Chemistry and Biochemistry

Chemistry is an excellent foundation for any scientific, professional or business career, including but not limited to agricultural chemistry, analytical chemistry, biochemistry, chemical engineering, dentistry, ecology and environmental chemistry, forensic science, geochemistry, management and marketing, materials science, medicine, optometry and ophthalmology, patent law, pharmacology, physical chemistry, plastics and polymer chemistry, renewable energy, synthetic organic chemistry, toxicology or veterinary science. Undergraduate research experiences are readily available under the supervision of a faculty advisor. Students are encouraged to meet with an undergraduate advisor to design a curriculum focused on their career goals.

All Chemistry majors begin in the Comprehensive Chemistry specialization, which provides a rigorous program with advanced study in analytical, organic and physical chemistry for the professional chemist. After the freshman year, all students pursuing a Bachelor of Science degree in the College of Science have the option to continue in Comprehensive Chemistry or move into a more specialized specialization, which builds upon the foundation course work in analytical, biochemistry, inorganic, organic and physical chemistry.

Pre-professional students and those interested in biological chemistry may pursue the Biochemistry specialization with additional advanced courses in other life sciences. The Environmental Chemistry specialization complements advanced study in analytical and organic chemistry with in depth study of environmental chemistry and related fields of engineering, forestry, geology, plant biology and soil science. The Forensic Chemistry specialization gives students the opportunity to study the science required for investigative research in a crime lab. Although not required for graduate study or employment as a chemist, students are encouraged to pursue certification from the American Chemical Society, 1155 Sixteenth St. NW, Washington, D.C.

Future business leaders can earn a Bachelor of Arts degree in the College of Science. The Business specialization allows students to pursue a minor degree in Business and Administration and is ideal preparation for a career in the production, management, marketing and technology transfer aspects of the chemistry industry. Additional course work is recommended to prepare for a Masters in Business Administration.

All science majors require proficiency in mathematics, which is prerequisite for upper level course work in chemistry. Students are encouraged to enroll in the highest level of mathematics appropriate to their background within the first semester. All students are expected to show proficiency in chemistry prerequisites that are chemistry courses with a grade of C or better, or obtain consent of the instructor for enrollment in the subsequent chemistry course. For chemistry majors, a grade of C or better is needed in every Chemistry Introductory course and in every Chemistry Foundation course to be eligible for graduation. A minimum grade point average of 2.0 in chemistry course work is needed in order for a student to receive a degree in chemistry. A student cannot repeat a course or its equivalent in which a grade of B or better was earned without the consent of the department.

Students wishing more detailed information should visit our website at chem.siu.edu or contact an undergraduate advisor at the Department of Chemistry and Biochemistry, Neckers Hall, Rm. 224 - Mail Code 4409, Southern Illinois University Carbondale, Carbondale, IL 62901.
# Bachelor of Science Degree in Chemistry

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Core Curriculum Requirements</td>
<td>39</td>
</tr>
<tr>
<td><strong>College of Science Academic Requirements</strong></td>
<td>6</td>
</tr>
<tr>
<td>Biological Sciences - (3 hours included in the UCC Life Sciences hrs, and 3 hours completed with CHEM 350) Mathematics – completed with major Physical Sciences – completed with major Supportive Skills - CS 201 or CS 202; ENGL 290 or ENGL 291 or ENGL 391; MATH 282 or MATH 483</td>
<td>6</td>
</tr>
<tr>
<td><strong>Chemistry Major Requirements</strong></td>
<td>62-64</td>
</tr>
<tr>
<td>CHEM 200 or CHEM 200H, CHEM 201, CHEM 202 or CHEM 202H, CHEM 210 or CHEM 210H, CHEM 211, CHEM 212 or CHEM 212H (3 hours included in the UCC Physical Science hours)</td>
<td>7</td>
</tr>
<tr>
<td>CHEM 330, CHEM 340, CHEM 341, CHEM 350, CHEM 351, CHEM 360, CHEM 361, CHEM 410, CHEM 411</td>
<td>24</td>
</tr>
<tr>
<td>MATH 150, MATH 250 (3 hours included in the UCC Mathematics hours)</td>
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</tr>
<tr>
<td>MATH 221 or MATH 251 or MATH 305 or MATH 483</td>
<td>3-4</td>
</tr>
<tr>
<td>PHYS 205A, PHYS 255A, PHYS 205B, PHYS 255B</td>
<td>8</td>
</tr>
</tbody>
</table>

One of the following specializations:

- **Biochemistry Specialization**
  - CHEM 442, CHEM 443, CHEM 452, CHEM 453
  - Six hours from the following: BIOL 305, BIOL 306; CHEM 434, CHEM 444, CHEM 451 A/B in lieu of CHEM 350, CHEM 456, CHEM 460/CHEM 463; MICR 301, MICR 302, MICR 425, MICR 460; PHSL 310, PHSL 401A, PHSL 401B, PHSL 410A, PHSL 410B, PHSL 420A, PHSL 420B, PHSL 460; PLB 320, PLB 419, PLB 427; ZOOL 409, ZOOL 418
  - 10

- **Comprehensive Chemistry**
  - CHEM 434, CHEM 442, CHEM 443, CHEM 460, CHEM 461
  - 13
<table>
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<tr>
<td>One of the following: CHEM 431, CHEM 439, CHEM 444, CHEM 451 A&amp;B in lieu of CHEM 350, CHEM 452, CHEM 456, CHEM 468, CHEM 479</td>
<td>3</td>
</tr>
<tr>
<td>Environmental Chemistry Specialization</td>
<td>15</td>
</tr>
<tr>
<td>CHEM 431, CHEM 434, CHEM 442, CHEM 443</td>
<td>12</td>
</tr>
<tr>
<td>MATH 483 (included in math hours above)</td>
<td></td>
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<tr>
<td>At least 3 hours from the following: CE 310, CE 418; FOR 452/FOR 452L; GEOL 418, GEOL 421; ME 410, ME 416; MICR 423, MICR 425; CSEM 442, CSEM 446, CSEM 447/ CSEM 448; PLB 427; ZOOL 411, ZOOL 432</td>
<td>3</td>
</tr>
<tr>
<td>Forensic Chemistry Specialization</td>
<td>15</td>
</tr>
<tr>
<td>CHEM 434, CHEM 439, CHEM 442, CHEM 443</td>
<td>12</td>
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<td>MATH 483 (included in math hours above)</td>
<td></td>
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<tr>
<td>PHIL 104 or PHIL 340 (3 hours included in UCC humanities)</td>
<td></td>
</tr>
<tr>
<td>At least 3 hours from the following: BIOL 305; GEOL 310, GEOL 417; MICR 301, MICR 302, MICR 454, MICR 460; PHSL 310, PHSL 401A, PHSL 401B, PHSL 420A, PHSL 420B; PLB 330; ZOOL 409</td>
<td>3</td>
</tr>
<tr>
<td>American Chemical Society Certification</td>
<td>3</td>
</tr>
<tr>
<td>Certification by the ACS requires a minimum of 300 contact hours of undergraduate research over at least two semesters, including two credit hours of CHEM 396 or CHEM 496H; attending undergraduate seminar, CHEM 490; and completion of a comprehensive research report under the direction of a faculty advisor. A student can receive ACS Certification with any of the above specializations.</td>
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</tr>
<tr>
<td>Chemistry Honors</td>
<td>6</td>
</tr>
<tr>
<td>Participation in Chemistry Honors requires completion of the ACS Certificate with 300 contact hours of undergraduate research, including two credit hours of CHEM 496H; attending undergraduate seminar, CHEM 490H; and completion of an honors thesis, CHEM 499H or UHON 499, under the direction of a faculty advisor. A faculty advisor approved proposal for an honors research project should be submitted one year prior to the expected completion of an honors thesis. A student can earn Chemistry Honors with any of the above specializations.</td>
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</tr>
</tbody>
</table>
1 A total of nine hours of biological science, mathematics, and physical science course work are accounted for in the 39-hour University Core Curriculum requirement. An additional two hours of human health are accounted for if students choose PHSL 310 as part of the Biochemistry Specialization.

2 A total of three hours of biological sciences are completed with biological chemistry or biochemistry. CHEM 451A may substitute for CHEM 350, if a student continues with CHEM 451B. Prerequisite is MATH 106, MATH 111 or MATH 108 and MATH 109. The elective hours are decreased by three to six hours for students who place into a course lower than calculus. Three hours of supportive skills are accounted for in the College of Science requirement and elective hours may increase by two hours if students choose MATH 483.

3 Students must complete all of the additional courses listed under the specialization as well as any prerequisites not listed here for all additional courses. These courses may substitute for electives and may require more than 120 total credit hours if not chosen wisely and with guidance from advisors.

### Bachelor of Arts Degree in Chemistry

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<td>Requirements for Major in Chemistry</td>
<td>62</td>
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<td>8</td>
</tr>
<tr>
<td>Business Specialization</td>
<td>21-22</td>
</tr>
</tbody>
</table>
### Chemistry Minor

The minor in chemistry requires a minimum of 20 semester hours of chemistry in formal course work including CHEM 200, CHEM 201, CHEM 210, CHEM 211 and three elective lecture courses at 300-level or above. At least one of the elective courses must include a lab component. All elective courses must be taken at SIU. A grade of C or better is needed in all elective courses to be eligible for a minor in chemistry. Microbiology majors may take MICR 425 in place of CHEM 350 to meet the requirements for a minor in chemistry.

### Forensic Science Minor

Required courses for the Forensic Science Minor amount to 15 hours, including nine hours of required courses and six hours of electives (with no more than four of the minimum six hours of electives from a single discipline/department).

**Required Courses:** nine hours: ANTH 231, CCJ 201, CHEM 173.

**Electives:** (note, some have prerequisites) six hours: AH 313; ANTH 240A, ANTH 440B, ANTH 441D, ANTH 455A, ANTH 455H, ANTH 465 (Internship in Forensics - must be arranged individually); BIOL 305; CCJ 290, CCJ 310, CCJ 330, CCJ 408; CHEM 439; PHIL 104, PHIL 340; PHSL 301; PLB 300, PLB 330; POLS 334; PSYC 305, PSYC 431, PSYC 440; SOC 372.

### American Chemical Society Certificate

The American Chemical Society (ACS) Certificate program prepares students for a career in the chemical industry or for further studies in graduate school. The certificate indicates that a student has completed the rigorous academic requirements for a degree in chemistry and has actively participated in undergraduate research under the direction of a faculty research advisor. Students should contact a faculty research advisor at least one year prior to graduation to apply for an undergraduate research position in their laboratory. Students will complete 300 hours of undergraduate research including two credit hours of CHEM 396 or CHEM 496H; attend undergraduate seminar, CHEM 490; and complete a comprehensive research report for submission to the department. An application to receive an ACS

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<td>3-4</td>
</tr>
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<td>ACCT 220, ACCT 230</td>
<td>6</td>
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<td>FIN 330</td>
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<td>MKTG 304</td>
<td>3</td>
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<tr>
<td>MGMT 304 or MGMT 318</td>
<td>3</td>
</tr>
<tr>
<td>Free Electives</td>
<td>7-10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>120</strong></td>
</tr>
</tbody>
</table>

1 A total of nine hours of biological science, mathematics, and physical science course work are accounted for in the 41-hour University Core Curriculum requirement. An additional three hours of social science are accounted for if students take ECON 240 in the Business Specialization.
Certificate must be submitted at least one month prior to graduation with verification by a faculty research advisor of completion of all requirements.

Chemistry Honors

All freshmen chemistry majors are strongly encouraged to enroll in CHEM 200H and to participate in the University Honors Program. The Chemistry Honors track includes completion of an ACS Certificate and an honors thesis under the supervision of a faculty research advisor. Applications for Chemistry Honors should be submitted at least one year prior to graduation and must include an honors research project proposal with a letter of support from a faculty research advisor. Acceptance and participation in an honors research project requires a 3.25 grade point average in all chemistry coursework. Students will complete 300 hours of undergraduate research including two credit hours of CHEM 496H; attend undergraduate seminar, CHEM 490H; complete an honors thesis, CHEM 499H; and present their thesis work as a seminar or poster presentation. The honors thesis and all chemistry honors courses may be included in the pursuit of an Honors Degree offered by the University Honors Program, which requires submission of an honors thesis project proposal to the Honors Program Director before the end of the junior year after approval from a faculty research advisor. The Honors Thesis course, University Honors 499, may substitute for CHEM 499H and requires submission of an honors thesis to the Honors Program Office and OpenSIUC.

Multiple Specializations in Chemistry

Students meeting the requirements for a Bachelor of Science degree in Chemistry may earn multiple specializations. All requirements for each specialization must be satisfied.

Transfer Credit

Credit for a course in chemistry successfully completed at another accredited institution will be accepted to meet major or minor requirements in chemistry at SIU, subject to the following conditions:

1. The course number must bear a departmental prefix clearly indicating the course is a chemistry (or biochemistry) course.
2. The course must have covered substantially the same material as a course currently offered at SIU to meet major requirements.
3. Any course used to meet major or minor requirements in chemistry must be explicitly approved by the Department of Chemistry and Biochemistry.

Chemistry and Biochemistry Courses

CHEM106 - Chemistry and Society 106-3 Chemistry and Society. (University Core Curriculum) [IAI Course: P1 903L] Exploration of the many implications that chemistry has upon modern society. Topics include air and water quality, global warming, acid rain, fossil, solar and nuclear fuels, nutrition and drugs. Three lectures per week except that every other week a three-hour lab is substituted for one of the lectures that week. Lab fee: $60.

CHEM125 - Prep General Chemistry 125-3 Preparatory General Chemistry. Preparation for general chemistry (CHEM 200). This course is designed to strengthen background knowledge and skills necessary for success in CHEM 200. Topics include unit conversions, periodic table, chemical formulas, chemical reactions, and stoichiometry, with a focus on mathematical problem solving, interpreting data from graphs and tables, and chemical reasoning.

CHEM140A - Chemistry 140A-4 Chemistry. (Advanced University Core Curriculum) [IAI Course: P1 902L] A two-semester course of general, organic and biological chemistry designed to meet the needs of nursing, dental hygiene, physical therapy, other allied health programs, agriculture, forestry and
other majors with comparable requirements. This course does not satisfy prerequisite requirements for other courses and is not applicable to a major in chemistry. CHEM 140A can serve as a preparation for CHEM 200 for students without a year of high school chemistry or for those who feel their background is inadequate. Three lectures and one three-hour laboratory per week. Pre- or Co-requisite: MATH 106, 108, 109, 110, 111, 125, 139, 140, 141 or 150. CHEM 140A satisfies University Core Curriculum Science Group I requirement in lieu of 106. Lab fee: $60.

CHEM140B - Chemistry 140B-4 Chemistry. A two-semester course of general, organic and biological chemistry designed to meet the needs of nursing, dental hygiene, physical therapy, other allied health programs, agriculture, forestry and other majors with comparable requirements. This course does not satisfy prerequisites for other courses and is not applicable to a major in chemistry. Three lectures and one three-hour laboratory per week. Prerequisite: CHEM 140A. Pre- or Co-requisite: MATH 106, 108, 109, 110, 111, 125, 139, 140, 141 or 150. CHEM 140A satisfies University Core Curriculum Science Group I requirement in lieu of 106. Lab fee: $60.

CHEM173 - Forensic Science 173-3 Introduction to Forensic Science. This course is designed to provide an introduction to forensic science and criminalistics and the techniques used in the modern forensic laboratory for the analysis of common types of physical evidence encountered at crime scenes. Topics include the recognition, identification, and evaluation of physical evidence such as DNA, hairs, fibers, drugs, blood, glass, soil, firearms, fingerprints, and documents. Three lectures per week. No prerequisite.

CHEM180 - Chemistry of Beer 180-2 The Chemistry of Beer and Brewing. The course covers the science and chemistry of beer and brewing. The history of beer and brewing will be introduced to follow the evolution of beer as a food and beverage, including how beer has impacted society and how brewing has been affected by society. The chemistry of the four basic ingredients of beer (water, malt, hops, and yeast) will be explored, as well as the chemistry of the brewing process. The various styles of beer will be introduced and discussed with respect to how the styles can be achieved based on the chemistry of the ingredients and process. Home brewing and commercial brewing will be compared. The course does not presume a background in chemistry and various chemical concepts will be introduced on an as needed basis.

CHEM181 - Chemistry of Beer Lab 181-1 The Chemistry of Beer and Brewing Laboratory. The laboratory complement to CHEM 180, The Chemistry of Beer and Brewing. The laboratory will cover various aspects of beer and brewing in a hands-on experiential environment. A major component will be guided tasting sessions of the various style categories of beer. Students will participate in brewing beer from base ingredients using various brewing techniques. Experiments conveying basic biology, chemistry and physical science concepts will be conducted. In addition, spectroscopic and chromatographic methods will be used to analyze flavor and ingredient components in beer. Special tours may also be arranged in regional breweries and hop yards. Students must be of legal drinking age prior to the first laboratory meeting. Special approval needed from the instructor. Lab fee: $90.

CHEM200 - Intro to Chemical Principles 200-3 Introduction to Chemical Principles. (Advanced University Core Curriculum course) [IAI Course: CHM 911] [IAI Course: P1 902] First-semester chemistry for students in science, pre-professional, engineering or technology programs. Atomic structure, molecular structure, bonding, solutions, stoichiometry, gases, liquids and solids. Three lectures per week. Students are required to attend a weekly one hour supervised computer workshop. Prerequisite: one year of high school chemistry or CHEM 140A or ACT Science score of at least 22; Prerequisite or Co-requisite: MATH 106, 108, 109, 111, 140 or 150; Concurrent enrollment in CHEM 201 and CHEM 202. With 201 satisfies University Core Curriculum Science Group I requirement in lieu of 106.

CHEM200H - Atoms and Molecules 200H-3 Chemistry of Atoms and Molecules. First semester of the accelerated chemistry course for chemistry majors and advanced students in science. Atoms, quantum theory, atomic structure, chemical bonds, molecular structure, and chemical reactions. Three lectures per week. Students are required to attend a weekly one hour supervised computer workshop. Prerequisite: declared Chemistry major or ACT Science score of at least 25; Prerequisite or Co-requisite: MATH 106, 108, 109, 111 or 150. Concurrent enrollment in CHEM 201 and CHEM 202H. With 201 satisfies University Core Curriculum Science Group I requirement in lieu of 106.

CHEM201 - General Chemistry Lab I 201-1 General Chemistry Laboratory I. (Advanced University Core Curriculum course) [IAI Course: P1 902L] [IAI Course: CHM 911] Synthesis and exploration of the
properties of compounds and elements. One three-hour laboratory per week. Prerequisite: completion of or concurrent enrollment in Chemistry 200. If Chemistry 200 is dropped, the laboratory course must also be dropped. With Chemistry 200 satisfies University Core Curriculum Science Group I requirement in lieu of 106. Lab fee: $60.


**CHEM202H - Atoms & Molecules Workshop** 202H-1 Atoms and Molecules Workshop. Supervised computer workshop meets one hour weekly for students in Chemistry of Atoms and Molecules. Concurrent enrollment in CHEM 200H.

**CHEM210 - General and Inorganic Chem** 210-3 General and Inorganic Chemistry. [IAI Code: CHM 912] Second semester chemistry for science, engineering or pre-professional majors. Rates of reaction, chemical equilibrium, acid-base equilibria, pH electrochemistry, transition metals, properties of inorganic compounds, nuclear chemistry and organic chemistry. Three lectures per week. Students are required to attend a weekly one hour supervised computer workshop. Prerequisite: MATH 106, 108, 109, 111, 140 or 150; C or better in CHEM 200, 201. Concurrent enrollment in CHEM 212.

**CHEM210H - Chemistry of Matter** 210H-3 Chemistry of Matter. Second semester of the accelerated chemistry course for chemistry majors and advanced students in science. Chemical properties of matter, kinetics, equilibrium, solution chemistry, thermodynamics, electrochemistry, nuclear chemistry and transition metals. Three lectures per week. Students are required to attend a weekly one hour supervised computer workshop. Prerequisite: MATH 106, 108, 109, 111 or 150; C or better in CHEM 200H or declared Chemistry major and A grade in CHEM 200; Concurrent enrollment in CHEM 211 and CHEM 212H.

**CHEM211 - General Chemistry Lab II** 211-1 General Chemistry Laboratory II. [IAI Code: CHM 912] Continued synthesis and exploration of properties of compounds and elements. Prerequisite: C or better in CHEM 200, 201; completion of or concurrent enrollment in CHEM 210. If CHEM 210 is dropped, CHEM 211 must also be dropped. Lab fee: $60.

**CHEM212 - General Chemistry Workshop** 212-1 General Chemistry Workshop. Supervised computer workshop meets one hour weekly for students in General and Inorganic Chemistry. Concurrent enrollment in CHEM 210.

**CHEM212H - Matter Workshop** 212H-1 Matter Workshop. Supervised computer workshop meets one hour weekly for students in Chemistry of Matter. Concurrent enrollment in CHEM 210H.

**CHEM296 - Introduction to Research** 296-1 to 2 Introduction to Research. Introduction to research under the direction and supervision of a faculty advisor. Safety training is required. Special approval needed from the instructor.

**CHEM330 - Quantitative Analysis** 330-5 Quantitative Analysis. A one-semester course in analytical chemistry that emphasizes quantitation by wet-chemical methods and modern instrumentation. Topics include statistics, sampling, gravimetry, multiple chemical equilibria, titrimetry, potentiometry, voltammetry, spectrophotometry and chromatography. Three lectures and two laboratories per week. Ability to solve algebraic equations and use of logarithms essential. Prerequisite: MATH 109, 111, 150 or 250; C or better in CHEM 210, 211. Lab fee: $60.

**CHEM339 - Intro to Organic Chemistry** 339-3 Introduction to Organic Chemistry. An introduction to the chemistry of carbon-based compounds. Intended to introduce students to functional groups; their structure properties and reactivity. For students requiring only one semester of organic chemistry. Three lectures per week. Prerequisite: C or better in CHEM 210, 211. Recommended: concurrent enrollment in CHEM 341.

**CHEM340 - Organic Chemistry I** 340-3 Organic Chemistry I. The first part of a two semester introduction to organic chemistry. This course will introduce basic nomenclature, bonding, stereochemistry, reactivity and the spectroscopic methods common to organic chemistry. Three lectures per week. Prerequisite: C or better in CHEM 210, 211.
CHEM341 - Organic Chemistry Lab I 341-2 Organic Chemistry Laboratory I. An introductory lab course based upon a problem-solving approach to organic chemistry. Students will identify and derivatize unknowns using modern organic techniques. One one-hour lecture and one four-hour laboratory per week. Prerequisite: C or better in CHEM 210, 211; 339 or 340 taken concurrently. Lab fee: $60.

CHEM350 - Biological Chemistry 350-3 Introduction to Biological Chemistry. Fundamental concepts in Biological Chemistry include biomolecular structure, enzyme catalysis, metabolism and gene expression. Three lectures per week. Prerequisite: C or better in CHEM 210 and 339 or 340; C or better in one semester biological sciences course (not University Core Curriculum course). Offered spring semester only.

CHEM351 - Biochemistry Laboratory 351-2 Biochemistry Laboratory. A one semester biochemistry laboratory covering techniques and laboratory procedures; isolation, purification and characterization of amino acids, peptides, proteins, nucleic acids, lipids and cofactors; spectroscopic and chromatographic analysis of biomolecules; study of protein-ligand interactions; enzyme kinetics. One one-hour lecture and one four-hour laboratory per week. Prerequisites: CHEM 210, 211, 339 or 340, 341. Prerequisite or co-requisite: CHEM 350 or 451B. Offered spring semester. Lab fee: $60.

CHEM360 - Physical Chemistry 360-3 Classical Physical Chemistry. An introduction to chemical, statistical thermodynamics and kinetics. Prerequisite: Mathematics 250; C or better in CHEM 210, 330 or concurrent enrollment. Mathematics 221 or 305 is recommended as prerequisite or concurrent enrollment. Offered fall semester only.

CHEM361 - Physical Chem Lab I 361-1 Physical Chemistry Laboratory I. Experiments relating to topics covered in 360. Prerequisite: CHEM 360 or concurrent enrollment. One three-hour laboratory per week. Offered fall semester only. Lab fee: $60.

CHEM386A - Problem Solving Workshop 386A-1 Problem Solving Workshop. A two semester workshop sequence for chemistry majors. One two-hour workshop per week per semester. Introduction to problem solving strategies with examples and practice problems. Prerequisite: Chemistry 200. Restricted to chemistry major.

CHEM386B - Problem Solving Workshop 386B-1 Problem Solving Workshop. A two semester workshop sequence for chemistry majors. One two-hour workshop per week per semester. Advanced problem solving with general applications. Prerequisite: CHEM 386A.

CHEM396 - Undergraduate Research 396-1 to 2 Undergraduate Research. Research under the direction and supervision of a faculty advisor culminating in a written report. Safety training is required. Prerequisite: one semester of chemistry with laboratory experience. Special approval needed from the instructor.

CHEM410 - Inorganic Lab 410-2 Inorganic Synthesis and Characterization Laboratory. Introduction to synthesis techniques and characterization methods of inorganic compounds. One four-hour lab per week. Not for graduate credit. Prerequisite: completion of or concurrent enrollment in CHEM 411. Offered spring semester only. Lab fee: $60.

CHEM411 - Intermediate Inorganic Chem 411-3 Intermediate Inorganic Chemistry. Fundamentals of inorganic chemistry, covering bonding and structure, coordination compounds and the chemistry of some familiar and less familiar elements. Three lectures per week. Prerequisite: CHEM 360. Offered spring semester only.

CHEM431 - Environmental Chemistry 431-3 Environmental Chemistry. Chemical principles applied to the environment and environmental problems. Chemical kinetics, thermodynamic and equilibrium concepts as they relate to the atmosphere, water and soil will be discussed to include current problems of pollutants, pollutant evaluation and pollutant remediation. Discussion of methods for the chemical analysis of environmental samples will also be included. Prerequisite: C or better in CHEM 330 and 340.

CHEM434 - Instrumental Analysis 434-2 to 4 Instrumental Analytical Chemistry. Theory and practice of instrumental measurements, including emission and absorption spectroscopic, capillary electrophoretic and chromatographic methods. Two lectures and two three-hour laboratories per week for four credits. Enrollment for two credit hours is restricted to graduate students in the Department of Chemistry and
Biochemistry who are advised to take instrumental analysis. Prerequisite: C or better in CHEM 330. Offered fall semester only. Laboratory fee: $60.

**CHEM439 - Forensic Chemistry** 439-3 Forensic Chemistry. A one-semester course in the analysis of forensics samples. Topics include sample collection and preservation, chain of custody, data validation and reports, and analytical methods which may include (as time permits) chromatography, mass spectroscopy, fluorescence and absorbance spectroscopy, fingerprint identification, and scanning electron and light microscopy. One lecture and one six-hour laboratory meeting per week. Prerequisite: C or better in CHEM 330 and 434. Offered spring semester only. Lab fee: $60.

**CHEM442 - Organic Chemistry II** 442-3 Organic Chemistry II. This is a continuation of 340 emphasizing topics that were not covered in the first semester. Topics will include the chemistry of aromatic compounds, dienes and other carbon-carbon bond forming reactions. Advanced topics such as polymers and biomolecules may also be covered. Three lectures per week. Prerequisite: C or better in CHEM 340, 341; concurrent enrollment in 443 is recommended. Offered spring semester only.

**CHEM443 - Organic Chemistry Lab II** 443-2 Organic Chemistry Laboratory II. A second organic laboratory course based upon a synthetic approach. Students will learn modern synthetic organic chemistry techniques including modern spectroscopic techniques. One one-hour lecture and one four-hour laboratory per week. Prerequisite: C or better in CHEM 340, 341, 442, or concurrent enrollment in 442. Offered spring semester only. Lab fee: $60.

**CHEM444 - Intermediate Organic Chem** 444-3 Intermediate Organic Chemistry. A transitional course between introductory and graduate level chemistry. The chemistry of carbon compounds based upon a mechanistic approach will be discussed. Three lectures per week. Prerequisite: C or better in CHEM 340 and 442. Offered fall semester only.

**CHEM451A - Biochemistry** 451A-3 Biochemistry. (Same as BCHM 451A and MBMB 451A) First half of the 451 A,B two semester course. Must be taken in A,B sequence. Three lectures per week. Introduction to biomolecules, biochemical techniques, expression of genetic information, basic thermodynamics, ligand binding, aqueous solutions, protein structure, spectroscopy. Prerequisites: CHEM 340 and CHEM 342 or 442, or equivalents.

**CHEM451B - Biochemistry** 451B-3 Biochemistry. (Same as MBMB 451B and BCHM 451B) Second half of 451A,B two semester course. Must be taken in A,B sequence. Basic kinetics, enzyme kinetics, enzyme inhibitors, regulation of enzymes, oxidation-reduction, high energy bonds, transport across membranes, intermediary metabolism, hormonal control of metabolism. Prerequisites: MBMB 451A or BCHM 451A or CHEM 451A or equivalent.

**CHEM452 - Advanced Biochemistry** 452-3 Advanced Biological Chemistry. Advanced study of biochemical chemistry including the structure-function relationship in proteins, the mechanism of enzyme reactions and the biochemical basis of gene expression, signal transduction, nerve impulses, molecular motors and other physiological processes. For graduate students, this course may be taken to meet deficiencies in biochemical knowledge, but will not meet the formal coursework requirements for the master or doctoral level degrees. Prerequisite: C or better in CHEM 340, 341, 350.

**CHEM453 - Advanced Biochemistry Lab** 453-2 Advanced Biochemistry Laboratory. A one semester advanced biochemistry laboratory covering techniques and laboratory procedures for the isolation, purification and characterization of biomolecules. Two three-hour laboratories per week. Prerequisites: C or better in CHEM 350 and CHEM 351. Lab fee: $60.

**CHEM456 - Biophysical Chemistry** 456-3 Biophysical Chemistry. (Same as MBMB 456 and BCHM 456) A one-semester course in Biophysical Chemistry intended for biochemists and molecular biologists. Emphasis will be on solution thermodynamics, kinetics and spectroscopy applied to biological systems. Prerequisites: CHEM 340 and CHEM 342 or 442, MATH 141 or 150, MBMB 451A or BCHM 451A or CHEM 451A, or equivalents.

**CHEM460 - Quantum Mechanics** 460-3 Quantum Mechanics and Spectroscopy. An introduction to quantum mechanics and spectroscopy. Prerequisite: MATH 250; C or better in CHEM 360. MATH 221 or 305 is recommended as prerequisite or concurrent enrollment. Offered spring semester only.
CHEM463 - Physical Chem Lab II 463-1 Physical Chemistry Laboratory II. Experiments relating to topics covered in 460. Prerequisite: C or better in CHEM 460 or concurrent enrollment. One three-hour laboratory per week. Offered spring semester only. Lab fee: $60.

CHEM468 - Application Symmetry to Chem 468-3 Application of Symmetry to Chemistry. The concepts of symmetry elements, groups and character tables will be taught. Symmetry will be applied to molecules in order to simplify and characterize their wave functions and vibrational frequencies. Prerequisite: C or better in CHEM 460. Offered spring semester in odd years only.

CHEM479 - Materials Chemistry 479-3 Principles of Materials Chemistry. Introduction to fundamental concepts of materials chemistry. Synthesis, characterization, processing and applications of different materials including solids, polymers, ceramics and molecularly designed materials. Prerequisite: CHEM 360, 411 or concurrent enrollment. Offered fall semester in odd years only.

CHEM489 - Special Topics in Chemistry 489-1 to 3 Special Topics in Chemistry. Special approval needed from the instructor and chair.

CHEM490 - Undergraduate Seminar 490-1 Undergraduate Seminar. Current topics in chemistry covered through literature review, presentations, reports of ongoing research and discussions. Prerequisite/Co-requisite: CHEM 296, CHEM 396 or CHEM 496. Special approval needed from the instructor.

CHEM490H - Honors Seminar 490H-1 Honors Seminar. Current topics in chemistry covered through literature review, presentations, reports of ongoing research and discussions. Pre/Co-requisite: CHEM 496H. Special approval needed from the instructor.

CHEM496H - Honors Research 496H-1 to 6 Honors Research. Independent research under the direction of a faculty advisor culminating in a written report. Safety training is required. Prerequisite: C or better in CHEM 330. Special approval needed from the instructor and a minimum 3.0 grade point average in all chemistry course work.

CHEM499H - Honors Thesis 499H-3 Honors Thesis. Preparation of a well-written honors thesis under the supervision of a faculty advisor based on an honors research project. The written thesis will be submitted to the faculty advisor and the department. A public presentation of the honors thesis research is required as a seminar or poster presentation. A proposal for honors research must be submitted to the department one year prior to completion of the honors thesis. Pre/Co-requisite: CHEM 496H.

CHEM506 - Chemistry Topics for Teachers 506-3 Chemistry Topics for Teachers. This graduate-level chemistry course covers topics, methods and activities that target the needs of elementary and middle school science teachers. The course consists of a combination of lectures and laboratory experiments. The specific subjects covered during the course change, depending on the needs of the current students. This course may only be taken as part of an approved major. Special approval needed from the instructor.


CHEM511B - Advanced Inorganic Chem II 511B-3 Advanced Inorganic Chemistry. Energetics, kinetics and mechanisms of inorganic systems. Prerequisite: one year of physical chemistry, CHEM 411.

CHEM519 - Advanced Topics Inorganic Chem 519-3 Advanced Topics in Inorganic Chemistry. Metal ions in biological processes and other selected topics to be announced by the department. Maximum credit nine semester hours. Special approval needed from the instructor.

CHEM531 - Intro Analytical Separations 531-3 Introduction to Analytical Separations. An introduction to the basic principles underlying separation science, with emphasis on all major chromatographies, gel and capillary electrophoresis, isoelectric focusing, field-flow fractionation, rate and isopycnic sedimentation, filtration, reverse osmosis and related methods. Prerequisite: MATH 250.

CHEM532 - Analytical Chem Instrumentation 532-3 Analytical Chemistry Instrumentation. Introduction to analog and digital electronics and the computer control of system components. The course will focus on
chemical instrumental and the use of filters, amplifiers and digital signal processing to improve sensitivity and detection limits. Two lectures and one three-hour laboratory per week. Prerequisite: CHEM 434.

CHEM533 - Analytical Spectroscopy 533-3 Analytical Spectroscopy. Fundamental and experimental aspects of electronic and vibrational spectrometry, with a particular emphasis on the spectroscopic analysis of atomic and molecular species. Various sources of electromagnetic radiation, detectors, optical components and the optimization of experimental methods are covered in detail. Common spectroscopic techniques are covered in detail and a portion of the course covers newly emerging techniques and developments. Prerequisite: CHEM 434.

CHEM534 - Electrochemistry 534-3 Electrochemistry. Fundamentals and applications of electrochemical methods, with emphasis on the thermodynamics and kinetics of electron transfer, electrode double-layer structures, as well as varied voltammetric techniques.

CHEM535 - Advanced Analytical Chem 535-3 Advanced Analytical Chemistry. Course surveys various statistical, data-manipulative, and numerical methods as applied to analytical chemistry, including probability distributions, methods of maximum likelihood, linear and nonlinear least squares, correlation coefficients, chi-square, F and T distributions, Pearson statistics, analysis of variance, convolution, deconvolution, cross-correlation, autocorrelation, data acquisition, Nyquist theorem, aliasing, digitization errors, digital filtering, Monte Carlo methods, and finite-difference equations. Prerequisite: CHEM 434.

CHEM536 - Principles Mass Spectrometry 536-3 Principles of Mass Spectrometry. This course is an introduction to mass spectrometry with a focus on pharmaceutical and biological applications. Topics that will be covered include instrument design, ionization techniques, tandem mass spectrometry, chromatography/mass spectrometry and mass spectral interpretation. Prerequisite: CHEM 434.

CHEM537 - Fluorescence Spectroscopy 537-3 Fluorescence Spectroscopy. Fundamental and experimental aspects of analytical methods based on the various phenomena of luminescence. General principles of luminescence are covered in detail, as well as analytical techniques based on fluorescence quenching, energy transfer, polarization, and time resolved methods. Aspects of source of electromagnetic radiation, detectors, and electronic/optical components are discussed specifically as they pertain to fluorescence spectroscopy. Newly emerging fluorescence based techniques are also discussed. Prerequisite: CHEM 434 and CHEM 533 (or consent of the instructor).

CHEM538 - Nano Probing/Imaging 538-3 Nanoscale Probing and Imaging. This course covers basic principles of scanning probe microscopy and spectroscopy including STM, AFM, ACM and NSOM, and the broad applications in nanoscale probing and imaging. Topics include surface characterization and manipulation, nanolithography, nanomaterials, self-assembly, molecular electronics, optoelectronics, nanoscale electron transfer, single-molecular spectroscopy, protein structures, enzyme dynamics, and living cell imaging. Prerequisite: undergraduate physical and analytical chemistry.

CHEM539 - Adv Topics in Analytical Chem 539-3 Advanced Topics in Analytical Chemistry. Selected topics of interest to practicing analytical chemists such as microanalytical chemistry, functional-group chemical determinations, absorption spectroscopy and electroanalytical chemistry. Maximum credit nine semester hours. Prerequisite: CHEM 434 with a minimum grade of C.


CHEM549 - Adv Topics in Organic Chem 549-3 Advanced Topics in Organic Chemistry. Specialized topics in organic chemistry. The topic to be covered is announced by the department. Maximum credit nine semester hours. Prerequisite: CHEM 542.
CHEM552 - Structure and Function 552-3 Biomolecular Structure and Function. This course will cover the structural basis of biomolecules with an emphasis on the chemical and physical aspects involved in the architecture of proteins and nucleic acids. The study of the physical properties of biomolecular interactions and assembly of biomolecules into macromolecular complexes will be covered. Interpretation of data from atomic resolution techniques will be discussed. Prerequisites: CHEM 350 or CHEM 451A/B or equivalent.

CHEM559 - Adv Topics in Biological Chem 559-3 Advanced Topics in Biological Chemistry. Specialized topics in biological chemistry. The topic to be covered is announced by the department. Maximum credit nine semester hours. Prerequisite: C or better in CHEM 350 or CHEM 451A,B or equivalent.

CHEM560 - Intro to Quantum Chemistry 560-3 Introduction to Quantum Chemistry. Basic principles and applications of quantum mechanics to chemistry. Topics include operator and vector algebra, classical mechanics, angular momentum, approximate methods, hydrogen-like atoms and molecular electronic structure. Three lectures per week. Prerequisite: one year of undergraduate physical chemistry.

CHEM561 - Molecular Orbital Theory 561-3 Molecular Orbital Theory. An introduction to molecular orbital theory. Applications and limitations of various methods. Three lectures per week. Prerequisite: one year of undergraduate physical chemistry including quantum mechanics.

CHEM562 - Adv Molecular Spectroscopy 562-3 Advanced Molecular Spectroscopy. Theory of rotational and vibrational spectroscopy, electronic spectroscopy of molecules. Three lectures per week. Prerequisite: CHEM 468 or consent of instructor.

CHEM563 - Comput Chem Materials Sci 563-3 Computational Chemical and Materials Sciences. An introduction to commercial molecular modeling softwares and to performing designed research projects related to chemical and materials sciences. Three lectures per week. Prerequisite: CHEM 360 and CHEM 460 (1 year of undergraduate Physical Chemistry) or consent of instructor.

CHEM564 - Statistical Thermodynamics 564-3 Statistical Thermodynamics. Principles of statistical mechanics and applications to equilibrium and nonequilibrium systems. Topics include ideal gases, monatomic crystals, lattice statistics, the cluster method, correlation functions, Brownian motion, the Boltzmann equation and the Kubo-Green technique. Three lectures per week.

CHEM569 - Adv Topics in Physical Chem 569-3 Advanced Topics in Physical Chemistry. Topic to be announced by the department. Maximum credit nine semester hours. Special approval needed from the instructor.

CHEM575 - Material Characterization 575-3 Methods of Materials Characterization. An introduction to the structural, morphological, spectroscopic, and thermal characterization techniques commonly used in materials chemistry. Special approval needed from the instructor.

CHEM579 - Topics Advanced Materials 579-3 Topics in Advanced Materials. Design and applications of advanced materials. Special topics will focus on contemporary research areas of interest as determined by the instructor. Special approval needed from the instructor.

CHEM592 - Introduction to Research 592-1 Introduction to Research. Introduction to the techniques and methods of chemical research including good laboratory practice, research ethics, record keeping, publication, patents and currently active research in this department. Graded S/U only.

CHEM593A - Graded Seminar 593A-1 Graded Seminar-Literature Seminar. Seminar presentations on advanced topics given in partial fulfillment of the requirements for the MS and PhD degrees in Chemistry.

CHEM593B - Graded Seminar 593B-1 Graded Seminar-Independent Proposal Presentation. Seminar presentations on advanced topics given in partial fulfillment of the requirements for the MS and PhD degrees in Chemistry.

CHEM593C - Graded Seminar 593C-1 Graded Seminar-Research Seminar. Seminar presentations on advanced topics given in partial fulfillment of the requirements for the MS and PhD degrees in Chemistry.
CHEM594A - Spec Readings-Analytical 594A-2 to 3 Special Readings in Chemistry. Assigned library work in any of these fields of chemistry with individual instruction by a staff member. Analytical. Maximum credit three hours.

CHEM594B - Spec Readings-Biochemistry 594B-2 to 3 Special Readings in Chemistry. Assigned library work in any of these fields of chemistry with individual instruction by a staff member. Biochemistry. Maximum credit three hours.

CHEM594C - Spec Readings- Inorganic 594C-2 to 3 Special Readings in Chemistry. Assigned library work in any of these fields of chemistry with individual instruction by a staff member. Inorganic. Maximum credit three hours.

CHEM594D - Spec Readings- Organic 594D-2 to 3 Special Readings in Chemistry. Assigned library work in any of these fields of chemistry with individual instruction by a staff member. Organic. Maximum credit three hours.

CHEM594E - Spec Readings-Physical 594E-2 to 3 Special Readings in Chemistry. Assigned library work in any of these fields of chemistry with individual instruction by a staff member. Physical. Maximum credit three hours.

CHEM594F - Spec Readings-Hist Chem 594F-2 to 3 Special Readings in Chemistry. Assigned library work in any of these fields of chemistry with individual instruction by a staff member. History Chemistry. Maximum credit three hours.


CHEM595B - Adv Seminar Chemistry-Biochem 595B-1 Advanced Seminar in Chemistry-Biochemistry. Advanced level talks presented by graduate students.

CHEM595C - Adv Sem-Inorganic 595C-1 Advanced Seminar in Chemistry. Advanced level talks presented by graduate students. Inorganic.


CHEM595E - Adv Sem-Physical Chem 595E-1 Advanced Seminar in Chemistry. Advanced level talks presented by graduate students. Physical chemistry.

CHEM596 - Master's Degree Research 596-1 to 6 (1 to 3 per semester) Master's Degree Research. Graded research for Master's Degree only. Maximum 6 credit hours. Prerequisite: Completion of at least 9 hours of graded graduate course work in the program. Restricted to admission to Master's program in Chemistry and Biochemistry. Special approval needed from student's graduate advisory committee.

CHEM597 - Professional Training 597-1 to 15 Professional Training. Experience in teaching of chemistry, instrument operation and special research projects. One hour required each semester in residence. Graded S/U only. Restricted to graduate standing.

CHEM598 - Research 598-1 to 50 (1 to 12 per semester) Research. Maximum credit 50 hours, except by permission of the student's graduate advisory committee. Graded S/U only. Special approval needed from the chair.

CHEM599 - Thesis 599-1 to 6 Thesis. Maximum credit six hours. Special approval needed from the chair.

CHEM600 - Dissertation 600-1 to 30 (1 to 12 per semester) Dissertation-Doctoral. Requirement for Ph.D. degree, 24 hours. Maximum credit 30 hours, except by permission of the student's graduate advisory committee. Prerequisite: CHEM 598.

CHEM601 - Continuing Enrollment 601-1 per semester Continuing Enrollment. For those graduate students who have not finished their degree programs and who are in the process of working on their dissertation, thesis, or research paper. The student must have completed a minimum of 24 hours of
dissertation research, or the minimum thesis, or research hours before being eligible to register for this course. Concurrent enrollment in any other course is not permitted. Graded S/U or DEF only.

**CHEM699 - Postdoctoral Research** 699-1 Postdoctoral Research. Must be a Postdoctoral Fellow. Concurrent enrollment in any other course is not permitted.

**Chemistry and Biochemistry Faculty**

**Bancroft, Senetta F.**, Assistant Professor, Ph.D., University of Akron, 2014.

**Deria, Pravas**, Assistant Professor, Ph.D., University of Pennsylvania, 2009.

**Du, Zhihua**, Associate Professor, Ph.D., University of Texas, 1997

**Gagnon, Keith T.**, Assistant Professor, Ph.D., North Carolina State University, 2007.

**Gao, Yong**, Associate Professor, Ph.D., University of Alberta, 1998.

**Ge, Qingfeng**, Professor, Ph.D., Tianjin University, 1991.

**Goodson, Boyd M.**, Professor, Ph.D., University of California, Berkeley, 1999.

**Hinckley, Conrad C.**, Professor, Emeritus, Ph.D., University of Texas, 1964.

**Kinsel, Gary R.**, Professor, Ph.D., University of Colorado-Boulder, 1989.

**Kohli, Punit**, Professor, Michigan State University 2000.

**Koropchak, John A.**, Professor, Emeritus, Ph.D., University of Georgia, 1980.

**Koster, David F.**, Professor, Emeritus, Ph.D., Texas A & M University, 1965.

**Moran, Sean D.**, Assistant Professor, Ph.D., Columbia University, 2008.

**McCarroll, Matthew E.**, Professor, Ph.D., University of Idaho, 1998.

**Plunkett, Kyle N.**, Associate Professor, Ph.D., University of Illinois, 2005.

**Shamsi, Mohtashim H.**, Assistant Professor, Ph.D., University of Toronto, 2012.

**Smith, Gerard V.**, Professor, Emeritus, Ph.D., University of Arkansas, 1959.

**Suni, Ian I.**, Professor, Ph.D., Harvard University, 1992.

**Trimble, Russell F.**, Professor, Emeritus, Ph.D., Massachusetts Institute of Technology, 1951.

**Tyrrell, James**, Professor, Emeritus, Ph.D., University of Glasgow, 1963.

**Wang, Lichang**, Professor and Chair, Ph.D., University of Copenhagen, 1993.

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Last updated: 01/13/2017

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**Catalog Year Statement:**

Students starting their collegiate training during the period of time covered by this catalog (see bottom of this page) are subject to the curricular requirements as specified herein. The requirements herein will extend for a seven calendar-year period from the date of entry for baccalaureate programs and three years for associate programs. Should the University change the course requirements contained herein subsequently, students are assured that necessary adjustments will be made so that no additional time is required of them.