

DEPARTMENT OF CHEMISTRY

<http://www.uvm.edu/~chem/>

Chemistry is the center of science. Chemists seek understanding of all aspects of the physical and biological worlds at the molecular level, developing methodologies to probe the structure of molecules and chemical reactions. These techniques are critical to solving biological and biomedical problems and also provide tools to address important problems in materials science, geology, and in the environmental sciences.

Chemistry students gain the intellectual skills needed to confront and solve difficult problems and develop a rigorous lifelong commitment to learning. In conjunction with the Chemistry Department's active Ph.D. program, undergraduate Chemistry majors work with faculty members and graduate students engaged in cutting-edge research. This participation brings state-of-the-art perspectives to undergraduate learning that can only be obtained at a modern research university.

Chemistry students learn to be creative thinkers, scientists, and clear communicators, under the guidance of internationally-recognized faculty who are deeply committed to teaching, advising, and research. Faculty regularly garner funding from the National Science Foundation, National Institutes of Health, and the U.S. Department of Energy, among others, for research in areas that include biomedical applications and drug development, environmental science, and materials science.

MAJORS

CHEMISTRY MAJORS

Chemistry B.A.

Chemistry B.S.

MINORS

CHEMISTRY MINOR

Chemistry

GRADUATE

Chemistry AMP

Chemistry M.S.

Chemistry Ph.D.

See the online Graduate Catalogue for more information.

Courses

CHEM 023. Outline of General Chemistry. 0 or 4 Credits.

One-semester survey of principles and concepts of general chemistry, topics covered include bonding, mole ratios, equilibrium and nuclear chemistry. May not be taken for credit concurrently with, or following receipt of, credit for CHEM 025, CHEM 031, or CHEM 035.

CHEM 025. Outline of General Chemistry. 3 Credits.

One-semester survey of principles and concepts of general chemistry, topics covered include bonding, mole ratios, equilibrium and nuclear chemistry. NO LABORATORY. May not be taken for credit concurrently with, or following receipt of, credit for CHEM 023, CHEM 031 or CHEM 035.

CHEM 026. Outline of Organic & Biochem. 0 or 4 Credits.

Broad overview of most important facts and principles of organic and biochemistry and interrelationships between these branches of chemistry. May not be taken for credit concurrently with, or following receipt of, credit for CHEM 028, CHEM 042 or CHEM 044. Prerequisite: CHEM 023 or CHEM 031.

CHEM 028. Outline of Organic & Biochem. 3 Credits.

Broad overview of most important facts and principles of organic and biochemistry and of interrelationships between these branches of chemistry. NO LABORATORY. May not be taken for credit concurrently with, or following receipt of, credit for CHEM 026, CHEM 042 or CHEM 044. Prerequisite: CHEM 023, CHEM 025, or CHEM 031.

CHEM 031. General Chemistry 1. 0 or 4 Credits.

First semester of a two-semester sequence. Topics include matter, stoichiometry, gas laws, thermochemistry, quantum theory, atomic structure, electronic configurations, bonding and intermolecular forces. May not be taken for credit concurrently with, or following receipt of, credit for, CHEM 023, CHEM 025 or CHEM 035.

CHEM 032. General Chemistry 2. 0 or 4 Credits.

Second semester of a two-semester sequence. Topics include solutions, kinetics, equilibrium, acid-base chemistry, aqueous ionic equilibria, thermodynamics, electrochemistry and nuclear chemistry. May not be taken for credit concurrently with, or following receipt of, credit for CHEM 036. Prerequisite: CHEM 031 or CHEM 035.

CHEM 035. General Chemistry for Majors 1. 0 or 4 Credits.

For students with a strong background in physical sciences. Topics include atomic and molecular structure, gas behavior, molecular geometries, intermolecular interactions, elementary thermochemistry and stoichiometry. May not be taken for credit concurrently with, or following receipt of, credit for CHEM 023, CHEM 025 or CHEM 031.

CHEM 036. General Chemistry for Majors 2. 0 or 4 Credits.

Second semester of a two-semester sequence. Topics include equilibrium thermodynamics (acid/base chemistry, solubility and electrochemistry), transition metal coordination complexes and spectroscopy. May not be taken concurrently with, or following receipt of, credit for CHEM 032. Prerequisite: CHEM 031 or CHEM 035.

CHEM 039. Introduction to Research. 2 Credits.

Overview of methods, areas, and instrumentation of modern chemical research, including hands-on laboratory experiences and written and oral presentations of a research project. Prerequisite: score of 4 or 5 on the AP Chemistry examination or Department permission.

CHEM 040. Introduction to Research. 2 Credits.

Overview of methods, areas, and instrumentation of modern chemical research, including hands-on laboratory experiences and written and oral presentations of a research project. Prerequisite: score of 4 or 5 on the AP Chemistry examination or Department permission.

CHEM 042. Intro Organic Chemistry. 0 or 4 Credits.

Bonding, structure, physical properties and chemical reactivity of basic organic functional groups and molecules of technological and biological significance, including carbohydrates, lipids, proteins. Not recommended for pre-medical students. May not be taken for credit concurrently with, or following receipt of, credit for CHEM 026, CHEM 028, CHEM 044, CHEM 141, or CHEM 143. Prerequisite: CHEM 023 or CHEM 031.

CHEM 044. Intro Organic Chemistry. 3 Credits.

Bonding, structure, physical properties and chemical reactivity of simple organic functional groups and molecules of technological and biological significance, including carbohydrates, lipids, proteins. NO LABORATORY. Not recommended for pre-medical students. May not be taken for credit concurrently with, or following receipt of, credit for CHEM 026, CHEM 028, CHEM 042, CHEM 141 or CHEM 143. Prerequisite: CHEM 023 or CHEM 025 Prerequisite: CHEM 023, CHEM 025, or CHEM 031.

CHEM 075. Global Energy Prospective. 1 Credit.

Overview of U.S. and global energy sources and uses; state of alternative energy; projected energy demand and impacts of conventional and alternative energy sources.

CHEM 090. Internship. 1-3 Credits.

An on-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

CHEM 095. Intro Special Topics. 1-18 Credits.

See Schedule of Courses for specific titles.

CHEM 096. Intro Special Topics. 1-18 Credits.

See Schedule of Courses for specific titles.

CHEM 121. Quantitative Analysis. 0 or 4 Credits.

Theory and practice of volumetric and gravimetric analysis. Theoretical discussion of indicators, buffers, pH, etc. Introduction to data analysis, spectrophotometry, and chromatography. Prerequisite: CHEM 032 or CHEM 036.

CHEM 131. Inorganic Chemistry. 3 Credits.

Symmetry, group theory, molecular structure; electronic structure of atoms; bonding models including MO, crystal field, and ligand field; solid state, acid-base, and simple organometallic systems. Prerequisite: CHEM 141 or CHEM 143.

CHEM 141. Organic Chemistry 1. 0 or 4 Credits.

Survey of properties and reactivity of organic compounds with consideration of bonding, stereochemistry, and reaction mechanisms. Designed for premedical and biological sciences students. May not be taken for credit concurrently with, or following receipt of, credit for CHEM 042, CHEM 044 or CHEM 143. Prerequisite: CHEM 032 or CHEM 036.

CHEM 142. Organic Chemistry 2. 0 or 4 Credits.

Survey of the reactivity of organic compounds and applications to synthesis. Spectroscopy is discussed in relation to compound characterization. Designed for premedical and biological sciences students. May not be taken for credit concurrently with, or following receipt of, credit for CHEM 144. Prerequisite: CHEM 141 or CHEM 143.

CHEM 143. Organic Chemistry for Majors 1. 0 or 4 Credits.

Survey of principles and reactivity of organic compounds with consideration of bonding, stereochemistry and reaction mechanism. Designed for chemistry majors. May not be taken for credit concurrently with, or following receipt of, credit for CHEM 042, CHEM 044 or CHEM 141. Prerequisite: CHEM 032 or CHEM 036.

CHEM 144. Organic Chemistry for Majors 2. 0 or 4 Credits.

Survey of the reactivity of organic compounds and applications to synthesis. Spectroscopy is discussed in relation to compound characterization. Designed for chemistry majors. May not be taken for credit concurrently with, or following receipt of, credit for CHEM 142. Prerequisite: CHEM 141 or CHEM 143.

CHEM 146. Advanced Organic Laboratory. 2 Credits.

Laboratory for chemistry majors that covers advanced techniques used in organic chemistry research. Hands-on practice in multi-step synthesis, purification, identification, and spectroscopy. Prerequisite: Prerequisite: CHEM 142 or CHEM 144.

CHEM 165. Intro Physical Chemistry. 3 Credits.

An introduction to physical chemistry concepts in quantum chemistry, thermodynamics, and kinetics, suitable for students from most science disciplines. Background in calculus and physics is required. Prerequisites: CHEM 032 or CHEM 036; MATH 020 or MATH 022 or MATH 023; PHYS 011 or PHYS 051.

CHEM 167. Physical Chemistry Preparation. 1 Credit.

Review of relevant mathematical and physical concepts as applied to physical chemistry. Prerequisites: CHEM 032 or CHEM 036, and MATH 022. Cross-listed with: MATH 167.

CHEM 190. Internship. 1-18 Credits.

An on-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

CHEM 191. Teaching Assistantship. 1-3 Credits.

Undergraduate student service as a teaching assistant, usually in an introductory level course in the discipline, for which credit is awarded. Offered at department discretion.

CHEM 192. Independent Study. 1-18 Credits.

A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting? under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

CHEM 195. Intermediate Special Topics. 1-18 Credits.

See Schedule of Courses for specific titles.

CHEM 196. Intermediate Special Topics. 1-18 Credits.

See Schedule of Courses for specific titles.

CHEM 198. Undergraduate Research. 1-18 Credits.

Undergraduate students work on research projects under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

CHEM 201. Advanced Chemistry Laboratory. 3 Credits.

Discussion and laboratory experiments using spectroscopy techniques (mass spectrometry, NMR, IR, UV/visible, and atomic spectroscopy) to solve problems in analytical, physical, and inorganic chemistry. Prerequisites: CHEM 121, and CHEM 142 or CHEM 144. CHEM 161 strongly recommended.

CHEM 202. Advanced Chemistry Laboratory. 2 Credits.

Laboratory problems requiring modern analytical, physical, and inorganic synthetic techniques. Journal article writing. Prerequisite: CHEM 201.

CHEM 205. Biochemistry I. 3 Credits.

Introduction to chemistry and structure of biological macromolecules; examination of mechanisms of chemical processes in biological systems including enzyme catalysis, biosynthesis, regulation, and information transfer. Prerequisite: CHEM 142 or CHEM 144. Cross-listed with: BIOC 205 and MMG 205.

CHEM 206. Biochemistry II. 3 Credits.

Continuation of Biochemistry I. Biochemistry of nucleic acids; nucleic acid based processes, such as replication and transcription; cellular information transfer, genomics, and proteomics. Prerequisite: BIOC 205, CHEM 205, or MMG 205. Cross-listed with: BIOC 206 and MMG 206.

CHEM 207. Biochemistry Lab. 2 Credits.

Introduction to biochemical tools, including spectrometry, chromatography, and electrophoresis; natural and recombinant enzyme isolation; assays of DNA-modifying enzymes; computer-based structure/function exercises. Prerequisite: BIOC 205, CHEM 205, or MMG 205. Cross-listed with: BIOC 207 and MMG 207.

CHEM 214. Polymer Chemistry. 3 Credits.

Polymer synthesis and characterization. Kinetic models for polymerization and copolymerization. Physical properties, characterization of polymers in the solid state and in solution. Prerequisite: CHEM 142 or CHEM 144, and CHEM 162.

CHEM 221. Instrumental Analysis. 3 Credits.

Systematic survey of modern methods of chemical analysis. Fundamental principles and applications of spectroscopy, electrochemistry, and separation techniques. Prerequisite: CHEM 121. Credit for or concurrent enrollment in CHEM 161 or CHEM 162 strongly recommended.

CHEM 223. Mass Spectrometry. 3 Credits.

An in-depth treatment of modern mass spectrometry, instrumentation and techniques with discussion of biological and chemical applications. Prerequisites: CHEM 142 or CHEM 144, and CHEM 221, or Instructor permission.

CHEM 225. Electroanalytical Chemistry. 3 Credits.

Principles and techniques of modern electrochemical analysis and applications to redox chemistry. Heterogeneous effects; voltammetry; electron-transfer processes and reactions. Prerequisite: CHEM 221.

CHEM 226. Analytical Spectroscopy. 3 Credits.

Principles of optical spectroscopic methods of analysis. Emphasis on theory and practice of atomic spectroscopy and new molecular spectroscopic methods. Prerequisite: CHEM 221. Alternate years.

CHEM 227. Spec Topics in Analytical Chem. 1-3 Credits.

Selected topics of current interest in analytical chemistry. New techniques and methodologies, especially in chemical instrumentation. Credit as arranged.

CHEM 228. Spec Topics in Analytical Chem. 1-4 Credits.

Selected topics of current interest in analytical chemistry. New techniques and methodologies, especially in chemical instrumentation. Credit as arranged.

CHEM 231. Advanced Inorganic Chemistry. 3 Credits.

Molecular symmetry and group theory with an emphasis on applications (vibrational and electronic spectra, bonding and reactivity); introduction to transition metal processes; bioinorganic chemistry. Prerequisite: CHEM 142 or CHEM 144.

CHEM 234. Organometallic Chemistry. 3 Credits.

Synthesis, structure, bonding, properties, reactions, and applications of organometallic systems; mechanisms of organometallic reactions including oxidative addition and insertion reactions with applications in catalysis. Prerequisite: CHEM 131 or CHEM 231.

CHEM 236. Physical Inorganic Chemistry. 3 Credits.

Determination of molecular and electronic structure of inorganic complexes using spectroscopic techniques. Topics include ligand field theory, magnetism, magnetic resonance, Mossbauer spectroscopy, and X-ray crystallography. Prerequisites: CHEM 131 or CHEM 231, and CHEM 161.

CHEM 237. Special Topics: Inorganic. 1-3 Credits.

Areas of current interest involving inorganic systems.

CHEM 238. Special Topics: Inorganic. 1-3 Credits.

Areas of current interest involving inorganic systems.

CHEM 241. Advanced Organic Chemistry 1. 3 Credits.

Stereochemistry, conformational analysis, stereoelectronic effects, transition state theory, molecular orbital theory, and reactivity criteria are discussed in regards to reaction mechanisms and functional group manipulations. Prerequisite: CHEM 142 or CHEM 144.

CHEM 242. Advanced Organic Chemistry 2. 3 Credits.

Modern synthetic organic methods and approaches to multi-step synthesis are discussed. Selected total syntheses are reviewed to highlight important concepts including diastereoselective and enantioselective processes. Prerequisite: CHEM 241.

CHEM 251. Physical Organic Chemistry. 3 Credits.

Experimental and computational techniques for determining and interpreting structure, properties and reactivity of organic molecules, with an emphasis on the mechanisms of organic reactions. Prerequisites: CHEM 142 or CHEM 144, and CHEM 161, or graduate standing.

CHEM 257. Special Topics in Organic Chem. 1-3 Credits.

Advanced level discussion of specific topics in organic chemistry of current interest such as photochemistry, carbenes, bioorganic chemistry, magnetic resonance, etc. Credit as arranged.

CHEM 258. Special Topics in Organic Chem. 1-3 Credits.

Advanced level discussion of specific topics in organic chemistry of current interest such as photochemistry, carbenes, bioorganic chemistry, magnetic resonance, etc. Credit as arranged.

CHEM 260. Advanced Physical Chemistry. 3 Credits.

Builds on the concepts from Introductory Physical Chemistry (CHEM 165). The three major areas of quantum chemistry, thermodynamics, and kinetics are extended in greater depth, and at a higher level of mathematical rigor. Prerequisite: CHEM 165. Co-requisites: CHEM 167 or MATH 121.

CHEM 262. Chemical Thermodynamics. 3 Credits.

Classical and statistical thermodynamics. Systematic study of applications of thermodynamics to chemical problems. Prerequisites: CHEM 161 and CHEM 162.

CHEM 264. Adv Quantum & Spectroscopy. 3 Credits.

In-depth theoretical discussion of molecular states, their symmetry, and transition probabilities. Explicit treatment of vibrations, electronic states, and vibronic spectroscopy. Prerequisites: CHEM 161 and MATH 121.

CHEM 267. Special Topics: Physical. 1-3 Credits.

Selected topics of current interest in physical chemistry.

CHEM 268. Special Topics: Physical. 1-3 Credits.

Selected topics of current interest in physical chemistry.

CHEM 282. Senior Seminar. 1 Credit.

Oral and written presentation of a subject of current chemical interest. Prerequisite: Audit of CHEM 381.

CHEM 284. Biochemistry Senior Seminar. 1 Credit.

Oral and written presentation of a biochemical topic, with a strong emphasis on citations from current literature. Undergraduates only. Cross-listed with: BIOC 284, MMG 284.

CHEM 285. Special Topics. 1-3 Credits.**CHEM 286. Special Topics. 1-3 Credits.****CHEM 290. Internship. 1-18 Credits.**

An on-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is Offered at department discretion.

CHEM 291. Undergraduate Research. 1-18 Credits.

Undergraduate students work on research projects under the supervision of a faculty member, for which credit is awarded. Offered at department discretion. Prerequisite: Departmental permission.

CHEM 292. Independent Study. 1-18 Credits.

A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting? under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

CHEM 293. Teaching Assistantship. 1-3 Credits.

Undergraduate student service as a teaching assistant, usually in an introductory level course in the discipline, for which credit is awarded. Offered at department discretion.

CHEM 295. Advanced Special Topics. 1-18 Credits.

See Schedule of Courses for specific titles.

CHEM 296. Advanced Special Topics. 1-18 Credits.

See Schedule of Courses for specific titles.