religious Studies (6 cr. hrs.)  
- Historical Studies (3 cr. hrs.)  
### Diversity and Social Justice  

### Science Breadth Requirements  
- Mathematics, Computer Sciences  
- CPS 132 Computer Programming for Engineering & Science  
- MTH 168 Analytic Geometry & Calculus I (Satisfies CAP Mathematics)  
- MTH 169 Analytic Geometry & Calculus II  
- MTH 218 Analytic Geometry & Calculus III  
- PHY 206 General Physics I - Mechanics (Applies to CAP Natural Science)  
- PHY 207 General Physics II - Electricity & Magnetism  
- PHY 208 General Physics III- Thermodynamics, Waves, and Fluids  
- PHY 210L General Physics Laboratory I  
- PHY 211L General Physics Laboratory II  

### Major Requirements  
1. **Year 1**  
   - CHM 123 General Chemistry & 123L General Chemistry Laboratory  
   - CHM 124 General Chemistry & 124L General Chemistry Laboratory  

2. **Year 2**  
   - CHM 201 Quantitative Analysis & 201L Quantitative Analysis Laboratory  
   - CHM 313 Organic Chemistry & 313L Organic Chemistry Laboratory  
   - CHM 314 Organic Chemistry & 314L Organic Chemistry Laboratory  

### Major Capstone  
1. The credit hours listed reflect what is needed to complete each CAP component. However, they should not be viewed as a cumulative addition to a student’s degree requirements because many CAP courses are designed to satisfy more than one CAP component (e.g., Crossing Boundaries and Advanced Studies) and may also satisfy requirements in the student’s major.  
2. May be completed with ASI 110 and ASI 120 through the Core Program.  
3. May be completed with ENG 100A and ENG 100B, by placement.  
4. May be completed with ENG 114 or ENG 198 or ASI 120.  
5. Must include two different disciplines and at least one accompanying lab.  
6. U.S. History AP and CLEP credit will not satisfy this requirement.  
7. May be completed with ASI 110 and ASI 120 through the Core Program. U.S. History AP and CLEP credit will not satisfy this requirement.  
8. May not double count with First-Year Humanities Commons, Second-Year Writing, Oral Communication, Social Science, Arts, or Natural Sciences CAP components, but may double count with courses taken to satisfy other CAP components and/or courses taken in the student’s major.  
9. The course or experience is designed by faculty in each major; it may, or may not, be assigned credit hours.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 303 &amp; 303L</td>
<td>Physical Chemistry and Physical Chemistry Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>CHM 304 &amp; 304L</td>
<td>Physical Chemistry and Physical Chemistry Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>CHM 317</td>
<td>Spectroscopic Identification of Organic Compounds</td>
<td>1</td>
</tr>
<tr>
<td>CHM 417</td>
<td>Inorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHM 418L</td>
<td>Inorganic Chemistry Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>CHM 495</td>
<td>Introduction to Research Seminar</td>
<td>0</td>
</tr>
<tr>
<td>Year 4</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>CHM 415 &amp; 415L</td>
<td>Analytical Chemistry and Analytical Chemistry Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>CHM 420</td>
<td>Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHM 451 &amp; 452</td>
<td>General Biochemistry I and General Biochemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHM 480</td>
<td>Professional Practices Seminar</td>
<td>1</td>
</tr>
<tr>
<td>CHM 490</td>
<td>Seminar IV (Satisfies CAP Major Capstone)</td>
<td>1</td>
</tr>
</tbody>
</table>

**Select three courses from:**

- CHM 404 Special Topics in Physical Chemistry
- CHM 412 Intermediate Organic Chemistry
- CHM 426 Biosynthetic Organic Chemistry
- CHM 427 Medicinal Chemistry
- CHM 462L Biochemistry Laboratory
- CHM 477 Honors Thesis Project
- CHM 478 and Honors Thesis Project
- CHM 497 Research Seminar
- CHM 498 and Research & Thesis
- CHM 499 Research & Thesis

**Bachelor of Science, Medicinal-Pharmaceutical Chemistry (MCM) minimum 120 hours**

**Common Academic Program (CAP)**

1. **First-Year Humanities Commons**
   - HST 103 The West & the World
   - REL 103 Introduction to Religious and Theological Studies
   - PHL 103 Introduction to Philosophy
   - ENG 100 Writing Seminar I
   - Second-Year Writing Seminar

2. **ASL 150 Introduction to the University Experience**

3. **Foreign Language**

4. **Social and Behavioral Sciences (Includes CAP Social Science)**

5. **Total Hours to total at least**

6. **Breadth**

7. **Social Science**

8. **Arts**

9. **Natural Sciences**

10. **Crossing Boundaries**

11. **Faith Traditions**

12. **Inquiry**

13. **Integrative**

14. **Advanced Study**

15. **Philosophy and/or Religious Studies (6 cr. hrs.)**

16. **Historical Studies (3 cr. hrs.)**

17. **Diversity and Social Justice**

18. **Major Capstone**

1. Should be completed during the first two years.
2. Advanced placement is permitted.
3. May substitute one approved science course from another department.

The credit hours listed reflect what is needed to complete each CAP component. However, they should not be viewed as a cumulative addition to a student’s degree requirements because many CAP courses are designed to satisfy more than one CAP component (e.g., Crossing Boundaries and Advanced Studies) and may also satisfy requirements in the student’s major.

May be completed with ASI 110 and ASI 120 through the Core Program.

May be completed with ENG 100A and ENG 100B, by placement.

May be completed with ENG 114 or ENG 198 or ASI 120.

Must include two different disciplines and at least one accompanying lab.

U.S. History AP and CLEP credit will not satisfy this requirement.

May be completed with ASI 110 and ASI 120 through the Core Program. U.S. History AP and CLEP credit will not satisfy this requirement.
May not double count with First-Year Humanities Commons, Second-Year Writing, Oral Communication, Social Science, Arts, or Natural Sciences CAP components, but may double count with courses taken to satisfy other CAP components and/or courses taken in the student’s major.

The course or experience is designed by faculty in each major; it may, or may not, be assigned credit hours.

Science Breadth Requirements
Satisfies CAP Mathematics and CAP Natural Science

<table>
<thead>
<tr>
<th>Course</th>
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<th>Hours</th>
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<tr>
<td>BIO 151</td>
<td>Concepts of Biology I: Cellular &amp; Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 151L</td>
<td>and Concepts of Biology Laboratory I: Cellular &amp; Molecular Biology</td>
<td></td>
</tr>
<tr>
<td>BIO 152</td>
<td>Concepts of Biology II: Evolution &amp; Ecology</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 152L</td>
<td>and Concepts of Biology Laboratory II: Evolution &amp; Ecology</td>
<td></td>
</tr>
<tr>
<td>MTH 148</td>
<td>Introductory Calculus I</td>
<td>6</td>
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<td>&amp; MTH 149</td>
<td>and Introductory Calculus II</td>
<td></td>
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<tr>
<td>MTH 367</td>
<td>Statistical Methods I</td>
<td>3</td>
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<tr>
<td>PHY 201</td>
<td>College Physics I</td>
<td>4</td>
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<tr>
<td>&amp; 201L</td>
<td>and College Physics Laboratory I</td>
<td></td>
</tr>
<tr>
<td>PHY 202</td>
<td>General Physics</td>
<td>4</td>
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<tr>
<td>&amp; 202L</td>
<td>and General Physics Laboratory</td>
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Major Requirements

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<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CHM 123</td>
<td>General Chemistry</td>
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<td>&amp; 123L</td>
<td>and General Chemistry Laboratory</td>
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<tr>
<td>CHM 124</td>
<td>General Chemistry</td>
<td>4</td>
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<tr>
<td>&amp; 124L</td>
<td>and General Chemistry Laboratory</td>
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<tr>
<td>Year 2</td>
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<tr>
<td>CHM 201</td>
<td>Quantitative Analysis</td>
<td>4</td>
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<td>&amp; 201L</td>
<td>and Quantitative Analysis Laboratory</td>
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<tr>
<td>CHM 313</td>
<td>Organic Chemistry</td>
<td>4</td>
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<td>&amp; 313L</td>
<td>and Organic Chemistry Laboratory</td>
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<tr>
<td>CHM 314</td>
<td>Organic Chemistry</td>
<td>4</td>
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<tr>
<td>&amp; 314L</td>
<td>and Organic Chemistry Laboratory</td>
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<td>Year 3</td>
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<tr>
<td>CHM 302</td>
<td>Physical Chemistry</td>
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<td>&amp; 302L</td>
<td>and Physical Chemistry Laboratory</td>
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<tr>
<td>CHM 317</td>
<td>Spectroscopic Identification of Organic Compounds</td>
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<tr>
<td>CHM 420</td>
<td>Biochemistry</td>
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<tr>
<td>CHM 462L</td>
<td>Biochemistry Laboratory</td>
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<tr>
<td>CHM 495</td>
<td>Introduction to Research Seminar</td>
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<tr>
<td>Year 4</td>
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<tr>
<td>CHM 319L</td>
<td>Advanced Organic Synthesis Laboratory</td>
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<tr>
<td>CHM 426</td>
<td>Biosynthetic Organic Chemistry</td>
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<td>CHM 427</td>
<td>Medicinal Chemistry</td>
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<tr>
<td>CHM 454</td>
<td>Rational Drug Design</td>
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<td>CHM 463L</td>
<td>Bioanalytical Chemistry Laboratory</td>
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<td>CHM 480</td>
<td>Professional Practices Seminar</td>
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<td>CHM 490</td>
<td>Seminar IV (Satisfies CAP Major Capstone)</td>
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</tbody>
</table>

Science Requirements

Select six semester hours from:

- CHM 412 Intermediate Organic Chemistry

Minor in Chemistry (CHM)

Chemistry

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CHM 123</td>
<td>General Chemistry</td>
<td>4</td>
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<td>&amp; 123L</td>
<td>and General Chemistry Laboratory</td>
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<tr>
<td>CHM 124</td>
<td>General Chemistry</td>
<td>4</td>
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<tr>
<td>&amp; 124L</td>
<td>and General Chemistry Laboratory</td>
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<tr>
<td>CHM 302</td>
<td>Physical Chemistry</td>
<td>3</td>
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<tr>
<td>or CHM 303</td>
<td>Physical Chemistry</td>
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</table>

Select three CHM courses (300/400 level)

Bachelor of Arts, Chemistry

First Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>ASI 150</td>
<td>Introduction to the University Experience</td>
<td>1</td>
</tr>
<tr>
<td>Social and Behavioral Sciences (Includes CAP Social Science)</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours to total at least 120

1 Substitute of more advanced courses is possible upon consultation with the Department of Chemistry chairperson.
2 Consult General Requirements for all Bachelor of Science programs and the Common Academic Program requirements.
3 Advanced placement is permitted.
4 Biochemistry courses CHM 451 and CHM 452 may be substituted, with CHM 452 counting as a general elective.
5 Chemistry graduate courses or advanced electives from other departments may be selected with the permission of the Department of Chemistry chairperson.
6 If composition requirement is waived, the student should seek the English elective. Advanced writing courses are recommended.

1 In consultation with the chairperson.

- Bachelor of Arts, Chemistry (p. 1)
- Bachelor of Science, Medicinal-Pharmaceutical Chemistry (p. 7)
- Bachelor of Science, Biochemistry (p. 8)
- Bachelor of Science, Chemistry (p. 4)
### Bachelor of Science, Medicinal-Pharmaceutical Chemistry

**First Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Hours</th>
<th>Spring</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>CHM 150</td>
<td>1</td>
<td>CHM 124 &amp; 124L</td>
<td>4</td>
</tr>
<tr>
<td>CHM 123 &amp; 123L</td>
<td>4</td>
<td>BIO 152 &amp; 152L</td>
<td>4</td>
</tr>
<tr>
<td>BIO 151 &amp; 151L (CAP Natural Science)</td>
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<td>MTH 149</td>
<td>3</td>
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<tr>
<td>MTH 148 (Satisfies CAP Mathematics)</td>
<td>3</td>
<td>REL 103, PHL 103, or HST 103 (CAP Humanities Commons)</td>
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<tr>
<td>ENG 100 (CAP Humanities Commons)</td>
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<td>REL 103, PHL 103, or HST 103 (CAP Humanities Commons)</td>
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<tr>
<td>Language</td>
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<td>Language</td>
<td>4</td>
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<tr>
<td>Social Science - intro level</td>
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<td>Social Science - 300/400 level</td>
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<tr>
<td>Language 141</td>
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**Second Year**

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<tr>
<th>Fall</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CHM 313 &amp; 313L</td>
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<td>CHM 201 &amp; 201L</td>
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<td>CHM 314 &amp; 314L</td>
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<td>PHY 202 &amp; 202L</td>
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<td>ENG 200 (CAP Writing Seminar)</td>
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<td>MTH 367</td>
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<td>CMM 100 (CAP Communication)</td>
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<td>REL 103, PHL 103, or HST 103 (CAP Humanities Commons)</td>
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<tr>
<td>SSC 200 (CAP Social Science)</td>
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<td>ENG 100 (CAP Humanities Commons)</td>
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**Third Year**

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<th>Fall</th>
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<tr>
<td>CHM 302</td>
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<td>PHY 202</td>
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<td>PHY 201 &amp; 201L (CAP Natural Science)</td>
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<td>PHY 202L</td>
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<td>CHM elective</td>
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<tr>
<td>CAP Faith Traditions</td>
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<td>CAP Arts / Creative and Performing</td>
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<tr>
<td>Social Science - elective</td>
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<td>SSC 200 (CAP Social Science)</td>
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**Fourth Year**

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<tr>
<td>CHM 480</td>
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<td>CHM 490 (Satisfies CAP Major Capstone)</td>
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<td>CHM elective</td>
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<td>CAP Inquiry</td>
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<td>CAP Advanced Philosophy/Religious Studies</td>
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<td>CAP Advanced Philosophy/Religious Studies</td>
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<td>CAP Advanced Historical Studies</td>
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<td>CAP Advanced Historical Studies</td>
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<td>General Elective (optional)</td>
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Total credit hours: 132
**Bachelor of Science, Biochemistry**

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<th>Hours</th>
<th>Spring</th>
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<td>CHM 123 &amp; 123L</td>
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<td>BIO 151 &amp; 151L (CAP Natural Science)</td>
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<td>ENG 100 (CAP Humanities Commons)</td>
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<td>MTH 168 (Satisfies CAP Mathematics)</td>
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**Total credit hours: 133**

**Bachelor of Science, Chemistry**

<table>
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<th>Fall</th>
<th>Hours</th>
<th>Spring</th>
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<td>ASI 150</td>
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<td>CHM 123 &amp; 123L</td>
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<tr>
<td></td>
<td>MTH 168 (Satisfies CAP Mathematics)</td>
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**Total credit hours: 133**
### Courses

**CHM 115. College Preparatory Chemistry. 3 Hours**
One-term course for students desiring to enter a science or engineering program but whose background is insufficient for CHM 123 and CHM 124. Unacceptable for credit toward chemistry requirements in any chemistry program.

**CHM 115L. College Preparatory Chemistry Laboratory. 1 Hour**
Course to accompany CHM 115 or to be elected by students in CHM 200 who lack previous chemistry laboratory experience. One three-hour laboratory each week.

**CHM 123. General Chemistry. 3,4 Hours**
Comprehensive treatment of the fundamentals of general chemistry. Prerequisite(s): One year of high school chemistry or equivalent.

**CHM 123L. General Chemistry Laboratory. 1 Hour**
Laboratory course to complement CHM 123. One three-hour laboratory session each week. Corequisite(s): CHM 123.

**CHM 124. General Chemistry. 3 Hours**
Comprehensive treatment of the fundamentals of general chemistry. Prerequisite(s): CHM 123.

**CHM 124L. General Chemistry Laboratory. 1 Hour**
Laboratory course to complement CHM 124. One three-hour laboratory session each week. Prerequisite(s): CHM 123L Corequisite(s): CHM 124.

**CHM 190. Seminar I. 0 Hours**
Overview of methods of scientific oral presentation and formal conversation within the molecular sciences professional community.

**CHM 200. Chemistry & Society. 3 Hours**
Examination of issues such as environmental quality, disease, hunger, synthetic materials, and law enforcement by the application of chemical principles. Course is for non-science majors. Depending upon background and experience, a student needing a laboratory course may enroll in SCI220L. Prerequisite(s): One year of high school chemistry or equivalent.

**CHM 201. Quantitative Analysis. 3 Hours**
Application of the principles of chemical equilibrium to the theory and techniques of gravimetric, volumetric, spectrophotometric, and electroanalytical methods of chemical analysis. Prerequisite(s): CHM 124, CHM 124L.

**CHM 201L. Quantitative Analysis Laboratory. 1 Hour**
Course to accompany CHM 201. One three-hour laboratory period each week.

**CHM 234. Energy Resources. 3 Hours**
The chemical and geological aspects of formation, production, and benefits/costs (including environmental impacts) of energy derived from fossil fuels (coal and hydrocarbons), biofuels (e.g., ethanol production), radioactive materials (nuclear power), and renewable sources (e.g., geothermal, hydro, wind, and solar power). Prerequisite(s): CHM 123, CHM 124. Corequisite(s): GEO 208.

**CHM 290. Seminar II. 0 Hours**
Overview of methods of scientific oral presentation and formal conversation within the molecular sciences professional community.

**CHM 302. Physical Chemistry. 3 Hours**
Essential elements of thermodynamics, chemical kinetics, equilibria, and electrochemistry for those with a primary interest in the life sciences. For B.A. chemistry majors and premedical, predental, and biology majors. Prerequisite(s): CHM 124.

**CHM 302L. Physical Chemistry Laboratory. 1 Hour**
Course to accompany CHM 302. One three-hour laboratory each week. Prerequisite(s): CHM 201, CHM 201L. Corequisite(s): CHM 302.

**CHM 303. Physical Chemistry. 3 Hours**
Fundamentals of thermodynamics, chemical kinetics, electrochemistry, and spectroscopy with a mathematics format. For B.S. chemistry and biochemistry majors and chemical engineers. Prerequisite(s): CHM 201 or equivalent. Corequisite(s): MTH 218.

**CHM 303L. Physical Chemistry Laboratory. 1 Hour**
Course to accompany CHM 303. One three-hour laboratory each week. Prerequisite(s): MTH 218.

**CHM 304. Physical Chemistry. 3 Hours**
Fundamentals of thermodynamics, chemical kinetics, electrochemistry, and spectroscopy with a mathematics format. For B.S. chemistry and biochemistry majors and chemical engineers.

**CHM 304L. Physical Chemistry Laboratory. 1 Hour**
Course to accompany CHM 304. One three-hour laboratory each week. Corequisite(s): MTH 218.

**CHM 313. Organic Chemistry. 3 Hours**
Major topics in organic chemistry including synthesis, mechanisms, stereochemistry, and spectroscopy. Required of all chemistry majors and students in the life sciences. Prerequisite(s): CHM 124.

**CHM 313L. Organic Chemistry Laboratory. 1 Hour**
Common separation, purification, and analytical techniques including chromatography and spectroscopy. One three-hour laboratory each week. Prerequisite(s): CHM 124, 124L Corequisite(s): CHM 313.
CHM 314. Organic Chemistry. 3 Hours
Major topics in organic chemistry including synthesis, mechanisms, stereochemistry, and spectroscopy. Required of all chemistry majors and students in the life sciences. Prerequisite(s): CHM 313.

CHM 314L. Organic Chemistry Laboratory. 1 Hour
Synthesis and characterization of organic materials utilizing skills from CHM 313L. One three-hour laboratory each week. Prerequisite(s): CHM 313L. Corequisite(s): CHM 314.

CHM 317. Spectroscopic Identification of Organic Compounds. 1 Hour
The use of nuclear magnetic resonance, infrared, and mass spectrometry in elucidating structures. Emphasis on interpretation and integration of spectral data in problem solving. Prerequisite(s): (CHM 314, CHM 314L) or equivalent.

CHM 319L. Advanced Organic Synthesis Laboratory. 1 Hour
Preparation of organic compounds by single and multi-step synthetic sequences. Basic techniques in synthesis including use of organometallics, inert atmosphere, temperature control, extraction, vacuum distillation, column chromatography, recrystallization, and spectroscopic characterization methods. One four-hour laboratory each week. Prerequisite(s): CHM 314, CHM 314L.

CHM 341. Environmental Chemistry. 3 Hours
An introduction to the chemical processes in the environment. Topics include chemical equilibrium in aqueous solution, reaction mechanisms as applied to atmospheric chemistry, and analytical methods commonly applied to environmental samples. Prerequisite(s): CHM 314 or permission of instructor.

CHM 341L. Environmental Chemistry Laboratory. 1 Hour
Laboratory course to accompany CHM 341. Corequisite(s): CHM 341.

CHM 390. Seminar III. 0 Hours
Overview of methods of scientific oral presentation and formal conversation within the molecular sciences professional community.

CHM 404. Special Topics in Physical Chemistry. 3 Hours
Thorough treatment of topics such as electrochemistry, macromolecules, photochemistry, or spectroscopy. May be repeated as topics change. Prerequisite(s): CHM 302 or CHM 303.

CHM 412. Intermediate Organic Chemistry. 3 Hours
Modern theory and practice of organic chemistry. May include structure-reactivity relationships, reaction mechanism, and synthetic topics not normally treated in introductory courses. Prerequisite(s): CHM 302 or equivalent; CHM 313, CHM 314; senior standing.

CHM 415. Analytical Chemistry. 2 Hours
Chemical analysis based on modern instrumentation. Chromatographic, electrochemical, and spectroscopic methods. Prerequisite(s): CHM 201, CHM 201L; (CHM 302 or CHM 304).

CHM 415L. Analytical Chemistry Laboratory. 2 Hours
Course to accompany CHM 415. Two three-hour laboratory sessions each week. Prerequisite(s): CHM 201L; CHM 302 or equivalent.

CHM 417. Inorganic Chemistry. 3 Hours
An advanced course in modern inorganic chemistry. Atomic structure, principles of bonding and structure, acid-base chemistry, periodicity, coordination compounds, nonaqueous solvents, electrochemistry, molecular symmetry, organometallic compounds, and the chemistry of selected representative elements. Prerequisite(s): CHM 314. Corequisite(s): CHM 302 or CHM 304.

CHM 418L. Inorganic Chemistry Laboratory. 1 Hour
Laboratory course dealing with the synthesis and characterization of inorganic and organometallic compounds. Topics include vacuum and inert atmosphere techniques, separation and purification, spectroscopic characterization, X-ray diffraction, magnetic moment, and conductance measurements. Prerequisite(s): CHM 201L, CHM 314L. Corequisite(s): CHM 417.

CHM 420. Biochemistry. 3 Hours
The fundamental aspects of the chemistry and biochemistry of carbohydrates, lipids, proteins, and nucleic acids. Enzymology, protein purification, bioenergetics, metabolism of carbohydrates, lipids, amino acids, nucleotides and nucleic acids, elementary molecular biology, and control processes are described. Acceptable preparation for medical school. Prerequisite(s): CHM 314.

CHM 420L. Biochemistry Lab for the Medical Sciences. 1 Hour
A laboratory course to accompany CHM420, biochemistry. Prerequisite(s): CHM314, CHM314L. Corequisite(s): CHM420.

CHM 426. Biosynthetic Organic Chemistry. 3 Hours
Mechanistic fundamentals of the biosynthesis and transformation of organic natural products, with special emphasis on medicinal compounds, toxins, pheromones and other secondary metabolite structures. Prerequisite(s): (CHM 314, CHM 314L) or equivalent.

CHM 427. Medicinal Chemistry. 3 Hours
The chemical mechanisms of action of the major drug classes will be surveyed with particular emphasis on the facets of organic chemistry that control drug-receptor interactions, metabolism and mechanisms of toxicity and resistance. First term. Prerequisite(s): CHM 314; (CHM 420 or CHM 451).

CHM 450. Advanced Organic Synthesis. 3 Hours
Fundamentals of synthesis and transformations of organic compounds, with emphasis on mechanisms; pericyclic reactions; small and medium ring synthesis; chemoselectivity, regioselectivity, stereoselectivity, retrosynthesis, functional group transformations, carbon-carbon bond forming reactions, oxidations, reductions and protecting groups. Prerequisite: (CHM 314, CHM 314L) or equivalent.

CHM 451. General Biochemistry I. 3 Hours
Discussion of the chemistry and biochemistry of carbohydrates, amino acids, proteins, and nucleic acids, including health-science and methodologic aspects. Descriptions of enzymology, protein purification, and carbohydrate metabolism related to such topics as bioenergetics, membranes, and disease processes. Recommended for students desiring entry into graduate and professional schools. Prerequisite(s): CHM 201, CHM 314.

CHM 452. General Biochemistry II. 3 Hours
Discussion of selected topics in bioenergetics, and metabolism of lipids, amino acids, porphyrins, nucleic acids, and proteins. Current aspects of nutrition, biochemical genetics, endocrinology, regulation, and genetic engineering addressed and related to health-science topics as time permits. Suitable preparation for medical school. Prerequisite(s): CHM 451.
CHM 454. Rational Drug Design. 3 Hours
Introduction to drug target selection, lead compound discovery, and application of structure-activity relationships and computational chemistry towards refinement and optimization of lead compounds and their derivatives. Use of molecular graphics software and publicly available macromolecular structure databases will provide the foundation for evaluating macromolecular models of drug targets and allow a hands-on exploration of the structure/function relationships of proteins that have been successful targets of rational drug design. Prerequisite(s): (CHM 420 or CHM 452) or equivalent.

CHM 462L. Biochemistry Laboratory. 1 Hour
Laboratory course to accompany biochemistry lecture courses. Spectrophotometry, pH and dissociation, enzymologic methodology and analytical techniques, chromatographic techniques. Corequisite(s): CHM 420 or CHM 451.

CHM 463L. Bioanalytical Chemistry Laboratory. 1 Hour
Introduction to analytical methods in current use in biochemistry. Course will focus on separations and spectroscopic methods for the analysis of biomolecules. Prerequisite(s): CHM 201, CHM 201L, CHM 302.

CHM 477. Honors Thesis Project. 3 Hours
First of two courses leading to the selection, design, investigation, and completion of an independent, original Honors Thesis project under the guidance of a faculty research advisor. Restricted to students in the University Honors Program with permission of the program director and department chairperson. Students pursuing an interdisciplinary thesis topic may register for three semester hours each in two separate disciplines in consultation with the department chairpersons. Prerequisite(s): Approval of University Honors Program.

CHM 478. Honors Thesis Project. 3 Hours
Second of two courses leading to the selection, design, investigation, and completion of an independent, original Honors Thesis project under the guidance of a faculty research advisor. Restricted to students in the University Honors Program with permission of the program director and department chairperson. Students pursuing an interdisciplinary thesis topic may register for three semester hours each in two separate disciplines in consultation with the department chairpersons. Prerequisite(s): Approved 477; approval of University Honors Program.

CHM 480. Professional Practices Seminar. 1 Hour
Practicum which culminates in the presentation of a technical talk on a topic in chemistry to peers and faculty members. Emphasis on the molecular scale of observation.

CHM 490. Seminar IV. 1 Hour
Presentation of a research topic during the weekly seminar series for the Department of Chemistry. Prerequisite(s): CHM 480.

CHM 495. Introduction to Research Seminar. 0 Hours
Research topics presented by visiting scientists and faculty, and the results of thesis research by senior students. Required of all junior chemistry and biochemistry majors in the B.S. programs. Grading Option two.

CHM 496. Professional Practices Seminar. 0 Hours
After discussions of the chemical literature and information retrieval, resumes, graduate education, and career opportunities, students present technical talks on topics with social, ethical, or historical implications. Required of all chemistry and biochemistry majors, both B.S. and B.A.

CHM 497. Research Seminar. 0 Hours
A series of seminars as described under CHM 495. Required of all senior chemistry and biochemistry majors in the B.S. programs.

CHM 498. Research & Thesis. 3 Hours
All students in the B.S. programs including co-op students are required to enroll for a minimum of three semester hours in a research course (CHM 498). Students may take additional research semester hours (CHM 499) if the work extends for more than two semesters. Successful completion of research courses requires the submission of a typewritten thesis and the presentation of a seminar. With the prior approval of the department chairperson, B.S. co-op students may substitute work experience for research. Prerequisite(s): Permission of department chairperson.

CHM 499. Research & Thesis. 1-3 Hours
All students in the B.S. programs including co-op students are required to enroll for a minimum of three semester hours in a research course (CHM 498). Students may take additional research semester hours (CHM 499) if the work extends for more than two semesters. Successful completion of research courses requires the submission of a typewritten thesis and the presentation of a seminar. With the prior approval of the department chairperson, B.S. co-op students may substitute work experience for research. Prerequisite(s): CHM 498; permission of department chairperson.