CHEMISTRY
(AS) {CHEM}

L/R 001. Introductory Chemistry I. (A) Physical World Sector. All classes. Corequisite(s): CHEM 051. Application for permission must be submitted to the department.

Similar in coverage to Chemistry 101. This course explores the basic concepts and principles of chemistry, with a greater emphasis on problem solving. It is designed for students with a lesser background in chemistry and/or mathematics. It is suitable for chemistry majors, non-majors, or preprofessional students.

L/R 012. Environmental Chemistry. (C) Physical World Sector. All classes. The course requires math literacy at the high school algebra level (2 years) and a willingness to learn Excel. Students must also have taken one year of high school chemistry.

The course aims to teach chemical content and principles in the context of significant environmental issues. Topics to be covered include: composition of the atmosphere; protecting the ozone layer; chemistry of global warming; traditional hydrocarbon fuels and energy utilization; water supply, its contaminants, and waste water treatment; acid rain; nuclear energy; and new energy sources. Students will develop critical thinking ability, competence to better assess risks and benefits, and skills that will lead them to be able to make informed decisions about technology-based matters.

L/R 015. Honors Chemistry I. (A) Physical World Sector. All classes.

An advanced course for students who have had AP Chemistry in high school. Included in the course coverage are: quantum mechanics of atoms, molecules and crystalline solids; statistical mechanics of gases, liquids, and solids; and coordination chemistry.

SM 022. Structural Biology. (C) May be counted as a General Requirement Course in Physical World. Class of 2009 & prior only. Freshman Seminar.

This course will explain in non-mathematical terms how essentially all biological properties are determined by the microscopic chemical properties of proteins. It will also explain how research results, especially those of structural biology, are presented to its various audiences.

051. Introductory Chemistry Laboratory I. (A) Corequisite(s): CHEM 001. Lab fee $150. When a student enrolls simultaneously in a laboratory course and a corequisite course, but subsequently drops or withdraws from the corequisite course, the student must drop or withdraw from the laboratory course.

An introductory laboratory course covering aspects of qualitative and quantitative analysis, determination of chemical and physical properties, and chemical synthesis.

L/L 053. General Chemistry Laboratory I. (C) Corequisite(s): CHEM 101. Lab fee $150. When a student enrolls simultaneously in a laboratory course and a corequisite course, but subsequently drops or withdraws from the corequisite course, the student must drop or withdraw from the laboratory course.

A general laboratory course covering aspects of qualitative and quantitative analysis, determination of chemical and physical properties, and chemical synthesis.

L/L 054. General Chemistry Laboratory II. (C) Corequisite(s): CHEM 102. Lab fee $150. When a student enrolls simultaneously in a laboratory course and a corequisite course, but subsequently drops or withdraws from the corequisite course, the student must drop or withdraw from the laboratory course.

Continuation of CHEM 053.

L/L 055. General Chemistry Laboratory I for Freshmen. (A) Corequisite(s): CHEM 101, Section 004. Lab fee $150. When a student enrolls simultaneously in a laboratory course and a corequisite course, but subsequently drops or withdraws from the corequisite course, the student must drop or withdraw from the laboratory course.

A general laboratory course covering aspects of qualitative and quantitative analysis, determination of chemical and physical properties, and chemical synthesis. This 0.5 c.u. lab course is an alternative to CHEM 053, but is only open to freshman students who are also enrolled in the special freshman section of CHEM 101 - Section 004.

L/L 056. General Chemistry Laboratory II for Freshmen. (B) Corequisite(s): CHEM 102, Section 001. Lab fee $150. When a student enrolls simultaneously in a laboratory course and a corequisite course, but subsequently drops or withdraws from the corequisite course, the student must drop or withdraw from the laboratory course.
Continuation of CHEM 055. This 0.5 c.u. lab course is an alternative to CHEM 054, but is only open to freshman students who are also enrolled in the special freshman section of CHEM 102 - Section 001.

L/R 101. General Chemistry I. (C) Physical World Sector. All classes. Corequisite(s): CHEM 053.

Basic concepts and principles of chemistry and their applications in chemistry and closely-related fields. The first term emphasizes the understanding of chemical reactions through atomic and molecular structure. This is a university level course, treating the material in sufficient depth so that students can solve chemical problems and can understand the principles involved in their solution. It includes an introduction to condensed matter. This course is suitable for majors or non-majors and is recommended to satisfy either major or preprofessional requirements for general chemistry. This course is presented for students with high school chemistry and calculus. Students with a lesser background than this should take Chemistry 1.

L/R 102. General Chemistry II. (C) Physical World Sector. All classes. Prerequisite(s): CHEM 101. Corequisite(s): CHEM 054.

Continuation of Chemistry 101. The second term stresses the thermodynamic approach to chemical reactions, electrochemical processes, and reaction rates and mechanisms. It includes special topics in chemistry.

L/R 221. Physical Chemistry I. (A) Prerequisite(s): CHEM 102, MATH 114, PHYS 150.

Introductory quantum mechanics, atomic and molecular structure, chemical bonding, and microscopic understanding of physical and chemical properties of molecules.

L/R 222. Physical Chemistry II. (B) Prerequisite(s): CHEM 221, PHYS 151.

Continuation of CHEM 221. Principles and applications of thermodynamics, and a molecular-based understanding of macroscopic properties.

L/L 223. Experimental Physical Chemistry I. (B) Prerequisite(s): CHEM 221. Lab fee $300.

Important methods, skills, and apparatus used for the acquisition and interpretation of quantitative information about chemical systems will be discussed in principle and used in the laboratory.

L/R 241. Principles of Organic Chemistry. (C) Prerequisite(s): CHEM 102.

Fundamental course in organic chemistry based upon the modern concepts of structure and mechanism of reactions.

L/R 242. Principles of Organic Chemistry. (C) Prerequisite(s): CHEM 241.

Continuation of CHEM 241.

L/L 245. Experimental Organic Chemistry I. (C) Prerequisite(s): CHEM 241. Corequisite(s): CHEM 242. Lab fee $300.

A basic laboratory course in which both the theoretical and practical aspects of a variety of organic reactions and multistep syntheses are emphasized. Modern chromatographic, instrumental, and spectroscopic techniques are applied to experimental organic chemistry. Course should be taken concurrently with CHEM 242 or in the semester immediately following. For safety reasons students will not be permitted to wear contact lenses in the laboratory.

PLEASE NOTE THE FOLLOWING: For the Summer and CGS offering of CHEM 245, it is a 2-semester course. Part 1 is taken in the first term for 0.0 CU and then Part 2 is taken in the second term immediately following the first for 1.0 CU.

L/L 246. Experimental Organic Chemistry II. (A) Prerequisite(s): CHEM 242 and 245. Corequisite(s): CHEM 261. Lab fee $300.

Advanced laboratory work on the synthesis, structure, and properties of organic compounds. Infrared, ultraviolet, and nuclear magnetic resonance spectroscopy. Lectures cover the theoretical basis and applications of modern spectroscopic methods. For safety reasons students will not be permitted to wear contact lenses in the laboratory.

251. Principles of Biological Chemistry. (C) Prerequisite(s): CHEM 102. Corequisite(s): CHEM 241.

Fundamentals of biological chemistry, including the structure of biological macromolecules and their mechanism of action, intermediary metabolism, and the chemical basis of information transfer.

L/R 261. Inorganic Chemistry I. (A) Corequisite(s): CHEM 241.

An introductory survey of the bonding, structure, and reactions of important metal and nonmetal compounds.

299. Directed Study and Seminar. (C) Prerequisite(s): Permission of undergraduate chairman.

Directed study projects and seminars as individuals or small groups under the supervision of a faculty member.

399. Independent Research. (C) Prerequisite(s): Permission of undergraduate chairman; a B average in chemistry, mathematics, and physics.

Independent project under the direction of a faculty member.

441. Advanced Organic Chemistry: Reactions, Mechanisms,and Stereoelectronic Effects. (A) Prerequisite(s): CHEM 242.

Study of important types of reactions and functional groups, with emphasis on synthetic usefulness, mechanisms, and stereoelectronic principles.

443. Modern Organic Synthesis. (A) Prerequisite(s): CHEM 241 and 242.

Introduction to advanced organic synthesis. Study of important synthetic reactions including: oxidations, reductions, and methods for the formation of carbon-carbon bonds, with an emphasis in chemoselectivity, stereoselectivity and asymmetric synthesis. Survey of modern methods for the synthesis of small, medium and large ring systems. Analysis of modern synthetic strategies, with illustrative examples from total synthesis of natural and unnatural products.

451. Biological Chemistry I. (A) Prerequisite(s): CHEM 242, 221 (may be concurrent), and 251 or permission of instructor.

Structure, dynamics, and function of biological macromolecules. Properties of macromolecular assemblies, membranes and their compartments. (Formerly, CHEM 450-I).

452. Biological Chemistry II. (B) Prerequisite(s): CHEM 242, 221, and 251 or permission of instructor.

Physical and chemical description of macromolecular information transfer. Gene organization, replication, recombination, regulation and expression. (Formerly, CHEM 450-II).

462. Inorganic Chemistry II. (C) Prerequisite(s): CHEM 261 or its equivalent and permission of instructor.

A detailed treatment of the theory and application of modern physical methods for the elucidation of structure and mechanism in inorganic and organometallic chemistry. An introduction to symmetry and group theory is followed by the application of these concepts to vibrational and electronic spectroscopy of inorganic complexes. Magnetic resonance is discussed in detail, including topics such as EPR, fourier transform methods, dynamic systems, and 2-dimensional NMR.

521. Statistical Mechanics I. (A) Prerequisite(s): CHEM 222.

Principles of statistical mechanics with applications to systems of chemical interest.

522. Statistical Mechanics II. (B) Prerequisite(s): CHEM 521.

A continuation of CHEM 521. The course will emphasize the statistical mechanical description of systems in condensed phases.

523. Quantum Chemistry I. (A) Prerequisite(s): CHEM 222.

The principles of quantum theory and applications to atomic systems.

524. Quantum Chemistry II. (B) Prerequisite(s): CHEM 523.

Approximate methods in quantum theory and applications to molecular systems.

525. Molecular Spectroscopy. (C)

A modern introduction to the theory of the interaction of radiation and matter and the practice of molecular spectroscopy. Conventional microwave, magnetic resonance, optical, photoelectron, double-resonance, and laser spectroscopic techniques will be included.

526. Chemical Dynamics. (B)

Theoretical and experimental aspects of important rate processes in chemistry.

555. (BMB 554) Macromolecular Crystallography: Methods and Applications. (A)

The first half of the course covers the principles and techniques of macro- molecular structure determination using X-ray crystallography. The second half of the course covers extracting biological information from X-ray crystal structures with special emphasis on using structures reported in the recent literature and presented by the students.

557. Mechanisms of Biological Catalysis. (C) Prerequisite(s): One year of organic chemistry and a biochemistry course, or permission of instructor.

Reaction mechanisms in biological (enzymes, abzymes, ribozymes) and biomimetic systems with emphasis on principles of catalysis, role of coenzymes, kinetics, and allosteric control.

559. Biomolecular Imaging. (B)

This course considers the noninvasive, quantitative, and repetitive imaging of targeted macromolecules and biological processes in living cells and organisms.Imaging advances have arisen from new technologies, probe chemistry, molecular biology, and genomic information. This course covers the physical principles underlying many of the latest techniques, and defines experimental parameters such as spatial and temporal resolution, gain, noise, and contrast. Applications to cellular and in vivo imaging are highlighted for confocal, two-photon, and force microscopies; single-molecule, CARS, and fluorescence correlation spectroscopy; FRET and fluorescence bleaching; mass spectroscopy; MRI, PET and SPECT. The role of molecular imaging agents comprised of proteins, organic or inorganic materials is widely discussed.

564. Organometallics. (C)

This course is focused on molecular species that contain metal-carbon bonds, and the role of these compounds in catalytic processes and organic synthesis. Aspects of the synthesis, structure and reactivity of important classes of organometallic compounds such as metallo alkyl, aryl, alkene, alkylidene and alkylidyne complexes are surveyed for the d and f block metals. Emphasis is placed on general patterns of reactivity and recurring themes for reaction mechanisms.

565. Main Group Chemistry. (C)

This course encompasses a comprehensive survey of the chemistry and properties of the p-block elements of the periodic table. Topics include syntheses, structures and reactivities of important compounds. In addition, alternative bonding theories which have been used to explain the unique properties of these compounds are critically examined.

567. (BMB 567) Bio-inorganic Chemistry. (C)

The course covers selected topics in bioinorganic chemistry; special emphasis is placed on dioxygen chemistry and electron transfer processes. Course topics include: (i) oxygen uptake and utilization; (ii) diatomic oxygen trans port; (iii) diatomic and monoatomic oxygen incorporation into substrates; (iv) metalloenzyme-catalyzed C-C bond formation; (v) the metallobiochemistry of DNA; (vi) metal-sulfide proteins; (vii) manganese-containing metalloproteins; (viii) Photosystem II: light-driven electron transfer and the biological water-splitting reaction; (ix) biological electron transfer; (x) electron transfer theory; (xi) mechanisms of energy storage and release; and (xii) long-distance electron transfer reactions.

600. Tutorial Studies. (C) Both terms. May be repeated for credit with permission of instructor.

Readings and discussion on various topics with various faculty members.

700. (BMB 700, PHRM630) Selected Topics in Chemistry. (C)

May be repeated for credit and may be taken for multiple course unit credit if more than one topic is offered in a term.

999. Independent Study and Research. (C) May be taken for multiple course unit credit.

(1) Advanced study and research in various branches of chemistry. (2) Seminar in current chemical research. (3) Individual tutorial in advanced selected topics.

Undergraduate BIOCHEMISTRY Courses (BCHE)

299. Undergraduate Research Projects. (C) 10-20 h., 1-2 c.u., admission by permission of the biochemistry undergraduate chairman.

Independent Research.

300. Senior Research Projects. (C) 10-20 h., 1-2 c.u., admission by permission of the biochemistry undergraduate chairman.

SM 404. Biochemistry Laboratory. (E) Year long course --initial registration must occur in Fall term, 0 c.u. for first term and 2 c.u. for second term, 10h. CHEM 451 or permission of instructor required.

Independent research projects in the laboratories of individual faculty members. A list of possible research supervisors is available in the Biochemistry office (357 Chemistry). In addition to their laboratory projects, students will attend a weekly seminar in which their own and related work will be discussed.

580. (PHYS580) Biological Physics. (C) Prerequisite(s): Physics 150-151 or 170-171, Math 104-114 or Math 104-115. Recommended: concurrent Physics 230 or prior Physics 250, basic background in chemistry and biology.