

# CHEMISTRY AND BIOCHEMISTRY (CHEM)

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## CHEM 0900. Chemistry Seminar. (0 Credits)

### CHEM 1102. Drug Discovery: From the Laboratory to the Clinic. (3 Credits)

A rigorous course for non-science majors on the scientific, public policy, and ethical considerations of drug development and commercialization. Topics include an introduction to basic concepts of chemical structure and bonding as applicable to medicinal chemistry, computational structure-based drug design methods, drug testing and approval process, economics of drug commercialization, and public policy issues.

**Attributes:** MANR, PSCI.

### CHEM 1104. Chemistry and the Artistic Image. (3 Credits)

This is a lecture/laboratory course intended for non-scientists as an introduction to the chemistry of artist materials and their interaction with light. Fundamental concepts of general chemistry are presented with an emphasis on such applications as recipe formulation, color science, preservation, and analytical technique. The course includes a laboratory component featuring experiments that explore the physical nature of color and basic photochemistry.

**Attribute:** PSCI.

### CHEM 1109. Chemistry of the Environment. (3 Credits)

An introduction to the principles of chemistry within the context of environmental and societal issues. These principles are introduced via sequential discussion of theories of matter and its transformation (chemical reactions), chemical sources of energy, and methods of testing and analysis. Specific applications, such as toxicity, pollution, and methods of remediation are discussed in conclusion.

**Attributes:** ENST, ESNS, ESPS, PSCI, SOIN.

### CHEM 1110. Forensic Science. (3 Credits)

An introductory lecture and laboratory course designed for non-science majors who have not taken chemistry. A study of the methods and techniques in forensic science. Topics include fires, explosions, drugs, forensic toxicology, glass and soil, paints, fibers, hair, blood, body fluids, fingerprints, toolmarks, and firearms. Several short lab experiments will be required.

**Attribute:** PSCI.

### CHEM 1311. General Chemistry I Recitation. (0 Credits)

Recitation to accompany General Chemistry I.

### CHEM 1312. General Chemistry II Recitation. (0 Credits)

Recitation to accompany General Chemistry II.

### CHEM 1321. General Chemistry I. (4 Credits)

This course covers the fundamental laws and theories of chemistry including chemical equations, atomic structure, gas laws, and chemical bonding (three-hour lecture and one-hour recitation). Note: Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attributes:** ENST, ENVS, ESNS, ESPS, NEUR.

**Mutually Exclusive:** NSCI 1321.

### CHEM 1322. General Chemistry II. (4 Credits)

(3-hour lecture and 1-hour recitation) A continuation of CHEM 1321, including kinetics, equilibrium, elementary thermodynamics and electrochemistry. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attributes:** ENVS, NEUR.

**Prerequisite:** CHEM 1321.

**Mutually Exclusive:** NSCI 1322.

### CHEM 1331. General Chemistry Lab I. (2 Credits)

(4 hour laboratory) A series of experiments selected to illustrate the topics covered in CHEM 1321. Lab fee.

**Mutually Exclusive:** NSCI 1331.

### CHEM 1332. General Chemistry Lab II. (2 Credits)

(4-hour laboratory) A selection of experiments designed to correspond to the material covered in CHEM 1322. An abbreviated qualitative analysis is also included. Lab fee.

**Prerequisites:** CHEM 1331 and CHEM 1321.

**Mutually Exclusive:** NSCI 1332.

### CHEM 1990. Introduction to Research. (0 Credits)

This course serves as an introduction to scientific research. The goals of the course are to introduce students to the process of scientific research by direct involvement. Students will participate in aspects of data collection, analysis, interpretation, and presentation. Open to all majors. First years and sophomores only. Registration only with permission of faculty mentor.

### CHEM 2511. Organic Chemistry I Recitation. (0 Credits)

Part of Organic Chemistry I. Weekly review of topics covered in lecture.

### CHEM 2512. Organic Chemistry II Recitation. (0 Credits)

Part of Organic Chemistry II. Weekly review of topics covered in lecture.

**Corequisite:** CHEM 2522.

### CHEM 2521. Organic Chemistry I. (4 Credits)

(3-hour lecture, 1 hour recitation) An introduction to bonding, structure and reactivity of organic compounds including aliphatic and aromatic hydrocarbons, alkyl halides and alcohols. Concepts include orbital hybridization, stereochemistry, equilibrium reactions, transition state theory and kinetics. Determination and discussion of reaction mechanisms will be emphasized. Chemical and spectral methods for structure elucidation, including NMR, IR, UV and MS will be discussed. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attributes:** ENVS, GEAC.

**Prerequisites:** CHEM 1322 and CHEM 1332.

**Mutually Exclusive:** NSCI 3121.

### CHEM 2522. Organic Chemistry II. (4 Credits)

(3-hour lecture, 1-hour recitation) A continuation of CHEM 2521. Concentrates on the chemistry of aromatic, carbonyl and amino compounds, with particular emphasis on reactive mechanisms and synthesis. Includes descriptive chemistry of biologically important molecules such as carbohydrates, proteins and lipids. Aspects of synthetically important cycloaddition reactions will also be discussed. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attributes:** ENSE, ENVS, GEAC, NECM, NEUR.

**Prerequisites:** CHEM 2521 and (CHEM 2531 or CHEM 2541).

**CHEM 2531. Organic Chemistry Lab I for Chem Majors. (2 Credits)**

A laboratory course introducing the student to the experimental techniques of organic chemistry.

**Corequisite:** CHEM 2521.

**CHEM 2532. Organic Chemistry Lab II for Chem Majors. (2 Credits)**

A continuation of CHEM 2531.

**Prerequisite:** CHEM 2531.

**Corequisite:** CHEM 2522.

**CHEM 2541. Organic Chemistry Lab I. (2 Credits)**

(4-hour laboratory, 1-hour lecture) A laboratory course introducing the students to the experimental techniques of organic chemistry. Lab fee.

**Corequisite:** CHEM 2521.

**Mutually Exclusive:** NSCI 3821.

**CHEM 2542. Organic Chemistry Lab II. (2 Credits)**

(4-hour laboratory, 1-hour lecture) A continuation of CHEM 2541. Lab fee.

**Prerequisites:** CHEM 2541 or CHEM 2531.

**Mutually Exclusive:** NSCI 3822.

**CHEM 3141. Methods of Biochemical Research. (3 Credits)**

The art and practice of scientific data collection, its compilation and synthesis, and its dissemination.

**Attribute:** EP3.

**Prerequisites:** (CHEM 2521) and (CHEM 2531 or CHEM 2541) and (CHEM 2522) and (CHEM 2532 or CHEM 2542) and (CHEM 4221).

**CHEM 3621. Physical Chemistry I. (4 Credits)**

This course provides an introduction to quantum mechanics and spectroscopy. Topics include the postulates of quantum mechanics, model quantum mechanical systems, the electronic structure of atoms and molecules, and different types of spectroscopy as applied to chemical systems. Note: Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAC.

**Prerequisites:** CHEM 1322 and PHYS 1702 and MATH 1207.

**Corequisite:** CHEM 3631.

**CHEM 3622. Physical Chemistry II. (4 Credits)**

This course introduces students to statistical mechanics, thermodynamics, and kinetics. Topics include the properties of gases, classical and statistical thermodynamics, phase and chemical equilibria, and kinetics. Note: Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attributes:** ENSE, ENVS, GEAC.

**Prerequisite:** CHEM 3621.

**CHEM 3631. Physical Chemistry Lab I. (2 Credits)**

This laboratory course is focused on applications of quantum mechanics and spectroscopy to chemical systems. Topics include electronic, vibrational, and rotational spectroscopy; electronic structure calculations; and other areas of contemporary physical chemistry.

**Corequisite:** CHEM 3621.

**CHEM 3632. Physical Chemistry Lab II. (2 Credits)**

This is a laboratory course focused on applications of thermodynamics and kinetics to chemical systems. Topics include the properties of gases, calorimetry, electrochemistry, the determination of rate laws, and other areas of contemporary physical chemistry.

**Attribute:** ENVS.

**CHEM 3721. Quantitative Analysis. (4 Credits)**

This lecture and laboratory course is devoted to the fundamental theory and practice of analytical chemistry, including volumetric, gravimetric, potentiometric, and spectrophotometric methods. (The class meets for 3 hours of lecture and 4 lab hours weekly.) Note: Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attributes:** ENSE, ENVS, GEAC.

**Prerequisites:** CHEM 1322 and CHEM 1332.

**CHEM 3722. Instrumental Analysis. (4 Credits)**

This lecture/laboratory course introduces students to the principles of chemical instrumentation, including instrument design and instrumental methods of chemical analysis. Topics include data generation, spectroscopic methods of analysis, and separation techniques. Three hours of lecture plus four hours of lab are required weekly. Note: Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attributes:** ENSE, ENVS, GEAC.

**CHEM 3990. Directed Research. (1 Credit)**

Students will work in the laboratory of a faculty mentor on an agreed upon project. Students will learn data collection, analysis, interpretation, and presentation techniques. Open to all majors. Sophomores, juniors, and seniors only. Registration only with permission of faculty mentor.

**Attribute:** ENVS.

**CHEM 4030. Chemistry Seminar. (0 Credits)**

A colloquium of contemporary chemical and scientific research. Completion of each of the four semesters during a major's junior and senior year required for graduation.

**CHEM 4221. Biochemistry I. (3 Credits)**

An introduction to the chemistry of biological polymers (carbohydrates, proteins, polynucleic acid), their monomeric constituents and lipids, emphasizing their biosynthesis and role as biostructural building blocks. Other specialized topics to be covered include enzyme kinetics, mechanism and regulation; energy conversion and dynamics; pre-biotic chemistry and theories of life's origin.

**Attributes:** GEAC, NECM, NEUR.

**Prerequisite:** CHEM 2522.

**Mutually Exclusive:** NSCI 4153.

**CHEM 4222. Biochemistry II. (3 Credits)**

Chemistry of the main constituents of living matter, nature, and mechanisms of biochemical processes, enzymes.

**Attribute:** GEAC.

**Prerequisite:** CHEM 4221.

**CHEM 4231. Biochemistry Lab I. (1 Credit)**

A laboratory course covering techniques used in the quantification, isolation and characterization of proteins, lipids, carbohydrates and nucleic acids. Exercises include spectrophotometry, chromatography, gel electrophoresis, protein assays, enzyme purification and kinetics, thermodynamic measurements, and DNA manipulations.

**Corequisite:** CHEM 4221.

**Mutually Exclusive:** NSCI 4853.

**CHEM 4241. Biomimetic Chemistry. (3 Credits)**

A study of biological polymers and molecular assemblies as molecular devices. The biological structures specifically adapted to catalysis, energy/signal transduction, and mechanical behavior will be examined in the context of modern mimetic and supramolecular chemistry.

**Attribute:** GEAC.

**Prerequisite:** CHEM 4221 (may be taken concurrently).

**CHEM 4251. Physical and Computational Models of Biochemical Systems. (3 Credits)**

Introduction to quantitative modeling of biochemical systems using physical principles of statistical thermodynamics and kinetics, mathematical principles of probability, random processes, statistical inference, and dynamical systems, and relevant computational simulation methods. Case studies include: viral replication dynamics; bacterial genetics and evolution of drug resistance; analysis of super-resolution microscopy and cryo-electron microscopy data; stochastic simulation of gene expression; epidemic modeling; analysis and design of cellular control circuits (e.g., feedback, homeostasis, genetic switches, and the mitotic clocks).

**Attributes:** GEAC, ICC.

**Prerequisites:** MATH 1207 and CHEM 1322.

**CHEM 4340. Environmental Chemistry. (3 Credits)**

An introduction to environmental chemistry for science majors covering chemical phenomena in both the geosphere and anthrosphere. Lecture topics include descriptive chemistry of the environment, analytical procedures, and the technology of remediation.

**Attributes:** ENSE, ENVS, GEAC.

**Prerequisite:** CHEM 3721.

**CHEM 4422. Inorganic Chemistry. (3 Credits)**

A comprehensive course dealing with the chemistry, preparation and properties of common elements.

**Prerequisite:** CHEM 3621.

**CHEM 4432. Inorganic Chemistry Lab. (1 Credit)**

A laboratory course to accompany CHEM 4422, including synthesis and characterization of inorganic compounds. Required of those students seeking ACS certification.

**CHEM 4621. Bionanotechnology and Introduction to Nanomedicine. (4 Credits)**

The course offers enhancement of the chemistry curriculum in response to extensive recent advances and investments in materials science with particular emphasis on developments in nanotechnology. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Prerequisite:** CHEM 2522.

**CHEM 4625. Computational Chemistry. (3 Credits)**

An upper level course on computational techniques in chemistry. The course will provide introductions to molecular mechanics in small and large systems and computational approaches to quantum chemistry, including ab initio, semi-empirical, and DFT methods.

**Prerequisite:** CHEM 3621.

**CHEM 4990. Independent Research. (0 to 3 Credits)**

Students will work with a faculty mentor on an agreed upon project. Students will cooperate with the faculty mentor on the project definition, data collection, analysis, interpretation, and the presentation of results. A comprehensive paper demonstrating a student's accomplishments during independent research is required. Open to all majors. Juniors and seniors only. Registration only with permission of faculty mentor The course does not count as a chemistry major elective.

**Attribute:** ENVS.

**Prerequisite:** CHEM 3990.

**CHEM 4999. Independent Study. (0 to 4 Credits)**

Independent research and readings with supervision from a faculty member.