

# CHEMISTRY (CHM)

## CHM-113: General Chemistry I (4 Credits)

**Co-requisite(s):** CHM-113L is required.

Students will study the principles of atomic and molecular structures, matter and measurement, chemical reactions, solution chemistry, thermochemistry, electronic structure, the periodic table and its trends, chemical bonding, gasses intermolecular forces and electrochemistry. Laboratory includes experiments related to lecture material.

*Fulfills Core Requirement in Natural Sciences.*

*Theme:* Engaging Creative, Aesthetic and Spiritual Experience.

*Lab Fee:* \$150.00

## CHM-113L: General Chemistry I Lab (0 Credits)

**Co-requisite(s):** CHM-113 is required.

An integrated lecture/laboratory course designed to teach students fundamental laboratory techniques and measurements in General Chemistry. Experiments include Introduction to Measurements and Error, Mole Ratio in Chemical Reactions via Conductivity, Determine the Empirical Formula of a Compound, Titration of an Acid with Standard NaOH, Determine the Limiting Reactant.

## CHM-114: General Chemistry II (4 Credits)

**Pre-requisite(s):** CHM-113 or permission from department chair is required.

**Co-requisite(s):** CHM-114L is required.

Students will continue the second semester of the general chemistry sequence. Topics include the principles of chemical kinetics, equilibrium, acid-base reactions, properties of solutions, electrochemistry, and thermodynamics. Laboratory includes experiments related to lecture material.

*Fulfills Core Requirement in Natural Sciences.*

*Theme:* Engaging Creative, Aesthetic and Spiritual Experience.

*Lab Fee:* \$150.00

## CHM-114L: General Chemistry II Lab (0 Credits)

**Co-requisite(s):** CHM-114 is required.

An integrated lecture/laboratory course designed to teach students fundamental laboratory techniques and measurements in General Chemistry. Experiments include Enthalpy of a Chemical Reaction, Colorimetric Analysis, Determine the Molar Mass of a Volatile Liquid, Molecular Weight by Freezing Point Depression, Determination of an Equilibrium Constant, Determine  $K_a$  of a Weak Acid by Half-Titration.

## CHM-121: Chemistry of Human Health (4 Credits)

**Co-requisite(s):** CHM-121L is required.

This survey course covers focused aspects of general, organic and biochemistry, including reactions, solution chemistry, biomolecule structure and interactions and nomenclature. Students develop critical thinking skills to be applied to human health.

*Fulfills Core Requirement in Natural Sciences.*

*Theme:* Engaging Creative, Aesthetic and Spiritual Experience.

*Lab Fee:* \$150.00

## CHM-121L: Chemistry of Human Health Lab (0 Credits)

**Co-requisite(s):** CHM-121 is required.

An integrated lecture/laboratory course designed to teach students fundamental laboratory techniques and measurements in the chemistry of human health. Experiments include Significant Figures, Measurements, and Density, Atomic Structure, Compounds and Formulas, Chemical Reactions, Urinalysis, Dilutions, Acids and Bases, Properties of Organic Compounds and Hydrocarbon Reactions, Lipids and Enzymes.

## CHM-130: Chemistry in Society (3 Credits)

The course entails learning, thinking about, and applying major laws, principles, concepts, and theories of chemistry to issues in contemporary society. In any one semester, topics may include air and water quality, global warming and forensic chemistry. The course will be offered in an instructor-led, online environment with regularly scheduled classroom review sessions.

*Fulfills Core Requirement in Natural Sciences.*

*Theme:* Building Global Awareness.

## CHM-203: Fundamentals of Organic Chemistry (4 Credits)

**Pre-requisite(s):** CHM-114 or CHM-121 is required.

The course provides a brief review of organic chemistry. The material is designed to focus on applicable areas of organic chemistry to students majoring in environmental studies or interested in health-related fields such as biotechnology or forensics.

## CHM-205: Organic Chemistry I (4 Credits)

**Pre-requisite(s):** CHM-114 is required.

**Co-requisite(s):** CHM-205L and CHM-205R are required.

A study of the common classes of organic compounds, including alkanes, alkenes, alkynes, and alkyl halides; their synthesis, and physical and chemical properties. An in-depth study of the basics of organic chemistry including bonding, reactivity, stereochemistry and reaction mechanisms will also be addressed. Laboratory work consists mainly of synthesis and characterization of organic compounds.

*Lab Fee:* \$150.00

## CHM-205L: Organic Chemistry I Lab (0 Credits)

**Co-requisite(s):** CHM-205 is required.

An integrated lecture/laboratory course designed to teach students fundamental laboratory techniques and measurements in Organic Chemistry. Experiments include Distillation of ethanol from wine, Steam distillation of citral from lemongrass oil, Acid/Base extraction, thin layer chromatography of pigments in spinach.

## CHM-205R: Organic Chemistry I Recitation (0 Credits)

**Co-requisite(s):** CHM-205 is required.

Additional Organic Chemistry problems are practiced and discussed every week in small peer led team learning (PLTL) groups during recitation class to foster a clear understanding of the course material.

## CHM-206: Organic Chemistry II (4 Credits)

**Pre-requisite(s):** CHM-205 is required.

**Co-requisite(s):** CHM-206L and CHM-206R are required.

A continuation of the mechanics and synthetic study of the common classes of organic compounds, including alcohols, aromatics, and carbonyl compounds, with an emphasis on the organic chemistry of biomolecules (e.g., carbohydrates, proteins, lipids, etc.). Structure determination using spectroscopic methods (IR, NMR, MS) is also introduced.

*Lab Fee:* \$150.00

## CHM-206L: Organic Chemistry II Lab (0 Credits)

**Co-requisite(s):** CHM-206 is required.

An integrated lecture/laboratory course designed to teach students fundamental laboratory techniques and measurements in Organic Chemistry. Experiments include Double dehydrobromination to an alkyne, Grignard synthesis, determination of an unknown compound, synthesis of benzocaine, Azo dye synthesis.

## CHM-206R: Organic Chemistry II Recitation (0 Credits)

**Co-requisite(s):** CHM-206 is required.

Additional Organic Chemistry problems are practiced and discussed every week in small peer led team learning (PLTL) groups during recitation class to foster a clear understanding of the course material.

**CHM-301: Analytical Chemistry (4 Credits)****Pre-requisite(s):** CHM-114 is required.**Co-requisite(s):** CHM-301L is required.

This course introduces students to the underlying theories involved in quantitative analysis. Topics include statistics, chemical equilibria and their analytical applications (acid-base, precipitation, complex formation, oxidation, reduction), spectro-analytical chemistry and electroanalytical chemistry.

**CHM-301L: Analytical Chemistry Lab (0 Credits)****Co-requisite(s):** CHM-301 is required.

An integrated lecture/laboratory course designed to teach students fundamental laboratory techniques and measurements in Analytical Chemistry. Experiments include Gravimetric Determination of Ca as  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  in simulated urine samples, Microscale spectrophotometric measurement of iron in foods by standard addition, Spectrophotometric determination of Iron in vitamin Tablets, Analysis of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  (Water hardness) in natural waters using EDTA titration, Determination of vitamin C in vitamin Tablets using Iodimetric titration.

**CHM-305: Physical Chemistry I (4 Credits)****Pre-requisite(s):** MTH-196 or MTH-203 and junior/senior academic standing are required.**Co-requisite(s):** CHM-305L is required.

Topics include the kinetic theory of gases and the first, second and third laws of thermodynamics and their application to the pure substances, simple mixtures, chemical equilibria and electrochemistry. Latter topics include statistical thermodynamics. Includes recitation and laboratory focusing on gases and thermodynamics.

*Lab Fee:* \$150.00**CHM-305L: Physical Chemistry I Lab (0 Credits)****Co-requisite(s):** CHM-305 is required.

An integrated lecture/laboratory course designed to teach students fundamental laboratory techniques and measurements in physical chemistry. Experiments include the determination of the numerical value of the gas constant, determination of the heat and entropy of vaporization of a substance, constant volume calorimetry and others.

**CHM-305R: Physical Chemistry I Recitation (0 Credits)****Pre/Co-requisite(s):** CHM-305 is required.

This recitation provides students with an additional hour of contact time with the instructor for assistance in problem solving physical chemistry related concepts.

**CHM-306: Physical Chemistry II (4 Credits)****Pre-requisite(s):** CHM-305 and junior/senior academic standing are required.**Co-requisite(s):** CHM-306L is required.

Topics include chemical kinetics, quantum mechanics, atomic, electronic and molecular structure, theoretical principles of spectroscopic and resonance methods, and molecular symmetry. Includes recitation and laboratory with experiments focusing on chemical kinetics, thermodynamics, quantum mechanics and spectroscopy.

*Lab Fee:* \$150.00**CHM-306L: Physical Chemistry II Lab (0 Credits)****Co-requisite(s):** CHM-306 is required.

An integrated lecture/laboratory course designed to teach students fundamental laboratory techniques and measurements in physical chemistry. Experiments include the kinetics of the iodine clock reaction, rotational/vibrational spectra of diatomic molecules, introduction to x-ray diffraction and others.

**CHM-306R: Physical Chemistry II Recitation (0 Credits)****Co-requisite(s):** CHM-306 is required.

This recitation provides students with an additional hour of contact time with the instructor for assistance in problem solving physical chemistry related concepts.

**CHM-309: Instrumental Analysis (4 Credits)****Pre-requisite(s):** CHM-301 or permission of instructor is required.**Co-requisite(s):** CHM-309L is required.

A study of the theory of modern instrumental methods of chemical analysis. Some of the topics include molecular spectroscopy (infrared, ultraviolet-visible, Luminescence, mass spectrometry, nuclear magnetic resonance), Atomic Spectroscopy (atomic absorption/emissions/fluorescence, atomic mass spectrometry, atomic X-ray spectroscopy) and Separation science (liquid and gas chromatography).

*Lab Fee:* \$150.00**CHM-309L: Instrumental Analysis Lab (0 Credits)****Co-requisite(s):** CHM-309 is required.

An integrated lecture/laboratory course designed to teach students fundamental laboratory techniques and measurements in Instrumental Analysis. Experiments include Determination of Calcium content in milk using Atomic Absorption Spectroscopy (AAS), Identification and Quantification of Volatile Organic compounds (VOCs), Benzene, Toluene, Ethylbenzene, o-xylene, m-xylene and p-xylene in Gasoline by GC/MS, HPLC Determination of Some frequently used Parabens in Sunscreens from the local stores, HPLC/MS/MS analysis of Per- and polyfluoroalkyl substances (PFAS) in drinking water and seawater samples.

**CHM-310: Environmental Chemistry (4 Credits)****Pre-requisite(s):** CHM-205 or CHM-206 is required.**Co-requisite(s):** CHM-310L is required.

A study of the chemistry of the environment applying the principles of chemistry to such topics as atmospheric chemistry, air pollution, water chemistry, water pollution, hazardous chemicals, and hazardous waste management.

*Lab Fee:* \$150.00**CHM-310L: Environmental Chemistry Lab (0 Credits)****Co-requisite(s):** CHM-310 is required.

An integrated lecture/laboratory course designed to teach students fundamental laboratory techniques and measurements in environmental chemistry. Experiments include Acid Rain and Pollution Prevention, Measuring Air Pollution, Air-Water Partitioning, Measuring Water Contamination, Soil Analysis, Examining Renewable Resources.

**CHM-407: Advanced Organic Chemistry (4 Credits)****Pre-requisite(s):** CHM-206 is required.**Co-requisite(s):** CHM-407L is required.

The goal of the Advanced Organic Chemistry course consists in strengthening the student's grasp of fundamental organic chemistry principles. These would include mechanism, structure, including molecular chirality, and organic synthesis, including the use of newer synthetic methods. The laboratory focuses on extending the students exposure to multistep synthesis and literature based larger scale synthesis.

*Lab Fee:* \$150.00

**CHM-407L: Advanced Organic Chemistry Lab (0 Credits)****Co-requisite(s):** CHM-407 is required.

An integrated lecture/laboratory course designed to teach students fundamental laboratory techniques and measurements in Advanced Organic Chemistry. Experiments include Separation of polyphenols from honey and evaluation of their antioxidant activity; Nature's Migraine Treatment: Isolation and Structure Elucidation of parthenolide from Tanacetum parthenium; Isolation of Curcumin from Turmeric, among others.

**CHM-408: Inorganic Chemistry (4 Credits)****Pre-requisite(s):** CHM-206 is required.**Co-requisite(s):** CHM-408L is required.

A detailed examination of structure and bonding along with studies in chemical and periodic trends, ligand substitution and reaction mechanisms, coordination chemistry, crystal structures of inorganic solids, symmetry and point groups, organometallic compounds, and spectroscopic tools used in inorganic chemistry. Laboratory includes experiments related to lecture material.

*Lab Fee:* \$150.00**CHM-408L: Inorganic Chemistry Lab (0 Credits)****Co-requisite(s):** CHM-408 is required.

An integrated lecture/laboratory course designed to teach students fundamental laboratory techniques and measurements in Inorganic Chemistry. Experiments include Preparation of Chromium and Manganese Complexes, Investigating the Structure of Solids by Diffraction, Preparation and Properties of an Aqueous Ferrofluid, Octahedral Complexes of Cobalt.

**CHM-410: Topics in Chemistry and Research Capstone (3 Credits)**

This is the chemistry department capstone course for the BS in Chemistry and the BS in Biochemistry. Recent topics in chemistry will be addressed in the form of required reading from the literature, guest speakers and attendance at local seminars. As part of the course, students will present current research results from the literature. Senior standing or permission of instructor is required.

**CHM-425: Chemistry of Proteins (3 Credits)****Pre-requisite(s):** BCH-403 is required.

This course is an advanced treatment of the chemistry of proteins and protein containing supramolecular structures. It will provide an understanding of the structure of proteins and how these structures relate to biological function. Topics covered include amino acids and their properties, types of structural elements, classification of proteins, protein functions, determination of protein structures, and applications of data and technology to study protein structure and function. Isolation and purification of proteins will also be discussed.

**CHM-430: Molecular Spectroscopy of Bio-Macromolecules (3 Credits)****Pre-requisite(s):** CHM-305 is required.

This course, which is team taught, covers the theory and applications of advanced spectroscopic methods applied in studying the structure and function of biomacromolecules such as DNA, coenzymes, cofactors, and polysaccharides. An overview of modern Fourier Transform NMR, including one- and two-dimensional methods (COSY, NOESY, TOCSY) will be explored. Mass spectrometry principles including examples of the potential, limitations, and applications of; desorption ionization, electron impact, interfaced chromatography mass spectrometry and high-resolution tandem-mass spectrometry will be presented. A discussion of the theory and applications of other spectroscopic techniques, including electron spin resonance (ESR), molecular vibrational (Raman, resonance Raman, and infrared) and laser fluorescence spectroscopies also will be presented.

**CHM-435: Biophysical Chemistry (3 Credits)****Pre-requisite(s):** MTH-196 or CHM-305 is required.

This course focuses on the physical chemistry principles that govern the behavior of biological systems. Emphasis will be placed on topics including the energetics of biomolecular dynamics and structure, protein folding, membranes and membrane proteins, spectroscopic investigations of macromolecules quantum mechanical descriptors and intermolecular interactions.

**CHM-440: Chemical and Enzyme Kinetics (3 Credits)****Pre-requisite(s):** MTH-196 or CHM-305 is required.

This course offers an in-depth survey into chemical kinetics with a focus on enzyme kinetics and catalysis. Topics of study include non-bonding interactions, catalysis energy diagrams and minimization, rate laws, kinetic analyses (simple and complex), steady state approximation, reaction mechanisms, inhibition and specific case studies.

**CHM-445: Medicinal Natural Products (3 Credits)****Pre-requisite(s):** CHM-206 and BCH-403 are strongly recommended.

A survey of the structure, occurrence, biosynthesis and pharmacological uses of compounds derived from nature, with emphasis on plants (particularly medicinal plants) and functional foods. The focus will be on the metabolic sequences leading to various classes of natural products. Some of the health conditions that are improved by natural products will also be discussed.

**CHM-450: Total Synthesis of Natural Products (3 Credits)****Pre-requisite(s):** CHM-206 is required.

This course is an in-depth coverage of the principle reactions leading to carbon-carbon bond formation, along with functional group transformations. Strategies and methods for organic synthesis of natural products will be discussed. Topics will include the reactivity, methodology, and mechanistic aspects of the reactions of alkenes and alkynes, oxidations and reductions, enolates and related nucleophiles, pericyclic reactions, and organometallic chemistry.

**CHM-455: Organic Chemistry of Drug Design and Drug Addition (3 Credits)****Pre-requisite(s):** CHM-206 and BCH-403 are strongly recommended.

This course is an overview of the organic chemical principles and reactions vital to the drug discovery, drug design, and drug development processes. Topics will include: pharmacophore identification, pharmacodynamics and pharmacokinetics, structure-activity relationships (SAR), combinatorial chemistry, drug-receptor interactions, enzymes as catalysts, drug resistance and synergism, and the use of computers in drug design. Case studies will be used to illustrate the rational discovery of drugs.

**CHM-460: Bioinorganic Chemistry (3 Credits)****Pre-requisite(s):** CHM-206 is required.

This course examines the chemistry of inorganic elements involved in life processes. The fundamentals of Inorganic Chemistry, Biochemistry, and Spectroscopy will be examined in the context of this course. Students will learn about metal ions and important roles they play in biological systems. Current research methods used in the field will be explored.

**CHM-465: Metals in Cells (3 Credits)****Pre-requisite(s):** CHM-206 is required.

This course examines the role that transition metals play in cellular processes. Special attention will be given to metal transport systems in bacteria. Students will gain an understanding of how metals are transported and regulated in cells as well as explore the techniques used to probe these metals.

**CHM-497: Undergraduate Research I (1-4 Credits)**

In-depth investigation of a specific topic in chemistry. Topic and credit to be approved by the faculty member who is acting as research adviser. Permission of instructor is required.

*Course Fee:* \$150.00

**CHM-498: Undergraduate Research II (1-6 Credits)**

**Pre-requisite(s):** CHM-497 and permission of instructor are required.

A continuation of CHM-497.

*Course Fee:* \$150.00

**CHM-499: Independent Study (2-4 Credits)**

Supervised study in an area not available in a regularly scheduled course.

Permission of department chair is required.