

CHEMISTRY (CHE)

The major in chemistry is designed to develop a broad and thorough understanding of the fundamentals of the discipline including an ability to respond to God's command to "subdue [the earth]" (Gen. 1:28). Scientific understanding is central to any Christian's view of God's creation and the world around us as we are taught by Scripture, "For since the creation of the world His invisible attributes are clearly seen, being understood by the things that are made..." (Rom 1:20). A study of chemistry is one of peering into our Lord's "invisible attributes" as he has revealed them through creation, molecules, atoms, and chemical reactions. By so doing, the Christian student will gain a greater appreciation of what God has done for His people.

There are two tracks in the chemistry major. Option A is designed for those students wishing to pursue a career in chemical research, as a lab technician, or to further their education in chemistry graduate studies. The requirements of option A correspond to American Chemical Society certification requirements. Option B is designed for pre-medicine, secondary education, and chemistry/business majors. The intent of this option is to give the student a solid background in chemistry that can be applied in a second area of study. Students in either option are encouraged to develop computer programming skills.

The chemistry minor provides a foundation for students majoring in another area to receive the chemistry/science training they will need in today's technological world.

Course of Study

- A. A major in chemistry following option A consists of a minimum of 43 credits in chemistry as follows:
1. General Chemistry: CHE 161, 162, 168, 169.
 2. Organic Chemistry: CHE 221, 222, 228.
 3. Analytical Chemistry: CHE 210, 310.
 4. Physical Chemistry: CHE 341, 342, 348, 349.
 5. Inorganic Chemistry: CHE 430.
 6. Electives: At least 7 credits including:
 - a. At least one advanced lab course from: CHE 358, 410, 428, 438, 448, 490, 498.
 - b. At least one course from: CHE 350, 391, 410, 420, 440, 491, 499.
 7. Collateral Requirements: MAT 221, 222, 223; PHY 201, 202.
- B. A major in chemistry following option B consists of a minimum of 36 credits in chemistry as follows:
1. General Chemistry: CHE 161, 162, 168, 169. (May be waived by testing.)
 2. Organic Chemistry: CHE 221, 222, 228.
 3. Analytical Chemistry: CHE 210, 310.
 4. Physical Chemistry: CHE 341, 348.
 5. Electives: At least 7 credits from the following: CHE 342, 349, 350, 358, 378, 391, 410, 420, 428, 430, 438, 440, 448, 490, 491, 498, 499.
 6. Collateral Requirements: MAT 221, 222, 223; PHY 201, 202.
- C. A minor in chemistry consists of a minimum of 24 credits as follows:
1. General Chemistry: CHE 161, 162, 168, 169.
 2. Organic Chemistry: CHE 221, 222, 228.
 3. Analytical Chemistry: CHE 210.
 4. Electives: At least one course from the following: CHE 310, 341, 342, 350, 410, 420, 428, 430.

Course Descriptions

CHE 101 Fundamentals of Chemistry. 4 cr.

This course for non-science majors explores the importance of chemistry in everyday life, emphasizing descriptive chemistry and developing quantitative concepts carefully. 3 lec., 3 hrs. lab.

CHE 161 General Chemistry 1. 4 cr.

A study of the fundamental laws and concepts of chemistry. The emphasis is placed on atomic and molecular structure and bonding, stoichiometry, thermodynamics, and solutions. 4 lec.

CHE 162 General Chemistry 2. 4 cr.

A continuation of CHE 161. This course includes the study of equilibrium systems, acid/base concepts, kinetics, phases of matter, electrochemistry, and nuclear chemistry. 4 lec. Prereq: CHE 161/168 with a grade of C or better.

CHE 168 General Chemistry Lab 1. 1 cr.

Introduction to basic laboratory techniques, with emphasis placed on atomic and molecular structure and bonding, stoichiometry, thermodynamics, and solutions. 3 hrs. lab. To be taken in conjunction with CHE 161. Prereq: CHE 161 or concurrent enrollment.

CHE 169 General Chemistry Laboratory 2. 1 cr.

Laboratory work exploring equilibrium systems, acid/base concepts, kinetics, phases of matter, and electrochemistry. 3 hrs. lab. To be taken in conjunction with CHE 162. Prereq: CHE 162 or concurrent enrollment, CHE 168 with a grade of C or better.

CHE 210 Quantitative Analysis. 3 cr.

A study of common analytical techniques, including gravimetric, titrimetric and spectrophotometric analysis, as well as separation techniques. 1 lec., 6 hrs. lab. Prereq: CHE 162/169.

CHE 221 Organic Chemistry 1. 3 cr.

An introduction to nomenclature, electronic structure and chemistry of carbon compounds, including free radical substitution, electrophilic addition to alkenes, nucleophilic aliphatic substitution and elimination reactions. 3 lec. Prereq: CHE 162/169.

CHE 222 Organic Chemistry 2. 3 cr.

A continuation of CHE 221 including spectroscopic methods of structure determination, aromatic and carbonyl chemistry, and amino acid chemistry. 3 lec. Prereq: CHE 221.

CHE 228 Organic Chemistry Laboratory. 2 cr.

Preparation and analysis of organic compounds; introductory qualitative analysis. 6 hrs. lab. Prereq: CHE 222 or concurrent enrollment.

CHE 310 Instrumental Analysis. 4 cr.

A study of common instrumental techniques including spectroscopic, chromatographic, electrochemical, and other physical methods for the analysis of materials. 2 lec., 6 hrs. lab. Prereq: CHE 210, PHY 202, or concurrent enrollment.

CHE 341 Physical Chemistry 1. 3 cr.

Includes properties of gases; concepts and methods of classical thermodynamics and their application to chemical systems including: chemical reactions, phase changes, and solubility; the phase rule, equilibrium, electrochemistry, kinetics. 3 lec. Prereq: CHE 162/169 MAT 222 (MAT 223 recommended), PHY 202.

CHE 342 Physical Chemistry 2. 3 cr.

Principles and methods of quantum mechanics and group theory as they apply to atomic and molecular structure and motion, rotational, vibrational and electronic spectra, resonance techniques, and the electric and magnetic properties of molecules. 3 lec. Prereq: CHE 162/169, MAT 223, PHY 202.

CHE 348 Physical Chemistry Laboratory 1. 1 cr.

Laboratory work illustrating physical chemistry principles including thermochemical and electrochemical measurements, kinetics, and bulk properties of matter. 3 hrs. lab. Prereq: CHE 341 or concurrent enrollment.

CHE 349 Physical Chemistry Laboratory 2. 1 cr.

Laboratory work emphasizing spectroscopic techniques including acquisition and analysis of rotational, vibrational and electronic spectra. 3 hrs. lab. Prereq: CHE 342 or concurrent enrollment.

CHE 350 Biochemistry 1. 3 cr.

The first course in a comprehensive biochemistry sequence studying the chemistry of biological systems. Topics include structure and chemistry of amino acids, carbohydrates, lipids, proteins, and nucleic acids, energetics, kinetics, enzyme mechanisms and regulation, and signal transduction. 3 lec. Prereq: CHE 222. This course is cross-listed as BIO 350, only BIO 350 or CHE 350 may be taken for credit, not both.

CHE 351 Biochemistry 2. 3 cr.

The second course in a comprehensive biochemistry sequence studying the chemistry of biological systems. A detailed survey of metabolic pathways and control (catabolic and anabolic) in bacteria, plants, and animals, as well as molecular physiology. 3 lec. Prereq: CHE 350. This course is cross-listed as BIO 351, only BIO 351 or CHE 351 may be taken for credit, not both.

CHE 358 Biochemistry Lab. 1 cr.

A survey of modern techniques in experimental Biochemistry. These include biomolecule separation, detection, and modification techniques; techniques for examining inherent biomolecule characteristics and interactions with other biomolecules; and bioinformatics and computational techniques. Using scientific writing to convey the results of experiments is emphasized. Prereq: CHE 350 or concurrent enrollment. This course is cross-listed as BIO 358, only BIO 358 or CHE 358 may be taken for credit, not both.

CHE 410 Advanced Analytical Chemistry. 3 cr.

Advanced techniques and theory of chemical analysis, with a focus on applications such as environmental chemistry, forensic science, and pharmaceuticals. 1 lec., 6 hrs. lab. Prereq: CHE 210.

CHE 420 Advanced Organic Chemistry. 2 cr.

Spectroscopic methods for structure determination. Use of molecular orbital theory and the Woodward-Hoffman rules and their role in determining reaction mechanisms. Discussion of advanced synthetic strategies. 2 lec. Prereq: CHE 222 and 228.

CHE 428 Advanced Organic Laboratory. 2 cr.

Advanced techniques in the synthesis of organic compounds. Compliments topics in CHE 420. 6 hrs. lab. Prereq: CHE 420 or concurrent enrollment.

CHE 430 Inorganic Chemistry. 3 cr.

Theories of bonding, electronic structure, properties and reactions of main group, transition metal, and organometallic compounds are discussed. 3 lec. Prereq: CHE 162.

CHE 438 Inorganic Chemistry Laboratory. 1 cr.

Synthesis and characterization of inorganic compounds. Includes Schlenk line and glove box techniques. Compliments topics in CHE 430. 3 hrs. lab. Prereq: CHE 430 or concurrent enrollment.

CHE 440 Advanced Physical Chemistry. 3 cr.

Advanced topics in physical chemistry which may include the following: treatment of thermodynamics and phase diagrams in complex systems, liquids and solids, advanced treatment of chemical kinetics and reaction dynamics, advanced quantum theory, statistical thermodynamics. Topics will vary with instructor and student interests. 3 lec. Prereq: CHE 342 or concurrent enrollment.

CHE 448 Advanced Physical Chemistry Laboratory. 1 cr.

Advanced methods in determining the physical properties of matter. Compliments topics in CHE 440. Experiments will vary with instructor and student interests. 3 hrs. lab. Prereq: CHE 440 or concurrent enrollment.

CHE 490 Internship. 1-3 cr.

By arrangement with department and college internship coordinator. See college internship guidelines.

CHE 498 Undergraduate Research. 1-3 cr.

Chemistry majors may arrange for independent research with a faculty research advisor. Students are encouraged to repeat this course with their research advisor. However, no more than three credits may be applied toward the major. Work may be carried out off campus with permission of department. Written report required. If two or more credits are received, an oral presentation is also required. Prereq: Consent of instructor.

CHE x91 Special Topics. 1-3 cr.

In-depth study of advanced topic in chemistry in which the primary research literature is stressed. Lecture, discussion, student presentations, and papers. Prereq: varies with topic. May be repeated for credit with a new topic.

CHE x92 Special Topics Laboratory. 1 cr.

Laboratory work emphasizing designing and executing a project under the supervision of the instructor. To be taken in conjunction with CHE x91. Prereq: permission of the instructor. May be repeated with a new topic.

CHE 199-499 Independent Study. 1-3 cr.

Advanced topics (non-laboratory) may be studied which are not normally included in the regular course offerings. By arrangement with the department.