

# CHEMISTRY (CHEM)

## CHEM 100 - The Chemistry of Everyday Life Credits 3

The basic principles of chemistry for the non-science major. Uses the materials of modern society as a theme for exploring the properties and structure of matter as well as the methods and consequences of transforming natural resources to consumer products. Core Curriculum: Approved for Core - Science. **Grade Mode:** A.

**Restriction(s):** Must be Undergraduate Level.

## CHEM 105 - General Chemistry I Credits 0,4

Principles and theories of the structure and properties of matter including stoichiometry, atomic theory, the periodic table, chemical bonding, molecular structure, nomenclature, chemical reactions, states of matter, gas laws and solutions. **Lecture/Lab Hours:** Three hours lecture; three hours laboratory; one hour recitation, weekly. Core Curriculum: Approved for Core - Science. **Note(s):** Course fee covers the provided lab coat and safety goggles. **Grade Mode:** A, N.

**Prerequisite(s):** Passing score on Chemistry Placement Exam; or CHEM 092, CHEM 104, or CHEM 107 with at least a 'B-'.

**Restriction(s):** Must be Undergraduate Level.

**Course Fee:** \$170.

## CHEM 106 - General Chemistry II Credits 0,4

Continuation of General Chemistry I. Subjects include chemical kinetics, equilibrium, thermodynamics, solubility, acidity, electrochemistry, coordination complexes and various special topics. **Lecture/Lab Hours:** Three hours lecture; three hours laboratory; one hour recitation, weekly. **Note(s):** A minimum grade of a 'C-' is required to subsequently register in CHEM 321 and CHEM 322; or CHEM 301 and CHEM 311. **Grade Mode:** A, N.

**Prerequisite(s):** CHEM 105.

**Restriction(s):** Must be Undergraduate Level.

**Course Fee:** \$130.

## CHEM 107 - Introduction to Chemistry Credits 3

This is an introductory course which provides an overview of chemistry and prepares students for their required chemistry courses in majors like nursing, kinesiology, biology, physics, chemistry, and engineering. Topics include scientific units and measurements, the nature and states of matter, atomic theory, chemical bonding, chemical reactions, and chemical interactions. **Lecture/Lab Hours:** Three hours lecture, weekly. Core Curriculum: Approved for Core - Science. **Note(s):** This course does not count towards the degree requirements in majors which need additional chemistry courses; required for students who did not pass the Chemistry Placement Exam, optional for all others; a minimum grade of 'B-' is required to subsequently register in CHEM 105, or a minimum grade of 'C' for CHEM 120; course may only be repeated once; additional attempts require permission of major advisor. **Grade Mode:** A.

**Restriction(s):** Must be Undergraduate Level.

**Repeat Limit (total number of credits):** 6.

## CHEM 110 - Chemistry Topics Credits 1-4

Various topics in introductory chemistry. **Grade Mode:** A.

**Restriction(s):** Must be Undergraduate Level.

## CHEM 120 - Principles of Organic and Biochemistry Credits 0,4

Chemical bonding, structure, properties and reactivity applied to organic and biochemical compounds. Includes basic metabolic processes with application to medicine and health. **Lecture/Lab Hours:** Three hours lecture; one hour recitation; three hours laboratory, weekly. Core Curriculum: Approved for Core - Science. **Note(s):** Meets the Nursing requirement in Chemistry; this course is also required for some Kinesiology and Physical Education programs; course fee covers the provided lab coat and safety goggles. **Grade Mode:** A, N.

**Prerequisite(s):** Passing score on Chemistry Placement Exam; or CHEM 105 or CHEM 107 with at least a 'C'.

**Restriction(s):** Must be Undergraduate Level.

**Course Fee:** \$130.

## CHEM 301 - Organic Chemistry I Credits 3

The first semester of the traditional yearlong course in organic chemistry. Structure, properties and reactivity of carbon-containing compounds with emphasis on reaction mechanisms. An introduction to the major functional groups and the instrumental methods for structure determination: IR, NMR, and MS. **Grade Mode:** A.

**Prerequisite(s):** CHEM 106 with a grade of 'C-' or better.

**Corequisite(s):** CHEM 311.

**Restriction(s):** Must be Undergraduate Level.

## CHEM 302 - Organic Chemistry II Credits 3

Continuation of Organic Chemistry I. Continued work with more complicated reactions and mechanisms. An introduction to computer-based drawing and searching tools. The last third of the course is devoted to the structure and properties of major biochemical substances. **Grade Mode:** A.

**Prerequisite(s):** CHEM 301.

**Corequisite(s):** CHEM 312.

**Restriction(s):** Must be Undergraduate Level.

## CHEM 311 - Laboratory in Organic Chemistry I Credit 1

Basic laboratory techniques for the synthesis, isolation, purification and analysis of organic compounds including the major chromatographic methods, TLC, GC, LC. **Lecture/Lab Hours:** Three hours laboratory weekly. **Grade Mode:** A.

**Corequisite(s):** CHEM 301.

**Restriction(s):** Must be Undergraduate Level.

**Course Fee:** \$185.

## CHEM 312 - Laboratory in Organic Chemistry II Credit 1

Continuation of the laboratory methods in organic chemistry including the major structural determination and analysis tools of NMR, IR, HPLC, UV/Vis. **Lecture/Lab Hours:** Three hours laboratory weekly. **Grade Mode:** A.

**Corequisite(s):** CHEM 302.

**Restriction(s):** Must be Undergraduate Level.

**Course Fee:** \$185.

## CHEM 321 - Basic Organic and Biochemistry Credits 3

Covers the basic nomenclature, structure, properties and reactivity of organic compounds and biomolecules such as carbohydrates, proteins and nucleic acids. Includes radical reactions and other topics essential to environmental and biochemical studies. **Lecture/Lab Hours:** Three hours lecture weekly. **Note(s):** This is a one semester terminal course and thus does not serve as a prerequisite for CHEM 302 or BIOS/CHEM 411; may not fulfill the requirement for medical school or other related health professions; fulfills the requirement for environmental science and human biology majors. **Grade Mode:** A.

**Prerequisite(s):** CHEM 106 with a grade of 'C-' or better.

**Corequisite(s):** CHEM 322.

**Restriction(s):** Must be Undergraduate Level.

- CHEM 322 - Basic Organic and Biochemistry Lab** **Credit 1**  
 Lab techniques and experiments related to the Basic Organic and Biochemistry lecture course. **Lecture/Lab Hours:** Three hours laboratory weekly. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 106 with a grade of 'C-' or better.  
**Corequisite(s):** CHEM 321.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$160.
- CHEM 332 - Environmental Chemistry** **Credits 0,4**  
 Quantitative introduction to the chemistry of the atmosphere and air pollution, energy and climate, toxic organic compounds, water pollution and purification, soil chemistry and waste disposal. **Lecture/Lab Hours:** Three hours lecture; three hours laboratory, weekly. **Grade Mode:** A, N.  
**Prerequisite(s):** CHEM 301 and CHEM 311; or CHEM 321 and CHEM 322.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$160.
- CHEM 350 - Analytical Chemistry** **Credits 0,5**  
 Covers classical chemical methods of analysis such as titrimetry and gravimetry along with various instrumental methods including electrochemistry, spectroscopy and chromatography. **Lecture/Lab Hours:** Three hours lecture; six hours laboratory, weekly. **Grade Mode:** A, N.  
**Prerequisite(s):** CHEM 301.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$160.
- CHEM 352 - Fundamentals of Material Science** **Credits 3**  
 Introduction to the structure-property relationships of engineering and natural materials including metals, ceramics, polymers and composites. Examines the strength of materials, strengthening mechanisms, diffusion, phase transformations, heat treatment and microstructure control. Considers how materials are selected for design of a product. **Grade Mode:** A.  
**Prerequisite(s):** PHSC 112 or PHSC 233; CHEM 105 and MATH 105.  
**Restriction(s):** Must be Undergraduate Level.
- CHEM 360 - Inorganic Chemistry** **Credits 3**  
 Covering the chemistry of the entire periodic table, the course begins with atomic theory and then introduces symmetry and group theory before looking in depth at chemical bonding and acid-base chemistry, the chemistry and properties of solids, coordination chemistry, organometallic chemistry, bioinorganic chemistry, and nanomaterials. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 302 with a grade of 'C-' or better; MATH 105.  
**Restriction(s):** Must be Undergraduate Level.
- CHEM 380 - Introduction to Physical Chemistry** **Credits 3**  
 Course introduces thermodynamics, kinetic and quantum mechanic principles underlying molecular properties and chemical reactivity with specific application to biological systems. Macromolecular behavior and spectroscopic tools are included. **Note(s):** MATH 106 strongly recommended. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 106, MATH 105; PHSC 112 or PHSC 233.  
**Restriction(s):** Must be Undergraduate Level.
- CHEM 390 - Introduction to Food Chemistry** **Credits 4**  
 This course will introduce students to the chemistry of the key components in foods, their properties and interactions, and changes that occur during different stages of production. Lectures will provide the molecular bases behind food behavior. The laboratory will give students practical experience in basic food chemistry techniques, and help demonstrate concepts from lecture. **Lecture/Lab Hours:** Three hours lecture, three hours laboratory, weekly. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 301, CHEM 311.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$160.
- CHEM 402 - Physical Chemistry I** **Credits 3**  
 Molecular energetics - the thermodynamic principles underlying energy changes in chemical systems and governing chemical reactions. Energetics of solutions, electrochemical cells, phase changes, and chemical equilibria are discussed. Quantum mechanics is introduced, including solutions to the time-independent Schrodinger equation, multi-electron systems, and polyatomic molecules. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 106, MATH 106; PHSC 112 or PHSC 233.  
**Restriction(s):** Must be Undergraduate Level.
- CHEM 405 - Physical Chemistry II** **Credits 0,4**  
 Building upon the thermodynamic and quantum mechanical foundation of Physical Chemistry I, this course applies quantum mechanics to Hartree-Fock theory and electronic, vibrational, and nuclear spectroscopies. Quantum effects are used to explain the origins of bulk material properties, the behavior of ensembles of molecules, diffusion, kinetics, and complex reaction systems. **Lecture/Lab Hours:** Three hours lecture, three hours laboratory, weekly. **Note(s):** MATH 205 strongly recommended. **Grade Mode:** A, N.  
**Prerequisite(s):** CHEM 402.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$160.
- CHEM 411 - General Biochemistry I** **Credits 3**  
 Structures and properties of biomolecular components of cells, including proteins, carbohydrates, lipids, nucleotides, nucleic acids, vitamins and coenzymes, kinetics and mechanism and regulation of enzyme action in biological systems. **Note(s):** BIOS 111 and BIOS 113 are recommended. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 302.  
**Restriction(s):** Must be Undergraduate Level.
- CHEM 412 - General Biochemistry II** **Credits 3**  
 Principles of metabolic processes; mathematical treatment of bioenergetics emphasizing major concepts and problem solving. **Lecture/Lab Hours:** Three hours lecture. **Note(s):** BIOS 111 and BIOS 113 are recommended. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 302.  
**Restriction(s):** Must be Undergraduate Level.
- CHEM 413 - Laboratory in General Biochemistry** **Credits 2**  
 A laboratory course to accompany CHEM 411, CHEM 412 (BIOS 411, BIOS 412). The isolation, characterization and analysis of biomolecules including the use of biochemical instrumentation and methodology for work in protein structure, enzymology, metabolism and genetics. **Lecture/Lab Hours:** Six hours laboratory weekly. **Note(s):** BIOS 111 and BIOS 113 are recommended. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 302.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$185.

- CHEM 420 - Special Topics in Chemistry** Credits 1-3  
Subjects include such areas as the chemical literature, various instrumental methods, polymers, organometallics and industrial chemistry. **Grade Mode:** A.  
**Restriction(s):** Must be Junior Class, or Senior Class; Environmental Science (BIES), Human Biology (BIHB), Physics (PHYS), Bio Sci:Secondary Instruction (BISI), Chemistry (CHEM), Engineering Physics (PHEP), Physical Science (PHSC), Biochemistry (BCHM), Biological Science (BIOS), or Applied Physics (PHAP); and Undergraduate Level.  
**Additional Fee(s):** May involve lab fees of up to \$185.
- CHEM 430 - Advanced Organic Chemistry** Credits 3  
A continuation of the year-long course in organic chemistry for those planning careers in chemistry. This course will deal with reaction mechanisms, unique reactivity and an in-depth study of multi-step syntheses from the chemical literature. An oral presentation on a current topic within organic chemistry will be required. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 301, CHEM 302, CHEM 311, CHEM 312 each with a 'C+' or higher.  
**Restriction(s):** Must be Undergraduate Level.
- CHEM 431 - Advanced Organic Chemistry Lab** Credits 2  
A continuation of the year-long course in organic chemistry for those planning careers in chemistry. Will incorporate more advanced laboratory techniques in the multi-step preparation of both reagents and compounds. Intermediate characterization as well as higher level use of spectroscopic and chromatographic techniques will be covered. **Lecture/Lab Hours:** Six hours laboratory weekly. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 430 (may be taken concurrently).  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$185.
- CHEM 440 - Introduction to Computational Chemistry** Credits 3  
This course introduces the principles of computational chemistry, including computational methods for molecular design, visualization, and the prediction of molecular properties such as charge, geometry, stability, photodynamics, and spectroscopic characteristics. The course will survey the most commonly used computational methods, their applicability and limitations, enabling students to select appropriate methods for the solution of practical problems in research and industrial applications. Beginning with visualization tools, the use of crystallographic data, the selection of coordinate systems, the course will progress through classical molecular dynamics and force fields to progressively more advanced quantum mechanical methods including semiempirical models, Hartree-Fock, configuration interaction, and the application of density functional theory. Students will learn to perform geometry optimization, location of transition states, conformational analysis, and prediction of molecular and spectroscopic properties. The course will also cover solvation models, excited states, and the application of quantum methods to large molecular clusters. The class features a project-based approach that makes use of the STH computing cluster and various software packages for quantum chemical visualization and calculations, primarily using the Unix operating system.  
**Grade Mode:** A.  
**Prerequisite(s):** CHEM 405, MATH 205 (may be taken concurrently).  
**Restriction(s):** Must be Chemistry (CHEM), Engineering Physics (PHEP), Biochemistry (BCHM), or Applied Physics (PHAP); and Undergraduate Level.  
**Course Fee:** \$100.
- CHEM 480 - Directed Research or Internship** Credits 1-3  
Research or industrial internship to provide practical experience in a field of the student's interest. Designed for students working on or off campus in a situation where directed research is possible. **Note(s):** May be taken multiple times for credit. **Grade Mode:** A.  
**Restriction(s):** Must be Junior Class, or Senior Class; Environmental Science (BIES), Human Biology (BIHB), Physics (PHYS), Bio Sci:Secondary Instruction (BISI), Chemistry (CHEM), Engineering Physics (PHEP), Physical Science (PHSC), Biochemistry (BCHM), Biological Science (BIOS), or Applied Physics (PHAP); and Undergraduate Level.  
**Repeat Limit (total number of credits):** 6.  
**Additional Fee(s):** May involve lab fees of up to \$185.