

CHEM - CHEMISTRY

CHEM 601 Analytical Chemistry I

Credits 3. 3 Lecture Hours. Fundamentals of chemical instrumentation. Modular approach to instrumental methods of chemical analysis; modules to be covered include digital electronics, modern optics, basic quantification and signal-to-noise enhancements. **Prerequisite:** Graduate classification in chemistry or approval of instructor.

CHEM 602 Analytical Chemistry II

Credits 3. 3 Lecture Hours. Modern analytical techniques, spectroscopies, chromatography, and "hyphenated" methods such as GC-FTIR, GC-MS, HPLC-MS, CE-LIF, and CE-MS are examined from the perspective of surface analysis, fundamentals of separation science and structural characterization of complex molecular systems. **Prerequisite:** CHEM 601.

CHEM 610 Organic Reactions

Credits 3. 3 Lecture Hours. Introduction to mechanisms and scope of the basic organic reaction types as applied to major functional groups. **Prerequisite:** CHEM 646 or approval of instructor.

CHEM 615 Organic Synthesis

Credits 3. 3 Lecture Hours. Application of organic reactions to synthesis of complex organic molecules. Synthesis design and methodology, scope and limitations of reactions and experimental design. **Prerequisite:** CHEM 610.

CHEM 616 Organometallic Transformations for Organic Synthesis

Credits 3. 3 Lecture Hours. Introduction to transition and main group metal-mediated reactions in organic synthesis; organometallic mechanisms in the context of homogeneous catalytic systems currently employed in synthetic laboratories; emphasis on the properties of transition metal complexes and their interactions with organic substrates that promote useful chemical transformations. **Prerequisite:** CHEM 646 recommended.

CHEM 618 NMR Spectroscopy

Credits 3. 3 Lecture Hours. Theory and practice of modern nuclear magnetic resonance spectroscopy; Bloch equations, relaxation and relaxation mechanisms, chemical exchange, pulse and Fourier-transform methods, selective excitation, 2-D methods and solid-state nuclear magnetic resonance. **Prerequisite:** Graduate classification in chemistry or approval of instructor.

CHEM 619 Analytical Spectroscopy

Credits 3. 3 Lecture Hours. Fundamentals of optical spectroscopy and applications; quantum mechanical description of light-matter interaction, linear and nonlinear spectroscopy, optics and spectroscopic instrumentation, optical signal detection and data acquisition/processing, applications of spectroscopic techniques in nanoscience. **Prerequisite:** CHEM 648 or approval of instructor.

CHEM 621 Chemical Kinetics

Credits 3. 3 Lecture Hours. Present theories about chemical reaction rates and mechanisms. **Prerequisite:** CHEM 328 or approval of instructor.

CHEM 623 Surface Chemistry

Credits 3. 3 Lecture Hours. Nature, structure and chemistry of surfaces; characterization of surfaces from surface energy to structure; relation to chemical processes. **Prerequisite:** Graduate classification in chemistry or approval of instructor.

CHEM 627 Principles of Biological Chemistry

Credits 3. 3 Lecture Hours. General principles of biological chemistry with an emphasis on the structures and mechanisms of action for proteins, nucleic acids and lipids. **Prerequisite:** Graduate classification.

CHEM 628 Coordination and Bioinorganic Chemistry

Credits 3. 3 Lecture Hours. Structure and reactivity of coordination compounds; reactions of metal ions with small biomolecules and the reactions of toxic metal ions; role of metal ions in biological systems including the function of metal ions in enzymes. **Prerequisite:** CHEM 633.

CHEM 629 Main Group Chemistry

Credits 3. 3 Lecture Hours. Chemistry of the ns and np elements of the periodic table and the noble gases including the organometallic chemistry of these elements. **Prerequisite:** CHEM 633.

CHEM 630 Bioorganic Chemistry

Credits 3. 3 Lecture Hours. Biorganic Chemistry. Introduction to current research areas of bioorganic chemistry and chemical genetic tools in exploring biological systems; DNA recombinant technology; histone chemical biology; protein glycosylation; protein engineering methods; gene transcription regulation; semi-synthesis of proteins with PTM analogs. **Prerequisites:** CHEM 627 or approval of instructor.

CHEM 631 Statistical Thermodynamics

Credits 3. 3 Lecture Hours. Methods of statistical mechanics based primarily on Boltzmann statistics; approach to thermodynamics through partition function; statistical concept of entropy.

CHEM 633 Principles of Inorganic Chemistry

Credits 3. 3 Lecture Hours. General principles of inorganic chemistry treated with a view to applications in other subfields of chemistry. **Prerequisite:** Graduate classification in chemistry or approval of instructor.

CHEM 634 Physical Methods in Inorganic Chemistry

Credits 3. 3 Lecture Hours. Determination of the molecular structure of inorganic and organometallic species; modern aspects of diffraction, magnetic resonance and vibrational methods. **Prerequisite:** CHEM 641 or CHEM 673.

CHEM 635 Introduction to X-ray Diffraction Methods

Credits 3. 3 Lecture Hours. Fundamentals of diffraction theory by crystals and the solution of crystal structures using this methodology. **Prerequisite:** BS in Chemistry, Physics, or Engineering.

CHEM 636 Mechanistic Inorganic Chemistry

Credits 2. 2 Lecture Hours. Reaction pathways in both main group and transition-metal complexes; factors which influence the reaction rate including nature of the metal, the coordination sphere, reaction conditions and catalytic intermediates. **Prerequisite:** CHEM 633.

CHEM 640 Laboratory Methods in Biological Chemistry

Credits 3. 1 Lecture Hour. 6 Lab Hours. Application of chemical techniques to the investigation and/or manipulation of biological systems; laboratory methods provides a hands-on opportunity to gain an understanding and appreciation for chemical biology techniques.

Prerequisite: Graduate classification or approval of instructor.

CHEM 641 Structural Inorganic Chemistry

Credits 3. 3 Lecture Hours. Introduction to chemical bonding; ionic, covalent, coordinate and hydrogen bonding; relationship of molecular orbital and ligand field theories to experimental studies of the electronic structure of inorganic molecules. **Prerequisites:** CHEM 633 and CHEM 673.

CHEM 642 Organometallic Chemistry and Homogeneous Catalysis

Credits 3. 3 Lecture Hours. Synthesis, structure and reactivity of organometallic compounds; elementary processes for general and radical reactions, mechanism of reactions at metal centers and applications to homogeneous catalysis. **Prerequisite:** CHEM 633.

CHEM 644 Natural Products Biosynthesis

Credits 3. 3 Lecture Hours. Survey of the chemical reactions occurring in living systems, describe the experimental methods used to study these reactions and examine the biosynthesis of the major families of natural products; emphasis on the mechanistic chemistry of the biosynthetic pathway. **Prerequisite:** Graduate classification or approval of instructor.

CHEM 646 Physical Organic Chemistry

Credits 3. 3 Lecture Hours. A detailed introduction to the theory and principles of organic chemistry; bonding and structure in organic chemistry, stereochemistry, reactive intermediates in organic chemistry and transition state theory; kinetics and thermodynamic approaches.

Prerequisite: CHEM 228 or approval of instructor.

CHEM 647 Spectra of Organic Compounds

Credits 3. 3 Lecture Hours. Correlations of molecular structure with spectroscopic and other physical properties; applications to modern problems in organic chemistry. **Prerequisite:** CHEM 646 or approval of instructor.

CHEM 648 Principles of Quantum Mechanics

Credits 3. 3 Lecture Hours. Classical mechanics and development of wave mechanics; application of wave mechanics to special chemical problems. **Prerequisite:** Approval of instructor.

CHEM 658 Molecular Modeling

Credits 2. 1 Lecture Hour. 3 Lab Hours. An introduction to molecular modeling with an emphasis on quantum level calculations. Lectures will cover the basic theory behind the calculations and lab work will focus on the practical application of modern computational chemistry codes.

Prerequisite: Graduate classification or approval of instructor.

CHEM 660 Nuclear Chemistry

Credits 3. 3 Lecture Hours. 0 Lab Hours. Radioactive decay, nuclear models, nuclear spectroscopy, nuclear reactions, fission and other topics of current interest in nuclear chemical research. **Prerequisite:** CHEM 464 or approval of instructor.

CHEM 661 Radiochemistry

Credits 3. 3 Lecture Hours. Fundamentals of radiochemistry, survey of the chemistry of radioelements, radiochemistry of the nuclear fuel cycle, environmental radiochemistry, and other topics of interest in current radiochemical research. **Prerequisite:** CHEM 464, NUEN 302, or approval of instructor.

CHEM 668 Biomedical Chemistry of Small Molecules Binding Protein Surfaces

Credits 3. 3 Lecture Hours. Bioorganic and medicinal chemistry converge in the study of small molecules binding protein surfaces; impact of monoclonal antibodies (mAbs) binding proteins on diagnostics, imaging, and targeted therapeutics, particularly for disruption of protein-protein interactions; discovery of small molecule agents to bind proteins via different combinatorial methods. **Prerequisites:** Graduate classification or approval of instructor.

CHEM 670 Physical Methods in Biological Chemistry

Credits 3. 3 Lecture Hours. Overview of current methods for the characterization of biological macromolecules, including protein structure, protein-ligand interactions, protein folding; techniques discussed include nuclear magnetic resonance, optical spectroscopy, calorimetry, electron paramagnetic resonance, Mössbauer spectroscopy, X-ray crystallography, electron microscopy, and mass spectrometry.

Prerequisite: Graduate classification or approval of instructor.

CHEM 672 Bioorganic Reaction Mechanisms

Credits 3. 3 Lecture Hours. Proposed mechanisms of action of various enzymes and coenzymes from the "model systems" approach; new developments, theory and established mechanisms. **Prerequisites:** CHEM 646; BICH 624.

CHEM 673 Symmetry and Group Theory in Chemistry

Credits 2 to 3. 2 to 3 Lecture Hours. Applications of symmetry and group theory to various types of chemical systems; classification of molecules into symmetry point groups and use of character tables. **Prerequisite:** Bachelor's degree in chemistry.

CHEM 678 Writing for Research Chemists and Allied Professionals

Credits 2 to 3. 2 to 3 Lecture Hours. Overview of the meticulous process of research publications; introduction to skills for precise, impactful communication within the stringent frameworks of leading scientific publications and other related writings. **Prerequisites:** Graduate classification.

CHEM 681 Seminar

Credit 1. 1 Lecture Hour. Oral presentations and discussions of recent advances in chemistry.

CHEM 682 Departmental Research Seminar

Credit 1. 1 Lecture Hour. Recent and significant research results presented by prominent chemists; interaction with visiting chemists during discussion sessions at the end of each seminar. May be repeated for credit. **Prerequisites:** Two semesters of CHEM 681.

CHEM 684 Professional Internship

Credits 1 to 4. 1 to 4 Other Hours. Supervised practical experience in professional functions appropriate to chemistry-related careers; completion of a scholarly report of these activities acceptable to graduate committee. **Prerequisites:** Graduate classification in chemistry; approval of committee chair and the graduate advisor.

CHEM 685 Directed Studies

Credits 1 to 6. 1 to 6 Other Hours. Special topics to suit small group requirements; more recent problems and results in various branches of chemistry; laboratory work or conference and discussion. **Prerequisite:** Graduate classification.

CHEM 686 Ethics in Chemical Research and Scholarship

Credit 1. 1 Lecture Hour. Ethical issues in chemical research and scholarship and methods for resolution of such issues; includes Texas A&M University Policies and Procedures, ethics and scientific truth, ethics and other scientists and ethics and society; case studies. **Prerequisite:** Graduate classification in chemistry or biochemistry.

CHEM 689 Special Topics in...

Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 8 Lab Hours. Selected topics in an identified area of chemistry. May be repeated for credit. **Prerequisites:** Graduate classification and approval of instructor.

CHEM 690 Theory of Chemical Research

Credits 3. 3 Lecture Hours. The design of research experiments in various subfields of chemistry and the evaluation of research results with the aid of examples taken from the current scientific literature. May be repeated for credit.

CHEM 691 Research

Credits 1 to 23. 1 to 23 Other Hours. Research for thesis or dissertation.

CHEM 695 Frontiers in Chemical Research

Credit 1. 1 Lecture Hour. Present status of research in a variety of significant chemical fields; content depends on the availability of visiting lecturers who will be selected because of distinguished international recognition in their fields of research. May be taken twice. **Prerequisite:** Graduate classification.

CHEM 697 Methods in Teaching Chemistry Laboratory

Credit 1. 1 Lecture Hour. 1 Lab Hour. An introduction to teaching methods associated with the teaching of introductory chemistry laboratories using graduate teaching assistants. Emphasis placed on effective communication, preparation, record keeping, and safe and effective management of an instructional laboratory. May be taken four times for credit. **Prerequisite:** Graduate classification in chemistry.