

# CHEMISTRY (CHEM)

## **CHEM 100 Chemical Foundations 2**

This online course explores the fundamental skills necessary for success in a college chemistry course. For students preparing to enroll in CHEM 121: General Chemistry I in the Fall semester or CHEM 118: Chemistry for Healthcare in the Spring. Helpful for the pre-med student. Topics include the periodic table, compound formulas and naming, measurement, unit conversions, physical and chemical changes, solutions, calculations, and symbols. The course will also address appropriate study skills and pacing. Offered in Summer II Session.

## **CHEM 105 Introduction to Forensic Chemistry 3**

This course is intended for criminal justice, education and other students interested in forensic science, and is part of the forensic chemistry minor. Primary methods of chemical analysis are discussed, including refractive index and density determinations; UV/VIS, IR and mass spectroscopy of organic compounds; chromatographic techniques; inorganic methods; microscopy; immunoassay; blood typing; and DNA analysis. Emphasis will be on application of these techniques to forensic evidence, including glass, soil, drugs, arson, metals, textile fibers, hair, paint, and blood. Case studies will be used to illustrate the scientific foundation for the examination of physical, chemical, and biological evidence. Three hour of lecture per week. There are no prerequisites. Offered in Fall.

**Core Category:** Natural Science

## **CHEM 111 Applied Chemistry: Air, Water and Energy 3**

This is a one-semester introductory chemistry course for the liberal arts student or middle level education major. Major concepts of modern chemistry are investigated in the context of their relevance to current environmental issues; including air pollution, ozone depletion, global warming, society's energy sources, water pollution, and acid rain. Chemical Topics include properties and states of matter, atomic structure and bonding, stoichiometry, spectroscopy, thermodynamics, nuclear reactions, electrochemistry, solutions, and acids and bases. Can be used as preparation for CHEM 118 or 121 for the allied health, biological studies, or environmental science major.

**Core Category:** Mathematics, Natural Science

## **CHEM 118 Chemistry for Healthcare 4**

This is a one-semester course in foundational chemistry designed for nursing students and others interested in health-related professions. Major concepts of chemistry are investigated in the context of their medical relevance. Topics such as measurement, unit conversions, nuclear changes, periodic trends, bonding, reactions, energy, solutions, and acids/bases will help develop the language of chemistry and the nature of interactions between atoms. The course culminates in a study of carbon-based compounds, including hydrocarbons, isomers, functional groups, and protein structure. Laboratory work includes a set of experiments and study modules to enhance and expand on class discussions. Three hours lecture. Two and one-half hours laboratory per week. Prerequisite: Minimum grade of C in college-level math course or permission from instructor. Offered in spring. For nursing students only

**Core Category:** Mathematics, Natural Science

**Corequisites:** CHEM 118L

## **CHEM 118L Chemistry for Healthcare Lab 0**

**Corequisites:** CHEM 118

## **CHEM 121 General Chemistry I 3**

Intensive introduction to the composition and properties of matter, models for atomic structure and bonding, periodicity of elements, stoichiometry, states of matter, solutions and organic chemistry. Prerequisites: a high school background in chemistry with a grade of B- or better or minimum grade of C in CHEM 111. Three hours lecture. CHEM 123 must be taken concurrently. For science majors. Offered in fall. Fulfills lab science requirement for science and math majors.

**Core Category:** Mathematics, Natural Science

**Corequisites:** CHEM 123

## **CHEM 122 General Chemistry II 3**

This second-semester course builds on skills developed in CHEM 121. By inquiring about particle action and interaction, theoretical models are developed and chemical behavior is described within the context of gas laws, thermochemistry, kinetics, equilibrium, acid-base theory, complex ions, entropy and free energy, electrochemistry, and nuclear reactions. Honors Track offered for select students. Prerequisite: Minimum grade of C in CHEM 121. Three hours lecture. CHEM 124 W to be taken concurrently. For science majors. Offered in spring

**Prerequisites:** CHEM 121

**Corequisites:** CHEM 124 or CHEM 124W

## **CHEM 123 General Chemistry Laboratory I 1**

Experiments are performed to introduce or illustrate concepts studied on CHEM 121. Foundational laboratory skills are introduced and reinforced throughout the semester. Emphasis is given to careful measurement and recording of data in a laboratory notebook. Students also prepare for lab sessions by determining the purpose and questions each lab exercise addresses. Includes use of molecular modeling software, guided inquiry projects, and FT-IR analysis. CHEM 121 must be taken concurrently. Three hours laboratory

## **CHEM 124 General Chemistry Laboratory II 1**

Experiments are performed to introduce or illustrate the concepts studied in CHE 121 and 122. Emphasis is placed on careful recording and analysis of observations. CHE 123 develops foundational laboratory skills. CHE 124 includes an introduction to qualitative analysis, computer-interfaced data collection and scientific writing. CHE 121 must be taken concurrently with CHE 123 and CHE 122 must be taken concurrently with CHE 124. Minimum grade of C in CHE 123 is prerequisite to CHE 124. Three hours laboratory. Offered only to Esperanza College Students.

**Corequisites:** CHEM 122

## **CHEM 124W General Chemistry Laboratory II 1**

Experiments are designed to integrate with and enhance the theory discussed in CHEM 122. Laboratory skills in pipetting, titration, dilution, measurement, and visible spectroscopy are further developed. Includes an introduction to calorimetry, pH, qualitative analysis, computer-interfaced data collection, and the use of AAS. This course is designated as a writing intensive course for science majors with emphasis on analyzing results, drawing conclusions, and communicating observations through formal discussion writing. A peer review process is used throughout the semester to further refine writing skills. Minimum grade of C in CHEM 123 is prerequisite. CHEM 122 must be taken concurrently. Three hours laboratory.

**Prerequisites:** CHEM 123

## **CHEM 130 Special Topics 1-3**

**CHEM 195 Preparation for Organic Chemistry 1**

This fully online course engages the fundamental skills necessary for success in a study of sophomore-level organic chemistry I. For students preparing to enroll in CHEM 211: Organic Chemistry I in the Fall semester. Helpful for the pre-med student. Topics include the structure and interactions of molecules (Lewis structures, bonding, isomers, nomenclature, intermolecular forces, acids and bases), energy pathways, and 3-dim visualization with molecular modeling software. Offered in the Summer II Session.

**CHEM 211 Organic Chemistry I 3**

This course introduces the student to the terminology, symbolism and logic that are needed to understand and solve organic chemistry problems involving nomenclature, functional group reactions, synthesis, mechanisms, and nuclear magnetic resonance. This includes the introduction to 3-D structure, a survey of functional groups, alkanes, alkenes, alkynes, alkyl halides, stereochemistry, and introductory problems in synthesis, reaction mechanisms, and NMR. Three hours lecture. CHEM 213W must be taken concurrently. Offered in fall.

**Prerequisites:** CHEM 122

**CHEM 212 Organic Chemistry II 3**

This course reinforces concepts from CHEM 211 and equips the student with the ability to solve organic chemistry problems involving nomenclature, functional group reactions, stereoselective synthesis, mechanisms, and structure proofs through the interpretation of mass, infrared, ultraviolet, and nuclear magnetic resonance spectra. This includes an introduction to the chemistry of the following functional groups: aromatic rings, alcohols, thiols, ethers, epoxides, sulfides, amines, and common carbonyl compounds. Three hours lecture. CHEM 214 must be taken concurrently. Offered in spring

**Prerequisites:** CHEM 211

**CHEM 213W Organic Chemistry Laboratory I: Techniques 1**

This laboratory course introduces basic organic chemistry lab techniques such as recrystallization, extraction, chromatography (thin layer, column, & gas), distillation, and filtration in the context of synthesizing organic compounds and isolating natural products. NMR spectroscopy is introduced and students learn to operate a 300 MHz FT-NMR spectrometer and interpret spectra. The course is designated as a Writing Intensive Course (WIC) for science majors in biochemistry and biology as well as chemistry students. CHEM 211 must be taken concurrently. Three and one-half hours laboratory

**CHEM 214 Organic Chemistry Laboratory II: Reactions 1**

As a continuation of CHEM 213, this laboratory course equips the student with synthetic experience at an intermediate level while incorporating topics from the lecture course (CHEM 212) such as stereochemistry, stereoselectivity, functional group transformations, protecting groups, proton FT-NMR, GC and FT-IR spectroscopy, and multi-step synthesis. Three and one-half hours laboratory. Prerequisite: Minimum grade of C in CHEM 213. CHEM 212 must be taken concurrently

**CHEM 230 Special Topics 1-4**

**Prerequisites:** CHEM 212; BIOL 152

**CHEM 231 Quantitative Analysis 4**

A study of the theory and practice of commonly used classical analytical techniques. Lecture material includes: statistics and evaluation of analytical data; theory of simple and complex equilibria; theory of acid-base, precipitation, redox, and complexation reactions; titrations; analytical electrochemistry; spectrophotometry; and the use of separation techniques in analysis. Laboratory experiments provide an opportunity to apply theory to real-world chemical problems. Includes formal scientific writing. Three hours lecture, three hours laboratory. Offered fall in alternate years.

**Prerequisites:** CHEM 122 and CHEM 124W

**Corequisites:** CHEM 231L

**CHEM 231L Quantitative Analysis Laboratory 0**

**Corequisites:** CHEM 231

**CHEM 304 Chemistry Laboratory Management 1**

This course prepares students to work in forensics or industry, and for secondary education majors desiring certification in chemistry. Training includes stock room management, inventory updates and consumable ordering, waste disposal, and safety training. Students will contribute to first-year chemistry laboratory session instruction on selected techniques and practices. Three hours per week. May be combined with work-study scholarship. Prerequisites: junior class standing and permission of department

**CHEM 320 Biochemistry I 3**

This course surveys the structure and basic biochemical properties of proteins, carbohydrates, and lipids within the context of living systems. Specific themes include the architecture and basic function of proteins, the catalytic strategies and regulation of enzymes, and a survey of the diverse structures and biochemical functions of carbohydrates and lipids. Three hours lecture. BIOL 152 is recommended. CHEM 322 must be taken concurrently. Offered in fall.

**Prerequisites:** CHEM 212; BIOL 152

**CHEM 321 Biochemistry II 3**

Building upon the foundation laid in CHEM 320, this course surveys the major biochemical pathways through which cells harvest and store chemical energy from the environment and then utilize that energy to drive the synthesis of macromolecules needed to sustain life. Specific emphases include the metabolism of carbohydrates and fatty acids, oxidative phosphorylation, and photosynthesis, protein synthesis, and the architecture and function of sensory systems and molecular motors. Three hours lecture. Offered in Spring.

**Prerequisites:** CHEM 320

**CHEM 322 Biochemistry Laboratory 1**

This laboratory course provides hands-on experience with common experimental techniques used in biochemical research. These techniques include expression and purification of recombinant protein from *E. coli*, affinity chromatography, size exclusion chromatography, protein gel electrophoresis, western blotting, ELISA, characterization of enzyme function by spectrophotometric assay, and an introduction to protein bioinformatics and protein structure visualization software. Includes formal scientific writing. Three and one-half hours laboratory. CHEM 320 must be taken concurrently.

**CHEM 330 Special Topics 1-4**

**CHEM 341 Structural Basis of Human Disease 3**

This course introduces techniques used to analyze protein structures at the atomic level and describes various research strategies to investigate the underlying molecular causes of disease. The course will then survey a variety of clinically significant human diseases for which the underlying cause is at least partially understood from the perspective of protein structure. An overview of strategies used in the pharmaceutical industry to develop effective therapies based on protein structure will be discussed. Three hours lecture. Offered spring in alternate years.

**Prerequisites:** CHEM 320, BIOL 311 and PHYS 152 or Instructor Consent

**CHEM 350 Advanced Inorganic Chemistry 3**

This course examines the foundational concepts and theories of inorganic chemistry and their applications. Major topics include coordination chemistry, symmetry and group theory, solid-state structures and energetics, and descriptive chemistry of the representative elements. Periodic properties are discussed systematically and bioinorganic applications are introduced. Offered online in summer.

**Prerequisites:** CHEM 212 or Instructor Consent

**CHEM 360 Advanced Organic Chemistry 3**

This course is designed to expand the understanding of the principles of organic chemistry, with an emphasis on modern physical organic chemistry, building on the fundamental concepts developed in CHEM 211 and CHEM 212. The topics include qualitative molecular orbital theory, structure of stable organic molecules and reactive intermediates, thermodynamic analysis of acids and bases, modern concepts of stereochemistry, energy surfaces and kinetic analysis, strategies of catalysis, and a brief introduction to organometallic chemistry. The course will be completed with the discussion of organic reaction mechanisms. Offered spring in alternate year.

**Prerequisites:** CHEM 212

**CHEM 380 Instrumental Analysis 4**

Lecture meetings include discussion of the theory, design and function of common analytical instrumentation in modern industrial and research laboratories. Laboratory work provides extensive hands-on experience in sample preparation and operation of instruments, including UV/VIS, FT-IR, AAS, FT-NMR, DSC, GC-FID, GC-MS and HPLC. Computerized data acquisition and manipulation is through the use of interfaced data stations. Includes formal lab report writing. Three hours lecture, three and one-half hours laboratory. Offered Spring in alternate years.

**Prerequisites:** CHEM 211 and CHEM 213

**Corequisites:** CHEM 380L

**CHEM 380L Instrumental Analysis Laboratory 0**

**Corequisites:** CHEM 380

**CHEM 390 Thermodynamics & Kinetics 4**

The laws of thermodynamics are described and applied to the gas phase, changes of state, chemical equilibria, and electrochemistry. Chemical kinetics and reaction dynamics are examined. Course is divided into two-thirds thermodynamics and one-third kinetics. Laboratory projects emphasize collaborative work and extensive peer review of written reports. Written reports, use of advanced instrumentation, symbolic math programming, and molecular modeling. Three hours lecture, four hours laboratory. Offered in spring in alternate years.

**Prerequisites:** CHEM 122, PHYS 152 and MATH 212

**CHEM 390L Thermodynamics, Kinetics Lab 0****CHEM 400 Directed Study 1-3****CHEM 408 Industrial Chemistry 3**

The content of this seminar-style course provides an overview of the chemical and business aspects of the chemical industry. Topics include the history of the chemical industry; sources of chemical feedstocks; the role of R & D and chemical engineering; patents and trade secrets; scale up and production; environmental and safety regulations; economic factors; marketing and sales; global trends. Both bulk and specialty chemicals will be considered. Current events and case studies will be emphasized and a plant tour may also be part of the course. A series of speakers from the industry will give seminars. Three hours lecture. Prerequisites: Minimum grade of C in CHEM 212/214. Open to science majors, and completes a minor in chemistry. Offered in alternate years.

**Prerequisites:** CHEM 212 and CHEM 214

**CHEM 411 Quantum Chemistry 4**

Introductory quantum mechanics and its application to atoms, bonding and fundamental theory of spectroscopy. Statistical thermodynamics is introduced as the link between quantum theory and thermodynamics. Laboratory includes molecular modeling research projects and symbolic math programming. Three hours lecture; three hours laboratory. Offered every other fall.

**Prerequisites:** CHEM 122, PHYS 152 and MATH 213

**Corequisites:** CHEM 411L

**CHEM 411L Quantum Chemistry Laboratory 0**

**Corequisites:** CHEM 411

**CHEM 420 Chemical Research 1-15**

The student will perform an original chemical or biochemical research project, designed and supervised by a research advisor. The student will conduct a comprehensive literature search, perform the original laboratory and/or computational work, manage the overall project, and keep a laboratory notebook. A minimum time commitment of three laboratory hours per week is expected for each credit hour. Graded P/F. The research may be performed at Eastern University or at an approved research program off campus. There is no tuition charge either for overload credit or for summer work. May be taken more than once. CHEM 425 is designed to follow CHEM 420.

**Course is Pass/Fail**

**CHEM 425W Project Presentation 1**

Results of an original research or internship project completed in CHEM 420 or 495 are presented by the student in the form of a seminar and a journal-formatted paper. The course is designed to improve the student's ability to communicate scientific results orally and in writing. There is no tuition charge either for overload credit or for summer work.

**Prerequisites:** CHEM 420 or CHEM 495

**CHEM 450 Chemistry Seminar 1**

This one-credit seminar is designed to contribute to the culminating student experience for majors in the Department of Chemistry by addressing issues and advancing dialogue at the interface of science and the Christian faith. Students will study the nature of science in terms of its epistemology and certain facets of its historical roots to make comparisons to a Christian worldview. By applying these ideas, issues in origins, bioethics, and environmental stewardship will be critiqued.

**CHEM 495 Internship 2-12**

All work internships must be pre-approved. An internship can be laboratory work in a chemical company, government lab or hospital; work as a technician in a pharmacy or other healthcare provider; or work on the business side of a chemical company- depending on the student's degree program. Work will be evaluated by the on-site supervisor and graded on a P/F basis. A literature research paper dealing with a process, procedure or topic encountered during the cooperative experience is required. With the supervisor's approval the paper is to be presented in CHEM 425W following the completion of CHEM 495. Hours credit will be determined by the department. May be taken more than once.

**Course is Pass/Fail**

**CHEM 498 Teaching Assistant 1-3**

**CHEM 499 Research Assistant 1-3**