Department of Chemistry

James S. Nowick, Department Chair  
1120 Natural Sciences II  
949-824-6018  
http://www.chem.uci.edu/

Overview

Chemistry is the science of molecules and materials. Chemistry plays a role in virtually all facets of life: whether you are interested in solar cells, medicines, food, personal care products, the atmosphere, minerals, your body, or even the origin of your own emotions, there is chemistry behind it. The Department of Chemistry at UCI is home to world-class faculty who engage in cutting edge research in diverse areas of chemistry, from atmospheric chemistry, to the biochemistry of cancer, to the development of new solar cell materials.

This broad perspective is also reflected in the courses offered through the Department of Chemistry, which range from general chemistry, to organic chemistry, to advanced topics such as molecular spectroscopy, nuclear chemistry, and chemical biology. On the undergraduate level, the Department offers various concentrations and tracks to majors, including programs in computational chemistry, biochemistry, chemical physics, synthesis, and chemistry education. Similarly, the Chemistry Graduate Program offers degrees and courses in all major sub-disciplines of chemistry including atmospheric chemistry, chemical biology, inorganic chemistry, organic chemistry, physical chemistry, and theoretical chemistry.

Undergraduate Program in Chemistry

The major in Chemistry is elected by students planning careers in the chemical sciences and frequently also by those whose interests lie in biology, medicine, earth sciences, secondary education, business, and law. The curriculum of the Department is designed to satisfy the diverse needs of these students and others who may have occasion to study chemistry. The year-long course CHEM M2A-CHEM M2B-CHEM M3C and CHEM M2LA-CHEM M2LB-CHEM M3LC (or the Honors sequence CHEM H2A-CHEM H2B-CHEM H2C and CHEM H2LA-CHEM H2LB-CHEM H2LC) is prerequisite to all study in the Department at more advanced levels. The subject matter of this course serves also as a thorough introduction to the varied aspects of modern chemistry for students who do not wish to pursue their studies beyond the introductory level.

One year of high school chemistry is strongly recommended for enrollment in CHEM M2A. Refer to the Guidelines for General Chemistry course placement located on the Testing Office website (http://www.testingcenter.uci.edu/chemistry.html). Students have an array of options to choose from in order to place into the first course. A preparatory course, CHEM 1P, is offered in summer and fall for those who have not taken a high school chemistry course, or who need additional preparation prior to entering CHEM M2A. A grade of C- or better in CHEM 1P automatically qualifies the student for CHEM M2A.

Completion of a one-year sequence in organic chemistry is required for Chemistry majors and for students of the life sciences. Certain advanced courses required of Chemistry majors may also be of interest to others.

The undergraduate program of the Chemistry Department emphasizes close contact with research. Chemistry majors are urged to engage in research or independent study under the direction of a faculty member. Information describing the procedures for arranging an undergraduate research opportunity is available on the Chemistry Department website (http://www.chem.uci.edu/undergrad).

Much of the important chemical literature is being and has been printed in foreign languages, principally German, Russian, Japanese, Chinese, and French. Reading competence in one or more of these languages is desirable, and Chemistry majors are encouraged to acquire this competence.

Chemistry majors who are interested in teaching chemistry at the secondary level are urged to consider completing the optional concentration in Chemistry Education. A two-year post-baccalaureate program for the M.S. in Chemistry and a California Secondary Teaching Credential is described in the Chemistry Graduate Program section. Chemistry majors who plan subsequent study in medical, dental, or other professional schools should request information concerning admission requirements directly from the schools which they seek to enter. Counseling about preparation for a career in the health sciences is provided by the health science advisors in the Francisco J. Ayala School of Biological Sciences. Those intending to pursue graduate studies in chemistry should discuss their plans with a faculty member no later than the fall quarter of their senior year.

Admission to the Major

Students may be admitted to the Chemistry major upon entering the University as freshmen, via change of major, or as transfer students from other colleges and universities. Information about change of major policies is available in the Physical Sciences Student Affairs Office and at the UCI Change of Major Criteria website (http://www.changeofmajor.uci.edu). For transfer student admission, preference will be given to junior-level applicants with the highest grades overall and who have satisfactorily completed the following required courses: one year of general chemistry with laboratory and one year of approved calculus. Completion of one year of organic chemistry is strongly recommended.
### Requirements for the B.S. in Chemistry

All students must meet the University Requirements. School Requirements: None.

#### Departmental Requirements

<table>
<thead>
<tr>
<th>Basic Requirements</th>
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</thead>
<tbody>
<tr>
<td>MATH 2A- 2B- 2D</td>
<td>Single-Variable Calculus and Single-Variable Calculus and Multivariable Calculus</td>
</tr>
<tr>
<td>PHYSICS 7C- 7D- 7E</td>
<td>Classical Physics and Classical Physics and Classical Physics</td>
</tr>
<tr>
<td>PHYSICS 7LC- 7LD</td>
<td>Classical Physics Laboratory and Classical Physics Laboratory</td>
</tr>
</tbody>
</table>

Select one of the following sequences and accompanying labs:

- CHEM M2A- M2B
  - Majors General Chemistry Lecture and Majors General Chemistry Lecture
- CHEM M3C
  - Majors Quantitative Analytical Chemistry
- CHEM M2LA- M2LB
  - Majors General Chemistry Laboratory and Majors General Chemistry Laboratory
- CHEM M3LC
  - Majors Quantitative Analytical Chemistry Laboratory
  - or
- CHEM H2A- H2B- H2C
  - Honors General Chemistry and Honors General Chemistry and Honors General Chemistry
- CHEM H2LA- H2LB- H2LC
  - Honors General Chemistry Laboratory and Honors General Chemistry Laboratory and Honors General Chemistry Laboratory

Select one of the following organic chemistry sequences and accompanying labs:

- CHEM 51A- 51B- 51C
  - Organic Chemistry and Organic Chemistry and Organic Chemistry
- CHEM M52LA- M52LB- M52LC
  - Majors Organic Chemistry Laboratory and Majors Organic Chemistry Laboratory and Majors Organic Chemistry Laboratory
  - or
- CHEM H52A- H52B- H52C
  - Honors Organic Chemistry and Honors Organic Chemistry and Honors Organic Chemistry
- CHEM H52LA- H52LB- H52LC
  - Honors Organic Chemistry Laboratory and Honors Organic Chemistry Laboratory and Honors Organic Chemistry Laboratory

Complete:

- CHEM 5
  - Scientific Mathematical and Computing Skills
- CHEM 107- 107L
  - Inorganic Chemistry and Inorganic Chemistry Laboratory
- CHEM 152
  - Advanced Analytical Chemistry
- CHEM 132A- 132B- 132C
  - Chemical Thermodynamics, Kinetics, and Dynamics and Quantum Principles, Spectroscopy, and Bonding and Molecular Structure and Elementary Statistical Mechanics

### Elective Requirements

Select at least five electives from the following lists, including at least two courses selected from the lecture list and two courses selected from the laboratory list:

**Lectures:**
- BIO SCI 98
  - Biochemistry
- BIO SCI 99
  - Molecular Biology
- CBEMS 110
  - Reaction Kinetics and Reactor Design
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBEMS 112</td>
<td>Introduction to Biochemical Engineering</td>
</tr>
<tr>
<td>CBEMS 130</td>
<td>Separation Processes</td>
</tr>
<tr>
<td>CBEMS 135</td>
<td>Chemical Process Control</td>
</tr>
<tr>
<td>CBEMS 143</td>
<td>Chemistry and Technology for the Nuclear Fuel Cycle</td>
</tr>
<tr>
<td>CBEMS 154</td>
<td>Polymer Science and Engineering</td>
</tr>
<tr>
<td>CHEM 125</td>
<td>Advanced Organic Chemistry</td>
</tr>
<tr>
<td>CHEM 127</td>
<td>Inorganic Chemistry II</td>
</tr>
<tr>
<td>CHEM 128</td>
<td>Introduction to Chemical Biology</td>
</tr>
<tr>
<td>CHEM 133</td>
<td>Nuclear and Radiochemistry</td>
</tr>
<tr>
<td>CHEM 137</td>
<td>Computational Chemistry</td>
</tr>
<tr>
<td>CHEM 138</td>
<td>Introduction to Computational Organic Chemistry</td>
</tr>
<tr>
<td>CHEM 141</td>
<td>Environmental Chemistry</td>
</tr>
<tr>
<td>CHEM 145A</td>
<td>Gas-Phase Atmospheric Chemistry</td>
</tr>
<tr>
<td>CHEM 145B</td>
<td>Multi-Phase Atmospheric Chemistry</td>
</tr>
<tr>
<td>CHEM 177</td>
<td>Medicinal Chemistry</td>
</tr>
<tr>
<td>CHEM 201</td>
<td>Organic Reaction Mechanisms I</td>
</tr>
<tr>
<td>CHEM 202</td>
<td>Organic Reaction Mechanisms II</td>
</tr>
<tr>
<td>CHEM 203</td>
<td>Organic Spectroscopy</td>
</tr>
<tr>
<td>CHEM 204</td>
<td>Organic Synthesis I</td>
</tr>
<tr>
<td>CHEM 205</td>
<td>Organic Synthesis II</td>
</tr>
<tr>
<td>CHEM 213</td>
<td>Chemical Kinetics</td>
</tr>
<tr>
<td>CHEM 215</td>
<td>Inorganic Chemistry I</td>
</tr>
<tr>
<td>CHEM 216</td>
<td>Organometallic Chemistry</td>
</tr>
<tr>
<td>CHEM 217</td>
<td>Physical Inorganic Chemistry</td>
</tr>
<tr>
<td>CHEM 218</td>
<td>Metallobiochemistry</td>
</tr>
<tr>
<td>CHEM 219</td>
<td>Chemical and Structural Biology</td>
</tr>
<tr>
<td>CHEM 221A</td>
<td>Fundamentals of Molecular Biophysics</td>
</tr>
<tr>
<td>CHEM 223</td>
<td>Biological Macromolecules</td>
</tr>
<tr>
<td>CHEM 224</td>
<td>Molecular and Cellular Biophotonics</td>
</tr>
<tr>
<td>CHEM 225</td>
<td>Polymer Chemistry: Synthesis and Characterization of Polymers</td>
</tr>
<tr>
<td>CHEM 228</td>
<td>Electromagnetism</td>
</tr>
<tr>
<td>CHEM 229A</td>
<td>Computational Methods</td>
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<tr>
<td>CHEM 229B</td>
<td>Computational Methods</td>
</tr>
<tr>
<td>CHEM 230</td>
<td>Classical Mechanics and Electromagnetic Theory</td>
</tr>
<tr>
<td>CHEM 231A</td>
<td>Fundamentals of Quantum Mechanics</td>
</tr>
<tr>
<td>CHEM 231B</td>
<td>Applications of Quantum Mechanics</td>
</tr>
<tr>
<td>CHEM 231C</td>
<td>Molecular Spectroscopy</td>
</tr>
<tr>
<td>CHEM 232A</td>
<td>Thermodynamics and Introduction to Statistical Mechanics</td>
</tr>
<tr>
<td>CHEM 232B</td>
<td>Advanced Topics in Statistical Mechanics</td>
</tr>
<tr>
<td>CHEM 232C</td>
<td>Non-Equilibrium Statistical Mechanics</td>
</tr>
<tr>
<td>CHEM 233</td>
<td>Nuclear and Radiochemistry</td>
</tr>
<tr>
<td>CHEM 235</td>
<td>Molecular Quantum Mechanics</td>
</tr>
<tr>
<td>CHEM 237</td>
<td>Mathematical Methods in Chemistry</td>
</tr>
<tr>
<td>CHEM 241</td>
<td>Current Issues Related to Tropospheric and Stratospheric Processes</td>
</tr>
<tr>
<td>CHEM 242A</td>
<td>Physical and Geometrical Optics</td>
</tr>
<tr>
<td>CHEM 242B</td>
<td>Applied Optics</td>
</tr>
<tr>
<td>CHEM 243</td>
<td>Advanced Instrumental Analysis</td>
</tr>
<tr>
<td>CHEM 244</td>
<td>Detection and Measurement of Radiation</td>
</tr>
<tr>
<td>CHEM 245A</td>
<td>Gas-Phase Atmospheric Chemistry</td>
</tr>
<tr>
<td>CHEM 245B</td>
<td>Multi-Phase Atmospheric Chemistry</td>
</tr>
<tr>
<td>CHEM 245C</td>
<td>Special Topics in Atmospheric Chemistry</td>
</tr>
<tr>
<td>CHEM 246</td>
<td>Separations and Chromatography</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
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</tr>
<tr>
<td>CHEM 247</td>
<td>Current Problems in Analytical Chemistry</td>
</tr>
<tr>
<td>CHEM 248</td>
<td>Electrochemistry</td>
</tr>
<tr>
<td>CHEM 249</td>
<td>Analytical Spectroscopy</td>
</tr>
<tr>
<td>CHEM 271</td>
<td>Structural X-Ray Crystallography</td>
</tr>
<tr>
<td>EARTHSS 142</td>
<td>Atmospheric Chemistry</td>
</tr>
<tr>
<td>EARTHSS 144</td>
<td>Marine Geochemistry and Biogeochemistry</td>
</tr>
<tr>
<td>PHYSICS 111A-111B</td>
<td>Classical Mechanics and Classical Mechanics</td>
</tr>
<tr>
<td>PHYSICS 112A-112B</td>
<td>Electromagnetic Theory and Electromagnetic Theory</td>
</tr>
</tbody>
</table>

**Laboratories:**
- BIO SCI M114L: Biochemistry Laboratory
- BIO SCI M116L: Molecular Biology Laboratory
- BIO SCI M118L: Experimental Microbiology Laboratory
- CBEMS 140A-140B: Chemical Engineering Laboratory I and Chemical Engineering Laboratory II
- CHEM 128L: Introduction to Chemical Biology Laboratory Techniques
- CHEM 133L: Nuclear and Radiochemistry Laboratory
- CHEM 153: Physical Chemistry Laboratory
- CHEM 156: Advanced Laboratory in Chemistry and Synthesis of Materials
- CHEM 160: Organic Synthesis Laboratory
- CHEM 170: Radioisotope Techniques
- CHEM 177L: Medicinal Chemistry Laboratory
- CHEM 180: Undergraduate Research
- PHYSICS 120-121W: Electronics for Scientists and Advanced Laboratory
- CHEM 197: Professional Internship

1. Courses must be taken for a letter grade.
2. At least three of the courses used to satisfy the Elective Requirement must be courses offered by the Chemistry Department, including at least one lecture course and one laboratory course.
3. CHEM 180 and CHEM H180 can be counted toward this requirement no more than once.

**Sample Program — Chemistry Majors**

Items in parentheses are recommended choices or alternatives.

**Freshman**
- **Fall**
  - CHEM M2A-M2LA (CHEM H2A, CHEM H2LA)
  - MATH 2A
  - Lower-division Writing
  - CHEM 11

- **Winter**
  - CHEM M2B-M2LB (CHEM H2B, CHEM H2LB)
  - MATH 2B
  - Lower-division Writing

- **Spring**
  - CHEM M3C-M3LC (CHEM H2C, CHEM H2LC)
  - MATH 2D
  - General Education

**Sophomore**
- **Fall**
  - CHEM 51A-52LA (CHEM H52A, CHEM H52LA)
  - CHEM 5
  - PHYSICS 7C-7LC

- **Winter**
  - CHEM 51B-52LB (CHEM H52B, CHEM H52LB)
  - General Education
  - PHYSICS 7D-7LD

- **Spring**
  - CHEM 51C-52LC (CHEM H52C, CHEM H52LC)
  - PHYSICS 7E
  - General Education

**Junior**
- **Fall**
  - CHEM 132A
  - CHEM 107
  - Chemistry Elective
  - General Education

- **Winter**
  - CHEM 132B
  - CHEM 152
  - Chemistry Elective
  - General Education

- **Spring**
  - CHEM 132C
  - CHEM 107L
  - Elective
  - General Education

**Senior**
- **Fall**
  - Elective/Research
  - Upper-division Writing
  - Chemistry Elective

- **Winter**
  - Elective/Research
  - Chemistry Elective
  - General Education

- **Spring**
  - Elective/Research
  - Chemistry Elective
  - General Education
Optional American Chemical Society Certification

For ACS Certification, the program must include:

A. The Chemical Biology lecture and lab courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>CHEM 128</td>
<td>Introduction to Chemical Biology</td>
</tr>
<tr>
<td>CHEM 128L</td>
<td>Introduction to Chemical Biology Laboratory Techniques</td>
</tr>
</tbody>
</table>

B. One course selected from the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 153</td>
<td>Physical Chemistry Laboratory</td>
</tr>
<tr>
<td>CHEM 156</td>
<td>Advanced Laboratory in Chemistry and Synthesis of Materials</td>
</tr>
<tr>
<td>CHEM 160</td>
<td>Organic Synthesis Laboratory</td>
</tr>
<tr>
<td>CHEM 180</td>
<td>Undergraduate Research</td>
</tr>
<tr>
<td>CHEM H180A</td>
<td>Honors Research in Chemistry</td>
</tr>
<tr>
<td>CHEM H180B</td>
<td>Honors Research in Chemistry</td>
</tr>
<tr>
<td>CHEM H180C</td>
<td>Honors Research in Chemistry</td>
</tr>
</tbody>
</table>

C. One course or the lecture/lab pair selected from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>CHEM 125</td>
<td>Advanced Organic Chemistry</td>
</tr>
<tr>
<td>CHEM 127</td>
<td>Inorganic Chemistry II</td>
</tr>
<tr>
<td>CHEM 133</td>
<td>Nuclear and Radiochemistry</td>
</tr>
<tr>
<td>CHEM 133L</td>
<td>Nuclear and Radiochemistry Laboratory</td>
</tr>
<tr>
<td>CHEM 138</td>
<td>Introduction to Computational Organic Chemistry</td>
</tr>
<tr>
<td>CHEM 141</td>
<td>Environmental Chemistry</td>
</tr>
<tr>
<td>CHEM 150</td>
<td>Computational Chemistry</td>
</tr>
<tr>
<td>CHEM 150L</td>
<td>Computational Chemistry Laboratory</td>
</tr>
<tr>
<td>CHEM 177</td>
<td>Medicinal Chemistry</td>
</tr>
<tr>
<td>CHEM 177L</td>
<td>Medicinal Chemistry Laboratory</td>
</tr>
<tr>
<td>or</td>
<td>CHEM 201-205, 213-249</td>
</tr>
</tbody>
</table>

D. One course or the lecture/lab pair selected from list B or C.

E. Independent research with a written thesis submitted as part of CHEM 180W or CHEM H181W.

Optional Concentrations and Specializations in Chemistry

The core chemistry curriculum provides the students with the foundational knowledge of the traditional areas of chemistry. In addition, the students have an option to focus their education on one of the following areas of chemistry by completing the chemistry core requirements and strategically choosing their elective requirements as shown below. At least two quarters of undergraduate research (CHEM 180, CHEM H180A, CHEM H180B, CHEM H180C) with a research group chosen in consultation with the faculty advisors are strongly recommended but not required for all the concentrations and specializations listed below. The names of the faculty advisors for each concentration and specialization can be found on the Department of Chemistry website.

Only one specialization or concentration may appear on the transcript. If students simultaneously satisfy requirements for more than one specialization or concentration, they should choose which one will be appearing on their transcript.

Optional Concentration in Chemical Biology

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>BIO SCI 97</td>
<td>Genetics</td>
</tr>
<tr>
<td>BIO SCI 98</td>
<td>Biochemistry</td>
</tr>
<tr>
<td>BIO SCI 99</td>
<td>Molecular Biology</td>
</tr>
<tr>
<td>CHEM 128</td>
<td>Introduction to Chemical Biology</td>
</tr>
<tr>
<td>CHEM 128L</td>
<td>Introduction to Chemical Biology Laboratory Techniques</td>
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</tbody>
</table>

Optional Specialization in Environmental Chemistry

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>CHEM 145A</td>
<td>Gas-Phase Atmospheric Chemistry</td>
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<tr>
<td>or EARTHSS 142</td>
<td>Atmospheric Chemistry</td>
</tr>
<tr>
<td>EARTHSS 144</td>
<td>Marine Geochemistry and Biogeochemistry</td>
</tr>
<tr>
<td>CHEM 141</td>
<td>Environmental Chemistry</td>
</tr>
<tr>
<td>Course</td>
<td>Title</td>
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</tr>
<tr>
<td>CHEM 153</td>
<td>Physical Chemistry Laboratory</td>
</tr>
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<td></td>
<td><strong>Optional Specialization in Medicinal Chemistry</strong></td>
</tr>
<tr>
<td>CHEM 128</td>
<td>Introduction to Chemical Biology</td>
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<tr>
<td>CHEM 128L</td>
<td>Introduction to Chemical Biology Laboratory Techniques</td>
</tr>
<tr>
<td>CHEM 160</td>
<td>Organic Synthesis Laboratory</td>
</tr>
<tr>
<td>CHEM 177</td>
<td>Medicinal Chemistry</td>
</tr>
<tr>
<td>CHEM 177L</td>
<td>Medicinal Chemistry Laboratory</td>
</tr>
<tr>
<td></td>
<td><strong>Optional Specialization in Nuclear and Radiochemistry</strong></td>
</tr>
<tr>
<td>CHEM 133</td>
<td>Nuclear and Radiochemistry</td>
</tr>
<tr>
<td>CHEM 133L</td>
<td>Nuclear and Radiochemistry Laboratory</td>
</tr>
<tr>
<td>CBEMS 143</td>
<td>Chemistry and Technology for the Nuclear Fuel Cycle</td>
</tr>
<tr>
<td>CHEM 153</td>
<td>Physical Chemistry Laboratory</td>
</tr>
<tr>
<td></td>
<td><strong>Optional Specialization in Synthetic Chemistry</strong></td>
</tr>
<tr>
<td>CHEM 125</td>
<td>Advanced Organic Chemistry</td>
</tr>
<tr>
<td>CHEM 127</td>
<td>Inorganic Chemistry II</td>
</tr>
<tr>
<td>CHEM 156</td>
<td>Advanced Laboratory in Chemistry and Synthesis of Materials</td>
</tr>
<tr>
<td>CHEM 160</td>
<td>Organic Synthesis Laboratory</td>
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<td></td>
<td><strong>Optional Concentration in Chemistry Education</strong></td>
</tr>
<tr>
<td>CHEM 193</td>
<td>Research Methods</td>
</tr>
<tr>
<td>EDUC 55</td>
<td>Knowing and Learning in Mathematics and Science</td>
</tr>
<tr>
<td>PHY SCI 5</td>
<td>California Teach 1: Introduction to Science and Mathematics Teaching</td>
</tr>
<tr>
<td>PHY SCI 105</td>
<td>California Teach 2: Middle School Science and Mathematics Teaching</td>
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<tr>
<td></td>
<td><strong>Optional Concentration in Theoretical and Computational Chemistry</strong></td>
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<tr>
<td></td>
<td>The concentration in Theoretical and Computational Chemistry aims to provide a rigorous education for Chemistry majors with special interests in theory and computation. Compared to the regular Chemistry major, additional courses in mathematics, physics, and computer science are required, while upper-division laboratory courses are optional. Enrolling in this concentration requires approval by a faculty advisor. The advisors will be members of the Theoretical and Computational Chemistry faculty group, and will assist the students in choosing elective courses tailored to the students' interests.</td>
</tr>
<tr>
<td>A. Complete the following:</td>
<td></td>
</tr>
<tr>
<td>MATH 3A</td>
<td>Introduction to Linear Algebra</td>
</tr>
<tr>
<td>MATH 3D</td>
<td>Elementary Differential Equations</td>
</tr>
<tr>
<td>PHYSICS 50</td>
<td>Mathematical Methods for Physical Science</td>
</tr>
<tr>
<td>CHEM 150</td>
<td>Computational Chemistry</td>
</tr>
<tr>
<td>CHEM 150L</td>
<td>Computational Chemistry Laboratory</td>
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<tr>
<td></td>
<td><strong>Select at least nine courses from the following or the Chemistry major electives:</strong></td>
</tr>
<tr>
<td>B. Select at least one from the following:</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 111A</td>
<td>Classical Mechanics</td>
</tr>
<tr>
<td>PHYSICS 112A</td>
<td>Electromagnetic Theory</td>
</tr>
<tr>
<td>PHYSICS 111B</td>
<td>Classical Mechanics</td>
</tr>
<tr>
<td>PHYSICS 112B</td>
<td>Electromagnetic Theory</td>
</tr>
<tr>
<td>PHYSICS 113A</td>
<td>Quantum Physics</td>
</tr>
<tr>
<td>PHYSICS 113B</td>
<td>Quantum Physics</td>
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<td>PHYSICS 113C</td>
<td>Quantum Physics</td>
</tr>
<tr>
<td>PHYSICS 115A</td>
<td>Statistical Physics</td>
</tr>
<tr>
<td>PHYSICS 125A</td>
<td>Mathematical Physics</td>
</tr>
<tr>
<td>PHYSICS 125B</td>
<td>Mathematical Physics</td>
</tr>
<tr>
<td></td>
<td>C. Select at least one from the following:</td>
</tr>
<tr>
<td>MATH 105A-105LA</td>
<td>Numerical Analysis and Numerical Analysis Laboratory</td>
</tr>
</tbody>
</table>
MATH 105B- 105LB  Numerical Analysis and Numerical Analysis Laboratory

STATS 7  Basic Statistics
STATS 110  Statistical Methods for Data Analysis I
STATS 111  Statistical Methods for Data Analysis II
STATS 112  Statistical Methods for Data Analysis III

D. Select at least one of the following:

EECS 12  Introduction to Programming
EECS 20  Computer Systems and Programming in C
EECS 22  Advanced C Programming
EECS 22L  Software Engineering Project in C Language

Optional Courses - The following courses are required for the regular Chemistry major, but optional for the Concentration in Theoretical and Computational Chemistry:

CHEM 5  Scientific Mathematical and Computing Skills
CHEM 107L  Inorganic Chemistry Laboratory
CHEM 152  Advanced Analytical Chemistry

All electives listed under the Chemistry major.

Sample Program - Concentration in Theoretical and Computational Chemistry

Items in parentheses are recommended choices or alternatives.

Freshman

Fall  Winter  Spring
MATH 2A  MATH 2B  MATH 2D
Lower-Division Writing  Lower-Division Writing  General Education

Sophomore

Fall  Winter  Spring
CHEM 51A- M52LA (CHEM H52A, CHEM H52LA)  CHEM 51B- M52LB (CHEM H52B, CHEM H52LB)  CHEM 51C- M52LC (CHEM H52C, CHEM H52LC)
PHYSICS 7C- 7LC  PHYSICS 7D- 7LD  PHYSICS 7E
MATH 3A  MATH 3D  PHYSICS 50

Junior

Fall  Winter  Spring
CHEM 132A  CHEM 132B  CHEM 132C
CHEM 107  PHYSICS 112A  PHYSICS 113A
PHYSICS 111A  General Education  EECS 20
EECS 12  General Education  General Education

Senior

Fall  Winter  Spring
CHEM 150  CHEM 150L  Elective/Research
MATH 105A- 105LA  EECS 22L (MATH 105B - MATH 105LB)  General Education
EECS 22 (STATS 7)  General Education  General Education
Upper-Division Writing  General Education  General Education

Sample program for transfer students entering at the Junior level

Junior

Fall  Winter  Spring
CHEM 132A  CHEM 132B  CHEM 132C
CHEM 107  STATS 7  PHYSICS 50
MATH 105A- 105LA  General Education  EECS 20
EECS 12  General Education  General Education

Senior

Fall  Winter  Spring
CHEM 150  CHEM 150L  PHYSICS 113A
PHYSICS 111A  General Education  EECS 22L
General Education  General Education  General Education
Upper-Division Writing  General Education  General Education
Secondary Teaching Certification Option

With additional course work and field experience offered through the UCI Cal Teach program, students who complete the concentration in Chemistry Education can also earn a California Preliminary Single Subject Teaching Credential. Completing the bachelor’s degree, concentration, and teacher certification in four years is possible with careful, early planning. Additional courses required for teacher certification are:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC 109</td>
<td>Reading and Writing in Secondary Mathematics and Science Classrooms</td>
</tr>
<tr>
<td>EDUC 143AW-143BW</td>
<td>Classroom Interactions I and Classroom Interactions II</td>
</tr>
<tr>
<td>EDUC 148</td>
<td>Complex Pedagogical Design</td>
</tr>
<tr>
<td>EDUC 158</td>
<td>Student Teaching Mathematics and Science in Middle/High School (two quarters)</td>
</tr>
<tr>
<td>LPS 60</td>
<td>The Making of Modern Science</td>
</tr>
</tbody>
</table>

Successful completion of EDUC 143AW-EDUC 143BW and EDUC 148 will be accepted in lieu of two electives (from the above Elective Requirements list) for students pursuing the concentration in Chemistry Education. For additional information about teacher certification requirements and enrollment procedures, see Preparation for Teaching Science and Mathematics. Interested students are strongly encouraged to contact the Cal Teach Resource and Advising Center or the Physical Sciences Student Affairs Office.

Sample Program — Concentration in Chemistry Education (with Secondary Teaching Certification option)

Items in parentheses are recommended choices or alternatives.

<table>
<thead>
<tr>
<th>Year</th>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Winter</td>
<td>MATH 2A</td>
<td>MATH 2B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PHY SCI 5</td>
<td>General Education</td>
</tr>
<tr>
<td>Sophomore</td>
<td>Fall</td>
<td>CHEM 51A- M52LA (CHEM H52C, CHEM H52LA)</td>
<td>CHEM 51B- M52LB (CHEM H52B, CHEM H52LB)</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>CHEM 5</td>
<td>PHYSICS 7C-7LC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PHY SCI 105</td>
<td>CHEM 193</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(PHYSICS 2)</td>
<td>General Education</td>
</tr>
<tr>
<td>Junior</td>
<td>Fall</td>
<td>CHEM 132A</td>
<td>CHEM 132B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHEM 107</td>
<td>CHEM 107L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EDUC 55</td>
<td>Chemistry Elective</td>
</tr>
<tr>
<td></td>
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<td>PHYSICS 7E</td>
<td>EDUC 143AW</td>
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<tr>
<td>Senior</td>
<td>Fall</td>
<td>Chemistry Elective</td>
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<td></td>
<td>Winter</td>
<td>EDUC 143BW</td>
<td>EDUC 109</td>
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<td></td>
<td>General Education</td>
<td>EDUC 158</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chemistry Elective</td>
<td>General Education</td>
</tr>
</tbody>
</table>

Additional Information

Honors Program in Chemistry

The Honors Program in Chemistry is a research-based program offered to selected Chemistry majors during their final year. Applicants to the program must have completed their junior year with a grade point average of at least 3.3 overall and in their Chemistry courses. They must also have demonstrated the potential of carrying out research of honors quality, as judged by the Chemistry faculty member who will supervise their research. Students in this program enroll in Honors Research in Chemistry (CHEM H180A-CHEM H180B-CHEM H180C) throughout their senior year and submit a formal thesis late in the spring quarter. They also enroll in the Honors Seminar in Chemistry (CHEM H181W), in which they receive instruction in scientific writing and present a formal research seminar. Successful completion of CHEM H181W satisfies the UCI upper-division writing requirement. NOTE: Students enrolled in the Honors Research in Chemistry (CHEM H180A-CHEM H180B-CHEM H180C) do not enroll in CHEM 180 (Undergraduate Research).

Students who complete these requirements, whose grade point average remains above the 3.3 standard, and whose research is judged to be of honors quality will graduate with Departmental Honors in Chemistry.
The Department also offers an Honors General Chemistry sequence, CHEM H2A-CHEM H2B-CHEM H2C. This course in general chemistry is designed for members of the Campuswide Honors Program (CHP) and other highly qualified students. It covers the same material as CHEM 1A-CHEM 1B-CHEM M3C, but in greater depth.

Additional information is available from the Chemistry Undergraduate Program Office.

### Planning a Program of Study

The departmental requirements leave the student a great deal of latitude in choice of courses; the student can choose to pursue interests ranging from biochemistry on the one hand to chemical physics on the other. Many of the basic requirements above coincide with those of the School of Biological Sciences. For this reason a double major in Chemistry and Biological Sciences is popular. The Department is approved by the American Chemical Society to offer an undergraduate degree certified by the Society as suitable background for a career in chemistry or for graduate study in chemistry. While it is not mandatory, it is desirable for students to pursue a course of study that the Department judges to merit a certified degree. Specifically, the following courses must be included in the program of study and must be taken for a letter grade:

- CHEM 128 or BIO SCI 98
  - Introduction to Chemical Biology
  - Biochemistry

And two laboratory courses from the list of upper-division laboratory courses that are not already required for the major from the following:

- CHEM 128L
  - Introduction to Chemical Biology Laboratory Techniques
- CHEM 152
  - Advanced Analytical Chemistry
- CHEM 153
  - Physical Chemistry Laboratory
- CHEM 156
  - Advanced Laboratory in Chemistry and Synthesis of Materials
- CHEM 160
  - Organic Synthesis Laboratory
- CHEM 170
  - Radioisotope Techniques
- CHEM 177L
  - Medicinal Chemistry Laboratory
- CHEM 180
  - Undergraduate Research (or CHEM H180)

### Sample Program — Chemistry-Biological Sciences Double Majors

Items in parentheses are recommended choices or alternatives.

#### Freshman

<table>
<thead>
<tr>
<th>Semester</th>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MATH 2A</td>
<td>MATH 2B</td>
<td>MATH 2D</td>
</tr>
<tr>
<td></td>
<td>BIO SCI 93</td>
<td>BIO SCI 94</td>
<td>General Education</td>
</tr>
<tr>
<td></td>
<td>CHEM 11</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>BIO SCI 2A</td>
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</table>

#### Sophomore

<table>
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<tr>
<th>Semester</th>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Sophomore</td>
<td>CHEM 51A- M52LA (CHEM H52A, CHEM H52LA)</td>
<td>CHEM 51B- M52LB (CHEM H52B, CHEM H52LB)</td>
<td>CHEM 51C- M52LC (CHEM H52C, CHEM H52LC)</td>
</tr>
<tr>
<td></td>
<td>CHEM 5</td>
<td>PHYSICS 7C- 7LC</td>
<td>PHYSICS 7D- 7LD</td>
</tr>
<tr>
<td></td>
<td>(Physics 2)</td>
<td>BIO SCI 98</td>
<td>BIO SCI 99</td>
</tr>
<tr>
<td></td>
<td>BIO SCI 97</td>
<td>General Education/Elective</td>
<td>BIO SCI 194S</td>
</tr>
</tbody>
</table>

#### Junior

<table>
<thead>
<tr>
<th>Semester</th>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>Junior</td>
<td>CHEM 132A</td>
<td>CHEM 132B</td>
<td>CHEM 132C</td>
</tr>
<tr>
<td></td>
<td>PHYSICS 7E</td>
<td>CHEM 107L</td>
<td>Bio. Sci. major course</td>
</tr>
<tr>
<td></td>
<td>CHEM 107</td>
<td>General Education/Elective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BIO SCI 100</td>
<td></td>
<td></td>
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</tbody>
</table>

#### Senior

<table>
<thead>
<tr>
<th>Semester</th>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior</td>
<td>Bio. Sci. major course</td>
<td>Chemistry Elective</td>
<td>Chemistry Elective</td>
</tr>
<tr>
<td></td>
<td>General Education/Elective</td>
<td>General Education/Elective</td>
<td>General Education/Elective</td>
</tr>
</tbody>
</table>

### Graduate Program

The Department offers an M.S. and a Ph.D. in Chemistry. The Ph.D. is granted in recognition of breadth and depth of knowledge of the facts and theories of modern chemistry and an ability to carry out independent chemical research demonstrated through submission of an acceptable doctoral
dissertation. The M.S. may be earned either through submission of an acceptable Master's thesis (Plan I) or through an approved program of graduate
course work and a comprehensive oral examination (Plan II). A Master's degree is not a prerequisite for admission to the Ph.D. program.

Students in the Ph.D. and M.S. Plan I (Thesis) programs are required to complete a minimum of seven approved four-unit courses including six
graduate-level courses. The M.S. Plan II (Non-Thesis) program requires that the student complete 10 four-unit courses including eight graduate level
courses and a comprehensive oral examination. Graduate students are expected to attain grades of B or better to remain in good academic standing.
The comprehensive oral examination assesses the competence of the candidate in the areas of chemistry covered by the chosen course work, with
unanimous agreement among the three examination committee members required for satisfactory completion.

Progress toward the Ph.D. during the first year is assessed by a written examination administered after completion of the first year of study. This
examination covers either research accomplishments during the first year or comprehensive knowledge acquired in course work. The time and content
of the examination depends upon the student's specific area of interest.

Training in teaching is an integral part of each graduate program, and all graduate degree candidates are expected to participate in the teaching
program for at least four quarters during their graduate career.

Participants in the Ph.D. program take an oral examination for formal Advancement to Candidacy. This examination consists of an oral defense before
a faculty committee of the student's dissertation research project, and an original research proposition conceived, developed, and documented by the
student. The committee may examine the student at this time on any subject it deems relevant to the independent pursuit of chemical research. For
students in organic chemistry, the candidacy exam must be taken by the end of the sixth quarter in residence. For students in inorganic chemistry, the
candidacy exam must be taken by the end of the seventh quarter in residence.

The most important component of the Ph.D. program is the doctoral dissertation, which must describe the results of original research performed by
the student under the supervision of a faculty member of the Department. The criterion for acceptability of the dissertation is that its contents be of a
quality suitable for publication in a scientific journal of high editorial standards. Each Ph.D. candidate is expected to present the work described in the
completed dissertation in a seminar before the Department, following which the candidate will be examined on the contents of the dissertation by a
committee of the faculty. A Master's thesis presented in partial fulfillment of the requirements for the M.S. under Plan I must also describe the results of a
student's original research performed under the direction of a faculty member. However, no public oral defense of the Master's thesis is required.

Residency requirements specify a minimum of six quarters in residence at UCI for Ph.D. candidates and three quarters for M.S. candidates.

The normative time for completion of the Ph.D. is five years, and the maximum time permitted is seven years.

Master of Science in Chemistry Plan I (Thesis Plan)
- Completion of a minimum of seven approved four-unit courses, including six graduate-level courses (as specified by the Department and excluding
  CHEM 280, CHEM 290, CHEM 291, and CHEM 399) with maintenance of a grade of B or better.
- Completion of the teaching requirement.
- Completion of three quarters in residence at UCI.
- Submission of an acceptable Master's thesis.

Master of Science in Chemistry Plan II (Non-Thesis Plan)
- Completion of 10 four-unit courses including eight graduate-level courses (as specified by the department and excluding CHEM 290, CHEM 291,
  and CHEM 399 and counting CHEM 280 no more than once) with a grade of B or better.
- Completion of the teaching requirement.
- Completion of three quarters in residence at UCI.
- Satisfactory completion of a comprehensive oral examination.

Doctor of Philosophy in Chemistry
- Completion of a minimum of seven approved four-unit courses, including six graduate-level courses (as specified by the Department and excluding
  CHEM 280, CHEM 290, CHEM 291, and CHEM 399) with maintenance of a grade of B or better. In addition, all students will be required to take a
  "Conduct of Research" course.
- Completion of the second-year Examination requirement.
- Completion of the Oral Examination requirement for Advancement to Candidacy.
- Completion of the teaching requirement.
- Completion of six quarters in residence at UCI.
- Submission of an acceptable doctoral dissertation.

Concentration in Chemical and Materials Physics
This is an interdisciplinary program between condensed matter physics and physical chemistry, which is designed to eliminate the barrier between these
two disciplines. Students with a B.S. in Physics, Chemistry, or Materials Science and Engineering, are encouraged to apply to the program. The goal
of the concentration in Chemical and Materials Physics (ChaMP) is to provide students with a broad interdisciplinary education in the applied physical sciences that emphasizes modern laboratory and computational skills. The program accepts students for both the M.S. and the Ph.D. Upon admission to the program, students are assigned two faculty advisors, one from the Department of Physics and Astronomy, and one from the Department of Chemistry, to provide guidance on curriculum and career planning.

Requirements

The curriculum for the M.S. program includes a summer session to assimilate students with different undergraduate backgrounds; formal shop, laboratory, and computational courses; a sequence on current topics to bridge the gap between fundamental principles and applied technology; and a course to develop communication skills. The required courses include thirteen core courses and three electives (subject to advisor approval) as follows:

### Core

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 206</td>
<td>Laboratory Skills</td>
</tr>
<tr>
<td>CHEM 208</td>
<td>Mathematics for Chemists</td>
</tr>
<tr>
<td>CHEM 229A</td>
<td>Computational Methods</td>
</tr>
<tr>
<td>CHEM 231A</td>
<td>Fundamentals of Quantum Mechanics</td>
</tr>
<tr>
<td>or PHYSICS 215A</td>
<td>Quantum Mechanics</td>
</tr>
<tr>
<td>CHEM 231B</td>
<td>Applications of Quantum Mechanics</td>
</tr>
<tr>
<td>or PHYSICS 215B</td>
<td>Quantum Mechanics</td>
</tr>
<tr>
<td>CHEM 231C</td>
<td>Molecular Spectroscopy</td>
</tr>
<tr>
<td>CHEM 232A- 232B</td>
<td>Thermodynamics and Introduction to Statistical Mechanics and Advanced Topics in Statistical Mechanics</td>
</tr>
<tr>
<td>CHEM 266</td>
<td>Current Topics in Chemical and Materials Physics</td>
</tr>
<tr>
<td>CHEM 273</td>
<td>Technical Communication Skills</td>
</tr>
<tr>
<td>or PHYSICS 273</td>
<td>Technical Communication Skills</td>
</tr>
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</table>

Select two of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 228</td>
<td>Electromagnetism</td>
</tr>
<tr>
<td>CHEM 230</td>
<td>Classical Mechanics and Electromagnetic Theory</td>
</tr>
<tr>
<td>PHYSICS 211</td>
<td>Classical Mechanics</td>
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<tr>
<td>PHYSICS 222</td>
<td>Continuum Mechanics</td>
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Select one of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>PHYSICS 133</td>
<td>Introduction to Condensed Matter Physics</td>
</tr>
<tr>
<td>PHYSICS 238A</td>
<td>Condensed Matter Physics</td>
</tr>
</tbody>
</table>

### Electives

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 213</td>
<td>Chemical Kinetics</td>
</tr>
<tr>
<td>CHEM 225</td>
<td>Polymer Chemistry: Synthesis and Characterization of Polymers</td>
</tr>
<tr>
<td>CHEM 229B</td>
<td>Computational Methods</td>
</tr>
<tr>
<td>CHEM 232C</td>
<td>Non-Equilibrium Statistical Mechanics</td>
</tr>
<tr>
<td>CHEM 233</td>
<td>Nuclear and Radiochemistry</td>
</tr>
<tr>
<td>CHEM 243</td>
<td>Advanced Instrumental Analysis</td>
</tr>
<tr>
<td>CHEM 248</td>
<td>Electrochemistry</td>
</tr>
<tr>
<td>CHEM 249</td>
<td>Analytical Spectroscopy</td>
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<tr>
<td>EECS 285B</td>
<td>Lasers and Photonics</td>
</tr>
<tr>
<td>ENGRMSE 259</td>
<td>Transmission Electron Microscopy</td>
</tr>
<tr>
<td>PHYSICS 134A</td>
<td>Physical and Geometrical Optics</td>
</tr>
<tr>
<td>PHYSICS 233A-233B</td>
<td>Principles of Imaging and Techniques in Medical Imaging I: X-ray, Nuclear, and NMR Imaging</td>
</tr>
<tr>
<td>PHYSICS 238A-238B-238C</td>
<td>Condensed Matter Physics and Condensed Matter Physics</td>
</tr>
</tbody>
</table>

In addition to the required courses, M.S. students complete a master’s thesis. Students are required to advance to candidacy for the master’s degree at least one quarter prior to filing the master’s thesis. There is no examination associated with this advancement, but the thesis committee needs to be selected and appropriate forms need to be filed. The M.S. program prepares students to compete for high-tech jobs or to begin research toward a Ph.D.
Successful completion of the M.S. requirements qualifies students for the Ph.D. program. Progress toward the Ph.D. is assessed by a written comprehensive examination administered in the summer after completion of the first year of study. This examination covers comprehensive knowledge acquired in course work, and the content of the examination depends upon the student’s specific area of interest.

Participants in the Ph.D. program take an examination for formal advancement to candidacy. It is typically taken within one year of successful completion of the comprehensive examination. To satisfy normative progress toward the degree, it must be taken by the end of the student’s third year. The examination is comprised of two parts: (a) a written report on a topic to be determined in consultation with the research advisor and (b) an oral report on research accomplished and plans for completion of the Ph.D. dissertation.

Graduate Gateway Program in Medicinal Chemistry and Pharmacology (MCP)
The one-year graduate Gateway Program in Medicinal Chemistry and Pharmacology (MCP) is designed to function in concert with selected department programs, including the Ph.D. in Chemistry. Detailed information is available in the Department of Pharmaceutical Sciences section and on the Pharmaceutical Sciences website. (http://www.pharmsci.uci.edu)

Faculty
Ioan Andricioaei, Ph.D. Boston University, Professor of Chemistry; Physics and Astronomy (chemical biology, physical chemistry and chemical physics, theoretical and computational)
Ara Apkarian, Ph.D. Northwestern University, Professor of Chemistry (physical chemistry and chemical physics)
Ramesh D. Arasasingham, Ph.D. University of California, Davis, Senior Lecturer of Chemistry (chemical education and inorganic chemistry)
Shane Ardo, Ph.D. Johns Hopkins University, Assistant Professor of Chemistry; Chemical Engineering and Materials Science (inorganic and organometallic, physical chemistry and chemical physics, polymer, materials, nanoscience)
Donald R. Blake, Ph.D. University of California, Irvine, UCI Distinguished Professor of Chemistry (analytical, atmospheric, environmental)
Kent Blasie, Ph.D. University of Michigan, Adjunct Professor of Chemistry
Suzanne A. Blum, Ph.D. University of California, Berkeley, Associate Professor of Chemistry; Chemistry (inorganic and organometallic, organic and synthetic, physical chemistry and chemical physics, polymer, materials, nanoscience)
Andrew Borovik, Ph.D. University of North Carolina at Chapel Hill, Professor of Chemistry (inorganic and organometallic, organic and synthetic)
David A. Brant, Ph.D. University of Wisconsin-Madison, Professor Emeritus of Chemistry (biophysical)
Kieron Burke, Ph.D. University of California, Santa Barbara, Professor of Chemistry; Physics and Astronomy (physical chemistry and chemical physics, polymer, materials, nanoscience, theoretical and computational)
Ann Marie Carlton, Ph.D. Rutgers University, Associate Professor of Chemistry (atmospheric and environmental, physical chemistry and chemical physics, theoretical and computational)
A. Richard Chamberlin, Ph.D. University of California, San Diego, Department Chair and Professor of Pharmaceutical Sciences; Chemistry; Pharmacology (chemical biology, organic and synthetic)
Robert Corn, Ph.D. University of California, Berkeley, Professor of Chemistry; Biomedical Engineering (analytical, chemical biology, physical chemistry and chemical physics, polymer, materials, nanoscience)
Robert J. Doedens, Ph.D. University of Wisconsin-Madison, Professor Emeritus of Chemistry (inorganic and organometallic)
Vy M. Dong, Ph.D. California Institute of Technology, Professor of Chemistry (organic and synthetic)
Kimberly D. Edwards, Ph.D. University of California, Irvine, Department Vice Chair and Senior Lecturer with Security of Employment of Chemistry (general chemistry)
Aaron P. Esser-Kahn, Ph.D. University of California, Berkeley, Associate Professor of Chemistry; Biomedical Engineering; Chemical Engineering and Materials Science (chemical biology, organic and synthetic, polymer, materials, nanoscience)
William J. Evans, Ph.D. University of California, Los Angeles, Professor of Chemistry (inorganic and organometallic)
Barbara J. Finlayson-Pitts, Ph.D. University of California, Riverside, Director of AirUCI and UCI Distinguished Professor of Chemistry; Chemistry (chemistry, analytical and environmental, physical chemistry and chemical physics)
Fillmore Freeman, Ph.D. Michigan State University, Professor of Chemistry (organic and synthetic, theoretical and computational)
Filipp Furche, Ph.D. University of Karlsruhe, Professor of Chemistry (physical chemistry and chemical physics, theoretical and computational)
Nien-Hui Ge, Ph.D. University of California, Berkeley, Associate Professor of Chemistry (analytical, chemical biology, physical chemistry and chemical physics, polymer, materials, nanoscience)

Robert B. Gerber, Ph.D. Oxford University, Professor Emeritus of Chemistry (atmospheric and environmental, physical chemistry and chemical physics, theoretical and computational)

Alon A. Gorodetsky, Ph.D. California Institute of Technology, Assistant Professor of Chemical Engineering and Materials Science; Chemistry (organic photovoltaics, electrical biosensors, nanotechnology, DNA, materials chemistry)

Michael T. Green, Ph.D. University of Chicago, Professor of Molecular Biology and Biochemistry; Chemistry (chemical, biology, inorganic and organometallic, physical chemistry and chemical physics, theoretical and computational)

Zhibin Guan, Ph.D. University of North Carolina at Chapel Hill, Professor of Chemistry; Biomedical Engineering; Chemical Engineering and Materials Science (chemical biology, organic and synthetic, polymer, materials, nanoscience)

Stephen Hanessian, Ph.D. Ohio State University, Director of Medicinal Chemistry and Pharmacology Graduate Program and Professor of Pharmaceutical Sciences; Chemistry; Pharmacology (organic chemistry)

John C. Hemminger, Ph.D. Harvard University, Professor of Chemistry (analytical, atmospheric and environmental, physical chemistry and chemical physics, polymer, materials, nanoscience)

Alan F. Heyduk, Ph.D. Massachusetts Institute of Technology, Department Vice Chair and Professor of Chemistry (chemical biology, inorganic and organometallic)

Wilson Ho, Ph.D. University of Pennsylvania, Donald Bren Professor and Professor of Physics and Astronomy; Chemistry (physical chemistry and chemical physics, polymer, materials, nanoscience)

Allon I. Hochbaum, Ph.D. University of California, Berkeley, Assistant Professor of Chemical Engineering and Materials Science; Chemistry (nanoscale materials and hybrid bio-inorganic devices for applications in clean energy)

Amanda J. Holton, Ph.D. University of California, Irvine, Lecturer with Potential Security of Employment of Chemistry (chemistry)

Kenneth C. Janda, Ph.D. Harvard University, Dean of the School of Physical Sciences and Professor of Chemistry (physical chemistry and chemical physics)

Elizabeth R. Jarvo, Ph.D. Boston College, Department Vice Chair and Associate Professor of Chemistry (inorganic and organometallic, organic and synthetic)

Susan M. King, Ph.D. Massachusetts Institute of Technology, Lecturer with Security of Employment of Chemistry (organic chemistry)

Matthew Law, Ph.D. University of California, Berkeley, Associate Professor of Chemical Engineering and Materials Science; Chemistry (inorganic and organometallic, physical chemistry and chemical physics, polymer, materials, nanoscience)

Renee Link, Ph.D. University of California, Irvine, Lecturer with Security of Employment of Chemistry (organic chemistry)

Chang C. Liu, Ph.D. Scripps Research Institute, Assistant Professor of Biomedical Engineering; Chemistry (genetic engineering, directed evolution, synthetic biology, chemical biology)

Andrej Luptak, Ph.D. Yale University, Associate Professor of Pharmaceutical Sciences; Chemistry; Molecular Biology and Biochemistry (chemical biology)

Vladimir A. Mandelshtam, Ph.D. Russian Academy of Sciences, Professor of Chemistry (physical chemistry and chemical physics, theoretical and computational)

Stephen Mang, Ph.D. University of California, Irvine, Lecturer with Potential Security of Employment of Chemistry (chemical education, advanced laboratories)

Craig C. Martens, Ph.D. Cornell University, Professor of Chemistry (physical chemistry and chemical physics, polymer, materials, nanoscience, theoretical and computational)

Rachel Martin, Ph.D. Yale University, Associate Professor of Chemistry; Molecular Biology and Biochemistry (analytical, chemical biology, physical chemistry and chemical physics)

George E. Miller, Ph.D. Oxford University, Senior Lecturer with Security of Employment Emeritus of Chemistry (analytical and radioanalytical chemistry and chemical education)
David L. Mobley, Ph.D. University of California, Davis, Associate Professor of Pharmaceutical Sciences; Chemistry (chemical biology, physical chemistry and chemical physics, theoretical and computational)

Harold W. Moore, Ph.D. University of Illinois at Urbana-Champaign, Professor Emeritus of Chemistry (organic and synthetic)

Shaul Mukamel, Ph.D. Tel Aviv University, UCI Distinguished Professor of Chemistry; Physics and Astronomy (physical chemistry and chemical physics, polymer, materials, nanoscience, theoretical and computational)

Craig Murray, Ph.D. University of Edinburgh, Assistant Professor of Chemistry (atmospheric and environmental, physical chemistry and chemical physics)

Mikael Nilsson, Ph.D. Chalmers University of Technology, Associate Professor of Chemical Engineering and Materials Science; Chemistry (actinide chemistry, solvent extraction fundamental chemistry and process development, extraction and detection equipment development, radiolysis and phase composition of organic solvent)

Sergey Nizkorodov, Ph.D. University of Basel, Department Vice Chair and Professor of Chemistry (analytical, atmospheric and environmental, physical chemistry and chemical physics)

James S. Nowick, Ph.D. Massachusetts Institute of Technology, Department Chair and Professor of Chemistry (chemical biology, organic and synthetic, polymer, materials, nanoscience)

Larry E. Overman, Ph.D. University of Wisconsin-Madison, UCI Distinguished Professor of Chemistry (chemical biology, inorganic and organometallic, organic and synthetic)

Reginald M. Penner, Ph.D. Texas A&M University, UCI Chancellor’s Professor of Chemistry (analytical, physical chemistry and chemical physics, polymer, materials, nanoscience)

Eric Potma, Ph.D. University of Groningen, Associate Professor of Chemistry; Electrical Engineering and Computer Science (analytical, chemical biology, physical chemistry and chemical physics)

Thomas L. Poulos, Ph.D. University of California, San Diego, UCI Chancellor’s Professor of Molecular Biology and Biochemistry; Chemistry; Pharmaceutical Sciences; Physiology and Biophysics (chemical biology)

Jennifer A. Prescher, Ph.D. University of California, Berkeley, Associate Professor of Chemistry; Molecular Biology and Biochemistry; Pharmaceutical Sciences (chemical biology, organic and synthetic)

Sergey V. Pronin, Ph.D. University of Chicago, Assistant Professor of Chemistry (organic chemistry)

Markus W. Ribbe, Ph.D. University of Bayreuth, UCI Chancellor’s Professor of Molecular Biology and Biochemistry; Chemistry (chemical biology, inorganic and organometallic)

Scott D. Rychnovsky, Ph.D. Columbia University, Professor of Chemistry (chemical biology, organic and synthetic)

Eric S. Saltzman, Ph.D. University of Miami, Professor of Earth System Science; Chemistry

A. J. Shaka, Ph.D. Oxford University, Professor of Chemistry (chemical biology, physical chemistry and chemical physics)

Kenneth J. Shea, Ph.D. Pennsylvania State University, Professor of Chemistry; Chemical Engineering and Materials Science (analytical, chemical biology, organic and synthetic, polymer, materials, nanoscience)

Manabu Shiraiwa, Ph.D. Max Planck Institute for Chemistry, Assistant Professor of Chemistry, UCI Chancellor’s Professor of Molecular Biology and Biochemistry; Chemistry (chemical biology, inorganic and organometallic)

Scott D. Rychnovsky, Ph.D. Columbia University, Professor of Chemistry (chemical biology, organic and synthetic)

Eric S. Saltzman, Ph.D. University of Miami, Professor of Earth System Science; Chemistry

A. J. Shaka, Ph.D. Oxford University, Professor of Chemistry (chemical biology, physical chemistry and chemical physics)

Kenneth J. Shea, Ph.D. Pennsylvania State University, Professor of Chemistry; Chemical Engineering and Materials Science (analytical, chemical biology, organic and synthetic, polymer, materials, nanoscience)

Manabu Shiraiwa, Ph.D. Max Planck Institute for Chemistry, Assistant Professor of Chemistry, UCI Chancellor’s Professor of Molecular Biology and Biochemistry; Chemistry (chemical biology, inorganic and organometallic)

Scott D. Rychnovsky, Ph.D. Columbia University, Professor of Chemistry (chemical biology, organic and synthetic)

Eric S. Saltzman, Ph.D. University of Miami, Professor of Earth System Science; Chemistry

A. J. Shaka, Ph.D. Oxford University, Professor of Chemistry (chemical biology, physical chemistry and chemical physics)

Kenneth J. Shea, Ph.D. Pennsylvania State University, Professor of Chemistry; Chemical Engineering and Materials Science (analytical, chemical biology, organic and synthetic, polymer, materials, nanoscience)

Manabu Shiraiwa, Ph.D. Max Planck Institute for Chemistry, Assistant Professor of Chemistry, UCI Chancellor’s Professor of Molecular Biology and Biochemistry; Chemistry (chemical biology, inorganic and organometallic)
Gregory A. Weiss, Ph.D. Harvard University, Professor of Chemistry; Molecular Biology and Biochemistry (analytical, chemical biology, organic and synthetic, polymer, materials, nanoscience)

Max Wolfsberg, Ph.D. Washington University, Professor Emeritus of Chemistry (physical chemistry and chemical physics, theoretical and computational)

Jenny Y. Yang, Ph.D. Massachusetts Institute of Technology, Assistant Professor of Chemistry (inorganic and organometallic, organic and synthetic, polymer, materials, nanoscience)

Albert Fan Yee, Ph.D. University of California, Berkeley, Professor of Chemical Engineering and Materials Science; Biomedical Engineering; Chemistry (materials science aspects of polymers and soft materials, particularly on how they are used to impact nanotechnology)

Courses

CHEM 1A. General Chemistry. 4 Units.
Atomic structure; general properties of the elements; covalent, ionic, and metallic bonding; intermolecular forces; mass relationships.

Prerequisite: MATH 5A or MATH 2A or PHYSICS 7C or CHEM 1P or placement via a score of 600 or higher on the SAT Mathematics Reasoning test, or a score of 27 or higher on the SAT Chemistry subject exam, or a score of 3 on the AP Chemistry exam, or a score of 4 or higher on the AP Calculus AB Exam, or a score of 3 or higher on the AP Calculus BC Exam, CHEM 1P with a grade of C- or better. Prerequisite or corequisite: PHYSICS 7C. Prerequisite or corequisite: MATH 2A. Prerequisite or corequisite: MATH 5A.

Restriction: Undeclared Majors have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Biological Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. Program in Nursing Science students have first consideration for enrollment. Dept Pharmaceutical Sciences students have first consideration for enrollment. Program in Public Health students have first consideration for enrollment.

(CHEM H2A, ENGR 1A)

CHEM 1B. General Chemistry. 4 Units.
Properties of gases, liquids, solids; changes of state; properties of solutions; stoichiometry; thermochemistry; and thermodynamics.

Prerequisite: CHEM 1A or ENGR 1A or CHEM H2A or AP Chemistry. CHEM 1A with a grade of C- or better. ENGR 1A with a grade of C- or better. CHEM H2A with a grade of C- or better. AP Chemistry with a minimum score of 4

Restriction: School of Biological Sciences students have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. Program in Nursing Science students have first consideration for enrollment. Dept Pharmaceutical Sciences students have first consideration for enrollment. Program in Public Health students have first consideration for enrollment. Undeclared Majors have first consideration for enrollment.

(CHEM H2B)

CHEM 1C. General Chemistry. 4 Units.
Equilibria, aqueous acid-base equilibria, solubility equilibria, oxidation reduction reactions, electrochemistry; kinetics; special topics.

Prerequisite: CHEM 1B. CHEM 1B with a grade of C- or better

Restriction: Undeclared Majors have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Biological Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. Program in Nursing Science students have first consideration for enrollment. Dept Pharmaceutical Sciences students have first consideration for enrollment. Program in Public Health students have first consideration for enrollment.

(CHEM H2C)

CHEM 1LA. General Chemistry Laboratory. 2 Units.
Training and experience in basic laboratory techniques through experiments related to lecture topics in Chemistry 1A. Materials fee.

Corequisite: CHEM 1A

Restriction: Undeclared Majors have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Biological Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. Program in Nursing Science students have first consideration for enrollment. Dept Pharmaceutical Sciences students have first consideration for enrollment. Program in Public Health students have first consideration for enrollment.
CHEM 1LC. General Chemistry Laboratory. 2 Units.
Training and experience in basic laboratory techniques. Chemical practice and principles illustrated through experiments related to lecture topics of CHEM 1A-B-C. Materials fee.
Corequisite: CHEM 1C
Prerequisite: CHEM 1B. CHEM 1B with a grade of C- or better
Overlaps with CHEM 1LE, CHEM H2LB, CHEM M2LB.
Restriction: Nursing Science Majors have first consideration for enrollment. Pharmaceutical Sciences Majors have first consideration for enrollment. Public Health Sciences Majors have first consideration for enrollment. School of Biological Sciences students have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. Div of Undergraduate Education students have first consideration for enrollment.

CHEM 1LD. General Chemistry Laboratory. 2 Units.
Training and experience in basic laboratory techniques. Chemical practice and principles illustrated through experiments related to lecture topics in CHEM 1A-B-C. Materials fee.
Prerequisite: CHEM 1C and CHEM 1LC or CHEM 1LE. CHEM 1C with a grade of C- or better. CHEM 1LC with a grade of C- or better. CHEM 1LE with a grade of C- or better
Overlaps with CHEM H2LB, CHEM M2LB.
Restriction: School of Biological Sciences students only. School of Physical Sciences students only. School of Engineering students only. Program in Nursing Science students only. Pharmaceutical Sciences Majors only. Public Health Sciences Majors only. No credit for CHEM M2LA if taken after CHEM 1LD. Undecided/Undeclared students also have first consideration for enrollment.

CHEM 1LE. Accelerated General Chemistry Lab. 3 Units.
Lecture and experiments covering chemical concepts for accelerated students who do not plan to take organic chemistry. Properties of gases, liquids, solutions, and solids; chemical equilibrium and chemical thermodynamics; atomic and molecular structure; chemical kinetics; electrochemistry. Materials fee.
Prerequisite: CHEM 1A or ENGR 1A or AP Chemistry. AP Chemistry with a minimum score of 3
Prerequisite or corequisite: CHEM 1A, ENGR 1A
Overlaps with CHEM 1LC.
Restriction: School of Engineering students have first consideration for enrollment. Biomedical Computing Majors have first consideration for enrollment.

CHEM 1P. Preparation for General Chemistry. 4 Units.
Units of measurement, dimensional analysis, significant figures; elementary concepts of volume, mass, force, pressure, energy, density, temperature, heat, work; fundamentals of atomic and molecular structure; the mole concept, stoichiometry; properties of the states of matter; gas laws; solutions concentrations.
Restriction: Biomedical Computing Majors have first consideration for enrollment. Undeclared Majors have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Biological Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. Program in Nursing Science students have first consideration for enrollment. Dept Pharmaceutical Sciences students have first consideration for enrollment. Program in Public Health students have first consideration for enrollment.

CHEM H2A. Honors General Chemistry. 4 Units.
Covers the same material as CHEM 1A-CHEM 1B-CHEM M3C but in greater depth. Additional topics will also be included as time permits.
Prerequisite: AP Chemistry or SAT Subject Chemistry. AP Chemistry with a minimum score of 4. SAT Subject Chemistry with a minimum score of 700
Overlaps with CHEM 1A.
Restriction: Campuswide Honors Program students only.
(II and Va ).
CHEM H2B. Honors General Chemistry. 4 Units.
Covers the same material as CHEM 1A-CHEM 1B-CHEM M3C but in greater depth. Additional topics will also be included as time permits.
Prerequisite: CHEM H2A and (CHEM H2LA or CHEM M2LA). CHEM H2A with a grade of B or better. CHEM H2LA with a grade of B or better. CHEM M2LA with a grade of B or better
Overlaps with CHEM 1B.

(II, Va)

CHEM H2C. Honors General Chemistry. 4 Units.
Covers the same material as CHEM 1A-CHEM 1B-CHEM M3C but in greater depth. Additional topics will also be included as time permits.
Prerequisite: CHEM H2B and (CHEM H2LB or CHEM M2LB). CHEM H2B with a grade of B or better. CHEM H2LB with a grade of B or better. CHEM M2LB with a grade of B or better
Overlaps with CHEM 1C.

(II, Va)

CHEM H2LA. Honors General Chemistry Laboratory. 3 Units.
Training and experience in fundamental and analytical laboratory techniques through experiments related to lecture topics in CHEM H2A-CHEM H2B-CHEM H2C. Materials fee.
Corequisite: CHEM H2A
Prerequisite: AP Chemistry or SAT Subject Chemistry. AP Chemistry with a minimum score of 4. SAT Subject Chemistry with a minimum score of 700
Overlaps with CHEM M2LA.
Restriction: Campuswide Honors Program students only.

CHEM H2LB. Honors General Chemistry Laboratory. 3 Units.
Training and experience in fundamental and analytical laboratory techniques through experiments related to lecture topics in CHEM H2A-CHEM H2B-CHEM H2C. Materials fee.
Corequisite: CHEM H2B
Prerequisite: CHEM H2A and (CHEM H2LA or CHEM M2LA). CHEM H2A with a grade of B or better. CHEM H2LA with a grade of B or better. CHEM M2LA with a grade of B or better
Overlaps with CHEM M2LB.
Restriction: No credit for CHEM 1LC if taken after CHEM H2LB or CHEM M2LB.

CHEM H2LC. Honors General Chemistry Laboratory. 3 Units.
Training and experience in fundamental and analytical laboratory techniques through experiments related to lecture topics in CHEM H2A-CHEM H2B-CHEM H2C. Materials fee.
Corequisite: CHEM H2C
Prerequisite: CHEM H2B and (CHEM H2LB or CHEM M2LB). CHEM H2B with a grade of B or better. CHEM H2LB with a grade of B or better. CHEM M2LB with a grade of B or better

CHEM M2A. Majors General Chemistry Lecture. 4 Units.
Covers the same material as CHEM 1A but in greater depth. Additional topics will be included as time permits.
Prerequisite: MATH 5A or MATH 2A or PHYSICS 7C or CHEM 1P or SAT Mathematics or ACT Mathematics or SAT Subject Chemistry or AP Chemistry or AP Calculus AB or AP Calculus BC. CHEM 1P with a grade of C- or better. SAT Mathematics with a minimum score of 600. ACT Mathematics with a minimum score of 27. SAT Subject Chemistry with a minimum score of 700. AP Chemistry with a minimum score of 3. AP Calculus AB with a minimum score of 4. AP Calculus BC with a minimum score of 3. Placement via a passing score on the ALEKS placement exam is also accepted.
Prerequisite or corequisite: MATH 5A, MATH 2A, PHYSICS 7C
Overlaps with CHEM 1A, CHEM H2A, ENGR 1A.
Restriction: Chemistry Majors have first consideration for enrollment.

(II and Va).
CHEM M2B. Majors General Chemistry Lecture. 4 Units.
Covers the same material as CHEM 1B but in greater depth. Additional topics will also be included as time permits.
Prerequisite: CHEM M2A and CHEM M2LA. CHEM M2A with a grade of C- or better. CHEM M2LA with a grade of C- or better
Overlaps with CHEM H2B, CHEM 1B.
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM M2LA. Majors General Chemistry Laboratory. 3 Units.
Training and experience in basic laboratory techniques through experiments related to lecture topics in CHEM 1A-CHEM 1B-CHEM M3C. Materials fee.
Corequisite: CHEM 1A or a score of 4 or higher on the AP Chemistry exam or CHEM H2A.
Prerequisite: High school chemistry.
Overlaps with CHEM H2LA, CHEM 1LD.
Restriction: Chemistry majors only. No credit for CHEM M2LA if taken after CHEM 1LD.

CHEM M2LB. Majors General Chemistry Laboratory. 3 Units.
Training and experience in basic laboratory techniques through experiments related to lecture topics in CHEM 1A-CHEM 1B-CHEM M3C. Materials fee.
Corequisite: CHEM 1B or CHEM H2B.
Prerequisite: (CHEM 1A or CHEM H2A or a score of 4 on the AP CHEM exam) and (CHEM M2LA or CHEM H2LA). CHEM 1A with a grade of C- or better. CHEM H2A with a grade of C- or better. CHEM M2LA with a grade of C- or better. CHEM H2LA with a grade of C- or better.
Overlaps with CHEM H2LB.
Restriction: CHEM 1LC may not be taken for credit if taken after CHEM H2LB or CHEM M2LB. Chemistry majors only.

CHEM M3C. Majors Quantitative Analytical Chemistry. 4 Units.
Topics include equilibria, aqueous acid-base equilibria, solubility equilibria, oxidation reduction reactions, electrochemistry; and kinetics with a special emphasis on the statistical treatment of data and analytical methods of chemical analysis.
Corequisite: CHEM M3LC
Prerequisite: (CHEM 1B or CHEM H2B) and (CHEM M2LB or CHEM H2LB). CHEM 1B with a grade of C- or better. CHEM H2B with a grade of C- or better. CHEM M2LB with a grade of C- or better. CHEM H2LB with a grade of C- or better.
Restriction: Chemistry Majors only.

CHEM M3LC. Majors Quantitative Analytical Chemistry Laboratory. 3 Units.
Training and experience in analytical laboratory techniques through experiments related to lecture topics in CHEM M3C. Materials fee.
Prerequisite: (CHEM 1B or CHEM H2B) and (CHEM M2LB or CHEM H2LB). CHEM 1B with a grade of C- or better. CHEM H2B with a grade of C- or better. CHEM M2LB with a grade of C- or better. CHEM H2LB with a grade of C- or better.
Restriction: Chemistry Majors only.

CHEM 5. Scientific Mathematical and Computing Skills. 4 Units.
Introduces students to mathematical skills, including complex numbers, linear algebra, differential equations, multivariable calculus, infinite series, Fourier series, and integral transforms; and computing skills, including plotting, data analysis (statistics and curve fitting), linear algebra, symbolic mathematics, and spectral analysis.
Corequisite: (CHEM 1C or CHEM H2C or CHEM M3C) and MATH 2D.
Restriction: Chemistry Majors only.

CHEM 11. New Chemistry Student Seminar.
Seminar for students who recently joined the chemistry major. Addresses available tracks in the major, research opportunities in the chemistry department, careers in chemistry, and relevant programs and resources for students.
Grading Option: Pass/no pass only.
Restriction: Freshmen students, transfer students, and students who recently changed their major to Chemistry have first consideration for enrollment.
CHEM 12. Chemistry Around Us. 4 Units.
Addresses ways in which chemistry affects everyday life. Topics include pollution, global warming, water supply/demands, biodiesel fuels, foods we eat, natural/synthetic materials, common drugs, drug design. Learn and apply basic chemistry concepts. Use risk/benefit analysis for optimal solutions.

(II and Va ).

CHEM H30A. Critical Analysis of Health Science Literature. 4 Units.
Focuses on evaluation of scientific literature. Aspects of scientific inquiry include scientific method, scientific research design, statistical analysis, and publication processes. Addresses why scientific inquiry cannot be separated from sociocultural influences and concerns. Examples drawn from research on health-related issues.

Restriction: Campuswide Honors Program students only.

(II and Va .).

CHEM 51A. Organic Chemistry. 4 Units.
Fundamental concepts relating to carbon compounds with emphasis on structural theory and the nature of chemical bonding, stereochemistry, reaction mechanisms, and stereoscopic, physical, and chemical properties of the principal classes of carbon compounds.

Prerequisite: (CHEM 1C or CHEM H2C or CHEM M3C) and (CHEM 1LD or CHEM H2LC or CHEM M3LC). CHEM 1C with a grade of C- or better. CHEM H2C with a grade of C- or better. CHEM M3C with a grade of C- or better. CHEM 1LD with a grade of C- or better. CHEM H2LC with a grade of C- or better. CHEM M3LC with a grade of C- or better.

Prerequisite or corequisite: CHEM 1LD

Overlaps with CHEM H52A.

Restriction: School of Biological Sciences students have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. Program in Nursing Science students have first consideration for enrollment. Dept Pharmaceutical Sciences students have first consideration for enrollment. Program in Public Health students have first consideration for enrollment. Undeclared Majors have first consideration for enrollment.

CHEM 51B. Organic Chemistry. 4 Units.
Fundamental concepts relating to carbon compounds with emphasis on structural theory and the nature of chemical bonding, stereochemistry, reaction mechanisms, and stereoscopic, physical, and chemical properties of the principal classes of carbon compounds.

Prerequisite: CHEM 51A and (CHEM 1LD or CHEM M52LA or CHEM H52LA). CHEM 51A with a grade of C- or better. CHEM 1LD with a grade of C- or better. CHEM M52LA with a grade of C- or better. CHEM H52LA with a grade of C- or better.

Overlaps with CHEM H52B.

Restriction: Undeclared Majors have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Biological Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. Program in Nursing Science students have first consideration for enrollment. Dept Pharmaceutical Sciences students have first consideration for enrollment. Program in Public Health students have first consideration for enrollment.

CHEM 51C. Organic Chemistry. 4 Units.
Fundamental concepts relating to carbon compounds with emphasis on structural theory and the nature of chemical bonding, stereochemistry, reaction mechanisms, and stereoscopic, physical, and chemical properties of the principal classes of carbon compounds.

Prerequisite: CHEM 51B and (CHEM 51LB or CHEM M52LB or CHEM H52LB). CHEM 51B with a grade of C- or better. CHEM 51LB with a grade of C- or better. CHEM M52LB with a grade of C- or better. CHEM H52LB with a grade of C- or better.

Overlaps with CHEM H52C.

Restriction: Undeclared Majors have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Biological Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. Program in Nursing Science students have first consideration for enrollment. Dept Pharmaceutical Sciences students have first consideration for enrollment. Program in Public Health students have first consideration for enrollment.
CHEM 51LB. Organic Chemistry Laboratory. 2 Units.
Modern techniques of organic chemistry, using selected experiments to illustrate topics introduced in CHEM 51A-CHEM 51B-CHEM 51C. Materials fee.

Corequisite: CHEM 51B
Prerequisite: CHEM 51A and (CHEM 1LD or CHEM H2LB or CHEM M2LB). CHEM 51A with a grade of C- or better. CHEM 1LD with a grade of C- or better. CHEM H2LB with a grade of C- or better. CHEM M2LB with a grade of C- or better

Overlaps with CHEM H52LA, CHEM M52LA.

Restriction: School of Biological Sciences students have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. Program in Nursing Science students have first consideration for enrollment. Dept Pharmaceutical Sciences students have first consideration for enrollment. Program in Public Health students have first consideration for enrollment. Undeclared Majors have first consideration for enrollment.

CHEM 51LC. Organic Chemistry Laboratory. 2 Units.
Modern techniques of organic chemistry, using selected experiments to illustrate topics introduced in CHEM 51A-B-C. Materials fee.

Corequisite: CHEM 51C
Prerequisite: CHEM 51B and CHEM 51LB. CHEM 51B with a grade of C- or better. CHEM 51LB with a grade of C- or better

Overlaps with CHEM H52LB, CHEM M52LB.

Restriction: School of Biological Sciences students have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. Program in Nursing Science students have first consideration for enrollment. Dept Pharmaceutical Sciences students have first consideration for enrollment. Program in Public Health students have first consideration for enrollment. Undeclared Majors have first consideration for enrollment.

CHEM 51LD. Organic Chemistry Laboratory. 2 Units.
Modern techniques of organic chemistry using selected experiments to illustrate topics introduced in CHEM 51A-CHEM 51B-CHEM 51C. Materials fee.

Prerequisite: CHEM 51C and CHEM 51LC. CHEM 51C with a grade of C- or better. CHEM 51LC with a grade of C- or better

Overlaps with CHEM H52LC.

Restriction: School of Biological Sciences students have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. Program in Nursing Science students have first consideration for enrollment. Dept Pharmaceutical Sciences students have first consideration for enrollment. Program in Public Health students have first consideration for enrollment. Undeclared Majors have first consideration for enrollment.

CHEM H52A. Honors Organic Chemistry. 4 Units.
Fundamental concepts of the chemistry of carbon compounds. Structural, physical, and chemical properties of the principal classes of carbon compounds.

Prerequisite: (CHEM 1C or CHEM H2C or CHEM M3C) and (CHEM 1LD or CHEM H2LC or CHEM M3LC)

Overlaps with CHEM 51A.

CHEM H52B. Honors Organic Chemistry. 4 Units.
Fundamental concepts of the chemistry of carbon compounds. Structural, physical, and chemical properties of the principal classes of carbon compounds.

Prerequisite: CHEM H52A and (CHEM H52LA or CHEM M52LA). CHEM H52A with a grade of C or better. CHEM H52LA with a grade of C or better. CHEM M52LA with a grade of C or better

CHEM H52C. Honors Organic Chemistry. 4 Units.
Fundamental concepts of the chemistry of carbon compounds. Structural, physical, and chemical properties of the principal classes of carbon compounds.

Prerequisite: (CHEM H52B or CHEM 51B). CHEM H52B with a grade of C or better. CHEM 51B with a grade of C or better

Overlaps with CHEM 51C.
CHEM H52LA. Honors Organic Chemistry Laboratory. 3 Units.
Fundamental techniques of modern experimental organic chemistry. Materials fee.
Corequisite: CHEM 51A
Prerequisite: (CHEM 1C or CHEM H2C or CHEM M3C) and (CHEM M3LC or CHEM H2LC or CHEM 1LD)
Overlaps with CHEM 51LB, CHEM M52LA.
Restriction: Campuswide Honors Program students only.

CHEM H52LB. Honors Organic Chemistry Laboratory. 3 Units.
Fundamental techniques of modern experimental organic chemistry. Materials fee.
Corequisite: CHEM 51B
Prerequisite: CHEM 51A and CHEM H52LA. CHEM 51A with a grade of C- or better. CHEM H52LA with a grade of C- or better
Overlaps with CHEM M52LB, CHEM 51LC.

CHEM H52LC. Honors Organic Chemistry Laboratory. 3 Units.
Fundamental techniques of modern experimental organic chemistry. Materials fee.
Prerequisite: CHEM 51B and CHEM H52LB. CHEM 51B with a grade of C- or better. CHEM H52LB with a grade of C- or better
Overlaps with CHEM 51LD, CHEM M52LC.

CHEM M52LA. Majors Organic Chemistry Laboratory. 3.0 Units.
Modern techniques of organic chemistry, using selected experiments to illustrate topics introduced in CHEM 51A-B-C. Materials fee.
Corequisite: CHEM 51A
Prerequisite: (CHEM 1C or CHEM H2C or CHEM M3C) and (CHEM H2LC or CHEM M3LC or CHEM 1LD)
Overlaps with CHEM H52LA, CHEM 51LB.
Restriction: Chemistry Majors only.

CHEM M52LB. Majors Organic Chemistry Laboratory. 3 Units.
Modern techniques of organic chemistry, using selected experiments to illustrate topics introduced in CHEM 51A-B-C. Materials fee.
Corequisite: CHEM 51B
Prerequisite: CHEM 51A and CHEM M52LA. CHEM 51A with a grade of C- or better. CHEM M52LA with a grade of C- or better
Overlaps with CHEM H52LB, CHEM 51LC.
Restriction: Chemistry Majors only.

CHEM M52LC. Majors Organic Chemistry Laboratory. 3 Units.
Modern techniques of organic chemistry, using selected experiments to illustrate topics introduced in CHEM 51A-B-C. Materials fee.
Corequisite: CHEM 51C
Prerequisite: CHEM 51B and CHEM M52LB. CHEM 51B with a grade of C- or better. CHEM M52LB with a grade of C- or better
Overlaps with CHEM H52LC, CHEM 51LD.
Restriction: Chemistry Majors only.

CHEM H90. The Idiom and Practice of Science. 4 Units.
A series of fundamental and applied problems in the chemical sciences are addressed. Topics may include the periodic table, electronic structure of atoms, chemical bonding, molecular structure, thermodynamics, and kinetics, with applications to energy and the environment, and/or biochemistry.
Restriction: Campuswide Honors Program students only.

(II, Va)
CHEM 101W. Writing for Chemists. 4 Units.
Students receive guidance on preparing research papers, proposals, reports, and other forms of scientific writing in chemistry-related fields, on effectively searching for and using chemical information, and on communicating data in poster and platform presentations.

Prerequisite: Satisfactory completion of the Lower-Division Writing requirement.
Restriction: Upper-division students only. Chemistry Majors have first consideration for enrollment.

CHEM 107. Inorganic Chemistry. 4 Units.
Introduction to modern inorganic chemistry. Principles of structure, bonding, and chemical reactivity with application to compounds of the main group and transition elements, including organometallic chemistry.

Prerequisite: CHEM 51C or CHEM H52C
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 107L. Inorganic Chemistry Laboratory. 3 Units.
Modern techniques of inorganic and organometallic chemistry including experience with glove box, Schlenk line, and vacuum line methods. Materials fee.

Prerequisite: CHEM 107
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 125. Advanced Organic Chemistry. 4 Units.
Rapid-paced comprehensive treatment of organic chemistry. Focuses on molecular structure, reactivity, stability, scope and mechanisms of organic reactions. Topics include: structure and bonding; theoretical organic chemistry; acidity and basicity; reactive intermediates; pericyclic reactions; stereochemistry; organic synthesis; natural products; organic photochemistry.

Prerequisite: CHEM 51C
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 127. Inorganic Chemistry II. 4 Units.
Advanced treatment of selected fundamental topics in inorganic chemistry, building on material presented in Chemistry 107. Molecular symmetry with applications to electronic structure and spectroscopy. Reaction kinetics and mechanisms; inorganic synthesis and catalysis; bioinorganic chemistry.

Prerequisite: CHEM 107
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 128. Introduction to Chemical Biology. 4 Units.
Introduction to the basic principles of chemical biology: structures and reactivity; chemical mechanisms of enzyme catalysis; chemistry of signalling, biosynthesis, and metabolic pathways.

Prerequisite: (CHEM 51C or CHEM H52C)
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 128L. Introduction to Chemical Biology Laboratory Techniques. 3 Units.
Introduction to the basic laboratory techniques of chemical biology: electrophoresis, plasmid preparation, PCR, protein expression, isolation, and kinetics. Materials fee.

Corequisite: CHEM 128
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 132A. Chemical Thermodynamics, Kinetics, and Dynamics. 4 Units.

Prerequisite: MATH 2D and (PHYSICS 7D or PHYSICS 7E) and (CHEM 5 or (MATH 3D and (EECS 10 or EECS 12 or ENGRMAE 10 or I&C SCI 31))
Prerequisite or corequisite: CHEM 5, MATH 3D
Overlaps with CHEM 131C.

Restriction: Chemistry Majors have first consideration for enrollment.
CHEM 132B. Quantum Principles, Spectroscopy, and Bonding. 4 Units.
Principles of quantum chemistry with applications to the elements of atomic structure, energy levels, and spectroscopy.
Prerequisite: (CHEM 132A or CBEMS 45C) and (PHYSICS 7D or PHYSICS 7E). CHEM 132A with a grade of C- or better.
Overlaps with CHEM 131A.

CHEM 132C. Molecular Structure and Elementary Statistical Mechanics. 4 Units.
Principles of quantum mechanics with applications to molecular spectroscopy and structure determination, and chemical bonding in simple molecules. Elements of statistical mechanics.
Prerequisite: CHEM 132B. CHEM 132B with a grade of C- or better.
Overlaps with CHEM 131B.

CHEM 133. Nuclear and Radiochemistry. 4 Units.
Advanced treatment of nuclear structure, nuclear reactions, and radioactive-decay processes. Introduction to nuclear activation analysis, isotope effects, radiation chemistry, hot-atom chemistry, nuclear age-dating methods, nuclear reactors, and nuclear power.
Prerequisite: (CHEM M3C or CHEM 1C or CHEM H2C) and MATH 2D
Same as CBEMS 133.
Overlaps with CHEM 170.
Restriction: Chemistry Majors have first consideration for enrollment. Chemical Engineering Majors have first consideration for enrollment. Materials Science Engineering Majors have first consideration for enrollment. CHEM 133 and CHEM 170 cannot both be taken for credit.
Concurrent with CBEMS 233 and CHEM 233.

CHEM 133L. Nuclear and Radiochemistry Laboratory. 3 Units.
Practical aspects of production, separation, safe handling, detection and measurement of radioactive isotopes. Experiments will use the UCI nuclear reactor and emphasize uses of radioisotopes in chemistry, engineering, biology, and medicine. Materials fee.
Prerequisite: CHEM 133. CHEM 133 with a grade of C- or better. Prerequisite or corequisite: CHEM 133.
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 137. Computational Chemistry. 4 Units.
Short introduction to programming languages and to representative algorithms employed in chemical research. Students have the opportunity to devise and employ their own codes and also to employ codes which are widely used in various fields of chemistry. Materials fee.
Corequisite: CHEM 132C
Prerequisite: CHEM 51C and (CHEM 131A or CHEM 132B)
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 138. Introduction to Computational Organic Chemistry. 4 Units.
An introduction to the use of computational chemistry to investigate reaction mechanisms, to calculate structures, and to predict properties of molecules. Students have the opportunity to perform calculations employing computational methods which are widely used in various fields of chemistry. Materials fee.
Prerequisite: CHEM 51C
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 141. Environmental Chemistry. 4 Units.
Processes that control the fate of chemicals in the environment. Chemistry of the atmosphere, hydrosphere, and soils, especially as it pertains to pollutants.
Prerequisite: (CHEM 51C or CHEM H52C) and (MATH 2B or AP Calculus BC). CHEM 51C with a grade of C- or better. CHEM H52C with a grade of C- or better. MATH 2B with a grade of C- or better. AP Calculus BC with a minimum score of 4
CHEM 145A. Gas-Phase Atmospheric Chemistry. 4 Units.
Sources, chemistry, sinks, and measurements of key atmospheric gaseous species. Chemistry of photochemical oxidant formation, transformation of key inorganic and organic trace gases, and stratospheric ozone cycling. Applications of atmospheric chemistry models to control strategies.
Prerequisite: CHEM 132A and CHEM 132B and CHEM 132C
Concurrent with CHEM 245A.

CHEM 145B. Multi-Phase Atmospheric Chemistry. 4 Units.
Chemical and physical processes leading to the production, aging, and removal of atmospheric particles. Multi-phase processes involving gases, particles, water droplets, and environmental surfaces. Approaches for modeling these processes with applications to control strategies.
Prerequisite: CHEM 145A
Concurrent with CHEM 245B.

CHEM 150. Computational Chemistry. 4 Units.
Basic concepts, methods, and techniques in computational chemistry: density functional and wavefunction theory, molecular property calculations, analysis tools, potential energy surfaces, vibrational effects, molecular dynamics simulations.
Prerequisite: MATH 3A and (CHEM 132C or PHYSICS 113A). MATH 3A with a grade of C- or better. CHEM 132C with a grade of C- or better.
PHYSICS 113A with a grade of C- or better
Restriction: Chemistry Majors have first consideration for enrollment.
Concurrent with CHEM 250.

CHEM 150L. Computational Chemistry Laboratory. 4 Units.
Introduction to the practice of modern computational chemistry through a series of advanced computational experiments.
Prerequisite: CHEM 150 and (CHEM 5 or PHYSICS 50 or EECS 12). CHEM 150 with a grade of C- or better. CHEM 5 with a grade of C- or better.
PHYSICS 50 with a grade of C- or better. EECS 12 with a grade of C- or better
Restriction: Chemistry Majors have first consideration for enrollment.
Concurrent with CHEM 250L.

CHEM 152. Advanced Analytical Chemistry. 5 Units.
In-depth treatment of modern instrumental methods for quantitative analysis of real samples and basic principles of instrument design. Laboratory experiments using spectroscopic, chromatographic, mass spectrometric, and other instrumental methods. Materials fee.
Prerequisite: (CHEM 1C or CHEM M3C or CHEM H2C) and (CHEM M3LC or CHEM H2LC or CHEM 1LD)
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 153. Physical Chemistry Laboratory. 4 Units.
Introduction to the modern experimental approaches and software tools used in spectroscopy, kinetics, electrochemistry, and other physical chemistry experiments. Basics of interfacing with instruments using LabView. Materials fee.
Corequisite: CHEM 132C
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 156. Advanced Laboratory in Chemistry and Synthesis of Materials. 4 Units.
Synthesis and characterization of organic and inorganic materials including polymers and oxides. Techniques include electron and scanning probe microscopy, gel permeation chromatography, X-ray diffraction, porosimetry, and thermal analysis. Materials fee.
Prerequisite: (CHEM 51C or CHEM H52C) and (CHEM 51LC or CHEM H52LC or CHEM M52LC) and (CHEM 131A or CHEM 132B or PHRMSCI 171)
Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 160. Organic Synthesis Laboratory. 4 Units.
Modern experimental techniques in organic synthesis including experience with thin-layer chromatography, liquid chromatography, and gas chromatography. Modern methods of structure elucidation including FT NMR are employed in the characterization of products. Materials fee.
Prerequisite: CHEM 51C and (CHEM 51LC or CHEM H52LC or CHEM M52LC)
Restriction: Chemistry Majors have first consideration for enrollment.
CHEM 170. Radioisotope Techniques. 4 Units.
Basic theory and practice of production, separation, safe handling, counting, applications of radioactive isotopes with emphasis on applications in chemistry, biology, and medicine. Materials fee.

Prerequisite: (CHEM 1C or CHEM M3C or CHEM H2C) and (CHEM 1LC or CHEM M3LC or CHEM H2LC)

Restriction: Chemistry Majors have first consideration for enrollment.

CHEM 177. Medicinal Chemistry. 4 Units.
An introduction of the basics of drug activity and mechanisms. Strategies used to identify lead compounds such as natural product chemistry, combinatorial chemistry, molecular modeling, and high-throughput screening. Relationship of molecular structure to pharmacological activity.

Prerequisite: CHEM 51A and CHEM 51B and CHEM 51C and (BIO SCI 98 or CHEM 128)

Same as PHRMSCI 177.

Restriction: Pharmaceutical Sciences Majors have first consideration for enrollment.

CHEM 177L. Medicinal Chemistry Laboratory. 3 Units.
An introduction of the basics of drug activity and mechanisms. Strategies used to identify lead compounds such as natural product chemistry, combinatorial chemistry, molecular modeling, and high-throughput screening. Relationship of molecular structure to pharmacological activity. Materials fee.

Corequisite: PHRMSCI 177 or CHEM 177.

Prerequisite: CHEM 51A and CHEM 51B and CHEM 51C and BIO SCI 100 and (BIO SCI 98 or CHEM 128)

Same as PHRMSCI 177L.

Restriction: Pharmaceutical Sciences Majors have first consideration for enrollment.

CHEM 180. Undergraduate Research. 4 Units.
Research for credit arranged with a faculty member to sponsor and supervise work. Student time commitment of 10 to 15 hours per week is expected, and a written research report is required at the end of each quarter of enrollment.

Repeatability: May be repeated for credit unlimited times.

CHEM 180W. Senior Thesis in Chemistry. 4 Units.
Students receive guidance on preparing research papers, proposals, reports, and other forms of scientific writing in chemistry-related fields; on effectively searching for and using chemical information; and on communicating data in poster and platform presentations.

Prerequisite: CHEM 180 or CHEM 199 or PHYSICS 195 or EARTHSS 199 or CBEMS 199 or ENGRCEE 199 or ENGRMAE 199 or BIO SCI 199 or PUBHLTH 199. CHEM 180 with a grade of A or better. CHEM 199 with a grade of A or better. PHYSICS 195 with a grade of A or better. EARTHSS 199 with a grade of A or better. CBEMS 199 with a grade of A or better. ENGRCEE 199 with a grade of A or better. ENGRMAE 199 with a grade of A or better. BIO SCI 199 with a grade of A or better. PUBHLTH 199 with a grade of A or better. Consent of the instructor is also accepted. Satisfactory completion of the Lower-Division Writing requirement.

Restriction: Upper-division students only. Chemistry Majors have first consideration for enrollment.

CHEM H180A. Honors Research in Chemistry. 4 Units.
Undergraduate honors research in Chemistry. A student time commitment of 10-15 hours per week is required.

Restriction: Chemistry Honors students only. Campuswide Honors Program students only.

CHEM H180B. Honors Research in Chemistry. 4 Units.
Undergraduate honors research in Chemistry. A student time commitment of 10-15 hours per week is required.

Prerequisite: CHEM H180A

Restriction: Campuswide Honors Program students only.
CHEM H180C. Honors Research in Chemistry. 4 Units.
Undergraduate honors research in Chemistry. A student time commitment of 10-15 hours per week is required.
Prerequisite: CHEM H180B
Restriction: Chemistry Honors students only. Chemistry majors participating in the Campuswide Honors Program students only.

CHEM H181W. Honors Seminar in Chemistry. 2 Units.
Students will receive guidance in the preparation of oral and written research presentations. A written thesis will be prepared and a formal research seminar will be presented.
Corequisite: CHEM H180C
Prerequisite: CHEM H180A and CHEM H180B. Satisfactory completion of the Lower-Division Writing requirement.

CHEM 191. Chemistry Outreach Program. 2 Units.
Involves intensive participation in the UCI Chemistry Outreach Program, which performs Chemistry demonstrations at local high schools.
Grading Option: Pass/no pass only.
Repeatability: May be taken for credit 6 times.

CHEM 192. Tutoring in Chemistry. 2 Units.
Enrollment limited to participants in the Chemistry Peer Tutoring Program.
Repeatability: May be taken for credit 9 times.
Restriction: The first eight may be taken for a letter grade. The remaining ten units must be taken Pass/Not Pass only. NOTE: No more than eight units may be counted toward the 180 units required for graduation. Satisfies no degree requirement other than contribution to the 180-unit total.

CHEM 193. Research Methods. 4 Units.
Explores tools of inquiry for developing and implementing science research projects. Students undertake independent projects requiring data collection, analysis, and modeling, and the organization and presentation of results. Additional topics include ethical issues and role of scientific literature.
Prerequisite: BIO SCI 14 or PHY SCI 5
Same as BIO SCI 108, PHYSICS 193.

CHEM 197. Professional Internship. 4 Units.
Internship program that provides students with opportunity to develop professional skills necessary for competitive placement in their chosen chemical-inspired industry. Students gain new and field-specific skills outside the classroom while participating in a supervised internship totaling 100 hours.
Prerequisite: Enrollment requires completion of an application form. Student selection is made by a selection committee.
Repeatability: May be taken for credit 3 times.
Restriction: Upper-division students only.

CHEM 199. Independent Study in Chemistry. 1-4 Units.
Independent research with Chemistry faculty. Student time commitment of three to four hours per week per unit is expected, and a written report on the independent study is required at the end of each quarter of enrollment.
Repeatability: Unlimited as topics vary.

CHEM 200. Conduct of Research. 2 Units.
Introduces new graduate students to ethical conduct of scientific research, mentoring, and current research in the Department of chemistry.
Repeatability: May be taken for credit 2 times.

CHEM 201. Organic Reaction Mechanisms I. 4 Units.
Advanced treatment of basic mechanistic principles of modern organic chemistry. Topics include molecular orbital theory, orbital symmetry control of organic reactions, aromaticity, carbonium ion chemistry, free radical chemistry, the chemistry of carbenes and carbanions, photochemistry, electrophilic substitutions, aromatic chemistry.
Prerequisite: CHEM 132A and CHEM 132B and CHEM 132C
CHEM 202. Organic Reaction Mechanisms II. 4 Units.
Topics include more in-depth treatment of mechanistic concepts, kinetics, conformational analysis, computational methods, stereoelectronics, and both solution and enzymatic catalysis.

Prerequisite: CHEM 201

CHEM 203. Organic Spectroscopy. 4 Units.
Modern methods used in structure determination of organic molecules. Topics include mass spectrometry; ultraviolet, chiroptical, infrared, and nuclear magnetic resonance spectroscopy.

Prerequisite: (CHEM 51A and CHEM 51B and CHEM 51C) or (CHEM H52A and CHEM H52B and CHEM H52C)
Restriction: Graduate students only.

CHEM 204. Organic Synthesis I. 4 Units.
Fundamentals of modern synthetic organic chemistry is developed. Major emphasis is on carbon-carbon bond forming methodology. Topics include carbonyl annelations, cycloadditions, sigmatropic rearrangements, and organometallic methods.

CHEM 205. Organic Synthesis II. 4 Units.
Fundamentals of modern synthetic organic chemistry will be developed. Major emphasis this quarter is on natural product total synthesis and retrosynthetic (antithetic) analysis.

Prerequisite: CHEM 204

CHEM 206. Laboratory Skills. 4-6 Units.
Introduces students to a variety of practical laboratory techniques, including lock-in, boxcar, coincidence counting, noise filtering, PID control, properties of common transducers, computer interfacing to instruments, vacuum technology, laboratory safety, basic mechanical design, and shop skills. Materials fee.

Same as PHYSICS 206.
Concurrent with PHYSICS 106.

CHEM 207. Chemistry for Physicists. 4 Units.
Introduction to fundamental concepts in molecular structure and reactivity: theory of bonding, valence and molecular orbitals; structure and reactivity in inorganic chemistry; elements in molecular group theory; nomenclature in organic chemistry; and survey of macromolecules.

Same as PHYSICS 207.

CHEM 208. Mathematics for Chemists. 4 Units.
Applications of mathematics to physical and chemical problems. Calculus of special functions, complex variables and vectors; linear vector spaces and eigenvalue problems. Differential equations.

Same as PHYSICS 208.

CHEM 213. Chemical Kinetics. 4 Units.
Surveys gas phase and organic reaction mechanisms and their relationship to kinetic rate laws; treats the basic theory of elementary reaction rates. A brief presentation of modern cross-sectional kinetics is included.

Prerequisite: CHEM 132A and CHEM 132B and CHEM 132C

CHEM 215. Inorganic Chemistry I. 4 Units.
Principles of modern inorganic chemistry with applications to chemical systems of current interest. Inorganic phenomena are organized into general patterns which rationalize observed structures, stabilities, and physical properties.

Prerequisite: CHEM 107 and CHEM 132A and CHEM 132B and CHEM 132C
Restriction: Graduate students only.

CHEM 216. Organometallic Chemistry. 4 Units.
Synthesis and reactivity of organometallic complexes with an emphasis on mechanisms. Topics include bonding and fluxional properties; metal-carbon single and multiple bonds; metal å-complexes. Applications to homogenous catalysis and organic synthesis are incorporated throughout the course.

Prerequisite: CHEM 107 or CHEM 215
CHEM 217. Physical Inorganic Chemistry. 4 Units.
General principles of the spectroscopy and magnetism of inorganic compounds. Characterization of inorganic complexes by infrared, near-infrared, visible, ultraviolet, NMR, EPR, EXAFS, and Mossbauer spectroscopies. Some necessary group theory developed.
Prerequisite: CHEM 215

CHEM 218. Metallobiochemistry . 4 Units.
A review of the biochemistry of metallic elements emphasizing: methods for studying metals in biological systems; the chemical basis for nature's exploitation of specific elements; structures of active sites; mechanisms; solid-state structures and devices; metals in medicine.
Prerequisite: CHEM 131C. Prerequisite or corequisite: CHEM 131C.
Same as MOL BIO 248.

CHEM 219. Chemical and Structural Biology. 4 Units.
A survey of the organic chemistry underlying biological function. Introduction to chemical genetics, receptor-ligand interactions, small molecule agonists and antagonists, combinatorial synthesis, high throughput assays, molecular evolution, protein and small molecule design.
Restriction: Graduate students only.

CHEM 221A. Fundamentals of Molecular Biophysics. 4 Units.
An overview of the principles and concepts in molecular biophysics. Topics covered include energy and entropy in biology, non-equilibrium reaction kinetics, random walks and molecular diffusion, molecular forces in biology.
Prerequisite: Undergraduate courses in physical chemistry and biochemistry.
Repeatability: May be taken for credit 3 times.

CHEM 223. Biological Macromolecules. 4 Units.
Introduction to nucleic acid and protein structure, dynamics, and function. Topics include analytical methods, molecular evolution, folding, and catalysis.
Same as PHRMSCI 223.

CHEM 224. Molecular and Cellular Biophotonics. 4 Units.
Principles underlying the application of photonic technologies to biomolecular and cellular systems. Sample technologies Optical Tweezers, Linear and Nonlinear Optical Microscopy and Fluorescence Lifetime and Correlation Methods, and their use to investigate emergent problems in Molecular, Cellular, and Developmental Biology.
Same as BME 224.
Restriction: Graduate students only.

CHEM 225. Polymer Chemistry: Synthesis and Characterization of Polymers. 4 Units.
Prerequisite: Undergraduate courses in organic and physical chemistry.

CHEM 228. Electromagnetism. 4 Units.
Maxwell’s equations, electrodynamics, electromagnetic waves and radiation, wave propagation in media, interference and quantum optics, coherent and incoherent radiation, with practical applications in interferometry, lasers, waveguides, and optical instrumentation.
Same as PHYSICS 228.

CHEM 229A. Computational Methods. 4 Units.
Mathematical and numerical analysis using Mathematica and C programming, as applied to problems in physical science.
Same as PHYSICS 229A.
Concurrent with PHYSICS 100.

CHEM 229B. Computational Methods. 4 Units.
Mathematical and numerical analysis using Mathematica and C programming, as applied to problems in physical science.
Same as PHYSICS 229B.
CHEM 230. Classical Mechanics and Electromagnetic Theory. 4 Units.
Fundamentals of classical mechanics and electromagnetic theory are developed with specific application to molecular systems. Newtonian, Lagrangian, and Hamiltonian mechanics are developed. Boundary value problems in electrostatics are investigated. Multipole expansion and macroscopic media are discussed from a molecular viewpoint.

Prerequisite: CHEM 132A and CHEM 132B and CHEM 132C

CHEM 231A. Fundamentals of Quantum Mechanics. 4 Units.
The postulates of quantum mechanics are discussed and applied to a variety of model problems.

Prerequisite: CHEM 131A and CHEM 131B and CHEM 131C

CHEM 231B. Applications of Quantum Mechanics. 4 Units.
Approximate methods for solving atomic and molecular structure problems are developed, and the application of quantum mechanics to spectroscopy is introduced.

Prerequisite: CHEM 231A

CHEM 231C. Molecular Spectroscopy. 4 Units.
Theory and techniques of spectroscopy as used for the study of molecular and condensed phase properties. Coherent time domain spectroscopies are covered.

Prerequisite: CHEM 231B

CHEM 232A. Thermodynamics and Introduction to Statistical Mechanics. 4 Units.
A detailed discussion from an advanced point of view of the principles of classical thermodynamics. The fundamentals of statistical mechanics. Topics include an introduction to ensemble theory, Boltzmann statistics, classical statistical mechanics, and the statistical mechanics of ideal gas systems.

Prerequisite: CHEM 131A and CHEM 131B and CHEM 131C

CHEM 232B. Advanced Topics in Statistical Mechanics. 4 Units.
Continued discussion of the principles of statistical mechanics. Applications to topics of chemical interest including imperfect gases, liquids, solutions, and crystals. Modern techniques such as the use of autocorrelation function methods.

Prerequisite: CHEM 232A

CHEM 232C. Non-Equilibrium Statistical Mechanics. 4 Units.
Phenomenology of material processes, including: kinetic theories of transport and continuum, linear response theory, critical phenomena of phase transition, self-assembly, and nucleation.

CHEM 233. Nuclear and Radiochemistry. 4 Units.
Advanced treatment of nuclear structure, nuclear reactions, and radioactive-decay processes. Introduction to nuclear activation analysis, isotope effects, radiation chemistry, hot-atom chemistry, nuclear age-dating methods, nuclear reactors, and nuclear power.

Same as CBEMS 233.

Restriction: Graduate students only.

Concurrent with CBEMS 133 and CHEM 133.

CHEM 235. Molecular Quantum Mechanics. 4 Units.
Application of quantum mechanics to calculation of molecular properties. Electronic structure of molecules.

Prerequisite: CHEM 231A

CHEM 237. Mathematical Methods in Chemistry. 4 Units.
Survey of essential math methods in chemistry. Topics may include series and limits, complex analysis, Fourier and Laplace transforms, linear algebra and operators (theory and algorithms), differential equations, and probability concepts for stochastic processes.
CHEM 241. Current Issues Related to Tropospheric and Stratospheric Processes. 4 Units.
Examination of current issues related to the atmosphere, including energy usage; toxicology; effects on humans, forests, plants, and ecosystems; particulate matter (PM10); combustion; modeling and meteorology; airborne toxic chemicals and risk assessment; application of science to development of public policies.
Prerequisite: ENGRMAE 261 or CHEM 245 or EARTHSS 240
Same as ENGRMAE 260.
Restriction: Graduate students only.

CHEM 242A. Physical and Geometrical Optics. 4 Units.
Focuses on the practical aspects of optics and optical engineering, starting at the fundamentals. Topics include geometrical optics, ray tracing, polarization optics, interferometers, and diffractive optics.
Same as CBEMS 242A.
Restriction: Graduate students only.
Concurrent with PHYSICS 134A.

CHEM 242B. Applied Optics. 4 Units.
Focuses on the treatment of a wide variety of tools and techniques used in optics, particularly in research. Subjects include an introduction to lasers, optical detection, coherent optics, spectroscopic techniques, and selected topics corresponding to the interest of the students.
Prerequisite: CHEM 242A
Same as CBEMS 242B.

CHEM 243. Advanced Instrumental Analysis. 4 Units.
Theory and applications of modern advanced instrumental methods of analysis. Includes data acquisition, storage, retrieval and analysis; Fourier transform methods; vacuum technologies; magnetic sector; quadrupole and ion trap mass spectrometry; surface science spectroscopic methods; lasers and optics.
Prerequisite: CHEM 152 and (CHEM 131A and CHEM 131B and CHEM 131C)

CHEM 244. Detection and Measurement of Radiation. 4 Units.
Basic principles of detection and measurement of ionizing radiation; both theory and practical aspects of measurement techniques for alpha, beta, gamma, and neutron radiation, properties of different detector materials, electronics and data treatments, and analysis.
Prerequisite: CHEM 233 or CBEMS 233
Same as CBEMS 244.
Restriction: Graduate students only.

CHEM 245A. Gas-Phase Atmospheric Chemistry. 4 Units.
Sources, chemistry, sinks, and measurements of key atmospheric gaseous species. Chemistry of photochemical oxidant formation, transformation of key inorganic and organic trace gases, and stratospheric ozone cycling. Applications of atmospheric chemistry models to control strategies.
Prerequisite: CHEM 131A and CHEM 131B and CHEM 131C

CHEM 245B. Multi-Phase Atmospheric Chemistry. 4 Units.
Chemical and physical processes leading to the production, aging, and removal of atmospheric particles. Multi-phase processes involving gases, particles, water droplets, and environmental surfaces. Approaches for modeling these processes with applications to control strategies.
Prerequisite: CHEM 245A

CHEM 245C. Special Topics in Atmospheric Chemistry. 4 Units.
The subjects covered vary from year to year.
Prerequisite: CHEM 245B
Repeatability: Unlimited as topics vary.

CHEM 246. Separations and Chromatography. 4 Units.
Introduction to modern separation techniques such as gas chromatography, high-performance liquid chromatography, supercritical fluid chromatography, capillary electrophoresis, and field flow fractionation. Applications of these separation strategies are discussed.
CHEM 247. Current Problems in Analytical Chemistry. 4 Units.
Surveys current research challenges in analytical chemistry. Topics include electrochemistry, chromatography, spectroscopy, and mass spectrometry.

CHEM 248. Electrochemistry. 4 Units.
Fundamentals of electrochemistry including thermodynamics and the electrochemical potential, charge transfer kinetics, and mass transfer. Methods based on controlled potential and controlled current are described; the effects of slow heterogeneous kinetics and the perturbation caused by homogeneous chemistry are discussed.

CHEM 249. Analytical Spectroscopy. 4 Units.
Advanced treatment of spectroscopic techniques and instrumentation. Atomic and molecular absorption, emission, and scattering processes and their application to quantitative chemical analysis are outlined. Puts different spectroscopic techniques in perspective and demonstrates most appropriate applications to analytical problems.

CHEM 251. Special Topics in Organic Chemistry. 1-4 Units.
Advanced topics in organic chemistry.
Repeatability: Unlimited as topics vary.

CHEM 252. Special Topics in Physical Chemistry. 1-4 Units.
Advanced topics in physical chemistry. Materials fee.
Repeatability: Unlimited as topics vary.

CHEM 253. Special Topics in Inorganic Chemistry. 4 Units.
Advanced topics in inorganic chemistry.
Prerequisite: CHEM 215
Repeatability: Unlimited as topics vary.

CHEM 254. Special Topics in Computational and Theoretical Chemistry. 4 Units.
Subjects covered vary from year to year.
Repeatability: Unlimited as topics vary.

CHEM 256. Materials Chemistry. 4 Units.
An introduction to crystalline solids, descriptive crystal chemistry, solid-state synthesis and characterization techniques, x-ray and electron diffraction, phase diagrams, electronic band structure of extended solids, semi conductors, and nanoscale inorganic materials.

CHEM 257. Current Topics in Chemical and Materials Physics. 1 Unit.
The subjects covered vary from year to year. Connection between fundamental principles and implementations in practice in science, industry, and technology.
Repeatability: May be repeated for credit unlimited times.
Same as PHYSICS 266.

CHEM 266. NMR Spectroscopy. 4 Units.
Students learn the theoretical basis of solid-state or solution NMR (alternate times), including the basics of pulse sequence design. Extensive literature reading is required.
Prerequisite: CHEM 231A
Repeatability: May be taken for credit 2 times.

CHEM 267. Structural X-Ray Crystallography. 4 Units.
The principles and practice of the determination of structures by single crystal X-Ray diffraction techniques. Crystal symmetry, diffraction, structure solution and refinement. Opportunities for hands-on experience in structure determination.
Prerequisite: CHEM 131A and CHEM 131B and CHEM 131C

CHEM 272. Industrial Chemistry. 4 Units.
Scientific, economic environmental aspects of the top 50 industrially produced chemicals, including: how they are obtained, and used; present and future sources of energy and raw materials, and the effects of chemical manufacturing on the price structure of our economy.
CHEM 273. Technical Communication Skills. 2 Units.
Development of effective communication skills, oral and written presentations, through examples and practice.

Grading Option: Satisfactory/unsatisfactory only.

Same as PHYSICS 273.

CHEM 280. Research. 2-12 Units.
Supervised original research toward the preparation of a Ph.D dissertation or M.S. thesis.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

CHEM 290. Seminar. 1 Unit.
Weekly seminars and discussions on general and varied topics of current interest in chemistry.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

CHEM 291. Research Seminar. 4 Units.
Detailed discussion of research problems of current interest in the Department. Format, content, and frequency of the course are variable.

Repeatability: Unlimited as topics vary.

Restriction: Graduate students only.

CHEM 292. Graduate Symposium. 2 Units.
Students present public seminars on literature-based research topics in contemporary chemistry. Topics to be chosen by student and approved by instructor.

Repeatability: May be repeated for credit unlimited times.

CHEM 299. Independent Study. 1-4 Units.
Independent research with Chemistry faculty.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

CHEM 399. University Teaching. 1-4 Units.
Required of and limited to Teaching Assistants.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be repeated for credit unlimited times.