

# Chemistry (CHM) - Courses

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## Courses

+CHM 100 Cr.4

### Contemporary Chemistry

A survey course focusing on applied chemistry. Fundamental chemistry and science concepts are developed and then used to study applications of this science to technology in society. Emphasis is placed on selected topics that are current. Course is not applicable to a major or minor in chemistry and does not meet the prerequisite requirement of any other chemistry course. Lect. 3, Lab 2. Offered Occasionally.

+CHM 103 Cr.5

### General Chemistry I

An introduction to chemistry including topics in atomic structure, chemical bonding, molecular structure, chemical stoichiometry, reactivity, states of matter, solutions, acid-base theory, and nuclear chemistry, and also including selected topics in descriptive and applied chemistry. Scientific inquiry, experimental design and data analysis are included. Lect. 3, Lab 3, Disc. 1. Prerequisite: grade of "C" or better in MTH 150 or placement into MTH 151 or higher. Students who are currently enrolled in CHM 103 may not register for this course again until after priority registration (unless they have instructor/department consent). Offered Fall, Spring, Summer.

CHM 104 Cr.5

### General Chemistry II

The second half of the two-semester sequence in general chemistry. The course provides an introduction to the topics of chemical kinetics, equilibria in the gas and solution phases, acid-base chemistry, solubility, thermochemistry, and electrochemistry. The laboratory portion of the course serves to reinforce and demonstrate the above concepts through experimentation. Lect. 3, Lab 3, Disc. 1. Prerequisite: grade of "C" or better in CHM 103. Students who are currently enrolled in CHM 104 may not register for this course again until after priority registration (unless they have instructor/department consent). Offered Fall, Spring.

CHM 250 Cr.3

### Introduction to Organic and Biochemistry

A survey course focusing on basic organic and biochemistry with applications to chemical processes in human and other living systems. Course is not applicable to a major or minor in chemistry and does not meet the prerequisite requirement of any other chemistry course. Prerequisite: grade of "C" or better in CHM 103. Students with credit in CHM 300 or CHM 325 cannot earn credit in CHM 250. Offered Spring.

CHM 271 Cr.1

### The Chemical Community

A sophomore level course for chemistry and biochemistry majors that exposes students to scientific communication (writing, speaking, presenting), the chemical literature and how to search it, potential careers in chemistry and career preparation, student opportunities such as internships and undergraduate research, and current and historical topics in chemistry including ethics in science. Students are expected to participate in discussions and complete various writing and presentation assignments. Prerequisite: CHM 104; sophomore standing; chemistry or biochemistry major. Offered Fall.

CHM 299 Cr.1

### Chemistry Tutor Training Practicum

This course is designed to offer training and supervision for tutors in the Murphy Learning Center. The course will include an overview of peer tutoring and learning theory, an overview of the general tutoring process, and an examination of best practices for tutoring various client populations. Students will develop a reflective tutoring practice based on readings and course discussions. The course must be taken during the student's first semester of employment in the Learning Center. Failure to complete the course will result in termination from the Learning Center. Students who repeat the course will engage more deeply with the content and provide meaningful insights for their peers. Repeatable for credit - maximum three. Consent of instructor. Pass/Fail grading. Offered Fall, Spring.

CHM 300 Cr.4

### Fundamental Organic Chemistry

This course is a study of the properties, reactions, and applications of the major classes of organic compounds that commonly appear in biological and environmental processes and systems. Theories relating structures of organic molecules to their chemical reactions are presented as unifying principles. Cross-disciplinary applications of organic chemistry to the life sciences and environmental concerns are included. This terminal organic chemistry course is recommended for students in the biological and allied health sciences when only one semester of organic chemistry is required. Course is applicable only to the following Chemistry and Biochemistry Department programs: the chemistry education major and minor, and the chemistry minor. Lect. 3, Disc. 1. Prerequisite: CHM 104; sophomore standing. Students with credit in CHM 303 cannot earn credit in CHM 300. CHM 300 does not satisfy the prerequisite requirement for CHM 304. Offered Fall, Spring, Summer.

CHM 301 Cr.5

### Analytical Chemistry

Theory and practice of selected methods of chemical analysis. Titrimetric, potentiometric, spectrophotometric and gas chromatographic methods of analysis are studied. Statistical treatment of data and techniques for quality assurance are also developed. The basic science component in the course is primarily directed towards ionic equilibria. Lect. 3, Lab 6. Prerequisite: CHM 104; sophomore standing. Offered Fall, Spring.

CHM 302 Cr.1

### Fundamental Organic Chemistry Laboratory

This is an introduction to common principles of molecular behavior and laboratory practices in organic chemistry. Applications of organic chemistry to the life sciences and environmental concerns are emphasized. This fundamental organic chemistry laboratory is recommended for students in the allied health sciences when an organic laboratory course is needed. Lab 3. Course is applicable only to the following chemistry and biochemistry programs: Chemistry Education major and minor, and the Chemistry minor. Prerequisite: CHM 300 or CHM 304 or concurrent registration. Students cannot earn credit in both CHM 302 and CHM 305. Offered Fall, Spring, Summer.

CHM 303 Cr.3

### Organic Chemistry Theory I

A study of the structure, methods of structure determination, stereochemistry and chemical behavior of hydrocarbons, alcohols, and halogenated hydrocarbons. Theories and mechanisms are introduced to explain chemical behavior. Prerequisite: CHM 104; sophomore standing. Students with credit in CHM 300 cannot earn credit in CHM 303. Offered Fall, Spring.

CHM 304 Cr.3

**Organic Chemistry Theory II**

A study of organic synthesis, common functional groups, carbanions, reaction mechanisms, lipids, carbohydrates, proteins and polymers. Prerequisite: CHM 303. Offered Fall, Spring.

CHM 305 Cr.2

**Organic Chemistry Laboratory**

This course is an introduction to common laboratory practices in organic chemistry. Experiments are designed to illustrate synthetic and separation techniques. Organic qualitative analysis is included. Lab 6. Prerequisite: CHM 304 or concurrent enrollment. Students cannot earn credit in both CHM 302 and CHM 305. Offered Fall, Spring, Summer.

CHM 309 Cr.3

**Physical Chemistry Theory I**

A study of real gases, equations of state, kinetic and molecular theory, properties of gases, molecular energies, classical thermodynamics, chemical equilibria, changes of state and reaction kinetics and mechanisms. Prerequisite: CHM 104; PHY 103 or PHY 203; PHY 104 or PHY 204; MTH 310 or concurrent enrollment. Offered Fall.

CHM 310 Cr.3

**Physical Chemistry Theory II**

Quantum mechanics, atomic and molecular spectroscopy, molecular structure, lasers, statistical thermodynamics, and other special topics are covered in this course. Prerequisite: CHM 309. Offered Spring.

CHM 312 Cr.3

**Atmospheric Chemistry**

This course is an overview of atmospheric chemistry including the ozone layer and ozone holes, tropospheric chemistry (both natural and the effects of air pollution), the greenhouse effect and the impact of human activities on climate change. It may also include topics related to urban and indoor air quality and means of generating energy that result in lower greenhouse gas emissions to the atmosphere. Prerequisite: CHM 300 or CHM 303. Offered Spring.

CHM 313 Cr.2

**Physical Chemistry Laboratory**

A laboratory course designed to teach, illustrate, and strengthen basic concepts in experimental physical chemistry. Topics include thermodynamics, kinetics, introductory spectroscopy, and occasional advanced topics in physical chemistry. Students will be exposed to current techniques and equipment used in investigating physical chemistry questions. An emphasis is placed on the development of proficiency in both oral and written scientific communication. Lab 6. Prerequisite: CHM 309. Offered Spring.

CHM 320 Cr.1-3

**Practicum in Chemistry**

A course designed for and adapted to the specific needs of select groups having specific interests in the applications of techniques and/or theories of chemistry, i.e., educational professionals, chemical technicians, medical technologists, etc. Lecture and laboratory will be adapted to the topic being taught. May be repeated for credit when different topic is presented. Prerequisite: to be determined - based on topic offered. Not applicable to a major in chemistry. Offered Occasionally.

CHM 322 Cr.4

**Chemistry of Materials**

This course introduces you to the world of materials science and the role that chemistry plays in both synthesis and applications of various materials. Students will begin with an overview of specific classes of materials such as metals, polymers, ceramics, semiconductors and carbon-based nanomaterials with a focus on commercially relevant systems. This knowledge will then be applied to understand composite materials and how they are used in specific applications such as fuel cells, batteries, solar cells and electrolyzers. A preliminary knowledge of organic nomenclature and analytical chemistry is a prerequisite. Laboratory exercises will be designed to complement your learning in lecture as well as augment skills in scientific writing. Lect. 3, Lab 3. Prerequisite: CHM 301; CHM 300 or CHM 303. Offered Spring.

CHM 323 Cr.2

**Polymer Chemistry Laboratory**

A practical introduction to the application of important techniques for polymer synthesis and characterization. Various polymerization approaches will be covered including bulk, solution and emulsion polymerization processes. Methods for analyzing molecular weights and molecular weight distributions will be employed. Instrumental techniques for the characterization of thermal, mechanical and surface properties of polymeric materials will also be emphasized. Lec. 1, Lab 3. Prerequisite: CHM 322. Offered Spring - Odd Numbered Years.

CHM 325 Cr.4

**Fundamental Biochemistry**

This course is the study of the fundamental chemical processes in biological systems emphasizing the structure and function of biological macromolecules, metabolism and the regulation of cellular processes, transport mechanisms, nature of biological energy, and applications to cellular and organismal function. Lect. 3, Lab 3. Prerequisite: CHM 300 or CHM 304 are required; a 300 or 400-level chemistry course with a lab (excluding CHM 461, CHM 489, and CHM 499) is recommended. Students with credit in CHM 417 cannot earn credit in CHM 325. Offered Fall, Spring.

CHM 330 Cr.3

**Industrial Chemistry**

An overview of both the scientific and commercial aspects of the chemical industry. Industrially important chemical processes will be discussed. Topics will include production and end use of basic inorganic chemicals of commercial importance, industrial gases, and petroleum-based products. The economics of various chemical processes will be presented. Global and local topics such as regulatory compliance, product liability, and patent/trade secret documentation may also be discussed. Prerequisite: CHM 300 or CHM 303. Offered Spring - Even Numbered Years.

CHM 331 Cr.3

**Fundamentals of Inorganic Chemistry**

This is a foundational course in inorganic chemistry intended to provide exposure to and understanding of the composition, structure, bonding properties and reactivity of inorganic compounds. Prerequisite: grade of "C" or better in CHM 104. Offered Fall.

CHM/BIO/PHY 356 Cr.2

**Curriculum and Assessment in Math and Science**

Students are introduced to state and national content standards and related theories on teaching and learning. They will apply this knowledge to develop a curricular framework. Topics will include: Learning outcomes, student misconceptions, balanced assessment, and lesson planning in the content areas. Prerequisite: declared math or science education major/minor; admission to teacher education. (Cross-listed with BIO/CHM/PHY; may only earn credit in one department.) Offered Fall.

CHM 361 Cr.3

#### **Radiochemistry**

A study of the decay of radioactive elements, detection of radiation, methods of analysis and applications such as neutron activation and radioactive dating. Lect. 2, Lab 2. Prerequisite: three semesters of chemistry courses. Students with credit in CHM 461 cannot earn credit in CHM 361. Offered Occasionally.

CHM 403 Cr.3

#### **Advanced Organic Chemistry**

Advanced topics in organic chemistry, including reaction mechanisms, molecular orbital theory, conservation of orbital symmetry, pericyclic reactions, photochemistry, aromaticity, stereochemistry, kinetics, isotope effects, linear free energy relationships, hard-soft acid-base theory, and selected examples of recent advances in synthetic organic chemistry. Prerequisite: CHM 304. Offered Fall - Even Numbered Years.

CHM 405 Cr.2

#### **Advanced Organic Synthesis**

This is an advanced course in organic chemistry intended to provide students with organic synthesis techniques that can be applied to other chemically-related fields. Synthesis, characterization, and separation techniques will be applied to organic compounds. Instrumental techniques such as nuclear magnetic resonance, infrared spectroscopy, gas chromatography, and mass spectrometry will be utilized, and appropriate use of chemical literature will be included. Prerequisite: CHM 305 or grade of "B" or better in CHM 302. Offered Fall - Odd Numbered Years.

CHM 407 Cr.3

#### **Biophysical Chemistry**

A study of the physical principles that drive the structure and behaviors of biological molecules. Topics include the relationship between the properties of biomolecular building blocks and macromolecular structure; application of different physical models (thermodynamic, quantum mechanical, statistical mechanical) to macromolecular structure and behavior; application of physical techniques (spectroscopy, calorimetry, etc.) to the characterization of macromolecular structure and behavior. Prerequisite: CHM 417 or CHM 325; MTH 207; MTH 208 or MTH 265 or concurrent enrollment; PHY 103 or PHY 203; PHY 104 or PHY 204. Offered Spring.

CHM 412 Cr.3

#### **Aquatic and Soil Chemistry**

This course examines the role of chemistry in shaping our environment, focusing specifically on aquatic and terrestrial systems. Students will learn how to apply fundamental chemical principles to complex real systems in order to characterize environmental behavior. Learning to understand and predict the fate of organic and inorganic pollutants in soil-water systems will be emphasized. Special topics that relate to current events will also be explored, and the connection between environmental issues and social/economic challenges will be examined. Prerequisite: CHM 300 or CHM 303. Offered Fall.

CHM 413 Cr.2

#### **Environmental Chemistry Laboratory**

This course is an exploration of chemical reactivity and measurement in atmospheric, terrestrial, and aquatic ecosystems. Students collect and analyze samples and perform experiments that validate major environmental topics. Lab experiments include measurement of the physical/chemical properties of air, water, and soil relative to environmental standards and toxic thresholds, as well as investigations of the chemistry of greenhouse gases, contaminants, indoor pollution, and acid rain. Lab 4. Prerequisite: CHM 300 or CHM 303 or CHM 301. Offered Fall.

CHM 417/517 Cr.4

#### **Biochemistry I: Macromolecules**

This course is the study of the structure and function of biological macromolecules with special emphasis on proteins. Topics include protein folding, protein-ligand interactions, protein function, and membrane structure and function. The laboratory focuses on contemporary biochemical techniques including quantitative biochemical assays, ligand binding, protein purification, and enzyme function. Lect 3, Lab 3. Prerequisite: "C" or better in CHM 300 or CHM 304 is required; a 300 or 400-level chemistry course with a lab (excluding CHM 461, CHM 489, and CHM 499) is recommended; junior standing. BIO 315 or MIC 425 also recommended. Students with credit in CHM 325 cannot earn credit in CHM 417. Offered Fall.

CHM 418 Cr.3

#### **Biochemistry II: Metabolism and Genetic Information**

This course provides a comprehensive and integrative approach to fundamental metabolism and the flow of genetic information. In particular, the course emphasizes the chemical principles governing metabolite inter-conversions, energy flow, regulation of metabolic pathways, and the maintenance of genetic information. Prerequisite: "C" or better in CHM 417; junior standing. BIO 306 and BIO 315, or MIC 416 and MIC 425 recommended. Offered Spring.

CHM 419 Cr.3

#### **Advanced Biochemistry Lab**

A capstone biochemistry laboratory course that provides students with the opportunity to undertake hypothesis-driven research. Students will use a variety of contemporary biochemical and biophysical techniques to study biomolecular structure and function. As the capstone course in the biochemistry major, students will give written and oral reports of their work that incorporate the primary literature. Lect. 1, Lab 6. Prerequisite: "C" or better in CHM 417; CHM 418 or concurrent enrollment; junior standing. Offered Spring.

CHM 421/521 Cr.1-3

#### **Advanced Topics in Chemistry**

An advanced topic in chemistry based on appropriate prior work in physical chemistry, organic chemistry, inorganic chemistry, and analytical chemistry. Lecture and laboratory will be adapted to the topic being taught. May be repeated for credit when different topic is presented. Repeatable for credit - no maximum. Prerequisite: determined based on topic offered and will include a minimum of three semesters of chemistry courses; junior standing. Offered Occasionally.

CHM 424 Cr.3

#### **Spectroscopy**

A survey of important spectroscopic methods used in chemistry; infrared and ultraviolet, proton and carbon-13 NMR, and mass spectrometry. Theory and practice of techniques are covered. Emphasis is placed on structure determination of organic molecules. Analysis of dynamic systems and mixtures may also be covered. Lect. 2, Lab 3. Prerequisite: CHM 300 or CHM 304; junior standing. Offered Spring - Even Numbered Years.

CHM 431 Cr.2

#### **Inorganic Synthesis and Methods**

This course is designed to cover the synthesis, characterization methods, and applications of inorganic-based materials. The techniques presented are immersed in numerous areas of chemistry disciplines ranging from inorganic to organic, analytical to nuclear, materials to physical, and even environmental to biochemistry. Both air-stable and air-sensitive methods will be covered and applications to real world situations will be the foundation for this course. Lab 6. Prerequisite: CHM 331 or concurrent enrollment; one 300-level laboratory course from CHM 301, CHM 302, CHM 305, CHM 313, CHM 322, or CHM 325. Offered Fall.

CHM 441 Cr.4

**Instrumental Analysis**

A study of the theory and principles of chemical instrumentation including the application of basic electronics, spectroscopy, separation science and electroanalytical methods of chemical analysis. Lect. 3, Lab 3. Prerequisite: CHM 301; junior standing. Offered Fall.

CHM 445/545 Cr.3

**Biochemistry of Antimicrobials**

A survey of the biochemistry and chemistry of drugs used to treat infectious diseases, including antibiotics, antivirals, antifungals, and anti-parasitic drugs. This course surveys biochemical mechanisms of action of clinically used antimicrobials, biochemical mechanisms of antimicrobial resistance, the biosynthesis of antimicrobials by microorganisms, chemical synthesis of antimicrobials, and approaches for the discovery of new antimicrobials. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Prerequisite: BIO 203 or BIO 315 or MIC 230; CHM 325 or CHM 417; junior standing. Offered Spring.

CHM 450 Cr.1-2

**Internship in Chemistry or Biochemistry**

This course is an academically relevant field experience in chemistry or biochemistry within government, industry, business, or community agencies. Students must have their internships approved and be advised by the department. Students must be on their internship worksite during the semester for which they are registered for academic credit. Credits earned will count only toward university electives and not toward the completion of any major or minor. Repeatable for credit - maximum four. Consent of department. Pass/Fail grading. Offered Fall, Spring, Summer.

CHM/BIO/MTH/PHY 451 Cr.2

**Curriculum and Content in Science and Mathematics**

This is a methods course for science education and mathematics education majors that focuses on how content knowledge and pedagogical content knowledge are used to inform instruction. The course will focus on exploration of state and national standards, academic language, and methods of assessment. Prerequisite: EDS 203, EDS 206; concurrent enrollment in the department's section of BIO/CHM/MTH/PHY 454 or BIO/CHM/MTH/PHY 455; admission to teacher education. (Cross-listed with BIO/CHM/MTH/PHY; may only earn credit in one department.) Consent of instructor. Offered Spring.

CHM/BIO/PHY 452 Cr.2

**The Learner and Learning in Science**

This is a methods course for science education majors that focuses on learning theories, equitable practices, and culturally relevant pedagogy. The course draws on recommendations from state and national standards. Prerequisite: EDS 203, EDS 206; concurrent enrollment in the department's section of BIO/CHM/MTH/PHY 454 or BIO/CHM/MTH/PHY 455; admission to teacher education. (Cross-listed with BIO/CHM/MTH/PHY; may only earn credit in one department.) Consent of instructor. Offered Fall.

CHM/BIO/PHY 454 Cr.2

**Field Experience I in Science Education**

This course is the first field experience in a school environment. Candidates plan and teach lessons within the designated grade range of 4-12. Candidates are introduced to classroom management and conflict resolution. A multi-day, consistent schedule in the middle or high school field experience classroom is established by the course instructor in consultation with the teacher candidate and cooperating teacher. Prerequisite: EDS 203, EDS 206; concurrent enrollment in the department's section of BIO/CHM/PHY 451 or BIO/CHM/PHY 452; admission to teacher education. (Cross-listed with BIO/CHM/PHY; may only earn credit in one department.) Consent of instructor. Offered Fall, Spring.

CHM/BIO/PHY 455 Cr.2

**Field Experience II in Science Education**

This course is the second field experience in a school environment. Candidates plan and teach lessons within the designated grade range of 4-12. Candidates are introduced to classroom management and conflict resolution. A multi-day, consistent schedule in the middle or high school field experience classroom is established by the course instructor in consultation with the teacher candidate and cooperating teacher. Prerequisite: EDS 203, EDS 206; concurrent enrollment in the department's section of BIO/CHM/PHY 451 or BIO/CHM/PHY 452; admission to teacher education. (Cross-listed with BIO/CHM/PHY; may only earn credit in one department.) Consent of instructor. Offered Fall, Spring.

CHM 461 Cr.4

**Nuclear Chemistry**

A study of the decay of radioactive nuclides with emphasis on the theory of nuclear decay. Laboratory will include the study of the detection of radiation, methods of radio analysis and the safe handling of unsealed radioactive sources. Lect. 3, Lab 3. Prerequisite: four semesters of chemistry courses; junior standing. Students with credit in CHM 361 cannot earn credit in CHM 461. Offered Spring.

CHM 479 Cr.1-4

**Field Research Station Experience**

This course explores real-world applications of chemical principles and analyses in an off-campus setting. This is an immersive experience at a partner research facility. Students interact with field research station scientists who share their expertise on the local system being studied. We study chemical tools and methods and experience these methods applied on site. The course includes data analysis. Topics may include the chemical principles of acid-base equilibrium, chemical solubility, spectrophotometric methods, fluorescence, plastics and materials, detection of molecules, and chemical separations. The course integrates scientific understanding with the local history and current impact of human cultures. The course includes reading scientific literature and news articles on current events related to the location of the field research station. Communication skills are developed via oral presentations and written formats to both scientists and non-scientists. The goals are to understand how chemical concepts are applied in the field and how scientific data can guide local communities. Repeatable for credit at different locations - maximum four. A maximum of two credits may apply to the chemistry major with environmental science concentration. Lect. .5, Lab .5, Field .5. Prerequisite: one of the following: CHM 301, CHM 302, CHM 305, CHM 313, CHM 325, CHM 413, CHM 417, or CHM 461. Offered Occasionally.

CHM 487 Cr.1

**Peer Instruction and Learning in Chemistry**

A structured course designed to introduce chemistry education majors and minors (Early Adolescence-Adolescence) to the proper methods of delivering general chemistry concepts to undergraduate students in CHM 103 and CHM 104. Repeatable for credit - maximum two. A maximum of two credits may be applied to the chemistry education major (Early Adolescence-Adolescence). A maximum of one credit may be applied to the chemistry education minor. Prerequisites: CHM 301; chemistry education (EA-A) major or minor plan; chemistry department consent. Consent of department. Offered Fall, Spring.

CHM 489 Cr.1-2

**Independent Study**

Independent study/research under the direction and supervision of a member of the chemistry faculty. Repeatable for credit - maximum two. Consent of department. Offered Fall, Spring, Summer.

CHM 499 Cr.1-2

**Research**

Laboratory research under the direction and supervision of a member of the chemistry departmental staff for selected students. A written or oral report will be required. Repeatable for credit - maximum six. Consent of department. Offered Fall, Spring, Summer.