CE 4470* Stormwater Management 3 (3) Evaluation of peak discharges for urban and rural basins, design of highway drainage structures such as inlets and culverts; stormwater and receiving water quality; best management practices, detention and retention ponds, and erosion and sediment control. Preq: CE 3420. Prq or concurrent enrollment: EES 4101.

CE 4560 Pavement Design and Construction 3 (3) Introduction to design methods, construction practices, maintenance strategies, and decision making process related to pavements. Other topics, such as environmental considerations and special pavement types and materials, are also covered. Preq: CE 3110 and CE 3510. Prq or concurrent enrollment: CE 3210.

CE 4570 Materials Testing and Inspection 3 (3) Introduction to the role of testing and inspection professionals in civil engineering projects. Uses a practical approach to applying concepts to real-world situations through the completion of several team projects such as material characterization, construction QC/QA, forensic evaluation, and proposal development. Preq: CE 3210 and 3510.

CE 4590 Capstone Design Project 3 (3) Students apply creativity with their engineering knowledge in the solution of open-ended civil engineering problems. Problems are formulated and solutions are evaluated by faculty and practicing engineers. Communication skills are developed through presentations, correspondence and project reports. Students are expected to have completed all required 300-level CE courses and a Technical Design Requirement. Coreq: CE 4591.

CE 4591 Capstone Design Project Laboratory 0 (6) Non-credit laboratory to accompany CE 4590. Coreq: CE 4590.

CE 4620* Coastal Engineering 1 3 (3) Introduction to coastal and oceanographic engineering principles, including wave mechanics, wave-structure interaction, coastal water-level fluctuations, coastal-zone processes, and design considerations for coastal structures and beach nourishment projects. Preq: CE 3410.

CE (GEOL) 4820* Groundwater and Contaminant Transport 3 (3) Basic principles of groundwater hydrology and transport of contaminants in groundwater systems; groundwater system characteristics; steady and transient flow; well hydraulics, design, and testing; contaminant sources, movement and transformations. May also be offered as GEOL 4820. Preq: Junior standing in the College of Engineering and Science and GEOL 1010.

CE 4870 Senior Honors Project 1-3 (1-3) Studies or laboratory investigations on special topics in civil engineering which are of interest to individual students and faculty members. Arranged on a project basis for a maximum of individual student effort under faculty guidance. May be repeated for a maximum of three credits. Preq: Senior standing in Civil Engineering Senior Departmental Honors Program.

CE 4880 Honors Research 1 2-3 (2-3) Individual research under the direction of a Civil Engineering faculty member. Preq: CE 3890.

CE 4890 Honors Research II 3 (3) Individual research under the direction of a Civil Engineering faculty member. Preq: CE 4880.

CE 4900 Special Projects 1-3 (1-3) Studies or laboratory investigations on special topics in civil engineering which are of interest to individual students and staff members. Arranged on a project basis with a maximum of individual student effort and a minimum of staff guidance. May be repeated for a maximum of three credits. Preq: Senior standing.

CE 4910* Selected Topics in Civil Engineering I 1-6 (1-6) Structured study of civil engineering topics not found in other courses. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: Consent of instructor.

CE 4990 Creative Inquiry—Civil Engineering 1-4 (1-4) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of four credits. Preq: Consent of faculty member/mentor.

COLLEGE OF ENGINEERING AND SCIENCE

CES 1900 Creative Inquiry in Engineering and Science I 1-3 (1-3) Individual or group projects in engineering and/or science. Projects may be interdisciplinary and involve analysis, design, and/or implementation. Instruction in methods, tools, and equipment will be included when appropriate. May be repeated for a maximum of six credits. Includes Honors sections. Preq: Consent of instructor.

CES 2900 Creative Inquiry in Engineering and Science II 1-3 (1-3) Individual or group projects in engineering and/or science. Projects may be interdisciplinary and involve analysis, design, and/or implementation. Instruction in methods, tools, and equipment will be included when appropriate. May be repeated for a maximum of six credits. Includes Honors sections. Preq: Sophomore standing and consent of instructor.

CES 3900 Creative Inquiry in Engineering and Science III 1-3 (1-3) Individual or group projects in engineering and/or science. Projects may be interdisciplinary and involve analysis, design, and/or implementation. Instruction in methods, tools, and equipment will be included when appropriate. May be repeated for a maximum of six credits. Includes Honors sections. Preq: Junior standing and consent of instructor.

CES 4900 Creative Inquiry in Engineering and Science IV 1-3 (1-3) Individual or group projects in engineering and/or science. Projects may be interdisciplinary and involve analysis, design, and/or implementation. Instruction in methods, tools, and equipment will be included when appropriate. May be repeated for a maximum of six credits. Includes Honors sections. Preq: Senior standing and consent of instructor.

CHEMISTRY


CH 1010 General Chemistry 4 (3) Introduction to the elementary concepts of chemistry through classroom and laboratory experience. Emphasizes chemical reactions and the use of symbolic representation, the mole concept and its applications and molecular structure. Includes Honors sections. Credit toward a degree will be given for only one of CH 1010 and CH 1050. Preq: CMPT score of 60 or higher; or CH 1040 or MATH 1050; or MATH 1010 or MATH 1020 or MATH 1030 with a C or better; or Preq or concurrent enrollment: MATH 1040 or MATH 1060 or MATH 1070 or MATH 1080 or MATH 2060 or MATH 2080 or STAT 2300. Coreq: CH 1011.

CH 1011 General Chemistry Laboratory 0 (3) Non-credit laboratory to accompany CH 1010. Coreq: CH 1010.

CH 1020 General Chemistry 4 (3) Continuation of CH 1010, treating solutions, rates of reactions, chemical equilibrium, electrochemistry, chemistry of selected elements, and an introduction to organic chemistry. Credit toward a degree will be given for only one of CH 1020 or CH 1060. Includes Honors sections. Preq: CH 1010 with a C or better. Coreq: CH 1021.

CH 1021 General Chemistry Laboratory 0 (3) Non-credit laboratory to accompany CH 1020. Coreq: CH 1020.

CH 1040 Concepts in Chemistry 2 (2) Covers chemical ideas and mathematical skills as applied to important topics including the particulate nature of matter, visualization of chemical behavior, and application of mathematical principles to describe chemical systems. Students who have received credit for any other chemistry course will not be allowed to enroll in or receive credit for CH 1040. To be taken Pass/No Pass only.

CH 1050 Chemistry in Context I 4 (3) The chemistry of societal issues, including air quality, global warming, acid rain, and alternative energy sources is discussed in the context of their impact on society. May not be taken as a prerequisite for organic chemistry. Credit toward a degree will be given for only one of CH 1010 or CH 1050. Coreq: CH 1051.

CH 1051 Chemistry in Context I Laboratory 0 (3) Non-credit laboratory to accompany CH 1050. Coreq: CH 1050.

CH 1060 Chemistry in Context II 4 (3) Continuation of CH 1050. Topics include the chemistry of nuclear energy, new energy sources, nutrition, medicines, new materials, and genetic engineering. May not be taken as a prerequisite for organic chemistry. Credit toward a degree will be given for only one of CH 1020 or CH 1060. Preq: CH 1010 or CH 1050. Coreq: CH 1061.
CH 1061 Chemistry in Context II Laboratory (3) Non-credit laboratory to accompany CH 1060. Coreq: CH 1060.

CH 1410 Chemistry Orientation I (1) Lectures, discussions, and demonstrations devoted to health and safety in chemistry laboratories; use of the chemical literature; and career planning. Preq or concurrent enrollment: CH 1010.

CH 1520 Chemistry Communication I 2 (2) Methods for scientific communication, including oral, written, and electronic formats. Service-learning projects engage participants with community needs pertaining to chemistry issues.

CH 1990 Creative Inquiry—Chemistry I 1-4 (1-4) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of eight credits. Preq: Consent of faculty member/mentor.

CH 2010 Survey of Organic Chemistry 3 (3) Introduction to organic chemistry emphasizing nomenclature, classes of organic compounds, and chemistry of functional groups. For students needing a one-semester course in organic chemistry. Credit toward a degree will be given for only one of CH 2010 or CH 2230. Preq: CH 1020.

CH 2020 Survey of Organic Chemistry Laboratory I 1 (3) Laboratory emphasizing standard techniques of organic laboratory analysis with the synthesis and characterization of organic molecules discussed in CH 2010. Credit will be given for only one of CH 2020 or CH 2270. Preq: CH 1020. Preq or concurrent enrollment: CH 2010.

CH 2050 Introduction to Inorganic Chemistry 3 (3) One semester treatment which emphasizes the properties and reactions of the more common chemical elements. Preq: CH 1020.

CH 2230 Organic Chemistry 3 (3) Introductory course in the principles of organic chemistry and the derivation of these principles from a study of the properties, preparations, and interrelationships of the important classes of organic compounds. Credit toward a degree will be given for only one of CH 2010 or CH 2230. Preq: CH 1020.

CH 2240 Organic Chemistry 3 (3) Continuation of CH 2230. Preq: CH 2230.

CH 2270 Organic Chemistry Laboratory I 1 (3) Synthesis and properties of typical examples of the classes of organic compounds. Credit toward a degree will be given for only one of CH 2020 or CH 2270 or CH 2290. Preq or concurrent enrollment: CH 2230.

CH 2280 Organic Chemistry Laboratory I 1 (3) Continuation of CH 2270. Preq: CH 2270. Preq or concurrent enrollment: CH 2240.

CH 2290 Organic Chemistry Laboratory I 1 (3) One-semester laboratory for Chemical Engineering students. Credit toward a degree will be given for only one of CH 2270 or CH 2290. Preq: CH 2230.

CH 2990 Creative Inquiry—Chemistry II 1-4 (1-4) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of eight credits. Preq: Consent of faculty member/mentor.

CH 3000 Selected Topics in Chemistry 1-3 (1-3) Comprehensive study of topics of current interest in chemistry. May be repeated for a maximum of twelve credits, but only if different topics are covered.

CH 4010 Organometallic Chemistry 3 (3) Organometallic compounds are useful in applications ranging from large-scale industrial reactions to antibiotics, and this versatility arises from the chemically unique metalcarbon bond. Course begins with fundamental coordination chemistry, then progresses through ligand substitution, oxidative addition/reductive elimination, catalytic transformations and polymerization reactions. Includes honors sections. Preq: CH 2230.

CH 4020 Inorganic Chemistry 3 (3) Basic principles of inorganic chemistry are discussed with special emphasis on atomic structure, chemical bonding, solid state, coordination chemistry, organometallic chemistry, and acid-base theories. The chemistry of certain selected elements is treated. Includes Honors sections. Preq: CH 3310 and CH 3320.

CH 4030 Advanced Synthetic Techniques 2 (6) Introduction to advanced laboratory techniques in synthesis and characterization of inorganic and organic compounds. Laboratory sessions consist of a set of eight experiments in modern fields of chemistry, including superconductivity, buckminsterfullerene, bioinorganic chemistry, medicinal chemistry, asymmetric synthesis, and polymer chemistry. Preq: CH 2050 or CH 4020; and CH 2270; and CH 2280; and CH 3400 or CH 4120.

CH 4040 Bioinorganic Chemistry 3 (3) Covers fundamentals of bioinorganic chemistry with review of necessary inorganic and biochemical concepts. Topics include metal uptake, transport, and storage in biological systems; functions of metals in proteins; metal ion interactions with nucleic acids; physical methods used in bioinorganic chemistry; heavy element toxicity, radiopharmaceuticals and other metalloids. Includes Honors sections. Preq: BCHM 3010 or CH 2050.

CH 4110 Instrumental Analysis 3 (3) Principles of operation and application of modern chemical instrumentation in the field of analytical chemistry. Topics include basic electronics, statistics, optical, mass, magnetic resonance, electron and x-ray spectrometries, radiochemistry, and separation science. Preq: CH 3310. Preq or concurrent enrollment: CH 3320.

CH 4120 Instrumental Analysis Laboratory 2 (5) Reinforces principles of chemical instrumentation described in CH 4110 by practical, hands-on experience. Aspects of sample preparation, standardization, data acquisition and interpretation, and report formulation procedures common in chemical analyses are considered for a range of modern instrumental methods. Preq or concurrent enrollment: CH 4110.

CH 4130 Chemistry of Aqueous Systems 3 (3) Study of chemical equilibria in aqueous systems, especially natural waters; acids and bases, dissolved CO2, precipitation and dissolution, oxidation-reduction, adsorption, etc. Includes Honors sections. Preq: CH 1020 or 1060.
CH 4140* Bioanalytical Chemistry 3 (3) Survey of selected areas of importance in bioanalytical chemistry. Fundamental principles, advanced topics, and applications of analytical measurements of biomolecules, bioassays, immunoassays, separations, mass spectrometry, method validation, macromolecular crystallography, microscopy, and imaging. Preq: CH 3130 and CH 4110.


CH 4250* Medicinal Chemistry 3 (3) Survey of the pharmaceutical drug discovery process. Covers discovery of candidate compounds, bioassay methods, and associated regulatory and commercial issues. Case studies are selected from the current literature. Preq: CH 2240.

CH 4270* Organic Spectroscopy 3 (2) Survey of modern spectroscopic techniques used in the determination of molecular structure. Emphasizes the interpretation of spectra: nuclear magnetic resonance, ultraviolet, infrared, mass spectrometry, optical rotatory dispersion, and circular dichroism. Includes Honors sections. Students are expected to have completed one year each of organic chemistry and physical chemistry. Coreq: CH 4271.

CH 4271* Organic Spectroscopy Laboratory 0 (3) Non-credit laboratory to accompany CH 4270. Coreq: CH 4270.

CH 4350* Atomic and Molecular Structure 3 (3) Introduction to quantum theory and its application to atomic and molecular systems. Topics include harmonic oscillator, hydrogen atom, atomic and molecular orbital methods, vector model of the atom, atomic spectroscopy, and molecular spectroscopy. Includes Honors sections. Preq: CH 3320.

CH 4430 Computational Quantum Chemistry and Electronic Structure Methods 3 (3) Hands-on introduction to electronic structure calculations. Topics include types of quantum mechanical calculations, the theory behind ab initio and density functional theory methods, basis sets and basis set effects. Emphasis is placed on understanding the results of calculations and relating them to basic chemical principles. Preq: CH 3320.

CH 4440 Research Problems 1-6 (3-18) Original investigation of an assigned problem in a fundamental branch of chemistry. Work must be carried out under the supervision of a member of the staff. May be repeated for a maximum of six credits. Includes Honors sections. Preq: Consent of instructor.

CHE 3000 Honors Seminar 1 (1) Acquaints students enrolled in the Departmental Honors Program with current research issues in the profession. This assists the student in preparing a research proposal for the Senior Thesis. To be taken Pass/No Pass only. Preq: CHE 2200 and CHE 2300; and admission to departmental honors program.

CHE 3070* Unit Operations Laboratory I 3 (3) Laboratory work in the unit operations of fluid flow, heat transfer, and evaporation. Stress is on the relation between theory and experimental results and the statistical interpretation of these results and on report preparation and presentation. Preq: CHE 2200 and CHE 2300. Coreq: CHE 3071.

CHE 3071 Unit Operations Laboratory I Laboratory 0 (3) Non-credit laboratory to accompany CHE 3070. Coreq: CHE 3070.


CHE 3210 Chemical Engineering Thermodynamics II 3 (3) Continuation of CHE 2200. Topics include thermodynamics of power cycles and refrigeration/liquefaction, thermodynamic properties of homogeneous mixtures, phase equilibria, and chemical reaction equilibria. Preq: CHE 2200 and MATH 2080.