

# CHEMISTRY (CHEM)

## Courses

### 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 3

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; one hour recitation, weekly. Core Curriculum: Approved for Core - Science. **Grade Mode:** A.

**Prerequisite(s):** Verified Advanced Placement (AP) Chemistry exam score of 3 or higher; verified Advanced Placement (AP) Calculus exam score of 3 or higher; MATH 150 (with passing or transferable grade); passing score on ALEKS Chemistry Prep Course; or completion of CHEM 107 with at least a C-.

**Corequisite(s):** CHEM 115.

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

### CHEM 106 - General Chemistry II Credits 3

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; one hour recitation, weekly.

**Grade Mode:** A.

**Prerequisite(s):** CHEM 105, CHEM 115.

**Corequisite(s):** CHEM 116.

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

### 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; one hour recitation, weekly. Core Curriculum: Approved for Core - Science. **Note(s):** Required for students who did not pass the Chemistry Placement Exam, optional for all others; a minimum grade of C- is required to subsequently register for CHEM 105 or CHEM 120; course may only be repeated once; additional attempts require permission of major advisor. **Grade Mode:** A.

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

### CHEM 110 - Chemistry Topics Credits 1-4

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

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

**Repeat Limit (after first attempt):** 10.

### CHEM 115 - General Chemistry I Lab Credit 1

A laboratory course to accompany CHEM 105 in support of CHEM 105 lecture topics. Introduction to the chemistry lab, qualitative and quantitative methodologies, data analysis and error propagation. Students will learn basic laboratory skills and the scientific method using modern equipment. **Lecture/Lab Hours:** Three hours laboratory weekly. **Note(s):** Course fee covers the provided lab coat and safety goggles. **Grade Mode:** A.

**Prerequisite(s):** Verified Advanced Placement (AP) Chemistry exam score of 3 or higher; verified Advanced Placement (AP) Calculus exam score of 3 or higher, or MATH 150 (with passing or transferable grade); passing score on ALEKS Chemistry Prep Course; or completion of CHEM 107 with at least a C-.

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

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

**Course Fee:** \$130.

### CHEM 116 - General Chemistry II Lab Credit 1

A laboratory course to accompany CHEM 106 in support of CHEM 106 lecture topics. Introduction to the chemistry lab, qualitative and quantitative methodologies, data analysis and error propagation. Students will also learn the basics of scientific writing through the formal laboratory report. **Lecture/Lab Hours:** Three hours laboratory weekly. **Note(s):** Course fee covers the provided lab coat and safety goggles. **Grade Mode:** A.

**Prerequisite(s):** CHEM 105, CHEM 115.

**Corequisite(s):** CHEM 106.

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

**Course Fee:** \$130.

### CHEM 120 - Principles of Organic and Biochemistry Credits 3

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, weekly. Core Curriculum: Approved for Core - Science. **Note(s):** Meets the chemistry requirement for Nursing program, and is an option for fulfilling chemistry in a few other majors; please see an academic advisor to select the appropriate chemistry course for your program. **Grade Mode:** A.

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

**Corequisite(s):** CHEM 121.

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

### CHEM 121 - Principles of Organic and Biochemistry Lab Credit 1

A laboratory course to accompany CHEM 120 in support of CHEM 120 lecture topics. Introduction to general, organic, and biochemistry laboratory techniques through qualitative and quantitative approaches. Students will learn basic lab skills and data analysis, with applications in clinical settings. **Lecture/Lab Hours:** Three hours laboratory weekly. **Note(s):** Course fee covers the provided lab coat and safety goggles. **Grade Mode:** A.

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

**Corequisite(s):** CHEM 120.

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

**Course Fee:** \$130.

- CHEM 125 - Current Topics in Chemistry** **Credits 3**  
The basic principles of chemistry through the lens of current topics for the non-science major. Topics may include areas such as forensic science, food chemistry, and environmental chemistry and toxicology. Core Curriculum: Approved for Core - Science. **Note(s):** May not be used to fulfill elective requirements for these majors: Chemistry (CHEM) or Biochemistry (BCHM). **Grade Mode:** A.  
**Restriction(s):** Must not be Chemistry (CHEM) or Biochemistry (BCHM); and must be Undergraduate Level.
- 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.  
**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 and LC. **Lecture/Lab Hours:** Three hours laboratory weekly. **Grade Mode:** A.  
**Corequisite(s):** CHEM 301.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$130.
- 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: NMR, IR, HPLC and UV/Vis. **Lecture/Lab Hours:** Three hours laboratory weekly. **Grade Mode:** A.  
**Corequisite(s):** CHEM 302.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$130.
- 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.  
**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.  
**Corequisite(s):** CHEM 321.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$130.
- CHEM 332 - Environmental Chemistry** **Credits 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.  
**Prerequisite(s):** CHEM 301 and CHEM 311; or CHEM 321 and CHEM 322.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$130.
- CHEM 350 - Analytical Chemistry** **Credits 3**  
Lecture course that will cover classical chemical methods of analysis such as titrations and gravimetry, and give an introduction to various instrumental methods including electrochemistry, chromatography, spectroscopy and mass spectrometry. **Lecture/Lab Hours:** Three hours lecture, weekly. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 301.  
**Corequisite(s):** CHEM 351.  
**Restriction(s):** Must be Undergraduate Level.
- CHEM 351 - Analytical Chemistry Lab** **Credit 1**  
Lab portion of analytical chemistry that will cover classical chemical methods of analysis such as titrations, gravimetry, and an introduction to various instrumental methods including electrochemistry, chromatography, spectroscopy and mass spectrometry. **Lecture/Lab Hours:** Three hours laboratory, weekly. **Note(s):** Course fee covers the provided lab coat and safety goggles. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 311.  
**Corequisite(s):** CHEM 350.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$130.
- 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 150.  
**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 150.  
**Restriction(s):** Must be Undergraduate Level.

- CHEM 380 - Introduction to Physical Chemistry** Credits 3  
 Course introduces thermodynamic and kinetic principles underlying molecular properties and chemical reactivity with specific application to biochemical and biological systems. Key instrumental techniques such as spectroscopy and microscopy are included. **Note(s):** MATH 151 strongly recommended. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 106, MATH 150; 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:** \$130.
- CHEM 402 - Physical Chemistry I** Credits 3  
 Molecular energetics - the thermodynamic principles underlying energy changes in chemical systems and governing chemical reaction kinetics, viewed from both macroscopic and microscopic perspectives. Energetics of solutions, electrochemical cells, phase changes, chemical equilibria and other applications are discussed. **Note(s):** MATH 151 (formerly MATH 106) strongly recommended. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 106, MATH 150; PHSC 112 or PHSC 233.  
**Restriction(s):** Must be Undergraduate Level.
- CHEM 405 - Physical Chemistry II** Credits 3  
 Quantum mechanics is introduced, including solutions to the time-independent Schrodinger equation, multi-electron systems, and polyatomic molecules, and applied 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. **Note(s):** MATH 250 strongly recommended. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 106, MATH 151; PHSC 112 or PHSC 233.  
**Restriction(s):** Must be Undergraduate Level.
- CHEM 406 - Physical Chemistry Lab** Credit 1  
 A laboratory course to accompany CHEM 402 and CHEM 405. Modern chemical instrumentation and experimental physical chemistry techniques, including spectroscopy, microscopy and calorimetry are introduced. Data and error analysis, oral and written communication of experimental work will be part of the laboratory experience. **Lecture/Lab Hours:** 3 hours laboratory weekly. **Note(s):** MATH 250 strongly recommended. **Grade Mode:** A, C.  
**Prerequisite(s):** CHEM 106, MATH 151; PHSC 112 or PHSC 233.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$130.
- CHEM 410 - Instrumental Analysis** Credits 2  
 Introduction to modern instrumental methods in chemical and biochemical analysis, including separations (i.e., chromatography, electrophoresis), optical spectroscopy, mass spectrometry, electrochemistry and micro-characterization. Principles of instrument design and applications to real-world problems will be discussed, emphasizing biochemical, environmental and forensic applications. **Lecture/Lab Hours:** One hour lecture, three hours lab, weekly.  
**Note(s):** CHEM 350 and CHEM 351 strongly recommended. **Grade Mode:** A.  
**Prerequisite(s):** CHEM 301, CHEM 311.  
**Restriction(s):** Must be Undergraduate Level.  
**Course Fee:** \$130.
- 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:** \$130.
- 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.  
**Repeat Limit (after first attempt):** 10.  
**Additional Fee(s):** May involve lab fees of up to \$130.
- 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:** \$130.

**CHEM 440 - Introduction to Computational Methods** Credits 3

This course introduces the principles of computational methods for molecular design, visualization, and the prediction of molecular properties. The course will survey the most commonly used computational methods including the application of density functional theory. The class features a project-based approach that makes use of the STH computing cluster and various software packages. **Grade Mode:** A.

**Prerequisite(s):** CHEM 405 or PHSC 311; MATH 250 (may be taken concurrently).

**Restriction(s):** Must be Chemistry (CHEM), Engineering Physics (PHEP), Biochemistry (BCHM), Applied Physics (PHAP), or Physics (PHYS); and Undergraduate Level.

**Course Fee:** \$130.

**CHEM 470 - Seminar in Advanced Chemistry and Biochemistry** Credit 1

Discussion of advances in chemistry and biochemistry as reported in literature and through guest presentations by researchers active in the field. Provides experience in library research, presentation and critical evaluation of chemical literature and an introduction to experimental design. **Note(s):** Recommended for students doing or planning to do research in chemistry or biochemistry. **Grade Mode:** A.

**Restriction(s):** Must be Junior Class or Senior Class; and Undergraduate Level.

**Repeat Limit (after first attempt):** 1.

**CHEM 480 - Internship** Credits 1-3

Internship to provide practical experience in a field of the student's interest. Designed for students working off campus. **Note(s):** Special approval required; may be taken multiple times for credit. **Grade Mode:** A.

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

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

**CHEM 490 - Directed Research** Credits 1-3

Research experience in a field of the student's interest. Designed for students working closely with faculty. **Note(s):** Special approval required; may be taken multiple times for credit. **Grade Mode:** A.

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

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

**Course Fee:** \$130.