The Department of Chemistry offers BS, BA, MS, MA, MAIS, and PhD degrees in Chemistry. The facilities, faculty, and curricular offerings in this department are approved by the American Chemical Society.

Chemistry provides a gateway to many professions. An undergraduate chemistry degree may serve as preparation for professional work in chemistry and related sciences; as a foundation to pursue applied fields including pharmaceutical chemistry, forensics, biotechnology, medicine, chemical processing, electronics, agricultural and food science, oceanography, marketing of scientific equipment or supplies, environmental sciences, and atmospheric science. It may also serve as a core for pre-professional students pursuing graduate work in pure or applied chemistry, and for those seeking positions as research chemists and technical experts in commercial laboratories and chemical industries, positions in local, state, and federal government facilities, and for postgraduate work leading to teaching positions in universities, colleges, community colleges, and high schools.

There are several degree programs available to undergraduate chemistry majors. All curricula involve general, organic, analytical, physical, and inorganic chemistry course work, plus two to three years of laboratory work in chemistry.

All chemistry majors take part or all of Experimental Chemistry, a six-term laboratory course sequence consisting of 22 project-style experiments. This program replaces the traditional separate divisional laboratory courses in chemistry taught at many universities. Students in this Integrated Laboratory Program work on two to five projects per term, each of which includes components of synthesis, analysis, theory and report writing spanning all areas of modern chemistry. One goal of the program is to provide students intensive hands-on experience in modern chemical instrumentation and computers as a foundation for both graduate studies and employment in science after graduation.

Most chemistry majors take advantage of the opportunity to become involved in research projects in the department. Working with a research group is an exciting way to apply ideas and skills acquired in formal course work. Students work closely with a faculty member and research group to set up their projects. Undergraduates also have the opportunity to present their research as a poster at the annual departmental poster session entitled ‘Chemistry in Action.’ Scheduling research time is flexible but three hours of work per week are required per credit. Areas of research available are highly varied and include synthesis of new compounds and materials, development and applications of chemical instrumentation, laser spectroscopy, surface science, reaction mechanisms, design and synthesis of polymers and optical materials, environmental chemistry, bioanalytical methods, and nuclear chemistry. Research experience is helpful when considering graduate work in chemistry and provides valuable experience for entering the job market. Students may also obtain valuable experience and credits for internships.

Graduate Studies

The Department of Chemistry offers graduate work leading toward Master of Arts, Master of Science, and Doctor of Philosophy degrees in analytical chemistry, inorganic chemistry, nuclear and radiation chemistry, organic chemistry, physical chemistry, and solid state chemistry. The major emphasis of the PhD program is on research. A nonthesis master's degree is available. Most graduate students working on a thesis in chemistry are supported either as graduate teaching assistants or as graduate research assistants.

Undergraduate Programs

Major
- Chemistry (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ba-bs-hba-hbs/)

Track One Options:
- Advanced Biochemistry (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ba-bs-hba-hbs/advanced-biochemistry-option/)
- Advanced Chemistry (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ba-bs-hba-hbs/advanced-chemistry-option/)
- Chemistry (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ba-bs-hba-hbs/)

Track Two Options
- Biochemistry (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ba-bs-hba-hbs/biochemistry-option/)
- Business (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ba-bs-hba-hbs/business-option/)
- Chemistry Education (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ba-bs-hba-hbs/chemistry-education-option/)
- Chemical Engineering (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ba-bs-hba-hbs/chemical-engineering-option/)
- Environmental Chemistry (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ba-bs-hba-hbs/environmental-chemistry-option/)
- Forensic Science (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ba-bs-hba-hbs/forensic-science-option/)
- Materials Science (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ba-bs-hba-hbs/materials-science-option/)
- Pre-Medicine (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ba-bs-hba-hbs/pre-medicine-option/)

Minor
- Chemistry (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-minor/)

Graduate Programs

Major
- Chemistry (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-ma-ms-phd/)

Minor
- Chemistry (http://catalog.oregonstate.edu/college-departments/science/chemistry/chemistry-graduate-minor/)

Michael M. Lerner, Head
153A Gilbert Hall
Oregon State University
Corvallis, OR 97331-4003
CH 122, *GENERAL CHEMISTRY, 5 Credits
A general chemistry sequence intended for majors in fields other than the physical sciences. (CH 122 and CH 123 are Bacc Core courses.)
Attributes: CPPS – Core, Pers, Physical Science
Prerequisite: CH 121 with C- or better or (CH 201 with C- or better or
(CH 231 with C- or better or CH 231H with C- or better))
Available via Ecampus

CH 123, *GENERAL CHEMISTRY, 5 Credits
A general chemistry sequence intended for majors in fields other than the physical sciences. (CH 122 and CH 123 are Bacc Core courses.) Lec/rec/lab.
Attributes: CPPS – Core, Pers, Physical Science
Prerequisite: CH 122 with C- or better or ((CH 232 with C- or better or
CH 232H with C- or better) and (CH 262 [C-] or CH 262H [C-] or CH 272 [C-]) or (CH 202 [C-] and CH 205 [C-]))
Available via Ecampus

CH 124, GENERAL CHEMISTRY, 3 Credits
A bridge course, allowing students who have taken one term of General Chemistry (CH 121) to complete the equivalent of one full semester of general chemistry. Entering students are expected to have a working knowledge of high school algebra, logarithms, and scientific notation.
Lec/lab.
Prerequisite: CH 121 with D- or better

CH 125, GENERAL CHEMISTRY, 2 Credits
A bridge course, allowing students who also take one term of General Chemistry (CH 123) to complete the equivalent of one full semester of General Chemistry. Entering students are expected to have a working knowledge of high school algebra, logarithms, and scientific notation.
Lec/lab. Offered via Ecampus only.
Prerequisite: CH 121 with D- or better and CH 124 [D-]
Recommended: One semester of general chemistry at another institution

CH 130, GENERAL CHEMISTRY OF LIVING SYSTEMS, 4 Credits
Introduction to organic chemistry and the chemistry of biological systems. Organic nomenclature and fundamental reactions, emphasizing topics such as amino acids, proteins, biochemical energy, and nucleic acids (DNA and RNA). Intended as a terminal course in chemistry, not to serve as a prerequisite to higher numbered chemistry courses. Lec/lab. Does not count toward a chemistry minor.
Available via Ecampus

CH 140, GENERAL, ORGANIC, AND BIOLOGICAL CHEMISTRY, 6 Credits
An introduction to general, organic, and biological chemistry. Intended as a terminal course in chemistry, not to serve as a prerequisite to higher numbered chemistry courses. Offered via Ecampus only.
Recommended: Entering students should have a working knowledge of high school algebra, logarithms, and scientific notation
Available via Ecampus

CH 199, SPECIAL TOPICS, 1-3 Credits
This course is repeatable for 3 credits.
CH 201, CHEMISTRY FOR ENGINEERING MAJORS, 3 Credits
A sequence of selected chemistry topics for pre-engineering students. Lec.
Prerequisite: MTH 111 (may be taken concurrently) with D- or better or MTH 112 (may be taken concurrently) with D- or better or MTH 251 (may be taken concurrently) with D- or better or MTH 251H (may be taken concurrently) with D- or better or MTH 252 (may be taken concurrently) with D- or better or MTH 252H (may be taken concurrently) with D- or better or MTH 254 (may be taken concurrently) with D- or better or MTH 254H (may be taken concurrently) with D- or better or Math Placement - ALEKS with a score of 060
Available via Ecampus

CH 202, CHEMISTRY FOR ENGINEERING MAJORS, 3 Credits
A sequence of selected chemistry topics for pre-engineering students. Lec.
Prerequisite: CH 121 with C- or better or CH 201 with C- or better or CH 231 with C- or better or CH 231H with C- or better
Available via Ecampus

CH 205, LABORATORY FOR CH 202, 1 Credit
Three-hour weekly session for the development of laboratory skills in general chemistry for engineers. Lec/lab.
Prerequisite: CH 202 (may be taken concurrently) with D- or better

CH 211, RECITATION FOR CHEMISTRY 201, 1 Credit
80-minute weekly session for the development of problem-solving skills in general chemistry for engineers. Rec.
Corequisites: CH 201

CH 212, RECITATION FOR CHEMISTRY 202, 1 Credit
One-hour weekly session for the development of problem-solving skills in general chemistry for engineers. Rec.
Corequisites: CH 202

CH 220, CAREERS IN CHEMISTRY, 1 Credit
Course for chemistry majors that discusses strategies for success in the study of chemistry and the varied career opportunities available. Topics range from surviving freshman chemistry to choices of advanced classes, study abroad opportunities, internships, getting into and succeeding in graduate school, choices of chemical careers in academia, industry, government, non-governmental organizations, and using chemistry as a foundation for careers in other areas such as law and business. Graded P/N.

CH 231, GENERAL CHEMISTRY, 4 Credits
A general chemistry sequence for students majoring in most sciences, pharmacy, and chemical engineering. CH 231 is a lecture course; CH 261 is the laboratory component. Lec/rec. (Bacc Core Course if taken with CH 261)
Attributes: CPPL – Core, Pers, PhySci Attached Lec
Prerequisite: MTH 111 (may be taken concurrently) with C- or better or MTH 112 (may be taken concurrently) with C- or better or MTH 251 (may be taken concurrently) with C- or better or MTH 251H (may be taken concurrently) with C- or better or MTH 252 (may be taken concurrently) with C- or better or MTH 252H (may be taken concurrently) with C- or better or MTH 254 (may be taken concurrently) with C- or better or MTH 254H (may be taken concurrently) with C- or better or Math Placement - ALEKS with a score of 060
Equivalent to: CH 221, CH 221H, CH 224H, CH 231H
Available via Ecampus

CH 231H, GENERAL CHEMISTRY, 4 Credits
A general chemistry sequence for students majoring in most sciences, pharmacy, and chemical engineering. CH 231H is a lecture course; CH 261H is the laboratory component. Lec/rec. (Bacc Core Course if taken with CH 261H)
Attributes: CPPL – Core, Pers, PhySci Attached Lec; HNRS – Honors Course Designator
Prerequisite: MTH 111 (may be taken concurrently) with C- or better or MTH 112 (may be taken concurrently) with C- or better or MTH 251 (may be taken concurrently) with C- or better or MTH 251H (may be taken concurrently) with C- or better or MTH 252 (may be taken concurrently) with C- or better or MTH 252H (may be taken concurrently) with C- or better or MTH 254 (may be taken concurrently) with C- or better or MTH 254H (may be taken concurrently) with C- or better or Math Placement - ALEKS with a score of 060
Equivalent to: CH 221, CH 221H, CH 224H, CH 231H
Available via Ecampus

CH 232, GENERAL CHEMISTRY, 4 Credits
A general chemistry sequence for students majoring in most sciences, pharmacy, and chemical engineering. CH 232 is a lecture course; CH 262 is the laboratory component. Lec/rec. (Bacc Core Course if taken with CH 262)
Attributes: CPPL – Core, Pers, PhySci Attached Lec
Prerequisite: CH 231 with C- or better or CH 231H with C- or better or CH 221 with C- or better
Equivalent to: CH 222, CH 225H, CH 232H
Available via Ecampus

CH 232H, GENERAL CHEMISTRY, 4 Credits
A general chemistry sequence for students majoring in most sciences, pharmacy, and chemical engineering. CH 232H is a lecture course; CH 262H is the laboratory component. Lec/rec. (Bacc Core Course if taken with CH 262H)
Attributes: CPPL – Core, Pers, PhySci Attached Lec; HNRS – Honors Course Designator
Prerequisite: CH 231 with C- or better or CH 231H with C- or better or CH 221 with C- or better
Equivalent to: CH 232
CH 233, GENERAL CHEMISTRY, 4 Credits
A general chemistry sequence for students majoring in most sciences, pharmacy, and chemical engineering. CH 233 is a lecture course; CH 263 is the laboratory component. (Bacc Core Course if taken with CH 263)

Attributes: CPPL – Core, Pers, PhySci Attached Lec
Prerequisite: (CH 232 with C- or better or CH 232H with C- or better) or CH 222 with C- or better
Equivalent to: CH 223, CH 226H, CH 233H
Available via ECampus

CH 233H, GENERAL CHEMISTRY, 4 Credits
A general chemistry sequence for students majoring in most sciences, pharmacy, and chemical engineering. CH 233H is a lecture course; CH 263H is the laboratory component. Lec/rec. (Bacc Core Course if taken with CH 263H)

Attributes: CPPL – Core, Pers, PhySci Attached Lec; HNRS – Honors Course Designator
Prerequisite: (CH 232 with C- or better or CH 232H with C- or better) or CH 222 with C- or better
Equivalent to: CH 233

CH 261, *LABORATORY FOR CHEMISTRY 231, 1 Credit
A general chemistry laboratory sequence for students majoring in most sciences, pharmacy, and chemical engineering. (Bacc Core Course if taken with CH 231)

Attributes: CPPS – Core, Pers, Physical Science
Corequisites: CH 231
Equivalent to: CH 261H, CH 271

CH 261H, *LABORATORY FOR CHEMISTRY 231H, 1 Credit
A general chemistry laboratory sequence for students majoring in most sciences, pharmacy, and chemical engineering. (Bacc Core Course if taken with CH 231H)

Attributes: CPPS – Core, Pers, Physical Science; HNRS – Honors Course Designator
Corequisites: CH 231H
Equivalent to: CH 261

CH 262, *LABORATORY FOR CHEMISTRY 232, 1 Credit
A general chemistry laboratory sequence for students majoring in most sciences, pharmacy, and chemical engineering. (Bacc Core Course if taken with CH 232)

Attributes: CPPS – Core, Pers, Physical Science
Prerequisite: CH 261 with D- or better or CH 261H with D- or better or CH 271 with D- or better or CH 221 with D- or better or CH 224H with D- or better
Corequisites: CH 232
Equivalent to: CH 262H, CH 272

CH 262H, *LABORATORY FOR CHEMISTRY 232H, 1 Credit
A general chemistry laboratory sequence for students majoring in most sciences, pharmacy, and chemical engineering. (Bacc Core Course if taken with CH 232H)

Attributes: CPPS – Core, Pers, Physical Science; HNRS – Honors Course Designator
Prerequisite: CH 261 with D- or better or CH 261H with D- or better or CH 271 with D- or better or CH 221 with D- or better or CH 224H with D- or better
Corequisites: CH 232
Equivalent to: CH 262

CH 263, *LABORATORY FOR CHEMISTRY 233, 1 Credit
A general chemistry laboratory sequence for students majoring in most sciences, pharmacy, and chemical engineering. (Bacc Core Course if taken with CH 233)

Attributes: CPPS – Core, Pers, Physical Science
Prerequisite: CH 262 with D- or better or CH 262H with D- or better or CH 272 with D- or better or CH 222 with D- or better or CH 225H with D- or better
Corequisites: CH 233
Equivalent to: CH 263

CH 271, *LABORATORY FOR CH 231 FOR CHEMISTRY MAJORS, 1 Credit
A general chemistry laboratory sequence for students majoring in chemistry. (Bacc Core Course if taken with CH 231)

Attributes: CPPS – Core, Pers, Physical Science
Corequisites: CH 231
Equivalent to: CH 271H

CH 272, *LABORATORY FOR CH 232 FOR CHEMISTRY MAJORS, 1 Credit
A general chemistry laboratory sequence for students majoring in chemistry. (Bacc Core Course if taken with CH 232)

Attributes: CPPS – Core, Pers, Physical Science
Prerequisite: CH 271 with D- or better or CH 221 with D- or better or CH 224H with D- or better
Corequisites: CH 232
Equivalent to: CH 272H
**CH 273, *LABORATORY FOR CH 233 FOR CHEMISTRY MAJORS, 1 Credit**

A general chemistry laboratory sequence for students majoring in chemistry. (Bacc Core Course if taken with CH 233)

**Attributes:** CPPS – Core, Pers, Physical Science

**Prerequisite:** CH 272 with D- or better or CH 222 with D- or better or CH 225H with D- or better

**Corequisites:** CH 233

**Equivalent to:** CH 273H

**CH 324, QUANTITATIVE ANALYSIS, 4 Credits**

A basic course in modern chemical analysis. Self-paced laboratory. CH 130 does not meet the prerequisites for this course.

**Prerequisite:** CH 123 with D- or better or CH 223 with D- or better or CH 226H with D- or better or ((CH 233 with D- or better or CH 233H with D- or better) and (CH 263 [D-] or CH 263H [D-] or CH 273 [D-]))

**Recommended:** One year of general chemistry

**Available via Ecampus**

**CH 331, ORGANIC CHEMISTRY, 4 Credits**

Service course covering aliphatic and aromatic chemistry. Introduction to nomenclature, mechanism and synthesis. Lec/rec. CH 130 does not meet the prerequisites for this course.

**Prerequisite:** CH 123 with C- or better or CH 223 with C- or better or CH 226H with C- or better or ((CH 233 with C- or better or CH 233H with C- or better) and (CH 263 [C-] or CH 263H [C-] or CH 273 [C-]))

**Recommended:** One year of general chemistry

**Available via Ecampus**

**CH 332, ORGANIC CHEMISTRY, 4 Credits**

Service course covering aliphatic and aromatic chemistry. Introduction to nomenclature, mechanism and synthesis. Lec/rec.

**Prerequisite:** CH 331 with C- or better

**Recommended:** One year of general chemistry

**Available via Ecampus**

**CH 334, ORGANIC CHEMISTRY, 3 Credits**

Professional course for majors in chemistry, biochemistry, chemical engineering and other students who need a year of organic chemistry. Interrelation of mechanistic and synthetic approaches.

**Prerequisite:** CH 334 with D- or better

**Recommended:** One year of general chemistry

**Equivalent to:** CH 336

**CH 335, ORGANIC CHEMISTRY, 3 Credits**

Professional course for majors in chemistry, biochemistry, chemical engineering and other students who need a year of organic chemistry. In-depth treatment of major classes of organic compounds. Interrelation of mechanistic and synthetic approaches.

**Prerequisite:** CH 334 with D- or better

**Recommended:** One year of general chemistry

**Equivalent to:** CH 361H

**CH 336, ORGANIC CHEMISTRY, 3 Credits**

Professional course for majors in chemistry, biochemistry, chemical engineering and other students who need a year of organic chemistry. In-depth treatment of major classes of organic compounds. Interrelation of mechanistic and synthetic approaches.

**Prerequisite:** CH 335 with D- or better

**Recommended:** One year of general chemistry

**CH 337, ORGANIC CHEMISTRY LABORATORY, 4 Credits**

Laboratory course in organic chemistry for nonmajors, designed to supplement CH 331, CH 332 and CH 334, CH 335, CH 336. Lec/lab.

**Prerequisite:** CH 331 with D- or better and CH 332 [D-] or (CH 334 [D-] and CH 335 [D-] and CH 336 [D-])

**Equivalent to:** CH 361H

**CH 361, EXPERIMENTAL CHEMISTRY I, 3 Credits**

First term of integrated laboratory program for chemistry majors highlighting techniques in organic, physical, and analytical chemistry. First-hand experience is gained using specialized glassware, scientific equipment and instrumentation plus computers. Essential technical laboratory standards and technical writing are emphasized. Lec/lab.

**Prerequisite:** (CH 221 with D- or better and CH 222 [D-] and CH 223 [D-]) or (CH 224H [D-] and CH 225H [D-] and CH 226H [D-]) or ((CH 231 [D-] or CH 231H [D-]) and (CH 261 [D-] or CH 261H [D-] or CH 271 [D-]) and (CH 232 [D-] or CH 232H [D-]) and (CH 262 [D-] or CH 262H [D-] or CH 272 [D-]) and (CH 233 [D-] or CH 233H [D-]) and (CH 263 [D-] or CH 263H [D-] or CH 273 [D-]))

**Recommended:** One year of general chemistry

**Equivalent to:** CH 361H

**CH 361H, EXPERIMENTAL CHEMISTRY I, 3 Credits**

First term of integrated laboratory program for chemistry majors highlighting techniques in organic, physical, and analytical chemistry. First-hand experience is gained using specialized glassware, scientific equipment and instrumentation plus computers. Essential technical laboratory standards and technical writing are emphasized. Lec/lab.

**Attributes:** HNRS – Honors Course Designator

**Prerequisite:** (CH 221 with D- or better and CH 222 [D-] and CH 223 [D-]) or (CH 224H [D-] and CH 225H [D-] and CH 226H [D-]) or ((CH 231 [D-] or CH 231H [D-]) and (CH 261 [D-] or CH 261H [D-] or CH 271 [D-]) and (CH 232 [D-] or CH 232H [D-]) and (CH 262 [D-] or CH 262H [D-] or CH 272 [D-]) and (CH 233 [D-] or CH 233H [D-]) and (CH 263 [D-] or CH 263H [D-] or CH 273 [D-]))

**Recommended:** One year of general chemistry

**Equivalent to:** CH 361
CH 362, EXPERIMENTAL CHEMISTRY I, 3 Credits
First-level integrated laboratory course for majors in chemistry and related disciplines, covering experimental techniques of analytical, inorganic, organic and physical chemistry. Lec/lab.
Prerequisite: (CH 361 with D- or better or CH 361H with D- or better) and CH 335 (may be taken concurrently) [D-]
Equivalent to: CH 362H

CH 362H, EXPERIMENTAL CHEMISTRY I, 3 Credits
First-level integrated laboratory course for majors in chemistry and related disciplines, covering experimental techniques of analytical, inorganic, organic and physical chemistry. Lec/lab.
Attributes: HNRS – Honors Course Designator
Prerequisite: (CH 361 with D- or better or CH 361H with D- or better) and CH 335 (may be taken concurrently) [D-]
Equivalent to: CH 362

CH 374, *TECHNOLOGY, ENERGY, AND RISK, 3 Credits
Decision-making in a technical, democratic society. Discussion of current issues such as acid rain, toxic organic chemicals in the environment, energy resources, etc. Does not meet the prereq for any other chemistry course. Does not meet requirements for chemistry minor. (Bacc Core Course)
Attributes: CSST – Core, Synthesis, Science/Technology/Society
Recommended: Completion of Bacc Core in physical science

CH 390, ENVIRONMENTAL CHEMISTRY, 3 Credits
Sources, reactions, transport, effects, and fates of chemical species in water, soil, air, and living environments and the effects of technology thereon.
Prerequisite: CH 331 with D- or better or CH 334 with D- or better
Available via Ecampus

CH 399, SPECIAL TOPICS, 1-16 Credits
Discussion of special topics in chemistry.
This course is repeatable for 99 credits.
Recommended: Completion of Bacc Core in the physical sciences

CH 401, RESEARCH, 1-16 Credits
This course is repeatable for 16 credits.

CH 403, THESIS, 1-16 Credits
This course is repeatable for 16 credits.

CH 405, READING AND CONFERENCE, 1-16 Credits
This course is repeatable for 16 credits.

CH 406, PROJECTS, 1-16 Credits
This course is repeatable for 16 credits.

CH 407, SEMINAR, 1-16 Credits
Equivalent to: CH 407H
This course is repeatable for 16 credits.

CH 407H, SEMINAR, 1-16 Credits
Attributes: HNRS – Honors Course Designator
Equivalent to: CH 407
This course is repeatable for 16 credits.

CH 410, INTERNSHIP, 1-16 Credits
This course is repeatable for 16 credits.

CH 411, INORGANIC CHEMISTRY, 3 Credits
Fundamental principles of inorganic chemistry including atomic structure, bonding models for molecules and solids, symmetry, acid/base chemistry, oxidation-reduction, and metal-ligand complexes.
Recommended: One year of general chemistry and college-level physics
Available via Ecampus

CH 412, INORGANIC CHEMISTRY, 3 Credits
Descriptive chemistry of the elements, focusing on main-group compounds, transition metal complexes, and solid-state chemistry.
Prerequisite: CH 411 with D- or better

CH 418, NUCLEAR CHEMISTRY, 3 Credits
Radioactive decay, nuclear properties, nuclear structure, alpha, beta, and gamma decay, nuclear reactions, fission, interaction of radiation with matter, chemical techniques, radiation safety, and nuclear instrumentation.
Recommended: Concurrent enrollment in (CH 440 or CH 540) or PH 314

CH 421, ANALYTICAL CHEMISTRY, 3 Credits
A professional sequence for majors in chemistry and related disciplines. Chemical equilibrium, analytical electrochemistry, separations, spectroscopy, instrumentation, and treatment of data.
Recommended: One year of general chemistry and one year of college physics. Concurrent enrollment in CH 440 or CH 540

CH 422, ANALYTICAL CHEMISTRY, 3 Credits
A professional sequence for majors in chemistry and related disciplines. Chemical equilibrium, analytical electrochemistry, separations, spectroscopy, basic electronics and instrumentation, and treatment of data.
Recommended: One year of general chemistry and one year of college physics. Concurrent enrollment in CH 441 or CH 541

CH 424, BIOANALYTICAL CHEMISTRY, 3 Credits
Analytical methods employed in the study of biologically important molecules. Separations (chromatography, electrophoresis), spectroscopy, mass spectrometry, biosensors, and immunoassays. Lec/lab. Not offered every year.
Recommended: One year of organic chemistry and one term of organic chemistry laboratory.
**CH 435, STRUCTURE DETERMINATION BY SPECTROSCOPIC METHODS, 3 Credits**
Use of ultraviolet, infrared, nuclear magnetic resonance, and mass spectra for determination of structures and stereochemistry of complex organic molecules.  
**Prerequisite:** CH 336 with D- or better and (CH 442 [D-] or CH 542 [D-])

**CH 440, PHYSICAL CHEMISTRY, 3 Credits**
Thermodynamics, electrochemistry, solutions, kinetic theory of gases, chemical kinetics, quantum theory and statistical mechanics, molecular structure and spectroscopy.  
**Prerequisite:** MTH 254 with D- or better or MTH 254H with D- or better  
**Recommended:** One year of general chemistry and one year of college physics  
*Available via Ecampus*

**CH 441, PHYSICAL CHEMISTRY, 3 Credits**
Thermodynamics, electrochemistry, solutions, kinetic theory of gases, chemical kinetics, quantum theory and statistical mechanics, molecular structure and spectroscopy.  
**Prerequisite:** (CH 440 with C- or better or CHE 311 with C- or better) and (MTH 254 [C-] or MTH 254H [C-])  
*Available via Ecampus*

**CH 442, PHYSICAL CHEMISTRY, 3 Credits**
Thermodynamics, electrochemistry, solutions, kinetic theory of gases, chemical kinetics, quantum theory and statistical mechanics, molecular structure and spectroscopy.  
**Prerequisite:** (MTH 254 with D- or better or MTH 254H with D- or better) and CH 441 [D-]  
**Recommended:** One year of general chemistry and one year of college physics

**CH 450, INTRODUCTORY QUANTUM CHEMISTRY, 3 Credits**
Elementary wave mechanics and matrix mechanics of atoms and molecules. Quantum basis of chemical structure. Not offered every year.  
**Prerequisite:** CH 442 with D- or better or CH 542 with D- or better  
**Recommended:** One year college physics

**CH 461, EXPERIMENTAL CHEMISTRY II, 3 Credits**
Second-level integrated laboratory course for majors in chemistry and related disciplines, covering experimental techniques of analytical, inorganic, organic and physical chemistry. Lec/lab.  
*Writing Intensive Course*

**CH 461H, EXPERIMENTAL CHEMISTRY II, 3 Credits**
Second-level integrated laboratory course for majors in chemistry and related disciplines, covering experimental techniques of analytical, inorganic and physical chemistry. Lec/lab.  
**Attributes:** HNRS – Honors Course Designator  
**Prerequisite:** (CH 362 with D- or better or CH 362H with D- or better) and CH 421 (may be taken concurrently) [D-] and CH 440 (may be taken concurrently) [D-]  
**Equivalent to:** CH 461

**CH 462, EXPERIMENTAL CHEMISTRY II, 3 Credits**
Second-level integrated laboratory course for majors in chemistry and related disciplines, covering experimental techniques of analytical, inorganic, organic and physical chemistry. Lec/lab. (Writing Intensive Course)  
**Attributes:** CWIC – Core, Skills, WIC  
**Prerequisite:** (CH 362 with D- or better or CH 362H with D- or better) and CH 441 (may be taken concurrently) [D-] and (CH 324 [D-] or CH 461 [D-] or CH 461H [D-])  
**Equivalent to:** CH 462H  
**Recommended:** CH 422

**CH 462H, EXPERIMENTAL CHEMISTRY II, 3 Credits**
Second-level integrated laboratory course for majors in chemistry and related disciplines, covering experimental techniques of analytical, inorganic, organic and physical chemistry. Lec/lab. (Writing Intensive Course)  
**Attributes:** CWIC – Core, Skills, WIC; HNRS – Honors Course Designator  
**Prerequisite:** (CH 362 with D- or better or CH 362H with D- or better) and (CH 324 [D-] or CH 461 [D-] or CH 461H [D-]) and CH 442 (may be taken concurrently) [D-]  
**Equivalent to:** CH 462  
**Recommended:** CH 422

**CH 463, EXPERIMENTAL CHEMISTRY II, 3 Credits**
Second-level integrated laboratory course for majors in chemistry and related disciplines, covering experimental techniques of analytical, inorganic, organic and physical chemistry. Lec/lab. (Writing Intensive Course)  
**Attributes:** CWIC – Core, Skills, WIC  
**Prerequisite:** (CH 362 with D- or better or CH 362H with D- or better) and (CH 324 [D-] or CH 461 [D-] or CH 461H [D-]) and CH 442 (may be taken concurrently) [D-]  
**Equivalent to:** CH 463H
CH 463H, EXPERIMENTAL CHEMISTRY II, 3 Credits
Second-level integrated laboratory course for majors in chemistry and related disciplines, covering experimental techniques of analytical, inorganic, organic and physical chemistry. Lec/lab. (Writing Intensive Course)
Attributes: CWIC – Core, Skills, WIC; HNRS – Honors Course Designator
Prerequisite: (CH 362 with D- or better or CH 362H with D- or better) and (CH 324 [D-] or CH 461 [D-] or CH 461H [D-]) and CH 442 (may be taken concurrently) [D-]
Equivalent to: CH 463

CH 464, EXPERIMENTAL CHEMISTRY II, 3 Credits
Second-level integrated laboratory course for majors in chemistry and related disciplines, covering experimental techniques of analytical, inorganic, organic and physical chemistry. Lec/lab. (Writing Intensive Course)
Attributes: CWIC – Core, Skills, WIC
Prerequisite: (CH 362 with D- or better or CH 362H with D- or better) and CH 442 (may be taken concurrently) [D-]
Equivalent to: CH 464H
Recommended: CH 461 or CH 461H or CH 324

CH 464H, EXPERIMENTAL CHEMISTRY II, 3 Credits
Second-level integrated laboratory course for majors in chemistry and related disciplines, covering experimental techniques of analytical, inorganic, organic and physical chemistry. Lec/lab. (Writing Intensive Course)
Attributes: CWIC – Core, Skills, WIC; HNRS – Honors Course Designator
Prerequisite: (CH 362 with D- or better or CH 362H with D- or better) and CH 442 (may be taken concurrently) [D-]
Equivalent to: CH 464H
Recommended: CH 461 or CH 461H or CH 324

CH 471, ADVANCED ORGANIC CHEMISTRY, 3 Credits
Principles of synthetic organic chemistry. Particular emphasis will be directed at understanding stereochemical outcomes in carbon-carbon bond-forming reactions (Diels-Alder, aldol, and pericyclic reactions). Other topics will include oxidation/reduction reactions, organometallic chemistry, and enantioselective methodologies.
Prerequisite: CH 336 with D- or better or CH 337 with D- or better

CH 490, COMPUTER PROGRAMMING FOR SCIENTISTS, 3 Credits
Programming, numerical and graphical analysis, problem solving, simulations and use of databases for information handling and retrieval. Applications to problems in chemistry.
Prerequisite: MTH 252 with D- or better or MTH 252H with D- or better

CH 501, RESEARCH, 1-16 Credits
Graded P/N.
This course is repeatable for 16 credits.

CH 503, THESIS, 1-16 Credits
This course is repeatable for 999 credits.

CH 505, READING AND CONFERENCE, 1-16 Credits
This course is repeatable for 16 credits.

CH 506, PROJECTS, 1-16 Credits
This course is repeatable for 16 credits.

CH 507, SEMINAR, 1-16 Credits
Student should enroll in the seminar section that meets the specific divisional requirements for credits and grading scheme or that is designated for teaching or mentoring programs. Graded P/N.
This course is repeatable for 16 credits.

CH 510, INTERNSHIP, 1-16 Credits
This course is repeatable for 16 credits.

CH 511, INORGANIC CHEMISTRY, 4 Credits
Fundamental principles of inorganic chemistry including atomic structure, bonding models for molecules and solids, symmetry, acid/base chemistry, oxidation-reduction, metal-ligand complexes, sol-gel chemistry and nanotechnology.
Recommended: CH 442 or CH 542

CH 512, INORGANIC CHEMISTRY, 4 Credits
Descriptive chemistry of the elements, focusing on main-group compounds, transition metal complexes, and solid-state chemistry.
Prerequisite: CH 511 with C or better

CH 513, SOLID STATE CHEMISTRY, 3-4 Credits
Basic principles of chemistry are applied to descriptions of structure-property relationships in inorganic solids. Topics include crystal structure, materials synthesis, chemical bonding, electronic properties, optical properties, and magnetism. Students who register for 4 credits will perform independent study of an advanced topic based on research literature.
This course is repeatable for 4 credits.
Recommended: CH 442 or CH 542

CH 516, RADIOCHEMISTRY, 4 Credits
Selected methods in radiochemical analysis. Actinide chemistry, activation analysis, radionuclide solvent extraction, and microbial reactions with radionuclides. Designed for majors in chemistry, chemical engineering, nuclear engineering, and radiation health physics. Lec/lab.
CROSSLISTED as CH 516/NSE 516.
Prerequisite: NE 531 with C or better or (RHP 531 with C or better and RHP 536 [C])
Equivalent to: CHE 516, NE 516, NSE 516, RHP 516
This course is repeatable for 12 credits.

CH 518, NUCLEAR CHEMISTRY, 3 Credits
Radioactive decay, nuclear properties, nuclear structure, alpha, beta, and gamma decay, nuclear reactions, fission, interaction of radiation with matter, chemical techniques, radiation safety, and nuclear instrumentation.
Recommended: Concurrent enrollment in (CH 440 or CH 540) or PH 314
CH 521, ANALYTICAL CHEMISTRY, 3 Credits
A professional sequence for majors in chemistry and related disciplines. Chemical equilibrium, analytical electrochemistry, separations, spectroscopy, instrumentation, and treatment of data. Recommended: One year of college chemistry and physics. Concurrent enrollment in CH 540

CH 522, ANALYTICAL CHEMISTRY, 3 Credits
A professional sequence for majors in chemistry and related disciplines. Chemical equilibrium, analytical electrochemistry, separations, spectroscopy, basic electronics and instrumentation, and treatment of data. Recommended: One year of college chemistry and physics. Concurrent enrollment in CH 541

CH 524, BIOANALYTICAL CHEMISTRY, 3 Credits
Analytical methods employed in the study of biologically important molecules. Separations (chromatography, electrophoresis), spectroscopy, mass spectrometry, biosensors, and immunoassays. Lec/lab. Not offered every year. Equivalent to: VM 524, VMB 524 Recommended: One year of organic chemistry and one term of organic chemistry laboratory.

CH 535, STRUCTURE DETERMINATION BY SPECTROSCOPIC METHODS, 3 Credits
Use of ultraviolet, infrared, nuclear magnetic resonance, and mass spectra for determination of structures and stereochemistry of complex organic molecules. Recommended: CH 336 and (CH 442 or CH 542)

CH 540, PHYSICAL CHEMISTRY, 3 Credits
Thermodynamics, electrochemistry, solutions, kinetic theory of gases, chemical kinetics, quantum theory and statistical mechanics, molecular structure and spectroscopy. Recommended: MTH 254 and one year of college chemistry and one year of college physics

CH 541, PHYSICAL CHEMISTRY, 3 Credits
Thermodynamics, electrochemistry, solutions, kinetic theory of gases, chemical kinetics, quantum theory and statistical mechanics, molecular structure and spectroscopy. Recommended: (CH 440 or CHE 311) AND (MTH 254 or MTH 254H)

CH 542, PHYSICAL CHEMISTRY, 3 Credits
Thermodynamics, electrochemistry, solutions, kinetic theory of gases, chemical kinetics, quantum theory and statistical mechanics, molecular structure and spectroscopy. Recommended: CH 541

CH 550, INTRODUCTORY QUANTUM CHEMISTRY, 3 Credits
Elementary wave mechanics and matrix mechanics of atoms and molecules. Quantum basis of chemical structure. Not offered every year. Prerequisite: CH 542 with C or better Recommended: One year college physics

CH 553, CHEMICAL THERMODYNAMICS, 3 Credits
The laws of chemical thermodynamics applied to analyze properties of gases, gas mixtures, liquid solutions, fluctuations, critical phenomena, and magnetic systems. Not offered every year. Recommended: CH 542

CH 571, ADVANCED ORGANIC CHEMISTRY, 3 Credits
Principles of synthetic organic chemistry. Particular emphasis will be directed at understanding stereochemical outcomes in carbon-carbon bond-forming reactions (Diels-Alder, aldol, and pericyclic reactions). Other topics will include oxidation/reduction reactions, organometallic chemistry, and enantioselective methodologies. Recommended: CH 336 or CH 337

CH 582, CHEMISTRY AND MATERIALS OF BATTERIES AND SUPER CAPACITORS, 3 Credits
Examines the chemistry and materials currently in use and proposed for future primary and secondary batteries and supercapacitors. After a brief historical review, we will examine in detail the state-of-the-art technologies including lithium-ion, lithium, and sodium-sulfur batteries and electrochemical double-layer capacitors, and future technologies such as metal-air and lithium-sulfur. Class discussions will focus on structure/performance relationships and other issues such as environmental impact, safety and cost. Offered via Ecampus only. Recommended: Full year of general chemistry, college-level physics and materials science background

CH 584, INSTRUMENTS AND ONLINE INTERACTIONS IN THE SCIENCES, 3 Credits
Examine methods and technologies for and incorporating virtual instruments and online interactions into laboratory courses to support learners in becoming critical thinkers and creative producers of their knowledge and understanding in science. Recommended: Basic computer literacy and one year of general chemistry, physics or biology Available via Ecampus

CH 590, COMPUTER PROGRAMMING FOR SCIENTISTS, 3 Credits
Programming, numerical and graphical analysis, problem solving, simulations and use of databases for information handling and retrieval. Applications to problems in chemistry. Recommended: MTH 252

CH 601, RESEARCH, 1-16 Credits
This course is repeatable for 16 credits.

CH 603, THESIS, 1-16 Credits
This course is repeatable for 999 credits.

CH 605, READING AND CONFERENCE, 1-16 Credits
This course is repeatable for 16 credits.
**CH 607, SEMINAR, 1-16 Credits**
Student should enroll in the seminar section that meets the specific divisional requirements for credits and grading scheme or that is designated for teaching or mentoring programs.
This course is repeatable for 16 credits.

**CH 614, SELECTED TOPICS IN INORGANIC CHEMISTRY, 4 Credits**
Nonsequence courses designed to acquaint the advanced graduate student with recent advances in fields such as solid state chemistry, theoretical inorganic chemistry, spectroscopy and magnetism, chemistry of coordination compounds, kinetics and mechanisms of inorganic reactions, acid-base theory and reactions in nonaqueous solvents, organometallic chemistry, and chemistry of the less familiar elements.
Not offered every year.
Equivalent to: CH 514
This course is repeatable for 8 credits.
Recommended: CH 413 or CH 513

**CH 615, SELECTED TOPICS IN ORGANIC CHEMISTRY, 4 Credits**
Focus is on cutting edge research topics in inorganic materials chemistry, which will evolve from year-to-year to stay up-to-date. Current journal articles, software programs, and lab demonstrations will be utilized.
Students will learn both content of a research area, as well as tools used in the practice.

**CH 616, CRYSTALLOGRAPHY AND X-RAY DIFFRACTION, 4 Credits**
Principles of crystallography and x-ray diffraction as applied to the structural characterization of both single crystals, powders, and thin films.
Equivalent to: CH 516
Recommended: At least one upper-level undergraduate inorganic chemistry course

**CH 630, ADVANCED ORGANIC CHEMISTRY, 3 Credits**
Molecular orbital bonding theory, orbital symmetry, reaction mechanisms, stereoisomerism, conformational analysis, and advanced methods of synthesis. Not offered every year.
Equivalent to: CH 530
Recommended: CH 336 and (CH 442 or CH 542)

**CH 631, ADVANCED ORGANIC CHEMISTRY, 4 Credits**
Carbon-carbon bond forming reactions, reaction mechanisms, stereoisomerism, conformational analysis, and advanced methods of synthesis. Not offered every year.
Equivalent to: CH 531
Recommended: CH 630

**CH 632, ADVANCED ORGANIC CHEMISTRY, 3 Credits**
Molecular orbital bonding theory, orbital symmetry, reaction mechanisms, stereoisomerism, conformational analysis, and advanced methods of synthesis. Not offered every year.
Equivalent to: CH 532
Recommended: CH 336 and (CH 442 or CH 542)

**CH 633, HYPOTHESIS, EVIDENCE, AND ARGUMENT IN ORGANIC CHEMISTRY, 2 Credits**
Immerses the student in the tools of scientific method as applied to current research topics in the chemical literature. The student will perform an extensive review of a modern topic in organic chemistry, prepare a written summary and analysis of this literature review and make a public oral presentation and discussion.
Prerequisite: CH 632 with C or better
This course is repeatable for 4 credits.

**CH 636, SELECTED TOPICS IN ORGANIC CHEMISTRY, 3 Credits**
Nonsequence courses designed to acquaint students with recent advances in organic chemistry and their application to special fields of study. Topics covered vary from term to term and year to year. Topics include: theoretical organic chemistry, recent advances in reaction mechanisms, advanced synthesis, free radical reactions, organic sulfur chemistry, and biosynthesis of natural products. CH 636, CH 637, CH 638 need not be taken in order. Not offered every year.
Equivalent to: CH 536
This course is repeatable for 12 credits.

**CH 637, SELECTED TOPICS IN ORGANIC CHEMISTRY, 3 Credits**
Nonsequence courses designed to acquaint students with advances in organic chemistry, specifically focusing on biosynthesis of natural products and enzyme reaction mechanisms. CH 636, CH 637, CH 638 need not be taken in order.
Equivalent to: CH 537
This course is repeatable for 12 credits.

**CH 638, SELECTED TOPICS IN ORGANIC CHEMISTRY, 3 Credits**
Nonsequence courses designed to acquaint students with recent advances in organic chemistry and their application to special fields of study. Topics covered vary from term to term and year to year. Topics include: theoretical organic chemistry, recent advances in reaction mechanisms, advanced synthesis, free radical reactions, organic sulfur chemistry, and biosynthesis of natural products. CH 636, CH 637, CH 638 need not be taken in order. Not offered every year.
Equivalent to: CH 538
This course is repeatable for 12 credits.

**CH 651, QUANTUM MECHANICS OF ATOMS AND MOLECULES, 3 Credits**
Not offered every year.
Equivalent to: CH 551
Recommended: CH 450 or CH 550
CH 652, QUANTUM MECHANICS OF MOLECULAR SPECTROSCOPY, 3 Credits
Not offered every year.
Equivalent to: CH 552
Recommended: CH 651

CH 660, SPECTROCHEMICAL ANALYSIS, 3 Credits
Theoretical concepts and methodology of optical spectrochemical methods of analysis, components of spectrometers, flame and electrothermal atomic spectrophotometry, ICP atomic emission spectrometry, molecular absorption and fluorescence spectrometry.
Equivalent to: CH 560
Recommended: CH 442 or CH 542

CH 661, SEPARATIONS: CHROMATOGRAPHY AND RELATED METHODS, 4 Credits
Theory, instrumentation, and practice of modern separation techniques (gas chromatography, liquid chromatography, electrokinetic separations) and sample preparation methods; handling and interpretation of chromatographic and electrophoretic data.
Equivalent to: CH 561
Recommended: CH 440 or CH 540

CH 662, ANALYTICAL ELECTROCHEMISTRY, 4 Credits
Study of current, voltage and time relationships in electrochemical cells. Offered alternate years.
Equivalent to: CH 562
Recommended: CH 442

CH 681, SELECTED TOPICS IN PHYSICAL CHEMISTRY, 2 Credits
Nonsequence courses designed to acquaint students with recent advances in physical chemistry. Topics include molecular structure determination (x-ray, electron and neutron diffraction), spectroscopy (nonlinear and multiphoton, magnetic resonance, photoelectron, Moessbauer effect), physical chemistry of condensed phases (ionic, molecular and liquid crystals, critical phenomena, mass transport), theoretical chemistry (chemical bonding, scattering theory, group theory, dynamics), electronic structure theory of molecules. Need not be taken in order. Not offered every year.
Equivalent to: CH 581
This course is repeatable for 12 credits.

CH 682, SELECTED TOPICS IN PHYSICAL CHEMISTRY, 2 Credits
Nonsequence courses designed to acquaint students with recent advances in physical chemistry. Topics include molecular structure determination (x-ray, electron and neutron diffraction), spectroscopy (nonlinear and multiphoton, magnetic resonance, photoelectron, Moessbauer effect), physical chemistry of condensed phases (ionic, molecular and liquid crystals, critical phenomena, mass transport), theoretical chemistry (chemical bonding, scattering theory, group theory, dynamics), electronic structure theory of molecules. Need not be taken in order. Not offered every year.
Equivalent to: CH 582
This course is repeatable for 12 credits.

CH 683, SELECTED TOPICS IN ANALYTICAL CHEMISTRY, 2 Credits
Nonsequence courses designed to acquaint the advanced graduate student with recent advances in analytical chemistry. Not offered every year.
Equivalent to: CH 583
This course is repeatable for 12 credits.

CH 684, SELECTED TOPICS IN ANALYTICAL CHEMISTRY, 2 Credits
Nonsequence courses designed to acquaint the advanced graduate student with recent advances in analytical chemistry. Not offered every year.
Equivalent to: CH 584
This course is repeatable for 12 credits.

CH 685, SELECTED TOPICS IN ANALYTICAL CHEMISTRY, 2 Credits
Nonsequence courses designed to acquaint the advanced graduate student with recent advances in analytical chemistry. Not offered every year.
Equivalent to: CH 585
This course is repeatable for 12 credits.
CH 686, SELECTED TOPICS IN NUCLEAR AND RADIATION CHEMISTRY, 2 Credits
Nonsequence courses designed to acquaint the advanced graduate student with recent advances in nuclear and radiation chemistry. Not offered every year.
Equivalent to: CH 586
This course is repeatable for 12 credits.

CH 687, SELECTED TOPICS IN NUCLEAR AND RADIATION CHEMISTRY, 2 Credits
Nonsequence courses designed to acquaint the advanced graduate student with recent advances in nuclear and radiation chemistry. Not offered every year.
Equivalent to: CH 587
This course is repeatable for 12 credits.

CH 688, SELECTED TOPICS IN NUCLEAR AND RADIATION CHEMISTRY, 2 Credits
Nonsequence courses designed to acquaint the advanced graduate student with recent advances in nuclear and radiation chemistry. Not offered every year.
Equivalent to: CH 588
This course is repeatable for 12 credits.

CH 692, ENVIRONMENTAL TRANSFORMATION OF ORGANIC COMPOUNDS, 3 Credits
Chemical, photochemical, and biological transformation reactions of organic compounds in the environment. Test methods and predictive models for determining the persistence of organic compounds in the environment. Offered alternate years.
Recommended: CH 336 and CH 440

CH 697, MASS SPECTROMETRY OF ORGANIC COMPOUNDS, 4 Credits
Physical principles of mass spectrometric instrumentation and interpretation of the mass spectra of organic compounds and biomolecules. Not offered every year.
Equivalent to: TOX 637