Chemistry - CHEM

Courses

CHEM 1010 SURVEY OF CHEMISTRY I (3) LEC. 3. Science Core. Survey of important topics from general and organic chemistry. Atomic and bonding theory, chemical reactions and stoichiometry, gas laws, solutions, acids and bases, hydrocarbons, alcohols, ethers and amines.

CHEM 1011 SURVEY OF CHEMISTRY I LABORATORY (1) LAB. 3. Pr. P/C CHEM 1010. Science Core. Laboratory experiments emphasizing course material in CHEM 1010.

CHEM 1020 SURVEY OF CHEMISTRY II (3) LEC. 3. Pr. CHEM 1010. Science Core. Survey of important topics from organic and biochemistry. Aldehydes and ketones, carboxylic acids, carbohydrates, lipids, proteins, enzymes, extracellular fluids, metabolism, nucleic acids, radioactivity.

CHEM 1021 SURVEY OF CHEMISTRY II LABORATORY (1) LAB. 3. Pr. P/C CHEM 1020 and CHEM 1011. Science Core. Laboratory experiments emphasizing course material in CHEM 1020.

CHEM 1030 FUNDAMENTALS CHEMISTRY I (3) DSL/LEC. Science Core. Atomic and molecular theory, chemical equations, stoichiometry, gas laws, thermochemistry, bonding, electronic structure, molecular geometries, solids, liquids, properties of solutions, problem-solving techniques. Credit will not be given for both CHEM 1030 and CHEM 1110 or CHEM 1117.

CHEM 1031 FUNDAMENTAL CHEMISTRY I LABORATORY (1) LAB. 3. Pr. P/C CHEM 1030 or P/C CHEM 1033. Science Core. Laboratory experiments emphasizing course material in CHEM 1030. Credit will not be given for both CHEM 1031 and CHEM 1111 or CHEM 1118.

CHEM 1040 FUNDAMENTAL CHEMISTRY II (3) LEC. 3. Pr. CHEM 1030 or CHEM 1033 or CHEM 1110 or CHEM 1117. Science Core. Chemical kinetics; chemical equilibrium; acids and bases; calculations of pH; equilibrium constants and thermodynamical properties; electrochemistry; descriptive chemistry. Credit will not be given for both CHEM 1040 and CHEM 1120 or CHEM 1127.

CHEM 1041 FUNDAMENTAL CHEMISTRY II LABORATORY (1) LAB. 3. Pr. (P/C CHEM 1040 or P/C CHEM 1043) and (CHEM 1031 or CHEM 1111 or CHEM 1118). Science Core. Laboratory experiments emphasizing course material in CHEM 1040. Credit will not be given for both CHEM 1041 and CHEM 1121 or CHEM 1128.

CHEM 1110 GENERAL CHEMISTRY I (3) LEC. 3. Pr. P/C MATH 1610 or P/C MATH 1613 or P/C MATH 1617. Science Core. Chemical principles for chemistry and related majors. Atomic and molecular theory, periodicity, chemical reactions, Stoichiometry, gases, thermochemistry, bonding, molecular geometries, liquids, solids, and solutions. Credit will not be given for both CHEM 1110 and CHEM 1030 or CHEM 1117.

CHEM 1111 GENERAL CHEMISTRY I LABORATORY (1) LAB. 3. Pr. P/C CHEM 1110 or P/C CHEM 1117. Science Core. Laboratory experiments emphasizing course material in CHEM 1110. Credit will not be given for both CHEM 1111 and CHEM 1031 or CHEM 1118.

CHEM 1117 HONORS GENERAL CHEMISTRY I (3) LEC. 3. Pr. Honors College. Science Core. General chemistry for students in the honors program. Topics similar to CHEM 1110, but covered in more depth. Credit will not be given for both CHEM 1117 and CHEM 1030 or CHEM 1110.

CHEM 1118 HONORS GENERAL CHEMISTRY I LABORATORY (1) LAB. 3. Pr. Honors College. CHEM 1117. Science Core. Laboratory experiments emphasizing course material in CHEM 1117. Credit will not be given for both CHEM 1118 and CHEM 1031 or CHEM 1111.

CHEM 1120 GENERAL CHEMISTRY FOR SCIENTISTS AND ENGINEERS II (3) LEC. 3. Pr. CHEM 1110 or CHEM 1117. Science Core. Continuation of CHEM 1110. Chemical kinetics, chemical equilibrium, acids and bases, thermodynamics, electrochemistry, representative element and transition metal chemistry. Credit will not be given for both CHEM 1120 and CHEM 1040 or CHEM 1127.

CHEM 1121 GENERAL CHEMISTRY II LABORATORY (1) LAB. 3. Pr. (P/C CHEM 1120 or P/C CHEM 1127) and (CHEM 1111 or CHEM 1118). Science Core. Laboratory experiments emphasizing course material in CHEM 1120. Credit will not be given for both CHEM 1121 and CHEM 1041 or CHEM 1128.

CHEM 1127 HONORS GENERAL CHEMISTRY II (3) LEC. 3. Pr. Honors College. CHEM 1117. Science Core. General chemistry for students in the honors program. Topics similar to CHEM 1120, but covered in more depth. Credit will not be given for both CHEM 1127 and CHEM 1040 or CHEM 1120.

CHEM 1128 HONORS GENERAL CHEMISTRY II LABORATORY (1) LAB. 3. Pr. Honors College. Science Core. Laboratory experiments emphasizing course material in CHEM 1127. Credit will not be given for both CHEM 1128 and CHEM 1041 or CHEM 1121.

CHEM 2030 SURVEY OF ORGANIC CHEMISTRY (3) LEC. 3. Pr. CHEM 1040 or CHEM 1120 or CHEM 1127. Structure, nomenclature and reactions of the functional group classes of organic compounds polymers, and molecules of biological interest. Credit will not be given for both CHEM 2030 and CHEM 2070.

CHEM 2070 ORGANIC CHEMISTRY I (3) LEC. 3. Pr. CHEM 1040 or CHEM 1043 or CHEM 1120 or CHEM 1127. In-depth study of organic chemistry including structure, nomenclature, reactions, reaction mechanisms, stereochemistry, synthesis and spectroscopic structure determination organized by the functional group approach. Considers alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, and aromatic compounds. Credit will not be given for both CHEM 2070 and CHEM 2030.

CHEM 2071 ORGANIC CHEMISTRY I LABORATORY (1) LAB. 3. Pr. (P/C CHEM 2070 or P/C CHEM 2077) and (CHEM 1041 or CHEM 1128 or CHEM 1121). Laboratory for CHEM 2070.

CHEM 2077 HONORS ORGANIC CHEMISTRY I (3) LEC. 3. Pr. Honors College. Organic chemistry for students in the honors program and Chemistry & Biochemistry majors. Topics similar to CHEM 2070, but covered in more depth. Additional credit will not be given for CHEM 2070. Member of the Honors College or CHEM 1110 with grade of A or B or CHEM 1040 with grade of A.

CHEM 2078 HONORS ORGANIC CHEMISTRY I LABORATORY (1) LAB. 3. Pr. P/C CHEM 2070 or P/C CHEM 2077. Laboratory experiments emphasizing course material in CHEM 2077. Additional credit will not be given for CHEM 2071. Course may be repeated for a maximum of 3 credit hours.

CHEM 2080 ORGANIC CHEMISTRY II (3) LEC. 3. Pr. CHEM 2070 or CHEM 2077. Continuation of CHEM 2070. Aldehydes, ketones, amines, carboxylic acids, esters, amides, anhydrides, polymers, carbohydrates and amino acids.

CHEM 2081 ORGANIC CHEMISTRY II LABORATORY (1) LAB. 1. Pr. (CHEM 2070 or CHEM 2077) and (CHEM 2071 or CHEM 2078) and (P/C CHEM 2080 or P/C CHEM 2087). Laboratory for CHEM 2080.

CHEM 2087 HONORS ORGANIC CHEMISTRY II (3) LEC. 3. Pr. Honors College or departmental approval. Organic chemistry for students in the honors program and Chemistry & Biochemistry majors. Topics similar to CHEM 2080, but covered in more depth. Additional credit will not be given for CHEM 2080. Member of the Honors College or CHEM 2077

CHEM 2088 HONORS ORGANIC CHEMISTRY II LABORATORY (1) LAB. 3. Pr. P/C CHEM 2080 or P/C CHEM 2087. Laboratory experiments emphasizing course material in CHEM 2087. Additional credit will not be given for CHEM 2081. May count either CHEM 2081 or CHEM 2088. Course may be repeated for a maximum of 3 credit hours.

CHEM 2100 PROFESSIONAL DEVELOPMENT (1) LEC. 1. This course is designed to introduce students to the many opportunities available in chemistry, both as a career choice and while as a student. Students will have the opportunity to investigate available options, will reflect on what career success means to the student, and will chart a pathway to student professional success.

CHEM 2980 INTRODUCTION TO UNDERGRADUATE RESEARCH IN CHEMISTRY (1-3) LAB. SU. Individual problems course. Students will work under the direction of a staff member on some problem of mutual interest. Departmental approval required. Only Freshman or Sophomore. Course may be repeated for a maximum of 6 credit hours.

CHEM 3000 CHEMICAL LITERATURE (1) LEC. 1. Pr. CHEM 2080 or CHEM 2087. Chemical literature with emphasis on primary and secondary sources and the various computer data bases available.

CHEM 3050 ANALYTICAL CHEMISTRY (3) LEC. 3. Pr. CHEM 1040 or CHEM 1120 or CHEM 1127. Theory and application of volumetric, potentiometric and photometric chemical analysis.

CHEM 3051 ANALYTICAL CHEMISTRY LABORATORY (1) LAB. 3. Pr. P/C CHEM 3050. Analytical techniques applied to chemical analysis.

CHEM 3160 SURVEY OF PHYSICAL CHEMISTRY (3) LEC. 3. Pr. CHEM 1040 or (CHEM 1120 or CHEM 1127). The principles of physical chemistry.

CHEM 4070 PHYSICAL CHEMISTRY I (3) LEC. 3. Pr. (CHEM 1040 or CHEM 1120 or CHEM 1127) and (MATH 2630 or MATH 2637) and (MATH 2650) and (PHYS 1610 or PHYS 1617). Principles of chemical thermodynamics, principles of application to problems of chemical interest.

CHEM 4071 PHYSICAL CHEMISTRY I LABORATORY (1) LAB. 3. Pr. P/C CHEM 4070.

CHEM 4080 PHYSICAL CHEMISTRY II (3) LEC. 3. Pr. CHEM 1040 or (CHEM 1120 or CHEM 1127) and (MATH 2630 or MATH 2637) and MATH 2650 and (PHYS 1610 or PHYS 1617). Principles of quantum mechanics and spectroscopy; application in molecular structure and in statistical thermodynamics.

CHEM 4081 PHYSICAL CHEMISTRY II LABORATORY (1) LAB. 3. Pr. P/C CHEM 4080. Laboratory for CHEM 4080.

CHEM 4100 INORGANIC CHEMISTRY (3) LEC. 3. Pr. CHEM 4080 or CHEM 3160. Principles of inorganic chemistry emphasizing periodic properties, bonding, structure and symmetry, the solid state, acid-base theory and coordination chemistry.

CHEM 4101 INORGANIC CHEMISTRY LABORATORY (1) LAB. 3. Pr. P/C CHEM 4100. Synthesis and characterization of a variety of inorganic compounds.

CHEM 4110 ORGANOMETALLICS AND CATALYSIS (3) LEC. 3. Pr. CHEM 4100. Departmental approval. Survey of organometallic chemistry and catalysis with main group, transition metal, and f-block elements.

CHEM 4130 INSTRUMENTAL ANALYSIS (3) LEC. 3. Pr. P/C CHEM 3050. Fundamental concepts used in instrumental analytical chemistry emphasizing spectrophotometric, electroanalytical and chromatographic analysis.

CHEM 4131 INSTRUMENTAL ANALYSIS LABORATORY (1) LAB. 3. Pr. P/C CHEM 4130. Laboratory for CHEM 4130.

CHEM 4920 CHEMISTRY INTERNSHIP (3) INT. 12. Departmental approval. Application of chemistry concepts and skills in a professional setting. The course may be repeated for a maximum of 6 credit hours.

CHEM 4950 UNDERGRADUATE SEMINAR (1) LEC. 1. Oral presentation and discussion of research in the area of specialization.

CHEM 4980 UNDERGRADUATE RESEARCH IN CHEMISTRY (3) LAB. 9. Departmental approval. This is an individual problem course. Each student will work under the direction of a staff member on some problem of mutual interest. Course may be repeated for a maximum of 9 credit hours.

CHEM 4997 HONORS THESIS (1-3) LEC. 3. Pr. Honors College. Departmental approval. Honors College Members Only; Course may be repeated for a maximum of 6 credit hours.

CHEM 5200 PYTHON PROGRAMMING IN CHEMISTRY (3) LEC. 3. Pr. CHEM 3160 or CHEM 4080. Computer programming in the Python language using specific examples relevant to different branches of chemistry. Emphasizes best practices for collaborative writing, documenting, and validating the program so that it is readable and maintainable.

CHEM 5280 COMPUTATIONAL CHEMISTRY (4) LEC. 3. LAB. 3. Pr. (CHEM 2080 or CHEM 2087) and CHEM 4080. Modern computational chemistry including molecular mechanics and quantum mechanical calculations.

CHEM 5450 FOUNDATIONS OF R FOR DBER (3) LEC. 3. R is an open-source statistical software that allows nearly limitless data manipulation, statistical analysis, and advance data visualizations for both the social and physical sciences required for quality research in discipline-based education research (DBER). This course will dedicate approximately one half to learning the basics of coding in R for many common tasks found in DBER (focusing on how to independently find and apply new functions as only a portion of functions can possibly be discussed) and the second half on applying these principles into real data from students' thesis or dissertation (or data can be provided by instructor).

CHEM 6200 PYTHON PROGRAMMING IN CHEMISTRY (3) LEC. 3. Computer programming in the Python language using specific examples relevant to different branches of chemistry. Emphasizes best practices for collaborative writing, documenting, and validating the program so that it is readable and maintainable.

CHEM 6280 COMPUTATIONAL CHEMISTRY (4) LEC. 3. LAB. 3. Pr. (CHEM 2080 or CHEM 2087) and CHEM 4080. Modern computational chemistry including molecular mechanics and quantum mechanical calculations.

CHEM 6450 FOUNDATIONS OF R FOR DBER (3) LEC. 3. R is an open-source statistical software that allows nearly limitless data manipulation, statistical analysis, and advance data visualizations for both the social and physical sciences required for quality research in discipline-based education research (DBER). This course will dedicate approximately one half to learning the basics of coding in R for many common tasks found in DBER (focusing on how to independently find and apply new functions as only a portion of functions can possibly be discussed) and the second half on applying these principles into real data from students' thesis or dissertation (or data can be provided by instructor).

CHEM 7100 ADVANCED INORGANIC CHEMISTRY (3) LEC. 3. Departmental approval. Current concepts of inorganic chemistry with an emphasis on theory, structure, bonding and reactivity.

CHEM 7110 PHYSICAL METHODS IN INORGANIC CHEMISTRY (3) LEC. 3. Pr. CHEM 7100. Or equivalent. Theory and application of techniques for obtaining information inorganic compounds including magnetism, multinuclear nmr, mass spectrometry, x-ray diffraction, vibrational and electronic spectroscopies.

CHEM 7120 ORGANOMETALLIC CHEMISTRY (3) LEC. 3. Pr. CHEM 7100. Departmental approval. Main group and transition metal organometallic chemistry.

CHEM 7160 ADVANCED TOPICS IN INORGANIC CHEMISTRY (3) LEC. 3. Pr. CHEM 7100. Departmental approval. Currently active research areas in inorganic chemistry. Course may be repeated for a maximum of 12 credit hours.

CHEM 7200 PHYSICAL ORGANIC CHEMISTRY (3) LEC. 3. This course will combine the foundations of undergraduate organic chemistry reactions and add to this the physical properties of chemical reactions as affected by real laboratory applications.

CHEM 7210 STRUCTURE ELUCIDATION OF ORGANIC COMPOUNDS (3) LEC. 3. Pr. CHEM 7200 or CHEM 7220. The early stages of this course will focus on the identification of functional groups, saturated, unsaturated and cyclic compounds using IR and NMR spectroscopy, as well as mass spectrometry. Detailed analyses of 1H NMR spectra, i.e., chemical shift, multiplet shape, and coupling constants will demonstrate the power of these methods in ascertaining atom connectivity in simple organic molecules. More advanced two-dimensional NMR techniques such as COSY, HSQC and HMBC will be discussed and used for determining the structures of more complex organic molecules. The determination of absolute and relative stereochemistry using Mosher ester analyses and NOESY, respectively, in chiral molecules will also be covered. Most of the structures that will be discussed and analyzed will be stereochemically complex systems and polycyclic molecules that require a combination of multiple one-dimensional and two-dimensional NMR techniques.

CHEM 7220 ORGANIC REACTIONS (3) LEC. 3. Pr. (CHEM 2070 or CHEM 2073 or CHEM 2077) and (CHEM 2080 or CHEM 2083 or CHEM 2087). Organic reactions are described in the context of oxidation; reduction; C-C, C-N, C-O bond forming; olefination; aldol (and related) condensations; pericyclic, fragmentation, ring-expansion and ring-contraction reactions; and, named organic reactions and their reaction mechanisms and their application to chemical synthesis. Concurrent enrollment with CHEM 7200 is highly recommended.

CHEM 7230 COMPLEX MOLECULE SYNTHESIS (3) LEC. 3. Pr. CHEM 7220. This class is focused on target-oriented chemical synthesis of complex organic molecules. The main objective is to teach students how to use retrosynthetic analysis, a method for disconnecting a complex molecule into simpler starting materials, as well classical and modern organic reactions to plan syntheses of organic compounds that are biologically relevant and important in the development of better pharmaceuticals. During the course of the semester, students will be introduced to important classes of natural products including terpenes, terpenoids, alkaloids, macrolides, polycyclic ethers, as well as designed molecules that are biologically relevant, but not natural products themselves. Identifying key structural components (i.e., retrons), stereogenic centers, and substructures that can be derived from the chiral pool will be emphasized in synthesis planning. All lecture content will come from the current literature, with only manuscripts published in the past 12 months being discussed in class. Students will be responsible for reading Classics in Total Synthesis on their own and tested on the content of this book as well as assigned current literature in class. Emphasis will be placed on identifying economical and streamlined synthetic protocols that can employ cascade or domino reaction sequences.

CHEM 7260 SPECIAL TOPICS IN ORGANIC CHEMISTRY (1-3) LEC. Pr. CHEM 7200. Advanced course in a research area in organic chemistry which is of mutual interest to graduate students and the instructor. Course may be repeated for a maximum of 6 credit hours.

CHEM 7270 SUPRAMOLECULAR CHEMISTRY: SYNTHESIS, STRUCTURES, AND APPLICATIONS (3) ST1. 3. Pr. CHEM 2080. Supramolecular Chemistry bridges organic, inorganic, surface science, and analytical chemistries. It is a topical area that explores synthesis, spatial organization, weak bonding interactions, hydrogen bonding or covalent bonding, and is interest for numerous industrial or pharmacy applications.

CHEM 7300 ADVANCED PHYSICAL CHEMISTRY (3) LEC. 3. Topics of general and current interest; may vary from year to year.

CHEM 7330 CHEMICAL KINETICS (3) LEC. 3. Theoretical and experimental aspects of reaction rates. The mathematics and characterization of chemically reacting systems.

CHEM 7350 QUANTUM AND STATISTICAL MECHANICS (3) LEC. 3. Pr. CHEM 7300. A quantum mechanical and statistical approach to molecular structure and chemistry.

CHEM 7370 SPECIAL TOPICS IN PHYSICAL CHEMISTRY (1-3) LEC. 3. Pr. CHEM 7300. Modern topics in advanced physical chemistry. Course may be repeated for a maximum of 3 credit hours.

CHEM 7380 MOLECULAR SPECTROSCOPY (3) LEC. 3. Pr. CHEM 7300. Theory and application of optical and magnetic resonance spectroscopy.

CHEM 7410 A DBER APPROACH TO TEACHING AND LEARNING IN CHEMISTRY (3) LEC. 3. Pr. CHEM 1030 and CHEM 1040. Discipline-based education research (DBER) theory andtrends, consuming and evaluating DBER research, activelearning in advanced chemistry topics, action research,review of pedagogical tools, assessment. This coursewill be of use to chemistry graduate students aimingfor careers in academia, masters education studentslooking to take a chemistry course for the fulfillmentof their degree requirements, and other fields that wantto know more about evaluating and critiquing current DBERliterature and methods.

CHEM 7500 ADVANCED ANALYTICAL CHEMISTRY (3) LEC. 3. Analytical principles, applications and methods, mathematical interpretations and current developments.

CHEM 7510 ELECTROANALYTICAL CHEMISTRY (3) LEC. 3. Pr. CHEM 7500. Analytical applications of electrochemistry.

CHEM 7530 ADVANCES IN BIOANALYTICAL CHEMISTRY (3) LEC. 3. Pr. CHEM 7500. Analytical Chemistry of microfluidic devices and "Lab on a chip." New methods of miniaturization of separations and analysis with emphasis on bioanalytical applications.

CHEM 7540 FLUORESCENCE IN BIOANALYTICAL CHEMISTRY: SPECTROSCOPY AND IMAGING (3) LEC. 3. Pr. CHEM 7500. Modern fluorescence-based bioanalytical methods as well as an advanced study of related literature. Standard approaches such as biosensors, nucleic acid analysis will be covered, as well as modern techniques such as Fluorescence microscopy, FRET, immunoassays, ELISAs and single-molecule detection.

CHEM 7550 PHOTO AND ELECTROCHEMISTRY (3) ST1. The course offers a simultaneous and comprehensive treatment of photochemistry and electrochemistry.

CHEM 7560 MASS SPECTROMETRY: INSTRUMENTATION AND APPLICATIONS (3) LEC. 3. Departmental approval. Several notable developments in mass spectrometry instrumentation platforms have been introduced which has led to significant increase in their implementations to various research and clinical applications. Learning about the fundamental principles of these instrumentation platforms will guide the users in selecting the correct instrument for a specific application. This course is designed to offer such an approach.

CHEM 7610 BIOCHEMISTRY AND BIOPHYSICS TECHNIQUES (3) LEC. 3. Fundamental concepts in biochemistry, molecular microbiology, and principles of physics will be introduced. This will be followed by presentations on the theory and practical application of common biophysical techniques. The techniques discussed will include, but will not be limited to: Raman, NMR, and Mass Spectrometry of biological molecules, X-ray Diffraction, Ion Mobility, Fluorescence Microscopy, Single-Molecule Approaches, EM/Cryo-EM, and Nano-particle techniques.

CHEM 7750 FORMAL PRESENTATIONS IN MODERN CHEMISTRY (1) LEC. 1. Oral presentations skills will be developed with a focus on the dissemination of new discoveries in the field of Chemistry. Course may be repeated for a maximum of 6 credit hours.

CHEM 7930 DIRECTED INDIVIDUAL STUDY (1-15) IND. Credit to be arranged. Course may be repeated for a maximum of 15 credit hours.

CHEM 7950 SEMINAR (1) SEM. 1. SU. Course may be repeated for a maximum of 6 credit hours.

CHEM 7990 RESEARCH AND THESIS (1-10) MST. Course may be repeated with change in topics.

CHEM 8990 RESEARCH AND DISSERTATION (1-10) DSR. Course may be repeated with change in topics.