CHEMISTRY (CHE)

CHE 100 CHEMISTRY AND SOCIETY
3, 3/0; NS23
Non-mathematical approach to the study of matter. Presentation of the fundamentals of chemistry followed by socially relevant topics such as toxic waste management, environmental pollution, space technology, agricultural chemistry, chemistry of consumer products, food processing, polymers, and plastics. Offered every semester.

CHE 110 INTRODUCTORY CHEMISTRY
3, 3/0
Preparation for college-level chemistry with an emphasis on mathematical methods used in chemistry. Introduction to atomic structure, atomic and formula mass, chemical equations, stoichiometry, solution concentration, acid-base chemistry. Mathematical methods include: the metric system, significant figures, dimensional analysis, conversion factors, word problems, quadratic equations, logarithms. Recommended for students who have not taken high school chemistry or need to develop the math skills required for CHE 101 and CHE 111. Course offered every semester.

CHE 111 FUNDAMENTALS OF CHEMISTRY I
3, 3/0; NS23
Prerequisites: MAT 114 or a higher level math with a minimum grade of C, SAT math with a minimum of 480, or ACT composite score with a minimum of 18; Corequisite: CHE 113. Fundamental principles of chemistry covering the nature, structure and properties of the atom, chemical bonding, geometry of molecules, the periodic table, gases, stoichiometry, chemical reactions, thermochemistry, and solution chemistry. Offered every semester.

CHE 112 FUNDAMENTALS OF CHEMISTRY II
3, 3/0
Prerequisites: CHE 111. Co-requisite CHE 114. Continuation of Fundamentals of Chemistry I. Liquids and solids, phase transitions, mixtures, colligative properties, chemical kinetics, chemical equilibria, chemical thermodynamics, electrochemistry, general properties of elements, and complex ion formation. Offered every semester.

CHE 113 LABORATORY FOR FUNDAMENTALS OF CHEMISTRY I
1, 0/3
Corequisites: CHE 111. Laboratory-based exploration of the basic chemical concepts taught in Fundamentals of Chemistry I (CHE 111). Experiments exploring the basic principles of chemical bonding, geometry of molecules, gases, stoichiometry, solution chemistry, and enthalpy. Lab safety, use of graphing software, and introduction to basic laboratory equipment. Offered every semester.

CHE 114 LABORATORY FOR FUNDAMENTALS OF CHEMISTRY II
1, 0/3
Prerequisites: CHE 111 and CHE 113; co-requisite: CHE 112. Laboratory-based exploration of the basic chemical concepts taught in Fundamentals of Chemistry II (CHE 112). Experiments exploring the phases of matter, physical properties of solutions, kinetics, thermodynamics, equilibrium, redox reactions, and basic electrochemistry. Safe laboratory practices and basic laboratory skills, introduction to basic spectrophotometry and the use of pH meters. Offered every semester.

CHE 189 TOPIC COURSE
1-3, 0/0
Prerequisite: CHE 100 or CHE 101 or CHE 111. Current topics in Chemistry. Offered occasionally.

CHE 201 ORGANIC CHEMISTRY I
3, 3/0
Prerequisite: CHE 112. Chemistry of organic compounds. Chemical bonding and structures of organic molecules. Reactivity and stability of organic compounds. Organic reaction mechanisms. Elementary syntheses of organic molecules. Offered every semester.

CHE 202 ORGANIC CHEMISTRY II
3, 3/0
Prerequisite: CHE 201. Continuation of CHE 201. Reactions and mechanisms of organic functional groups, such as alcohols, ethers, aldehydes, ketones, carboxylic acids, acid derivatives, and aromatic compounds. Identifications of organic compounds using spectroscopic methods (UV, IR, NMR, and MS). Organic reaction mechanisms to predict reaction outcomes. Syntheses of organic molecules. Offered annually in the spring semester.

CHE 203 ORGANIC CHEMISTRY LABORATORY I
1, 0/3
Prerequisite: CHE 112 and CHE 114; Prerequisite or Concurrent registration: CHE 201. Laboratory techniques in organic chemistry including distillation, crystallization, extraction, sublimation, and chromatography are learned by application to the synthesis and purification of organic compounds. Experiments chosen from a variety of possible topics such as isolation of natural products, separation of mixtures, and synthesis. Offered every semester.

CHE 204 ORGANIC CHEMISTRY LABORATORY II
1, 0/3
Prerequisite: CHE 203. Prerequisite or concurrent registration: CHE 202. Continuation of CHE 203. Synthesis, isolation, purification, and identification of organic compounds with emphasis placed on spectroscopic methods of structure determination. Experiments chosen from a variety of possible topics such as multistep synthesis, mechanistic studies, and qualitative organic analysis. Offered every semester.

CHE 295 INTRODUCTORY RESEARCH IN CHEMISTRY
1-3, 0/0
Prerequisite: Instructor Permission. Scholarship or creative work conducted under the supervision of a faculty member. Offered occasionally.

CHE 301 ANALYTICAL CHEMISTRY
4, 3/3
Prerequisites: CHE 112 and CHE 114. Fundamental principles and laboratory applications of analytical chemistry. Elementary statistics, chemical equilibrium, acids and bases, redox reactions, gravimetry, separations, spectrophotometry, and basic electrochemistry. Laboratory experiences including acquisition of hands-on analytical laboratory skills and guided experiments selected from the course topics. Offered annually.

CHE 305 PHYSICAL CHEMISTRY I
3, 3/0
Prerequisites: CHE 202, CHE 301, PHY 112, and, MAT 263 (or concurrently), or, instructor's permission. A study of the fundamental concepts in thermodynamics and equilibria of matter and polymer solutions. Topics include: zero, first, second and third laws of thermodynamics, thermochemistry, chemical equilibrium, phase diagrams and the equilibrium of phase change, ideal vs. real solutions, introduction to polymer science, thermodynamic analysis of polymeric solutions. Offered annually in the fall semester.

CHE 306 PHYSICAL CHEMISTRY II
3, 3/0
Prerequisite: CHE 305, and MAT 263. The second semester of a two-semester sequence in physical chemistry. Topics include quantum chemistry, atomic and molecular structure, molecular and atomic spectroscopies, kinetic theory of gases, and kinetics. Offered spring only.

CHE 307 PHYSICAL CHEMISTRY LABORATORY I
1, 0/3
Prerequisites: CWP 102, CHE 204, CHE 301, and CHE 305 or concurrent registration. Thermodynamic studies on the properties of solids, liquids and gases, including polymer solutions, using modern techniques. Laboratory experiments include: treatment and analysis of raw data, morphology of polymers, thermogravimetric analysis of solids, heat of combustion of solids, heat of reactions' solutions, heat of sorption of gases into polymers, heat of evaporation of liquids, heat capacities of gases and solid –liquid phase equilibrium. Utilizing the literature and practice in recording and disseminating data collected using an electronic notebook, organizing and writing a scientific report. Offered annually in the fall semester.

CHE 308 PHYSICAL CHEMISTRY LABORATORY II
1, 0/3
Prerequisites: CHE 305 and CHE 307 and MAT 263 AND CWP 102 or ENG 102. A laboratory study of principles of physical chemistry covered in CHE 306. Topics include determination of rate laws; ultraviolet, visible, and infrared spectroscopy; and photochemistry. Data analysis using statistical methods and error analysis is required. Offered spring only.

CHE 310 LITERATURE OF CHEMISTRY
1, 1/0
Prerequisite or Concurrent Registration: CHE 201 or CHE 321. Sources of chemical literature. Experiences in chemical information searching and retrieval, including examples of computer searching. Offered fall only.

CHE 315 ENVIRONMENTAL CHEMISTRY AND TECHNOLOGY
3, 3/0
Prerequisite: CHE 112 or CHE 102. Discussion of chemical reactions in air, water, and soil. Effect of human activities on the chemical environment. Alternative energy sources, pollution-control methods and devices. Offered occasionally.

CHE 321 PRINCIPLES OF ORGANIC CHEMISTRY
4, 3/3
Prerequisite: CHE 102 or CHE 112/CHE 114. Survey of organic chemistry. Structural isomerism, acid-base and mode of hybridization of carbon in organic compounds. Saturated, unsaturated and aromatic hydrocarbons, IUPAC nomenclature, R/S rule, E/Z isomers and Fisher projection. Nucleophiles, electrophiles, nucleophilic substitution and elimination reaction. Reactivity and selectivity of organic compounds. Not open to chemistry/forensic chemistry majors. Offered fall only.

CHE 322 BIOLOGICAL CHEMISTRY
4, 3/3
Prerequisite: CHE 202 or CHE 321. Structure and functions of the substances of biochemical interest found in living systems, supplemented by illustrative laboratory work. Not open to chemistry or forensic chemistry majors. Offered spring only.

CHE 325 MEDICATIONS
3, 3/0
Prerequisites: CHE 201 or CHE 321. Structure and mechanism of action for common medications; history of drug development and discovery; FDA regulations governing drug testing and sale; drug's potential to reach its target via various routes of administration; underlying causes of common drug-interactions; differences between prescription, over the counter, generic, herbal, and schedule drugs. Formerly CHE 300. Not open to the students who took CHE 300 previously. Offered occasionally.

CHE 327 MEDICINAL PLANT CHEMISTRY
2, 1/2
Prequisites: CHE 202, CHE 204, CHE 325. Overview of plants as sources of chemical compounds; Classes of natural products from plant sources, their biosynthesis, and their uses in medicine, flavorings, cosmetics, and recreation; Extraction, purification, and analysis of phytochemical compounds from the different parts of plants; Overview of the cannabis and hemp industry and applicable regulations. Offered occasionally.

CHE 331 PRINCIPLES OF PHYSICAL CHEMISTRY
3, 3/0
Prerequisites: CHE 202, MAT 126 or MAT 162, PHY 108 or PHY 112, or permission of instructor. A one-semester survey course exploring the principles of physical chemistry, oriented toward the needs of chemistry majors and students in environmental and health related sciences. Topics include thermodynamics, kinetics, quantum chemistry, and atomic and molecular spectroscopies. Offered spring only.

CHE 360 INTRODUCTION TO INORGANIC CHEMISTRY
3, 3/0
Prerequisites: CHE 202. Descriptive inorganic chemistry of the main group and transition metal elements. Atomic structure and trends in the periodic table. Theories of chemical bonding. Introduction to crystal field, ligand field and molecular orbital theories. Inorganic chemistry of important industrial processes, including metallurgy. Role of metal ions in biological systems. Offered fall only.

CHE 389 TOPIC COURSE
3, 0/0
Current advanced topics in Chemistry. Offered occasionally.

CHE 399 INTERNSHIP IN CHEMISTRY
1-6, 0/0
Prerequisite: Permission of instructor. Hands on experience in approved research and/or development project of current interest to local chemical industry. Offered every semester.

CHE 403 INSTRUMENTAL ANALYSIS
3, 3/0
Prerequisites: CHE 301; CHE 331 or CHE 306 recommended. Principles of modern analytical instruments and their applications for chemical analysis. Statistical treatment of data, basic electronics and signal processing, basic optics, molecular and atomic spectroscopy, chromatography and separations, electrochemical methods, and mass spectrometry. Offered spring semester.

CHE 404 INSTRUMENTAL ANALYSIS LAB
2, 0/6
Prerequisite: CHE 403 and Instructor Permission. Laboratory course based on modern analytical instruments used in industry and research labs. Principles and practical applications of analytical instruments. Instrumental analysis lab techniques. Analysis of experimental data and errors. Offered every fall semester.

CHE 406 ANALYTICAL TOXICOLOGY
3, 2/3
Prerequisites: CHE 202, CHE 403. Introductory analytical toxicology for pharmaceutical, forensic, and clinical analysis; Exploration of the main categories of inorganic and organic toxins; sample collection and treatment; chromatographic separation; spectroscopic and mass spectral determination of various toxic compounds and plant products in clinical, forensic, and environmental samples. Offered every other spring.

CHE 427 CANNABIS ANALYSIS
2, 1/2
Prerequisite: CHE 404. Overview of instrumental methods for the chemical analysis of target analytes in the cannabis or cannabis-derived products. Use of laboratory analytical instruments for the separation, identification, and quantification of chemicals for the potency test and quality control of cannabis or its products. Development and validation of analytical methods. Offered spring semester.

CHE 462 ADVANCED INORGANIC CHEMISTRY
3, 2/3
Prerequisites: CHE 202, CHE 204, CHE 305, CHE 360, and CHE 306 or concurrent. Physical inorganic and transition metal chemistry. Development of symmetry and its applications to the spectroscopy of inorganic systems. Crystal field, ligand field and molecular orbital theories. Organometallic chemistry, homogenous and heterogeneous catalysis. Metal ions in bioinorganic systems, inorganic materials. Advanced synthetic methods and methods of characterization. Offered spring only.

CHE 465 INTERGRATED PHYSICAL AND INORGANIC CHEMISTRY LABORATORY
2, 0/6
Prerequisite: CHE 360 (or concurrently) AND CHE 331 (or concurrently). Introduction to the principles of physical and inorganic chemistry lab. Advanced synthetic and characterization methods for transition metal complexes, reactions involving polymers, thermogravimetric analysis of solids, kinetic experiments, and computational calculations. Utilizing literature resources, recording and disseminating data, and inquiry-driven research projects, with a focus on topics like heterogeneous catalysis and green chemistry. Offered every spring.

CHE 470 BIOCHEMISTRY I
3, 3/0
Prerequisites: CHE 202; BIO 211 recommended. Study of the molecular structure and function of the four major classes of biomolecules: proteins, nucleic acids, lipids, and carbohydrates. Examination of enzyme kinetics, mechanism, and regulation. Examination of the molecular nature of DNA replication and an introduction to recombinant DNA technology. Offered fall only.

CHE 471 BIOCHEMICAL TECHNIQUES
2, 1/3; IN23, RE23
Prerequisites: CHE 204 and CHE 301. Prerequisite or concurrent registration: CHE 470. Techniques used in the collection and analysis of experimental data on biochemical systems. Participation in laboratory experiments illustrating biochemical techniques and general biochemical principles. Practice in recording and disseminating data collected in a modern biochemistry laboratory, including: record keeping via a laboratory notebook, organizing and writing a scientific report, and giving an oral presentation on scientific results. Offered fall only.

CHE 472 BIOCHEMISTRY II
3, 3/0
Prerequisites: CHE 202, CHE 470. A continuation of CHE 470 Biochemistry I. Examination of metabolic processes in living systems. Relationship of metabolic enzyme activity to cellular control. The chemistry of genetic information, storage and expression. Offered spring only.

CHE 495 SPECIAL PROJECT
1-3, 0/0
Prerequisite: Faculty project adviser permission. Offered every semester.

CHE 497 CHEMISTRY MICROCOURSE
1-3, 1/0
Examination of significant disciplinary issues, topics, or practices. Offered occasionally.
Equivalent Course: FOR 497

CHE 499 INDEPENDENT STUDY
2-12, 0/0
Prerequisite: Faculty project adviser permission. Offered every semester.

CHE 501 QUANTITATIVE CHEMICAL ANALYSIS
3, 2/6
Not open to students who have had CHE 301 or equivalent. Advanced theoretical background and laboratory techniques required for quantitative and qualitative chemical analysis; emphasis on fundamental principles and applications of gravimetric, volumetric, electrochemical, and spectrophotometric analytical techniques; statistics for experimental data handling; conducting independent chemical analysis projects.

CHE 530 ADVANCED ENVIRONMENTAL CHEMISTRY
3, 3/0
Suggested Prerequisite: CHE 201 or equivalent. Chemistry of the environment, air, water, soil, living environments, and the effects of technology thereon; the atmosphere, industrial ecosystems, phase interactions, water pollution and treatment, air pollution, global warming and green chemistry, smog, hazard wastes, soil chemistry, and toxicological chemistry.

CHE 540 SPECIAL TOPICS IN ORGANIC CHEMISTRY
3, 3/0
Suggested Prerequisite: CHE 202 or equivalent. Advanced topics, discussed in detail, with emphasis on the current state of knowledge; topics are essentially independent of each other. Class may be repeated, provided that a student has not already received credit for the same topic.

CHE 571 BIOCHEMICAL PRINCIPLES I
3, 3/0
Prerequisites: CHE 202 or equivalent; BIO 211 or BIO 214 recommended; not open to students who have taken CHE 470 or equivalent. Molecular structure and function of the four major classes of biomolecules: proteins, nucleic acids, lipids, and carbohydrates. Enzyme kinetics, mechanism, and regulation. Molecular nature of DNA replication; introduction to recombinant DNA technology.

CHE 572 ADVANCED BIOCHEMISTRY
3, 3/0
Suggested Prerequisite: CHE 571 or CHE 470 or equivalent; not open to students who have had CHE 472 or equivalent. Examination of metabolic processes in living systems. Relationship of metabolic enzyme activity to cellular control. The chemistry of genetic information, storage and expression.

CHE 588 TOPICS COURSE
3, 3/0

CHE 590 INDEPENDENT STUDY
1-3, 0/0
Independent investigation into a specific area of chemistry. Topic selected by student in consultation with a faculty member.

CHE 596 GRADUATE CONFERENCE IN CHEMISTRY
1-3, 3/0
Participation in a regional, national, or international conference in the field of chemistry overseen by a faculty member. Offered occasionally.

CHE 598 GRADUATE MICRO-COURSE
1-3, 0/0
Examination of significant disciplinary issues, topics, or practices.
Equivalent Course: FOR 598

CHE 626 SYMMETRY, GROUP THEORY, AND VIBRATIONAL SPECTROSCOPY
1, 1/0
Prerequisites: CHE202 and CHE204 or equivalents. Symmetry, point groups, and simple applications of group theory, with special emphasis on the vibrational spectroscopy of small molecules. Use of the department's IR spectrometers.

CHE 627 X-RAY CRYSTALLOGRAPHY
1, 1/0
Prerequisites: CHE 202 AND CHE 204 or equivalents. The seven crystal systems, 14 Bravais lattices, 32 crystallographic point groups, 230 space groups, the theory of X-ray diffraction, and the methods of crystal structure determination. Data mining using structural databases (Brookhaven Protein Data Bank and Cambridge Structural Database) for various applications in organic, coordination, pharmaceutical, and forensic chemistry. Collecting powder and/or single crystal diffraction data on the department's X-ray diffractometers; solving and refining a crystal structure using the appropriate software packages.

CHE 628 NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY
1, 1/0
Prerequisites: CHE 202 and CHE 204 or equivalents. Theory and practice of nuclear magnetic resonance spectroscopy, including pulse and two-dimensional methods. Use of the department's NMR spectrometer.

CHE 629 MASS SPECTROMETRY
1, 1/0
Prerequisites: CHE202 and CHE204 or equivalents. Theory and practice of mass spectrometry. Basic physics of mass spectrometry and ionization methods. Gas phase chemistry, rearrangements, and ion molecule reactions. Use of the department's electron impact ionization and electrospray mass spectrometers.

CHE 670 BIOMOLECULES: PROTEINS, NUCLEIC ACIDS, AND ENZYMES
3, 3/0
Prerequisites: CHE202 or equivalent. Structure-function relationships in proteins, enzymes, and nucleic acids. Introduction to biochemical techniques for the study of proteins, nucleic acids, and enzymes. Examination of the molecular basis of enzyme function, signal transduction, and neural and sensory responses in living systems.

CHE 672 FORENSIC MOLECULAR BIOLOGY
4, 3/3
Prerequisites: CHE 470 D or BIO 305 and BIO 303 or BIO 350 and FOR 612 or CHE 312 or equivalents. Applications of biology, biochemistry, and genetics to forensic science with an in-depth look at the evidential information that can be obtained from blood, semen, saliva, and hair. Details of DNA profiling, including DNA extraction, DNA quantification, PCR amplification, STR analysis and interpretation, and mtDNA sequencing. Protein polymorphisms and immunological tests. Laboratory component providing hands-on experience with techniques commonly used in a forensic biology laboratory.
Equivalent Course: BIO 672

CHE 680 ADVANCED ANALYTICAL CHEMISTRY
3, 3/0
Prerequisites: CHE 501 or equivalent, or instructor permission. A study of chemical analysis using representative instrumental techniques, including spectroscopy, chromatography, and mass spectroscopy; emphasis on fundamental theory, principles of operation, capabilities, and limitations of various analytical instruments; integration of laboratory-based demonstrations of data collection and analysis using selected analytical techniques.

CHE 690 MASTER'S PROJECT
1-4, 0/0
A study on a problem of special interest planned and executed with consultation and advisement from the instructor and the student's project committee. The project will be submitted in acceptable form according to directions given by the Chemistry Department and presented orally to an audience of Chemistry Department faculty and students.

CHE 698 JOURNAL SEMINAR
1, 1/0
Prerequisites: Matriculated status in the M.S. in Forensic Science program or instructor permission. Examination of methods used to compose and deliver an effective seminar in the sciences. Searching the scientific literature. Oral presentation of a topic from the current literature in chemistry or forensic science. Required of all students in the M.S. in Forensic Science program. Offered every fall semester.

CHE 699 THESIS SEMINAR AND DEFENSE
2, 2/0
Prerequisites: CHE 698. Oral presentation of master’s thesis research at a departmental seminar. Defense of master’s thesis to thesis committee. Required of all students in the M.S. in Forensic Science program who are completing the Thesis Option. Offered every semester.

CHE 721 THESIS/PROJECT CONTINUATION
0, 0/0

CHE 722 THESIS/PROJECT EXTENDED
0, 0/0

CHE 795 RESEARCH THESIS IN CHEMISTRY
1-12, 0/0
Individual investigation of an original problem in Chemistry submitted in acceptable form according to directions given by the Chemistry Department and the Graduate School.