CHEMISTRY

Phillips 430
715-836-3417
Department Website (https://www.uwec.edu/academics/college-arts-sciences/departments-programs/chemistry)

The degree programs in chemistry offer the opportunity to build a useful and marketable set of technical skills while obtaining a well-rounded liberal arts education. The Chemistry Department offers several majors and interdisciplinary programs with varying degrees of specialization designed to meet the needs and interests of a broad range of students. The A.C.S. certified majors are ideal for students seeking a rigorous and focused course of study and are well suited to those seeking employment in the chemical industry or planning graduate study in chemistry or biochemistry. The liberal arts major offers broader professional options and is more flexible in terms of elective coursework and is paired with a minor or second major. The liberal arts major is also an excellent choice for pre-medicine, pre-dentistry, and other pre-professional students. The chemistry teaching major is tailored to the needs of chemistry students interested in secondary education, and the chemistry with business emphasis major is ideal for those seeking a business career in a technical industry. Pre-pharmacy students often declare a chemistry with business emphasis major, as do other pre-professional students. Students interested in biological chemistry may also consider the interdisciplinary comprehensive major in biochemistry/molecular biology offered jointly by the Biology and Chemistry Departments.

Faculty/student collaborative research is the hallmark of the Chemistry Department. These hands-on learning opportunities are key to acquainting students with the day-to-day activities of practicing chemists and often lead to summer employment and internship opportunities. Many students also have the opportunity to present their work at professional meetings prior to graduation.

The Chemistry Department is accredited by the American Chemical Society (A.C.S.) to certify its comprehensive degrees as meeting the breadth and depth requirements of the A.C.S. There are three A.C.S certified options.

Honor Societies and Student Organizations:
The UW-Eau Claire student affiliate chapter of the American Chemical Society (ACS-SA) is a national award-winning organization that involves students in social, professional, and service activities at the university and in the community. This group has continued since the A.C.S. incorporated ACS-SA members into its general membership as Student Members. The UW-Eau Claire ACS-SA helps inform fellow students of curricular options and career opportunities and coordinates a tutoring program serving students in lower-level chemistry courses. All chemistry and biochemistry/molecular biology students are encouraged to become members of ACS-SA.

Departmental Honors in Chemistry
Open to students in all chemistry programs who meet the following requirements:

1. GPA of 3.50 or higher, both cumulative and in chemistry courses.
2. Participation in a collaborative research project with a chemistry faculty member that results in:
3. a presentation at an off-campus research conference, and
4. completion of CHEM 497 with a favorable review of the manuscript by the research advisor and at least two additional faculty members.

Procedure: Students seeking Departmental Honors must:

1. Complete all requirements listed above.
2. Complete the Departmental Honors Application that includes: the application form with required signatures, a transcript, and copies of the CHEM 497 manuscript and presentation abstract.
3. Forward a completed application to the Student Affairs Committee Chair by the date specified on the form.

Note: Names of Departmental Honors graduates must be forwarded to the University Honors Program Director and Registrar at least three weeks prior to commencement.

Information for All Students about General Chemistry Placement

NOTE 1: CHEM 105 is the first course in a two-semester general chemistry sequence that includes CHEM 105, CHEM 106 and CHEM 109, while CHEM 115 combines material from this two-semester sequence into a single one-semester course. Students, especially chemistry, biochemistry/molecular biology (B/MB), and materials science majors (see Note 5), who meet the enrollment criteria described in NOTES 2 and 3 are strongly encouraged to take CHEM 115 to complete their general chemistry requirement in a single semester.

NOTE 2: High school math performance is the best predictor of success in all 100-level chemistry courses. Students who place into MATH 114 or higher should almost always take CHEM 115. Students who place into Math 109 or lower should take CHEM 105 and CHEM 106 as their first semester, followed by CHEM 109. Students who place into MATH 112 or MATH 113 should consider their chemistry background and anticipated degree program when choosing between CHEM 105/106 and CHEM 115. Students with a strong high school chemistry background (see NOTE 3), and who are planning to major (or minor) in chemistry, B/MB, or materials science should usually take CHEM 115. Students with less chemistry preparation, or who are not planning on majoring (or minorig) in chemistry, B/MB, or materials science should probably start by taking CHEM 105 and CHEM 106.

NOTE 3: A "strong background" in high school chemistry can take several forms. Successful completion of an AP chemistry course or similarly enriched chemistry course constitutes a strong background. Successful completion of two years of high school chemistry; or one year of high school chemistry and one year of high school physics generally provides a strong background as well.

NOTE 4: Students who take CHEM 115, and after consultation with their CHEM 115 instructor in the first 2 of weeks of the course determine that CHEM 105/106 is the more appropriate starting point for them in chemistry, will be allowed to transfer to CHEM 105/106. Therefore, for close decisions between original enrollment in CHEM 105/106 or CHEM 115, students are encouraged to enroll in CHEM 115.

NOTE 5: Chemistry, B/MB, and materials science majors and minors receive 6 credits toward the major for CHEM 115 or a combination of CHEM 105, CHEM 106, and CHEM 109. Therefore, these students should take CHEM 115 if they meet the enrollment criteria so that they can move on sooner to other courses in their major.

Faculty
James Phillips, Chair
Scott Bailey-Hartsel
Sudeep Bhattacharyay
Michael Carney
Patricia Cleary
Bart Dahl
Jennifer Dahl
Stephen Drucker
Abbey Fischer
Warren Gallagher
Jason Halfen
Sanchita Hati
Krysti Knoche Gupta
David Lewis
Cheryl Muller
James Phillips
Kurt Wiegel
Thao Yang

**Majors**

- Comprehensive Major: Chemistry, A.C.S., General Emphasis - B.A./B.S.
- Comprehensive Major: Chemistry, A.C.S., Biochemistry Emphasis - B.A./B.S.
- Major: Chemistry, Liberal Arts - B.A./B.S.
- Major: Chemistry, Teaching - B.S.
- Comprehensive Major: Chemistry with Business Emphasis - B.A./B.S.
- Comprehensive Major: Biochemistry/Molecular Biology, Liberal Arts - B.A./B.S. (Interdisciplinary Major)
- Comprehensive Major: Physical Science, Teaching (Interdisciplinary Major)

**Minors**

- Minor: Chemistry, Liberal Arts
- Minor: Chemistry, Teaching

**CHEM 100 Chemistry: Issues and Answers (3 crs)**
Prerequisite: No credit if taken after CHEM 101, 103, 105, 106 or 115
- No credit toward chemistry major or minor.

An exploration into the world of atoms and molecules, designed to develop an understanding of the behavior of matter and how chemistry has both solved and created problems in our developing society.

Attributes: GE IIB Natural Science-Chemistry, Lab Science, LE-K1 Natural Sciences, LE-K1L Natural Sciences with Lab, Special Course Fee Required
Lecture/Discussion Hours: 2
Lab/Studio Hours: 2

**CHEM 103 General Chemistry I (4 crs)**
Prerequisite: MATH 20, or two years of college-preparatory algebra, or a suitable mathematics placement test score. High school chemistry completed.
No credit if taken after or concurrently with CHEM 101 or CHEM 115.
Introduction to principles of chemistry, including atomic structure, periodic properties of elements, chemical bonding, molecular structure, physical properties of compounds, chemical reactions, and stoichiometry.

Attributes: GE IIB Natural Science-Chemistry, Lab Science, LE-K1 Natural Sciences, LE-K1L Natural Sciences with Lab, Special Course Fee Required
Lecture/Discussion Hours: 3
Lab/Studio Hours: 3

**CHEM 104 General Chemistry II (4 crs)**
Prerequisite: Grade of C or above in CHEM 101 or CHEM 103. No credit if taken after CHEM 115.
Continuation of Chemistry 103. Equilibrium, thermodynamic and kinetic aspects of chemical reactions; acid-base, precipitation and redox reactions; transition metal compounds; organic compounds; nuclear reactions.

Attributes: GE IIB Natural Science-Chemistry, Lab Science, Special Course Fee Required
Lecture/Discussion Hours: 3
Lab/Studio Hours: 3

**CHEM 105 General Chemistry I Lecture (3 crs)**
Prerequisite: MATH 20 or a suitable mathematics placement test score. High School chemistry completed. No credit if taken after CHEM 103 or CHEM 115.
- If taking both CHEM 105 and CHEM 106, concurrent enrollment strongly recommended.

Principles of chemistry, including atomic structure, physical and periodic properties, structure and bonding, reactions, thermochemistry, and stoichiometry.

Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

**CHEM 106 General Chemistry I Laboratory (2 crs)**
Prerequisite: MATH 20 or a suitable math placement score. High School chemistry completed. CHEM 105 or concurrent enrollment. No credit after CHEM 103 or 115.
A general chemistry lab/discussion experience. Gases, reactions, stoichiometry, solution chemistry, thermochem. Data collection, management, and interpretation.

Attributes: LE-K1 Natural Sciences, LE-K1L Natural Sciences with Lab, Special Course Fee Required
Lecture/Discussion Hours: 1
Lab/Studio Hours: 2

**CHEM 109 General Chemistry II with Lab (4 crs)**
Prerequisite: Grade of C or above in both CHEM 105 and CHEM 106; or Grade of C or above in CHEM 103; No credit if taken after CHEM 104 or CHEM 115.
Solution properties and intermolecular forces; equilibrium, thermodynamic and kinetic aspects of chemical reactions; acid-base, precipitation, and redox reactions.

Attributes: Special Course Fee Required
Lecture/Discussion Hours: 3
Lab/Studio Hours: 3
CHEM 115 Chemical Principles (6 crs)
Prerequisite: MATH 109, or 3 years of above-average work in college-prep MATH and a suitable math placement test score. Strong performance in at least one year of high school chemistry. No credit if taken after or concurrently with CHEM 103, 104, 106, 109.
- See Note 3 regarding strong performance in high school chemistry under "Information for All Students about General Chemistry Placement" on the Chemistry Department catalog overview page.
Principles of chemistry, including chemical properties and the periodic table, atomic structure, chemical bonding, equilibria, thermodynamics, acid-base reactions, oxidation-reduction reactions and complexation reactions.
Attributes: GE IIB Natural Science-Chemistry, Lab Science, LE-K1 Natural Sciences, LE-K1L Natural Sciences with Lab, Special Course Fee Required
Lecture/Discussion Hours: 3
Lab/Studio Hours: 6

CHEM 121 Elementary Chemical Education (1 cr)
Prerequisite: CHEM 101 or CHEM 103. Limited to elementary education/science majors.
- No credit toward chemistry major or minor.
Elementary education majors will review chemical principles learned in Chemistry 101 or 103. They will then work on developing methods to teach those and related chemical principles to K-8 students.
Lecture/Discussion Hours: 1
Lab/Studio Hours: 0

CHEM 127 Chemistry and Climate (3 crs)
- No credit toward chemistry major or minor.
An inquiry into the magnitude and causes of global climate change, and an introduction to the physical and chemical principles that drive the climate system. Assumes no prior experience with chemistry, physics, or earth science.
Attributes: GE IIB Natural Science-Chemistry, LE-K1 Natural Sciences, LE-R3 Civic and Environmental Issues
Lecture Hours: 2
Discussion Hours: 1

CHEM 150 Survey of Biochemistry (3 crs)
Prerequisite: Grade of C or above in CHEM 101, CHEM 103, CHEM 105 and 106, or CHEM 115. No credit if taken after CHEM 325 or CHEM 452.
- No credit toward chemistry major or minor.
Introductory organic chemistry along with a survey of the structure, chemical reactivity, and biological activity of molecules derived from living systems. Emphasis will be placed on tying the course content to a greater understanding of human health and disease.
Attributes: GE IIB Natural Science-Chemistry, LE-K1 Natural Sciences
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

CHEM 161 Chemistry and Culture of Food and Cooking (3 crs)
- No credit toward chemistry major or minor.
This course will focus on the chemistry of food and cooking but will also examine historical and cultural aspects of food.
Attributes: GE IIB Natural Science-Chemistry, LE-I1 Integration, LE-K1 Natural Sciences, Special Course Fee Required
Lecture Hours: 3
Discussion Hours: 0

CHEM 191 Current Topics in Chemistry (1-3 crs)
- No credit toward chemistry major or minor. Not applicable toward laboratory course requirement for natural sciences for B.A. and B.S. degrees in the College of Arts and Sciences.
Chemistry topics of current interest investigated at a level suitable for first and second year undergraduates.
Attributes: GE IIB Natural Science-Chemistry

CHEM 213 Quantitative Analysis (4 crs)
Prerequisite: Grade of C or above in CHEM 104 or CHEM 109 or CHEM 115, or consent of instructor.
Theory, applications, and calculations involved in methods of chemical analysis.
Attributes: LE-S3 Creativity, Special Course Fee Required
Lecture/Discussion Hours: 2
Lab/Studio Hours: 6

CHEM 218 Introduction to Inorganic Chemistry (3 crs)
Prerequisite: CHEM 104 or CHEM 109 or CHEM 115
Introduction to inorganic compounds and reactions, with emphasis upon their applications in the environment, in commerce, and in life. Principles of molecular structure, acid-base and redox reactions, and coordination chemistry are applied.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

CHEM 274 Chemical Industry Seminar (1 cr)
Prerequisite: CHEM 104 or CHEM 109 or CHEM 115 or concurrent registration
A series of lectures by faculty and industrial speakers introduce students to various chemical and related industries and to the career opportunities and occupational qualifications for careers in chemistry and related fields.
Lecture/Discussion Hours: 1
Lab/Studio Hours: 0
CHEM 296 Student Academic Apprenticeship in Chemistry (1-2 crs)
Prerequisite: Total GPA of 3.0 required.
Consent: Department Consent Required
- Grade of B (3.0) or above in the course in which the student will apprentice. No credit toward chemistry major.

Qualified students, selected and supervised by faculty members, facilitate teaching and learning in a specific course. Students enhance their knowledge of chemistry and their ability to communicate that knowledge.

Attributes: Service-Learning, Full 30 Hours
Repeat: Course may be repeated for a maximum of 4 credits
Grading Basis: S/U Only Grade Basis

CHEM 304 Environmental Chemistry (3 crs)
Prerequisite: CHEM 104 or CHEM 109 or CHEM 115
A study of the chemistry of the environment, including the atmosphere, natural waters, and soils. Students will refine chemical knowledge by examining specific problems related to environmental issues.

Attributes: GE IIB Natural Science-Chemistry, LE-K1 Natural Sciences, LE-R3 Civic and Environmental Issues
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

CHEM 318 Bioinorganic Chemistry (3 crs)
Prerequisite: CHEM 218, CHEM 321, or CHEM 325.
This course will explore the biological chemistry of the transition metals, including metalloprotein structure and function, small-molecule synthetic modeling systems, metal ion trafficking in biological systems, bioorganometallic chemistry, and the uses of metals in medicine.

Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

CHEM 325 Organic Chemistry I with Laboratory (4 crs)
Prerequisite: CHEM 104 or CHEM 109 or CHEM 115 with a grade of C or above.
No credit if taken after CHEM 321 or CHEM 322.
Introduces molecular structure and bonding, organic nomenclature, acid/base properties of organic compounds, stereochemistry, resonance, mechanisms, and synthetic reactions illustrating functional group interconversion. Microscale laboratory techniques for the preparation, isolation, purification, and characterization of organic compounds.

Attributes: GE IIB Natural Science-Chemistry, Lab Science, Special Course Fee Required
Lecture/Discussion Hours: 3
Lab/Studio Hours: 3

CHEM 326 Organic Chemistry II with Laboratory (4 crs)
Prerequisite: CHEM 326 with a grade of C or above.
Provides a deeper analysis of organic synthesis and mechanisms, including substitution, elimination, aromatic, carbonyl and enolate chemistry. An emphasis on multistep synthesis and detailed mechanisms. The laboratory component involves advanced purification and synthetic techniques.

Attributes: Special Course Fee Required
Lecture/Discussion Hours: 3
Lab/Studio Hours: 3

CHEM 352 Fundamentals of Biochemistry (4 crs)
Prerequisite: CHEM 326 or concurrent enrollment. Credit may not be earned in both CHEM 352 and CHEM 452.
- No more than six credits from a combination of CHEM 352 and CHEM 454 for chemistry majors, chemistry minors, or biochemistry/molecular biology majors.

This course is designed for nonbiochemistry/molecular biology science majors who require a one semester course in biochemistry. The fundamental chemical, structural, and metabolic aspects of lipids, proteins, carbohydrates, and nucleic acids are covered.

Lecture/Discussion Hours: 4
Lab/Studio Hours: 0

CHEM 361 Molecules and Medicine (3 crs)
Prerequisite: CHEM 326 and BIOL 111.
The major classes of medicinally-active natural and synthetic drugs, their structure, design, origin, biosynthesis and mode of action will be presented. This course will also cover basic pharmacology and modern drug design principles.

Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

CHEM 397 Chemical Literature and Communication (2 crs)
Prerequisite: Limited to chemistry majors.
Consent: Instructor Consent Required
Focuses on modern chemical information literacy, preparing presentations, literature reviews, manuscripts and proposals. May also include chemical safety, ethics, experimental design, formulating research questions.

Grading Basis: A-F Grades Only
Lecture/Discussion Hours: 2
Lab/Studio Hours: 0

CHEM 399 Independent Study - Juniors (1-3 crs)
Prerequisite: Minimum junior standing.
Consent: Department Consent Required
Individual research projects under the direction of a faculty member.
Repeat: Course may be repeated

CHEM 401 Inorganic Chemistry (3 crs)
Prerequisite: CHEM 218; and CHEM 433 or concurrent registration.
Structure, bonding, and reactivity of inorganic compounds. Symmetry and group theory, vibrational analysis, and molecular orbital theory. Arrhenius and Lewis acid/base concepts. Organometallic and bioinorganic compounds, reactions, and mechanisms.

Attributes: Undergraduate/Graduate Offering
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0
CHEM 406 Biophysical Chemistry (4 crs)
Prerequisite: CHEM 352 or CHEM 452; PHYS 212 or PHYS 232; MATH 111 or MATH 114. No credit if taken after CHEM 433 or CHEM 434. No more than four credits can be counted from a combination of CHEM 405, CHEM 406, and CHEM 433 toward any chemistry major or minor.
Consent: Instructor Consent Required
An introduction to the physical chemical approaches to studying biological macromolecules. Emphasis will be placed on thermodynamics, and the methods for determining and analyzing the structures and functions of biological macromolecules.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 2

CHEM 411 Survey of Industrial Chemistry (3 crs)
Prerequisite: CHEM 218 and CHEM 326.
- Capstone experience for chemistry with business emphasis majors.
Survey of manufacturing processes, applications, and economics of major inorganic and organic chemicals and polymers, including those involved in the production of plastics, fibers, elastomers, pesticides, pharmaceuticals, detergents, electronics, and pollution control technologies.
Attributes: Undergraduate/Graduate Offering, Capstone Course, Field Trip(s) Required
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

CHEM 420 Advanced Synthesis Laboratory (2 crs)
Prerequisite: CHEM 218 and CHEM 323 or CHEM 326. No credit if taken after CHEM 324.
An advanced, interdisciplinary laboratory experience with emphasis on the synthesis, purification, and spectroscopic characterization of inorganic and organic compounds.
Attributes: Special Course Fee Required
Lecture/Discussion Hours: 0
Lab/Studio Hours: 6

CHEM 426 Modern Organic Chemistry (3 crs)
Prerequisite: CHEM 326
Selected advanced topics in organic chemistry, including reaction mechanisms and synthesis, with emphasis on recent developments in the field.
Attributes: Undergraduate/Graduate Offering
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

CHEM 433 Physical Chemistry I (4 crs)
Prerequisite: CHEM 213, CHEM 218; MATH 215; PHYS 232 or concurrent enrollment. No more than four credits can be counted from a combination of CHEM 405, CHEM 406, and CHEM 433 toward any chemistry major or minor.
A quantitative study of the physical properties of matter emphasizing the macroscopic perspective. Topics include: gas behavior, chemical thermodynamics, phase equilibrium, mixtures and solutions, chemical equilibrium, electrochemistry, and chemical kinetics.
Attributes: Undergraduate/Graduate Offering
Lecture/Discussion Hours: 4
Lab/Studio Hours: 0

CHEM 434 Physical Chemistry II (4 crs)
Prerequisite: CHEM 433
Continuation of Chemistry 433. The quantitative study of the physical properties of matter emphasizing the microscopic perspective. Topics include: quantum theory, atomic and molecular structure, chemical bonding, molecular symmetry, spectroscopy, resonance techniques, and statistical mechanics.
Attributes: Undergraduate/Graduate Offering
Lecture/Discussion Hours: 4
Lab/Studio Hours: 0

CHEM 438 Physical Analysis Laboratory (2 crs)
Prerequisite: CHEM 434 or concurrent registration.
An advanced, project-oriented laboratory course in physical and analytical chemistry. Beyond reinforcing the fundamental concepts in these sub-fields, particular emphasis will be placed on technical writing, and the development of hands-on laboratory skills.
Attributes: Undergraduate/Graduate Offering, Capstone Course, Special Course Fee Required
Lecture/Discussion Hours: 0
Lab/Studio Hours: 6

CHEM 444 Modern Applied Separations and Spectrometry (3 crs)
Prerequisite: CHEM 213, CHEM 218, and CHEM 326 or concurrent enrollment. Laboratory-centered instruction in the application of modern chromatography (GC and HPLC) spectrometry (MS, UV/Vis and FT-IR) to the analysis of real-world samples. Emphasis on preparation to BS-level careers in chemical industry.
Attributes: Field Trip(s) Required, Special Course Fee Required
Grading Basis: A-F Grades Only
Lecture/Discussion Hours: 2
Lab/Studio Hours: 3

CHEM 452 Biochemistry I (3 crs)
Prerequisite: CHEM 326 or CHEM 326. No credit after CHEM 352.
Chemistry of important constituents of living matter. Topics include proteins, carbohydrates, lipids, and nucleic acids. Also included are bioenergetics and basic enzyme kinetics and mechanism.
Attributes: Undergraduate/Graduate Offering
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 453</td>
<td>Biochemistry Laboratory</td>
<td>2 crs</td>
<td>CHEM 213; CHEM 452 or concurrent registration.</td>
<td>Study of experimental methods of analysis in biochemistry and their use in determination of structure and function. Attributes: Undergraduate/Graduate Offering, Special Course Fee Required</td>
</tr>
<tr>
<td>CHEM 454</td>
<td>Biochemistry II</td>
<td>3 crs</td>
<td>CHEM 452</td>
<td>Study of advanced concepts in biochemistry, especially those involving metabolism and their regulatory mechanism of action. Attributes: Undergraduate/Graduate Offering</td>
</tr>
<tr>
<td>CHEM 460</td>
<td>Polymer Chemistry</td>
<td>3 crs</td>
<td>Grade of C or above in CHEM 326.</td>
<td>An introduction to synthetic and naturally occurring polymers with a focus on synthesis, analysis, and structure/property relationships. The history and development of polymers will be discussed as well as the impact on industry and society. Attributes: Undergraduate/Graduate Offering</td>
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<tr>
<td>CHEM 491</td>
<td>Special Topics</td>
<td>1-3 crs</td>
<td>Minimum junior standing.</td>
<td>Lectures with possible laboratory work covering specific areas not normally discussed in regular classes, and of special interest to students or faculty. Possible topics include medicinal chemistry, wastewater chemistry and applied spectroscopy. Attributes: Special Course Fee Required</td>
</tr>
<tr>
<td>CHEM 495</td>
<td>Directed Studies</td>
<td>1-3 crs</td>
<td>15 credits in college CHEM courses.</td>
<td>Course projects will be structured to fit the needs, interests, and goals of the students. Repeat: Course may be repeated</td>
</tr>
<tr>
<td>CHEM 497</td>
<td>Independent Study (ACS)</td>
<td>1-3 crs</td>
<td>Minimum junior standing.</td>
<td>Individual research projects under the direction of a faculty member. A comprehensive written report describing the work completed, including an appropriate bibliography, is required. Repeat: Course may be repeated for a maximum of 6 credits</td>
</tr>
<tr>
<td>CHEM 499</td>
<td>Independent Study - Seniors</td>
<td>1-3 crs</td>
<td>Minimum senior standing.</td>
<td>Individual research projects under the direction of a faculty member. Repeat: Course may be repeated</td>
</tr>
<tr>
<td>CHEM 601</td>
<td>Inorganic Chemistry</td>
<td>3 crs</td>
<td>CHEM 218 and CHEM 433/CHEM 633 or concurrent registration.</td>
<td>Structure, bonding, and reactivity of inorganic compounds. Symmetry and group theory, vibrational analysis, and molecular orbital theory. Arrhenius and Lewis acid/base concepts. Organometallic and bioinorganic compounds, reactions, and mechanisms. Attributes: Field Trip(s) Required</td>
</tr>
<tr>
<td>CHEM 611</td>
<td>Survey of Industrial Chemistry</td>
<td>3 crs</td>
<td>CHEM 218 and CHEM 326.</td>
<td>Survey of manufacturing processes, applications, and economics of major inorganic and organic chemicals and polymers, including those involved in the production of plastics, fibers, elastomers, pesticides, pharmaceuticals, detergents, electronics, and pollution control technologies. Attributes: Field Trip(s) Required</td>
</tr>
<tr>
<td>CHEM 626</td>
<td>Modern Organic Chemistry</td>
<td>3 crs</td>
<td>CHEM 326</td>
<td>Selected advanced topics in organic chemistry, including reaction mechanisms and synthesis, with emphasis on recent developments in the field. Attributes: Special Course Fee Required</td>
</tr>
<tr>
<td>CHEM 633</td>
<td>Physical Chemistry I</td>
<td>4 crs</td>
<td>CHEM 213, CHEM 218, MATH 215; PHYS 232 or concurrent enrollment.</td>
<td>A quantitative study of the physical properties of matter emphasizing the macroscopic perspective. Topics include: gas behavior, chemical thermodynamics, phase equilibrium, mixtures and solutions, chemical equilibrium, electrochemistry, and chemical kinetics. Attributes: Field Trip(s) Required</td>
</tr>
</tbody>
</table>
**CHEM 634 Physical Chemistry II (4 crs)**
Prerequisite: CHEM 433/CHEM 633
  • Cross-listed with CHEM 434. Credit may not be earned in both courses.

Continuation of Chemistry 433/633. The quantitative study of the physical properties of matter emphasizing the microscopic perspective. Topics include: quantum theory, atomic and molecular structure, chemical bonding, molecular symmetry, spectroscopy, resonance techniques, and statistical mechanics.

Grading Basis: No S/U Grade Option
Lecture/Discussion Hours: 4
Lab/Studio Hours: 0

**CHEM 638 Physical Analysis Laboratory (2 crs)**
Prerequisite: CHEM 434/CHEM 634 or concurrent registration.
  • Cross-listed with CHEM 438. Credit may not be earned in both courses.

An advanced, project-oriented laboratory course in physical and analytical chemistry. Beyond reinforcing the fundamental concepts in these sub-fields, particular emphasis will be placed on technical writing, and the development of hands-on laboratory skills.

Attributes: Special Course Fee Required
Grading Basis: No S/U Grade Option
Lecture/Discussion Hours: 0
Lab/Studio Hours: 6

**CHEM 652 Biochemistry I (3 crs)**
Prerequisite: CHEM 326 or CHEM 323. Credit may not earned in both CHEM 352 and CHEM 452/ CHEM 652.
  • Cross-listed with CHEM 452. Credit may not be earned in both courses.

Chemistry of important constituents of living matter. Topics include proteins, carbohydrates, lipids, and nucleic acids. Also included are bioenergetics and basic enzyme kinetics and mechanism.

Grading Basis: No S/U Grade Option
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

**CHEM 654 Biochemistry II (3 crs)**
Prerequisite: CHEM 452/CHEM 652
  • Cross-listed with CHEM 454. Credit may not be earned in both courses.

Study of advanced concepts in biochemistry, especially those involving metabolism and their regulatory mechanism of action.

Grading Basis: No S/U Grade Option
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

**CHEM 660 Polymer Chemistry (3 crs)**
Prerequisite: Grade of C or above in CHEM 326.
  • Cross-listed with CHEM 460. Credit may not be earned in both courses.

An introduction to synthetic and naturally occurring polymers with a focus on synthesis, analysis, and structure/property relationships. The history and development of polymers will be discussed as well as the impact on industry and society.

Grading Basis: No S/U Grade Option
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

**CHEM 796 Directed Studies (1-3 crs)**
Summer workshop for teachers.

Repeat: Course may be repeated for a maximum of 6 credits
Grading Basis: No S/U Grade Option

**CHEM 797 Independent Study (1-3 crs)**
Consent: Department Consent Required
Individual project under the direction of a faculty member.

Repeat: Course may be repeated
Grading Basis: No S/U Grade Option