CHEM - Chemistry

Courses numbered 500 to 799 = *undergraduate/graduate*. (Individual courses may be limited to undergraduate students only.) Courses numbered 800 to 999 = *graduate*.

CHEM 514. Inorganic Chemistry (3).
General education math and natural sciences course. Basic inorganic chemistry emphasizing molecular symmetry and structure, fundamental bonding concepts, ionic interactions, periodicity of the elements, systematics of the chemistry of the elements, acid-base chemistry and nonaqueous solvents, classical coordination chemistry and introductory bioinorganic chemistry. Prerequisite(s): CHEM 212 with a grade higher than C-; CHEM 531 strongly suggested but not required.

CHEM 523. Analytical Chemistry (4).
General education math and natural sciences course. Evaluation of data, theory and application of gravimetric analysis and precipitation, neutralization and oxidation-reduction volumetric analysis. Course requires a lab fee. Prerequisite(s): CHEM 212 with a grade higher than C-. Corequisite(s): CHEM 523L.

CHEM 524. Instrumental Methods of Chemical Analysis (4).
Introduces spectroscopic techniques (UV-Visible atomic absorption, molecular absorption, infrared, mass spectrometry and NMR), electrochemical techniques (potentiometry, voltammetry and coulometry) and separation techniques (gas chromatography and HPLC). Applications of computer and automated methods of analysis also covered. Course requires a lab fee. Prerequisite(s): CHEM 531; CHEM 532 strongly recommended but not required. Corequisite(s): CHEM 524L.

CHEM 531. Organic Chemistry I (5).
General education math and natural sciences course. Introduces the study of carbon compounds emphasizing reaction mechanisms, stereochemistry and spectrographic analysis. Credit is not allowed for both CHEM 531 and 535. Course requires a lab fee. Prerequisite(s): CHEM 212 with a grade higher than C-. Corequisite(s): CHEM 531L.

CHEM 532. Organic Chemistry II (5).
Continuation of CHEM 531 emphasizing the structure and reactions of principal functional groups and compounds of biological interest. Credit is not allowed for both CHEM 532 and 536. Course requires a lab fee. Prerequisite(s): CHEM 531 with a grade higher than C-. Corequisite(s): CHEM 532L.

CHEM 533. Elementary Organic Chemistry (3).
One-semester survey of organic chemistry, examining various classes of organic compounds, organic reactions and reaction mechanisms. Establishes an understanding of the relationship between structure and reactivity, with particular emphasis on the importance of organic chemistry to the health sciences and biomedical engineering. Credit is not allowed for both CHEM 533 and 531. Course does not meet the needs of chemistry majors or premed students. Prerequisite(s): CHEM 212 with a grade higher than C-.

CHEM 535. Organic Chemistry I (3).
Introduces the study of carbon compounds emphasizing reaction mechanisms, stereochemistry and spectrographic analysis. This course does not include a lab, is open only to biomedical engineering majors and does not meet the needs of chemistry majors or premed students. Credit is not allowed for both CHEM 535 and 531. Prerequisite(s): must be a biomedical engineering major and have completed CHEM 212 with a grade higher than C-.

CHEM 536. Organic Chemistry II (3).
Continuation of CHEM 535 emphasizing the structure and reactions of principal functional groups and compounds of biological interest. Course does not include a lab, is open only to biomedical engineering majors and does not meet the needs of chemistry majors or premed students. Credit is not allowed for both CHEM 536 and 532. Prerequisite(s): must be a biomedical engineering major and have completed CHEM 531 or 535 with a grade higher than C-.

CHEM 545. Physical Chemistry I (3).
General education math and natural sciences course. Introduces fundamentals of thermodynamics with the goal of understanding the driving forces behind chemical and physical changes and equilibria. Covers the laws of thermodynamics and explores concepts involving work, heat and simple mechanical processes. Introduces Helmholtz and Gibbs energy as thermodynamic indicators of spontaneity/equilibria. Applies these concepts to the study of phase changes, chemical equilibria, ideal and non-ideal solutions, electrolytes and chemical kinetics. Prerequisite(s): CHEM 212 with a grade higher than C-, one year of college physics, MATH 243 or its equivalent.

CHEM 546. Physical Chemistry II (3).
Covers elementary quantum mechanics and its applications to chemistry. Begins with a historical comparison between classical and quantum mechanics, then builds from the postulates of quantum mechanics to explore the Schrödinger equation and its use in solving problems involving particles, rotating bodies and vibrations. Special emphasis on spectroscopy and approximation methods relevant to chemistry. Prerequisite(s): CHEM 212 with a grade higher than C-, one year of college physics, and MATH 243 or its equivalent.

CHEM 547. Physical Chemistry Lab (2).
Laboratory experiments and exercises that reinforce physical chemistry concepts of thermodynamics, equilibrium, spectroscopy and error analysis. Students gain practical, hands-on experience with computerized data acquisition and learn computational techniques for data reduction and analysis. For undergraduate credit only. Course requires a lab fee. Pre- or corequisite(s): CHEM 545, CHEM 546.

CHEM 605. Medicinal Chemistry (3).
For students interested in chemistry related to the design, development and mode of action of drugs. Describes those organic substances used as medicinal agents and explains the mode of action and chemical reactions of drugs in the body; illustrates the importance and relevance of chemical reactions as a basis of pharmacological activity, drug toxicity, allergic reactions, carcinogenicity, etc.; and brings about a better understanding of drugs. Includes transport, basic receptor theory, metabolic transformation of drugs, discussion of physical and chemical properties in relation to biological activity, drug design, structure-activity relationships and discussion of a select number of organic medicinal agents. Prerequisite(s): CHEM 532 or equivalent; a semester of biochemistry (CHEM 661 or 662) and a year of biology are strongly recommended.

CHEM 615. Advanced Inorganic Chemistry (3).
Includes modern bonding theories, structure and spectra of inorganic compounds, coordination and organometallic chemistry, boranes, inorganic ring systems and polymers, inorganic environmental chemistry, mechanisms of inorganic reactions and solid state chemistry. Prerequisite(s): CHEM 514. Pre- or corequisite(s): CHEM 546.

CHEM 616. Inorganic Chemistry Lab (2).
Experimental methods of inorganic chemistry. An introduction to the synthetic and analytical techniques that are employed in modern inorganic chemistry. For undergraduate credit only. Course requires a lab fee. Pre- or corequisite(s): CHEM 615.

CHEM 661. Principles of Biochemistry (3).
General education math and natural sciences course. Survey course for chemistry majors including chemistry/business majors and students in life sciences. Not recommended for the BS in chemistry-

premedicine or biochemistry field majors for whom CHEM 662 and 663 are required. Introduces thermodynamics and biological oxidation-reduction reactions; structure, metabolism and synthesis of proteins, carbohydrates, lipids and nucleic acids; enzyme kinetics, photosynthesis and transfer of genetic information. Credit is not allowed in both CHEM 661 and 662. Prerequisite(s): CHEM 532, 533, or 536.

CHEM 662. Biochemistry I (3).
Study of major constituents of the cell: protein, carbohydrate, glycoprotein, lipid, nucleic acid, nucleoprotein, enzyme catalysis, biological oxidations, photosynthesis and introduction to intermediary metabolism. A fundamental background of biology or microbiology is recommended but not essential. Credit is not granted for both CHEM 661 and 662. Prerequisite(s): CHEM 532 or equivalent. Pre- or corequisite(s): CHEM 523 or equivalent.

CHEM 663. Biochemistry II (3).
Studies metabolism and control of carbohydrates, lipids, phosphoglycerides, spingolipids, sterols, amino acids and proteins; synthesis of porphyrins, amides and polyamines; synthesis and metabolism of purines, pyrimidines and nucleotides; synthesis and structure of DNAs, RNAs and proteins; organization and functioning of genes; evolution of proteins and nucleic acids, hereditary disorders of metabolism, biochemistry of endocrine glands, major nutrients and vitamins, body fluids and generalized tissues. A fundamental background of biology or microbiology is recommended but not essential. Prerequisite(s): CHEM 662 with a grade higher than C-.

CHEM 664. Biochemistry Laboratory (3).
Practical training in biochemical procedures and literature searching; experiments include isolation, characterization and assay of biomolecules and use of centrifugation, chromatography, electrophoresis, spectrophotometry, enzyme kinetics and molecular cloning techniques. For undergraduate credit only. Prerequisite(s): CHEM 532. Pre- or corequisite(s): CHEM 662 or CHEM 663.

CHEM 666. Special Topics in Biochemistry (3).
An umbrella course created to explore a variety of subtopics differentiated by letter (e.g., 666A, 666B). Not all subtopics are offered each semester – see the course schedule for availability. Students enroll in the lettered courses with specific topics in the titles rather than in this root course. Prerequisite(s): BIOL 211, CHEM 662, CHEM 663.

CHEM 669. Research in Biochemistry (2).
Cross-listed as BIOL 669. Students in the biochemistry field major participate in a biochemistry research project under the direction of a faculty member. Requires a written report summarizing the results. For undergraduate credit only. Repeatable once for credit. Prerequisite(s): BIOL 420, and CHEM 662 or 663, and CHEM 664 and instructor's consent.

CHEM 690. Independent Study and Research (1-3).
Studies performed must be directed by a faculty member in the department of chemistry. For undergraduate credit only. Repeatable for a total of 3 credit hours. Prerequisite(s): departmental consent.

CHEM 700. Chemistry Seminar (1).
Students give seminars on either papers recently published in the literature or on their own research. Repeatable for credit.

CHEM 701. Chemistry Colloquium (1).
Speakers for the colloquium consist of outstanding chemists from other institutions and faculty. Repeatable for credit.

CHEM 715. Advanced Spectroscopy (3).
Introduces 1H and 13C NMR spectroscopy including basic concepts such as integration, chemical shifts, diamagnetic shielding, magnetic anisotropy, spin-spin coupling (first and second-order), coupling constants, proton decoupled 13C NMR interpretation of 1H and 13C NMR spectra. More advanced topics include NOE and protein structural mapping, and multidimensional techniques such as COSY, DEPT, INEPT, molecular motion by NMR, coupling to I>0 metal centers, including those with <100 percent natural abundance, virtual coupling in metal complexes, NMR of paramagnetic systems and use of paramagnetic shift reagents. Introduces mass spectroscopy including instrumentation-magnetic sector, quadrupole, ion trap, MS-MS; sample preparation and interfaces-GC-MS, LC-MS, electrospray, MALDI; methods of ionization-electron impact, chemical ionization, electrospray, interpretation of mass spectra-basic concepts, fragmentation patterns. Introduces the interpretation of mid-infrared spectroscopy of complex molecules and ionic compounds followed by the synthesis of results from NMR, MS and mid IR spectra to determine structure. Emphasizes the interpretation of results for understanding electronic and molecular properties of chemical compounds related to their symmetry. Prerequisite(s): CHEM 532 or equivalent; or admission to a chemistry graduate program.

CHEM 717. Advanced Spectroscopy II (3).
Introduces electronic and vibrational spectroscopy, EPR and magnetic properties of compounds. Studies the electric field interaction of radiation, electronic and vibrational spectroscopy, and the magnetic field interaction of radiation, EPR and magnetism, with molecular systems examining the different changes in state that molecules can undergo. Emphasizes the interpretation of results for understanding electronic and molecular properties of chemical compounds related to their symmetry and structure. Prerequisite(s): CHEM 532, 546, 615, or their equivalents; or admission to a chemistry graduate program.

CHEM 719. Modern Synthetic Methods (3).
Introduces modern synthetic methods in chemistry. Detailed investigation of the synthetic chemistry of anions is followed by a detailed survey of functional group interconversions, then oxidation and reduction reactions. Introduces the topic of retrosynthetic analysis. Topics in inorganic synthesis include organometallic bond forming and breaking reactions, ligand synthesis and replacement, solid state synthesis and topics in bioinorganic synthesis. Prerequisite(s): CHEM 532 and 615, or their equivalents; or admission to a chemistry graduate program.

CHEM 721. Advanced Biochemistry (3).
Introduces advanced biochemical concepts, processes and techniques. A comprehensive survey of structure and functions of biomolecules including proteins, nucleic acids, lipids, DNA replication and translation. Covers biological membrane and membrane transport. Enzyme mechanisms and kinetics and protein structure/function are discussed in detail. Biochemical, molecular biological, biophysical and chemical techniques that are commonly used in the study of biochemical processes are introduced and discussed. Prerequisite(s): CHEM 661 or 663 or their equivalents; or admission to a chemistry graduate program.

CHEM 722. Advanced Physical Chemistry (3).
In-depth overview of the fundamentals of thermodynamics, kinetics, quantum mechanics and statistical mechanics as they apply to chemistry. Special emphasis is placed on solution thermodynamics, kinetics of coupled reactions, statistical mechanics of macromolecules and quantum mechanics as it applies to spectroscopy. Prerequisite(s): CHEM 545 and 546, or their equivalents; or admission to a chemistry graduate program.

CHEM 734. Instrumental Methods for Research (3).
Designed to prepare graduate students or other researchers to perform spectroscopy experiments relevant to their research. The identity of organic compounds can be determined by the information provided by several types of spectra: mass, infrared, nuclear magnetic resonance, fluorescence and ultraviolet. Students learn to operate such instruments

as the Varian 2200 GC/MS mass spectrometer, the ThermoNicolet Avatar FTIR spectrophotometer, the Varian Mercury 300 and Inova 400 NMR spectrometers, the Fluorolog fluorescence spectrophotometer and the Hitachi U-2010 and Varian Cary 100 UV-Vis spectrophotometers in the department's NMR and analytical facilities. Focuses on technique and not the interpretation of spectra. On successful completion of this course, students are authorized to use departmental instruments. Prerequisite(s): CHEM 524 or equivalent, or departmental consent, or admission to a chemistry graduate program.

CHEM 781. Cooperative Education (1-4).
Academic program that expands a student's learning experiences through paid employment in a supervised educational work setting related to the student's major field of study or career focus. Repeatable for credit.

CHEM 809. Special Studies in Chemistry (2-3).
An umbrella course created to explore a variety of subtopics differentiated by letter (e.g., 809A, 809B). Not all subtopics are offered each semester – see the course schedule for availability. Students enroll in the lettered courses with specific topics in the titles rather than in this root course.

CHEM 809AA. Polymer Chemistry (3).
Provides an in-depth introduction into the following topics: synthesis and synthetic modification of polymers; polymerization kinetics, thermodynamics, reaction mechanisms, structure-property and structure-reactivity relationships; analysis of the polymer literature; review of modern advances in making polymers; current status of various polymerization mechanisms and what issues are controversial. Prerequisite(s): CHEM 531 and CHEM 532, or one year of organic chemistry.

CHEM 809AB. Ion Mobility Separations (3).
Focuses on ion mobility spectrometry or separations (IMS), starting from the governing physical foundations and logically proceeding to the instrumental development and modern research and commercial IMS instrumentation and exemplary analytical applications. A particular focus is on the multidimensional methods involving IMS, integrating mass spectrometry (MS), tandem MS, gas-phase chemical reactions such as the ozone-induced dissociation, liquid chromatography (LC), and various spectroscopies. Given the current landscape of IMS employment in industry and frontline R&D defining future use, the course emphasizes the IMS/MS platforms and applications to biomedical research (in proteomics, metabolomics, glycomics and structural biology) and the forensic and environmental analyses. The course covers both linear IMS and novel approaches of differential or field asymmetric waveform IMS (FAIMS), with the lab part involving the Differential IMS/MS platform in exemplary analyses of small molecules and large proteins. Prerequisite(s): CHEM 523 and CHEM 524.

CHEM 809X. Protein Folding and Human Disease (3).
Biochemical understanding of proteins and nucleic acids is fueling the revolution in medicine, demonstrating how the basic principles of biochemical structure govern molecular regulation in normal human health or malfunction in disease. This course introduces graduate students to the relevant concepts of protein structure and function, protein folding, and diseases associated with protein misfolding and/or dysfunction. Special attention is focused on protein misfolding and aggregation as this has been associated with over 40 human diseases. This course includes lectures, directed readings and student presentations to cover seminal and current papers on the biochemistry of conformational diseases including topics such as protein folding and misfolding, protein degradation pathways, effects of protein aggregation on cell function, model systems to study protein aggregation, and novel approaches to prevent protein aggregation. Prerequisite(s): one year of undergraduate organic chemistry and at least one semester of biochemistry.

CHEM 809Y. Neurochemistry (3).
Covers advanced neurochemical concepts, processes and techniques. A comprehensive survey of biological membrane, membrane transport, electrical properties of membrane, transmembrane signaling, receptors and transmembrane proteins; quantitative aspects of ligand-receptor interaction; second messengers; acetylcholine; catecholamines; other neurotransmitters; molecular biology of vision; blood-brain barrier; and neurochemical disorders. Prerequisite(s): chemistry graduate student status or departmental consent.

CHEM 809Z. Organic, Bioorganic and Medicinal Chemistry (3).
Exposes students to selected modern organic synthetic methods, including rearrangements and cycloaddition reactions, and their utilization in the construction of molecules of biological interest. Additional topics include peptide chemistry, enzyme structure and function, enzyme kinetics, the design of covalent and non-covalent inhibitors, and an overview of the drug discovery process. Prerequisite(s): CHEM 532 and one semester of biochemistry.

CHEM 835. Bio-organic Chemistry (3).
Includes the chemistry of amino acids and peptides, enzyme structure and function, and inhibitor design. Prerequisite(s): CHEM 532, 661, or CHEM 663 or equivalent.

CHEM 890. Research in Chemistry (1-12).
Research for the student planning to receive an MS. Research is directed by a faculty member. Repeatable for credit.

CHEM 990. Research in Chemistry (1-11).
Research for the student planning to receive the PhD. Research is directed by a faculty member. Repeatable for credit.