

# Chemistry (CHEM)

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**CHEM 1010. Introduction to Chemistry PP. (3 Credits)**

Prerequisite(s): MAT 1010 or higher with a C- or better, OR STAT 1040 or STAT 1045 or above with a C- or better, OR a placement score equivalent to MATH 1050 or above

Corequisite(s): CHEM 1015 (optional)

Assumes no previous knowledge of chemistry. Presents the foundations of chemistry to students who need preparation for further study in chemistry as well as to students who only want to take an introductory course. Covers chemical measurements, atomic structure, formulas, chemical reactions and equations, chemical nomenclature, stoichiometry, molecules and chemical bonding, gas laws, liquids, solids, solutions, acids and bases.

**CHEM 1015. Introduction to Chemistry Lab. (1 Credit)**

Corequisite(s): CHEM 1010

A lab designed to accompany CHEM 1010. Provides practical experience to support chemistry foundational learning. Emphasizes chemical measurements, atomic structure, formulas, chemical reactions and equations, chemical nomenclature, stoichiometry, molecules and chemical bonding, gas laws, liquids, solids, solutions, acids and bases.

Course lab fee of \$31 applies.

**CHEM 1110. Elementary Chemistry for the Health Sciences PP. (4 Credits)**

Pre- or Corequisite(s): MAT 1010 or MAT 2015 or STAT 1040 or STAT 1045, or a placement score into MATH 1050 or higher.

Introduces the fundamentals of chemistry to students in the health sciences. Covers chemical measurements and calculations, atomic structure, chemical bonding, chemical reactions, states of matter, solutions, chemical equilibrium, acid-base systems, and introduces organic chemistry.

**CHEM 1115. Elementary Chemistry Laboratory. (1 Credit)**

Pre- or Corequisite(s): CHEM 1010 or CHEM 1110

Introduces inorganic laboratory experiments including density, precipitation, determination of empirical formulas, gas laws and acid-base reactions.

Course Lab fee of \$27 applies.

**CHEM 1120. Elementary Organic Bio-Chemistry. (4 Credits)**

Prerequisite(s): CHEM 1110

Introduces organic and biochemistry for non-chemistry majors entering nursing and other allied health fields such as medical technology, physical therapy, nutrition, and environmental technology. Studies the nomenclature of organic compounds, organic functional groups and their reactivities, stereochemistry, major biomolecules and their metabolism, enzymes, chemical communications, and chemistry of heredity. May also be used to prepare for organic chemistry (CHEM 2310 and 2320).

**CHEM 1125. Elementary Organic Bio-Chemistry Laboratory. (1 Credit)**

Prerequisite(s): CHEM 1110 and CHEM 1115

Corequisite(s): CHEM 1120

An introductory organic bio-chemistry laboratory class for non-chemistry majors who need a laboratory to accompany Elementary Organic Bio-Chemistry (CHEM 1120). Explores identifications and reactions of organic functional groups and conducts experiments with biomolecules.

Course Lab fee of \$80 applies.

**CHEM 1210. Principles of Chemistry I PP. (4 Credits)**

Prerequisite(s): MATH 1080, MATH 1050, MATH 1055 or any higher MATH course with a C- or better, or appropriate placement scores for MATH 1060 or higher. Also, it is highly recommended to have prior chemistry experience in high school or in CHEM 1010

Corequisite(s): CHEM 1215

First semester of a full-year course primarily for students in the physical and biological sciences and engineering. Covers fundamentals of chemistry including atoms, molecules, reactions, stoichiometry, chemical bonding, thermochemistry, and gas laws.

**CHEM 1215. Principles of Chemistry I Laboratory. (1 Credit)**

Corequisite(s): CHEM 1210

Primarily for students in the physical and biological sciences and engineering. Introduces laboratory safety and chemical waste disposal practices.

Teaches techniques of using standard laboratory equipment. Shows how to record laboratory data and prepare laboratory reports. Experiments follow topics in CHEM 1210.

Course Lab fee of \$26 applies.

**CHEM 1220. Principles of Chemistry II PP. (4 Credits)**

Prerequisite(s): CHEM 1210 with a grade of C- or higher

Corequisite(s): CHEM 1225

Continuation of Chemistry 1210. Primarily for students in the physical and biological sciences and engineering. Covers intermolecular interactions, properties of solutions, kinetics, equilibria, thermodynamics, and electrochemistry.

**CHEM 1225. Principles of Chemistry II Laboratory. (1 Credit)**

Prerequisite(s): CHEM 1215 with a C- or better

Corequisite(s): CHEM 1220

Is designed for the physical and biological sciences and engineering. Teaches intermolecular interactions, properties of solutions, kinetics, equilibria, thermodynamics, and electrochemistry. Follows CHEM 1215 and emphasizes topics from CHEM 1220.

Course Lab fee of \$42 applies.

**CHEM 1250. Chemistry Cornerstone- Research and Careers. (1 Credit)**

Explores scientific literature, culture and careers. Teaches college success strategies for STEM fields to support students interested in a STEM major.

**CHEM 1260. Chemistry Cornerstone- Ethics. (1 Credit)**

Explores scientific ethics. Teaches college success strategies for STEM fields to support students interested in a STEM major.

**CHEM 2310. Organic Chemistry I. (4 Credits)**

Prerequisite(s): CHEM 1220 with a grade of C- or higher

Corequisite(s): CHEM 2315

The first in a series of two organic chemistry classes for students majoring in science and for those interested in careers in medicine, dentistry, veterinary science, and pharmacy, who must complete two semesters of organic chemistry. Teaches bonding and structures of organic molecules. Explores the relationship between structure and reactivity of organic functional groups. Introduces the concepts of nomenclature, stereochemistry, and reaction mechanism.

Canvas Course Mats \$84/Wiley applies.

**CHEM 2315. Organic Chemistry I Laboratory. (1 Credit)**

Prerequisite(s): CHEM 1220, CHEM 1225

Corequisite(s): CHEM 2310

The first of a series of two laboratory courses to accompany CHEM 2310 and 2320. For students majoring in science and those interested in careers in medicine, dentistry, veterinary science, and pharmacy. Introduces safety in organic chemistry lab and chemical waste disposal. Teaches basic separatory, purification, and analytical techniques in organic chemistry such as crystallization, melting points, distillation and chromatography. Introduces organic synthesis using simple organic reactions. Introduces natural product isolation.

Course Lab fee of \$88 applies.

**CHEM 2320. Organic Chemistry II. (4 Credits)**

Prerequisite(s): CHEM 2310 & CHEM 2315 with a C- or higher

Corequisite(s): CHEM 2325

Introduces spectroscopic techniques used in identification of organic compounds. Teaches carbon-carbon bond formation strategies. Introduces the concept of aromaticity. Teaches free radicals and their effects on environment and life. Surveys biologically important organic molecules such as carbohydrates, proteins, lipids, and nucleic acids.

Canvas Course Mats \$84/Wiley applies.

**CHEM 2325. Organic Chemistry II Laboratory. (1 Credit)**

Prerequisite(s): CHEM 2315

Corequisite(s): CHEM 2320

The second of a series of two laboratory courses to accompany CHEM 2310 and 2320. For students majoring in science and those interested in careers in medicine, dentistry, veterinary science, and pharmacy. Provides hands-on experience in organic synthesis using a series of single and multistep transformations. Teaches identification of products of reactions using spectroscopic techniques. Explores biologically important organic molecules.

Course Lab fee of \$88 applies.

**CHEM 3000. Analytical Chemistry. (2 Credits)**

Prerequisite(s): CHEM 1220, CHEM 1225 and Advanced University Standing

Corequisite(s): CHEM 3005

For Chemistry majors and others interested in the basic principles of chemical measurement. Studies principles of quantitative analysis, stoichiometry, equilibrium theory, and volumetric analysis. Introduces error analysis and instrumental methods, especially electrochemistry, spectrophotometry, chromatography, and mass spectrometry

**CHEM 3005. Analytical Chemistry Laboratory. (2 Credits)**

Prerequisite(s): CHEM 1220, CHEM 1225, and University Advanced Standing

Corequisite(s): CHEM 3000

For Chemistry majors and others interested in the basic principles of chemical measurement. Laboratory companion to CHEM 3000. Involves conducting experiments in quantitative and qualitative analysis, including volumetric and gravimetric analysis. Also, students will conduct experiments in introductory instrumental methods, including experiments in spectrophotometry, electrochemistry, and chromatography.

Course Lab fee of \$146 applies.

**CHEM 3020. Environmental Chemistry. (3 Credits)**

Prerequisite(s): CHEM 1225 and University Advanced Standing

Studies the chemistry of soil, ground water, hazardous waste, and the atmosphere. Explores current environmental concerns and issues.

**CHEM 3025. Environmental Chemistry Laboratory. (1 Credit)**

Prerequisite(s): CHEM 1225 and University Advanced Standing

Laboratory course which supports CHEM 3020, Environmental Chemistry. Introduces laboratory, sampling, and data analyses techniques used in environmental laboratories. Covers air sampling, and soil and water analysis using a variety of instruments and techniques.

**CHEM 3060. Physical Chemistry I WE. (4 Credits)**

Prerequisite(s): CHEM 1250, CHEM 1260, PHYS 2220, and University Advanced Standing

Corequisite(s): CHEM 3065

Offers an advanced discussion of the laws of thermodynamics and chemical thermodynamics. Applies the laws to chemical reactions and equilibrium. Covers changes of state, including phase diagrams. Discusses real gases and real solutions. Introduces electrochemistry and chemical kinetics.

**CHEM 3065. Physical Chemistry I Lab. (1 Credit)**

Prerequisite(s): University Advanced Standing

Corequisite(s): CHEM 3060

Demonstrates physical chemistry experiments exploring principles and concepts introduced in CHEM 3060. Teaches design and execution of physical chemistry experiments and interpretation of the observations, as well as application of physical chemistry to solving physical chemistry problems.

Course lab fee of \$75 applies.

**CHEM 3070. Physical Chemistry II. (4 Credits)**

Prerequisite(s): CHEM 3060, MATH 2210 and University Advanced Standing

Corequisite(s): CHEM 3075

Provides an advanced discussion of quantum mechanics, including solutions to the Schrodinger wave equation. Connects quantum mechanics with observables, including spectroscopy.

**CHEM 3075. Physical Chemistry II Lab. (1 Credit)**

Prerequisite(s): CHEM 3060, CHEM 3065, and University Advanced Standing

Corequisite(s): CHEM 3070

Demonstrates physical chemistry experiments exploring principles and concepts. Provides opportunity to design and execute physical chemistry experiments and interpretation of the observations. Applies physical chemistry to solving physical chemistry problems.

**CHEM 3080. Physical Chemistry III. (3 Credits)**

Prerequisite(s): CHEM 3070 and University Advanced Standing

Teaches the fundamentals of statistical mechanics and chemical kinetics, as well as the fundamentals of the specialized topics of the physical chemistry of chemical symmetry, computational chemistry, NMR spectroscopy, and electrochemistry.

**CHEM 3100. Advanced Inorganic Chemistry. (4 Credits)**

Prerequisite(s): University Advanced Standing

Pre- or Corequisite(s): CHEM 3000

Reviews major trends across the periodic table. Surveys basic structure, bonding, and oxidation states of the elements. Introduces inorganic stereochemistry including coordination compounds.

**CHEM 3115. Advanced Inorganic Chemistry Lab. (1 Credit)**

Prerequisite(s): CHEM 3005 and University Advanced Standing

Corequisite(s): CHEM 3100

Explores principles and concepts introduced in CHEM 3100. Teaches design and execution of inorganic chemistry experiments and interpretation of the observations. Uses application of inorganic chemistry to solving inorganic chemistry problems.

Course Lab fee of \$130 applies.

**CHEM 3300. Biomolecular Modeling and Simulations. (4 Credits)**

Cross-listed with: BTEC 3300

Prerequisite(s): CHEM 3600 or BIOL 3600, and University Advanced Standing

Introduces students to the field of molecular modeling and simulations and to the wide range of problems that can be tackled using computational methods. Focuses on biomolecular simulations and computer-aided drug discovery. Emphasizes the connection between structure, dynamics, and function. Teaches application of algorithmic thinking to solving complex problems. Develops practical skills needed to perform simulations and analyze the results. Develops understanding of the inherent approximations and limitations of the methods for adequate assessment of modeling results. Covers topics such as molecular visualization and rendering, molecular dynamics simulations, and computer-aided drug discovery through virtual screening and small molecule docking.

**CHEM 3410. Introduction to Formulations I. (3 Credits)**

Prerequisite(s): CHEM 1210 and CHEM 1215

Offers a comprehensive training for a potential formulations chemist to create formulations for the kinds of products that are being formulated in Utah by many different companies. Covers the different classes of compounds, and their contributing properties, that are included in health and beauty products. Provides training to create formulas with precision and accuracy. Covers the driving force for formulation decisions including environmental awareness, customer interests and financial implications. Course lab fee of \$104 applies for equipment and supplies.

**CHEM 3420. Introduction to Formulations II. (3 Credits)**

Prerequisite(s): CHEM 1210 and CHEM 1215

Focuses on nutritional supplements and ingested products that range from single molecule extracted supplements to protein shakes made from raw materials. Offers a comprehensive training for a potential formulations chemist to create formulations for the kinds of nutritional supplements and edible products that are being formulated in Utah by many different companies. Covers the different classes of compounds, and raw materials and their contributing properties, that are included in nutritional supplement and edible products. Provides training to create formulas with precision and accuracy. Covers the driving force for formulation decisions including environmental awareness, ethical concerns, customer interests and financial implications. This course can be taken prior to or in conjunction with CHEM 3410. Course lab fee of \$104 applies for equipment and supplies.

**CHEM 3600. Biological Chemistry. (3 Credits)**

Cross-listed with: BIOL 3600

Prerequisite(s): University Advanced Standing

Pre- or Corequisite(s): CHEM 2320

Introduces principles of the chemical processes that define living organisms. Covers structure and function of proteins, carbohydrates, lipids and nucleic acids. Explores metabolic pathways, biosynthesis, enzymatics, thermodynamics, membrane dynamics and related processes within a living cell. Emphasizes molecular mechanisms of reactions and their outcome.

**CHEM 3605. Biological Chemistry Lab. (1 Credit)**

Cross-listed with: BIOL 3605

Prerequisite(s): University Advanced Standing

Corequisite(s): BIOL 3600

Introduces laboratory techniques in biochemistry. Studies methods and theory behind purification of proteins and nucleic acids including chromatography and electrophoresis. Uses methods in assessing enzyme activity and kinetics and protein structure analysis. Includes analysis and manipulation of DNA and RNA.

Course Lab fee of \$145 applies.

**CHEM 3620. Biological Chemistry II. (3 Credits)**

Cross-listed with: BIOL 3620

Prerequisite(s): (CHEM 3600 or BIOL 3600) and University Advanced Standing

Is a continuation of CHEM 3600. Teaches in-depth the biochemistry of molecular and cell biology processes. Explores the topics of molecular information flow and signaling. Examines current understanding in biochemical methods and ideas beyond those discussed in Biochem I.

**CHEM 3800. Energy Use on Earth. (3 Credits)**

Cross-listed with: ENVT 3800, PHYS 3800

Prerequisite(s): (PHYS 1010 or PHSC 1000 or GEO 1010 or GEO 2040 or METO 1010) and (MATH 1050 or MATH 1055) and CHEM 1010 and University Advanced Standing

Covers the science of energy production and consumption. Quantitatively analyzes various methods of energy production, distribution, and end use in all sectors of our society, including transportation, residential living, and industry. Examines the impacts of our energy consumption on the environment and prospects for alternative energy sources. Is intended for science majors interested in energy use in society or in an energy related career, and for students in other majors who feel that a technical understanding of energy use will help them to understand and mitigate its impact in our society.

**CHEM 4000. Instrumental Analysis WE. (2 Credits)**

Prerequisite(s): CHEM 3000, and University Advanced Standing

Corequisite(s): CHEM 4005

Covers modern instrumental methods and basic principles of instrumentation. Includes spectroscopic and chromatographic analysis.

**CHEM 4005. Instrumental Analysis Laboratory. (2 Credits)**

Prerequisite(s): CHEM 3000, CHEM 2325, and University Advanced Standing

Corequisite(s): CHEM 4000

Experiments in selected areas of instrumental methods of analysis. Covers both quantitative and qualitative methods of analysis. Includes introductory laboratory exercises and laboratories using advanced sample preparation and instrumental analysis techniques. Involves the independent creation and implementation of an advanced laboratory exercise.

Course Lab fee of \$333 applies.

**CHEM 4030. Radiochemistry. (3 Credits)**

Prerequisite(s): CHEM 1220, MATH 1210, and University Advanced Standing

Introduces nuclear and radiochemistry, stressing the fundamentals of nuclear structure, systematics of nuclear decay, the detection and measurement of radiation, radiation protection, and the role of nuclear chemistry in medical, environmental and scientific applications. Discusses nuclear fuel cycles and nuclear waste problems.

**CHEM 4600. Structure Determination. (3 Credits)**

Prerequisite(s): CHEM 2320, and University Advanced Standing

Corequisite(s): CHEM 4605

Explores integrated topics in organic, inorganic, physical, solid-state, and biochemistry using advanced theory. Enables hands-on use and manipulation of state-of-the-art instrumentation. Examines primary chemistry literature, and involves substantial problem solving using spectroscopic and spectrometric data.

**CHEM 4605. Structure Determination Laboratory. (1 Credit)**

Prerequisite(s): CHEM 2320 and University Advanced Standing

Corequisite(s): CHEM 4600

Exposes students to integrated topics in organic, inorganic, physical, solid-state, and biochemistry using advanced theory. Enables hands-on use and manipulation of state-of-the-art instrumentation. Immerses students in the primary chemistry literature, and involves substantial problem solving using spectroscopic and spectrometric data. Taken as a corequisite with CHEM 4600.

Course lab fee of \$204 applies.

**CHEM 4700. Proteomics. (3 Credits)**

Cross-listed with: BIOL 4700

Prerequisite(s): (CHEM/BIOL 3600 or BIOL 3400 or BIOL 4300) and University Advanced Standing

Explores the fundamentals of discovery-based biochemistry, especially of proteins, relating proteomics to other fields of discovery-based chemistry, biology, and biochemistry, and to the field of systems biology. Establishes the relevance of proteomics to human concerns, including the health sciences and chemical fields.

**CHEM 4800. Pharmacology. (3 Credits)**

Prerequisite(s): (CHEM 3600 or BIOL 3600) and University Advanced Standing

Explores the science behind pharmacological therapeutics. Examines general considerations such as pharmacokinetics, drug metabolism, and toxicology. Surveys focused topics including drugs and drug targets for a wide variety of diseases.

**CHEM 482R. Chemistry Internship. (1-4 Credits)**

Prerequisite(s): CHEM 2320, a minimum GPA of 3.0, Departmental approval of the internship proposal, and University Advanced Standing

Provides supervised, practical, and research experience for students preparing for careers in chemistry. May be repeated for a maximum of 6 credit hours as per school standards. May be graded credit/no credit.

**CHEM 489R. Undergraduate Research in Chemistry. (1-4 Credits)**

Prerequisite(s): Departmental approval and University Advanced Standing

Conducts research on a project determined by the student jointly with a chemistry faculty and approved by the Chemistry Department Chair.

Emphasizes experimental technique, data collection and analysis, and preparation of research for presentation to an audience of peers. May be repeated for a maximum of 6 credits toward graduation.

**CHEM 491R. Advanced Topics in Inorganic Chemistry. (3 Credits)**

Prerequisite(s): Instructor Approval and University Advanced Standing

Examines advanced and current topics of inorganic chemistry including bioinorganic chemistry, organometallic chemistry, symmetry and molecular orbital theory, and the descriptive chemistry of main-group compounds. Varies from semester to semester. Offered on demand. May be repeated for a maximum of 9 credits.

**CHEM 4920. Chemistry Capstone- Literature/Seminar. (1 Credit)**

Prerequisite(s): CHEM 2320 with a C- or higher and University Advanced Standing; ENGL 2010 highly recommended

Engages in current chemistry topics. Enables familiarity with chemistry literature resources, teaches chemistry research and design, and facilitates preparation for further education and employment in chemistry-related fields. Focuses on current topics in chemistry and on chemistry literature.

**CHEM 4930. Chemistry Capstone- Ethics/Seminar. (1 Credit)**

Prerequisite(s): CHEM 2320 with a C- or higher and University Advanced Standing

Teaches chemistry research and design for further education and employment in chemistry-related fields. Focuses on scientific ethics, current topics in chemistry, chemistry literature and formal report writing based on American Chemical Society guidelines.

**CHEM 495R. Advanced Topics in Organic Chemistry. (3 Credits)**

Prerequisite(s): CHEM 2310, CHEM 2320, Instructor approval, and University Advanced Standing

For students majoring in Chemistry. Varies from semester to semester. May be repeated for a maximum of 9 credits. Topics include organic synthesis, reaction mechanisms, and identification of organic compounds.

**CHEM 496R. Special Topics in Chemistry. (1-4 Credits)**

Prerequisite(s): CHEM 2320, Junior or Senior standing, instructor approval, and University Advanced Standing

Explores special topics in chemistry. Topics vary depending on student demand and current topics of significance in chemistry. May be repeated for a maximum of 8 credits toward graduation.

**CHEM 499R. Independent Study and Research. (1-4 Credits)**

Prerequisite(s): Instructor approval and University Advanced Standing

Uses independent study on selected topics and conducting experiments in the same topic. Provides guidance by a faculty member. May be taken for a maximum of 4 credits.

**CHEM 525R. Advanced Topics for Chemistry Teachers. (1-5 Credits)**

Prerequisite(s): Departmental Approval

For licensed teachers or teachers seeking to recertify their chemistry endorsement from the Utah State Office of Education. Teaches principles of chemistry and pedagogy of teaching chemistry for teachers in public or private schools. Emphasizes correlation with the Utah Core Curriculum, the National Science Education Standards, and the Benchmarks of Project 2061. Topics will vary.