

# CHEMISTRY (CHEM)

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**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, LE-R3 Civic and Environmental Issues, Special Course Fee Required

Lecture/Discussion Hours: 2

Lab/Studio Hours: 2

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**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

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**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

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**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

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**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

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**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 II Natural Sciences, LE-K1 Natural Sciences, LE-R3 Civic and Environmental Issues

Lecture Hours: 2

Discussion Hours: 1

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**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

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**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

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**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

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**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

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**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

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**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

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**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

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**CHEM 318 Bioinorganic Chemistry (3 crs)**

Prerequisite: CHEM 218 and 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

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**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 II Natural Sciences, Lab Science, Special Course Fee Required

Lecture/Discussion Hours: 3

Lab/Studio Hours: 3

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**CHEM 326 Organic Chemistry II with Laboratory (4 crs)**

Prerequisite: CHEM 325 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

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**CHEM 344 Modern Applied Separations and Spectrometry (2 crs)**

Prerequisite: Prerequisite: CHEM 213; Prerequisite or Concurrent Enrollment: CHEM 218 and CHEM 326

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 for baccalaureate-level careers in chemical industry.

Attributes: Special Course Fee Required

Grading Basis: A-F Grades Only

Lecture/Discussion Hours: 1

Lab/Studio Hours: 3

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**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

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**CHEM 361 Molecules and Medicine (3 crs)**

Prerequisite: CHEM 326 and BIOL 221 or CHEM 352 or CHEM 452.

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

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**CHEM 374 Chemical Industry Seminar (1 cr)**

Prerequisite: CHEM 109 or CHEM 115

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

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**CHEM 375 Frontiers in Chemical Research Seminar (1 cr)**

Prerequisite: CHEM 109 or CHEM 115

A series of lectures from faculty from academic institutions describing their chemistry research programs and career development in the chemical field. Course addresses skill development in scientific communication and scientific literature.

Lecture/Discussion Hours: 1

Lab/Studio Hours: 0

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**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

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**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

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**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.

Attributes: LE-I1 Integration

Lecture/Discussion Hours: 3

Lab/Studio Hours: 2

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**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: LE-I1 Integration, Undergraduate/Graduate Offering, Capstone Course, Field Trip(s) Required

Lecture/Discussion Hours: 3

Lab/Studio Hours: 0

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**CHEM 420 Advanced Synthesis Laboratory (3 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: 8

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**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

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**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

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**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

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**CHEM 438 Physical Analysis Laboratory (2 crs)**

Prerequisite: CHEM 433  
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

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**CHEM 452 Biochemistry I (3 crs)**

Prerequisite: BIOL 221, BIOL 223 or concurrent enrollment, and 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

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**CHEM 453 Biochemistry Laboratory (2 crs)**

Prerequisite: CHEM 213; CHEM 352 or CHEM 452. CHEM 352 or CHEM 452 can be taken concurrently.  
Consent: Instructor Consent Required  
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  
Lecture/Discussion Hours: 0  
Lab/Studio Hours: 6

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**CHEM 454 Biochemistry II (3 crs)**

Prerequisite: CHEM 452  
Study of advanced concepts in biochemistry, especially those involving metabolism and their regulatory mechanism of action.

Attributes: Undergraduate/Graduate Offering  
Lecture/Discussion Hours: 3  
Lab/Studio Hours: 0

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**CHEM 460 Polymer Chemistry (3 crs)**

Prerequisite: Grade of C or above in CHEM 326.  
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  
Lecture/Discussion Hours: 3  
Lab/Studio Hours: 0

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**CHEM 490 Chemistry Internship (1-6 crs)**

Prerequisite: A minimum of six earned credits in CHEM courses numbered 200 or above. A minimum 2.5 GPA in CHEM courses.  
Consent: Instructor Consent Required  
A supervised on-the-job experience in the chemical industry or other chemistry- or biochemistry-related workplace.

Repeat: Course may be repeated for a maximum of 6 credits  
Lab/Studio Hours: 0  
Independent Study Hours: Variable

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**CHEM 491 Special Topics (1-3 crs)**

Prerequisite: Minimum junior standing.  
Consent: Instructor Consent Required  
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.

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**CHEM 495 Directed Studies (1-3 crs)**

Prerequisite: 15 credits in college CHEM courses.  
Consent: Department Consent Required  
Course projects will be structured to fit the needs, interests, and goals of the students.

Repeat: Course may be repeated

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**CHEM 497 Independent Study - Research Manuscript (1-3 crs)**

Prerequisite: Minimum junior standing.

Consent: Department Consent Required

- *College of Arts and Sciences rules governing independent study apply.*

Individual research projects under the direction of a faculty member, with a substantial, culminating written report. The report is typically in a professional, journal-article format, with an extensive bibliography, and a significant body of original work. This course is typically taken after 399 and/or 499.

Repeat: Course may be repeated for a maximum of 6 credits

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**CHEM 499 Independent Study - Seniors (1-3 crs)**

Prerequisite: Minimum senior standing.

Consent: Department Consent Required

Individual research projects under the direction of a faculty member.

Repeat: Course may be repeated

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**CHEM 601 Inorganic Chemistry (3 crs)**

Prerequisite: CHEM 218; and CHEM 433/CHEM 633 or concurrent registration.

- *Dual-listed with CHEM 401. Credit may not be earned in both courses.*

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.

Grading Basis: No S/U Grade Option

Lecture/Discussion Hours: 3

Lab/Studio Hours: 0

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**CHEM 611 Survey of Industrial Chemistry (3 crs)**

Prerequisite: CHEM 218 and CHEM 326.

- *Dual-listed with CHEM 411. Credit may not be earned in both courses.*

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

Grading Basis: No S/U Grade Option

Lecture/Discussion Hours: 3

Lab/Studio Hours: 0

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**CHEM 626 Modern Organic Chemistry (3 crs)**

Prerequisite: CHEM 326

- *Dual-listed with CHEM 426. Credit may not be earned in both courses.*

Selected advanced topics in organic chemistry, including reaction mechanisms and synthesis, with emphasis on recent developments in the field.

Grading Basis: No S/U Grade Option

Lecture/Discussion Hours: 3

Lab/Studio Hours: 0

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**CHEM 633 Physical Chemistry I (4 crs)**

Prerequisite: CHEM 213, CHEM 218, MATH 215; PHYS 232 or concurrent enrollment.

- *Dual-listed with CHEM 433. Credit may not be earned in both courses.*

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.

Grading Basis: No S/U Grade Option

Lecture/Discussion Hours: 4

Lab/Studio Hours: 0

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**CHEM 634 Physical Chemistry II (4 crs)**

Prerequisite: CHEM 433/CHEM 633

- *Dual-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

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**CHEM 638 Physical Analysis Laboratory (2 crs)**

Prerequisite: CHEM 434/CHEM 634 or concurrent registration.

- *Dual-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

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**CHEM 652 Biochemistry I (3 crs)**

Prerequisite: BIOL 221, BIOL 223, and CHEM 326. Credit may not be earned in both CHEM 352 and CHEM 452/ CHEM 652.

- *Dual-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

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**CHEM 653 Biochemistry Laboratory (2 crs)**

Prerequisite: CHEM 213; CHEM 452/CHEM 652 or concurrent registration.

Consent: Instructor Consent Required

- *Dual-listed with CHEM 453. Credit may not be earned in both courses.*

Study of experimental methods of analysis in biochemistry and their use in determination of structure and function.

Attributes: Special Course Fee Required

Grading Basis: No S/U Grade Option

Lecture/Discussion Hours: 0

Lab/Studio Hours: 6

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**CHEM 654 Biochemistry II (3 crs)**

Prerequisite: CHEM 452/CHEM 652

- *Dual-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

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**CHEM 660 Polymer Chemistry (3 crs)**

Prerequisite: Grade of C or above in CHEM 326.

- *Dual-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

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**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

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**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

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