

Eastern Oregon University

Chemistry

PROGRAM OBJECTIVES

The chemistry degree program prepares chemistry majors for graduate work in pure and applied chemistry, for employment as research chemists and chemical technicians, for entrance into schools for education in the health science and environmental fields, for governmental civil service and teaching positions.

LEARNING OUTCOMES

Chemistry graduates will be able to apply pertinent chemical knowledge to the solution of diverse scientific, environmental, and social problems in the following learning outcomes

1. Content Knowledge: Students will understand the basic chemical/biochemical principles and content in the major specialty areas, which include inorganic, organic, physical, analytical, and biochemistry.
2. Applied Learning Skills: Students will acquire safe chemical/biochemical laboratory practices and techniques including the use of instrumentation and computers.
3. Inquiry and Integrated Learning: Students will be able to design and conduct chemical/biochemical research with appropriate documentation including literature searches.
4. Communication and Critical Thinking: Students will understand the importance of the discipline to modern society and be able to communicate chemical/biochemical information both orally and in writing to their peers and the public.

MEANS OF ASSESSMENT

Students are assessed by standardized examinations as they progress through the courses they take. This measures them in comparison to national standards. In addition, the capstone courses they take involve assessment by the entire chemistry faculty members during their oral presentations. The results of their individual research projects are measures of their proficiency to design and conduct meaningful experiments.

REQUIREMENTS FOR THE BACHELOR OF ARTS OR THE BACHELOR OF SCIENCE IN CHEMISTRY

1. Complete Eastern graduation requirements with at least a "C-" in each course required for the Chemistry degree and have a grade point average of 2.00 or better.
2. Complete a minimum of 62 credit hours in Chemistry, of which 44 or more must be 300 or 400 level courses.
3. Complete a minimum of 34 credit hours in mathematics, physics, and computer science courses.
4. A minimum of 20 chemistry credit hours must be completed at Eastern Oregon University.
5. The designated capstone courses are **CHEM 401** and **CHEM 407**.
6. Include within your planned program 96 hours in Chemistry

and related areas as outlined below:

CHEMISTRY REQUIREMENTS

- CHEM 204, 205, 206** General Chemistry (15)
CHEM 285 Chemical Safety (1)
CHEM 320 Analytical Chemistry (3)
CHEM 321 Analytical Chemistry Laboratory (2)
CHEM 334 Organic Chemistry I (4)
CHEM 335 Organic Chemistry II (4)
CHEM 336 Organic Chemistry III (4)
CHEM 338 Organic Chemistry I Laboratory (1)
CHEM 339 Organic Chemistry II Laboratory (1)
CHEM 401 Research (1)
CHEM 407 Seminar (1)
CHEM 421 Instrumental Analysis (3)
CHEM 422 Instrumental Analysis Laboratory (2)
CHEM 440 Thermodynamics (4)
CHEM 441 Quantum Mechanics (4)
CHEM 442 Chemical Dynamics (4)
CHEM 443 Thermodynamics Laboratory (1)
CHEM 444 Quantum Mechanics Laboratory (1)
CHEM 445 Chemical Dynamics Laboratory (1)

At least five elective credit hours to be selected from the following:

- CHEM 360** Environmental Chemistry (4)
CHEM 361 Environmental Chemistry Laboratory (1)
CHEM 402 Service Learning In Chemistry (1-3)
CHEM 410 Selected Topics (1-6)
CHEM 411 Inorganic Chemistry (4)
CHEM 412 Inorganic Chemistry Laboratory (1)
CHEM 437 Organic NMR Spectroscopy (2)
CHEM 450 Structural Biochemistry (4)
CHEM 451 Metabolic Biochemistry (4)
CHEM 454 Biochemistry Laboratory (2)

Related Area Requirements

- MATH 251, 252, 253** Calculus (12)
CS 161 Foundations of Computer Science I (4)
PHYS 221, 222, 223 General Physics with Calculus (15)
 Approved electives in **CS, MATH, PHYS,** or **STAT** (3-5)
 Students may not also attain a major in Biochemistry or a minor in Environmental Chemistry.

TYPICAL FIRST YEAR CURRICULUM

Fall

- CHEM 204** General Chemistry (5) [1]
MATH 251 Calculus (4) [2]
 General Education or Elective Courses (6) [3]

Winter

- CHEM 205** General Chemistry (5) [1]
MATH 252 Calculus (4) [2]
 General Education or Elective Courses (6) [3]

Spring

- CHEM 206** General Chemistry (5)
MATH 253 Calculus (4) [2]
UPR
 General Education or Elective Courses (6) [3]

TYPICAL SECOND YEAR CURRICULUM

Fall

- CHEM 334** Organic Chemistry I (4)
 General Education or Elective Courses (11) [3]

Winter

- CHEM 335** Organic Chemistry II (4)
CHEM 338 Organic Chemistry I Laboratory (1)
 General Education or Elective Courses (10) [3]

Spring

- CHEM 285** Chemical Safety (1)
CHEM 336 Organic Chemistry III (4)
CHEM 339 Organic Chemistry II Laboratory (1)
 General Education or Elective Courses (9) [3]

TYPICAL THIRD YEAR CURRICULUM

Fall

- CHEM 320** Analytical Chemistry (3)
CHEM 321 Analytical Chemistry Laboratory (2)
CHEM 401 Research (1) (Capstone)
PHYS 221 General Physics I with Calculus (5)
CS 161 Foundations of Computer Science I (4)

Winter

- PHYS 222** General Physics II with Calculus (5)
 General Education or Elective Courses (10) [3]

Spring

- PHYS 223** General Physics III with Calculus (5)
 Chemistry Electives (5) [4]
 General Education or Elective Courses (5) [3]

TYPICAL FOURTH YEAR CURRICULUM

Fall

- CHEM 407** Seminar (1) (Capstone)
CHEM 440 Thermodynamics (4)
CHEM 443 Thermodynamics Laboratory (1)
 Science/Math Electives (3-5) [5]
 General Education or Elective Courses (3-6) [3]

Winter

- CHEM 421** Instrumental Analysis (3)
CHEM 422 Instrumental Analysis Laboratory (2)
CHEM 441* Quantum Mechanics (4)
CHEM 444 Quantum Mechanics Laboratory (1)
 General Education or Elective Courses (5) [3]

Spring

- CHEM 442** Chemical Dynamics (4)
CHEM 445 Chemical Dynamics Laboratory (1)
 General Education or Elective Courses (10) [3]

*Only if taken under a CHEM prefix and not if taken under the prefix PHYS 321.

Note: [1] Students not meeting admission requirements in CHEM 204, 205 should enroll in CHEM 101, 102.

[2] Students may need to enroll in lower level math sequence as determined by an Eastern evaluation.

[3] Selected to meet general education requirements.

[4] Selected from CHEM 360 Environmental Chemistry; CHEM 361 Environmental Chemistry Lab; CHEM 411 Inorganic Chemistry; CHEM 412 Inorganic Chemistry Lab; CHEM 437 Organic NMR Spectroscopy; CHEM 450 Structural Biochemistry; CHEM 451 Metabolic Biochemistry; CHEM 454 Biochemistry Lab; or CHEM 410 Selected Topics.

[5] Selected from 300 or 400 level physics, mathematics, statistics, or computer science to meet the chemistry program requirements.

REQUIREMENTS FOR THE BACHELOR OF ARTS OR THE BACHELOR OF SCIENCE IN CHEMISTRY IN 3-2 CHEMICAL ENGINEERING PROGRAM

1. Students wishing to complete a Chemistry degree at Eastern Oregon University and a second degree in Chemical Engineering at Oregon State University should attend Eastern three years and then transfer to OSU for two years to complete the requirements for the Chemistry degree at Eastern and the Chemical Engineering degree at OSU.

2. Complete Eastern graduation requirements with at least a "C-" in each course required for the Chemistry degree and have a grade point average of 2.00 or better.

3. Complete the Chemistry requirements and the related area requirements for B.A. or B.S. in Chemistry, and

4. Complete MATH 321, each individual course with a grade of "C-" or better, and with a combined 2.00 GPA or better.

REQUIREMENTS FOR THE MINOR IN CHEMISTRY

1. A minimum of 30 graded credits in chemistry as follows:

Required:

CHEM 206 General Chemistry (5)

Select 25 hours from the courses listed below:

CHEM 204 General Chemistry (5)

CHEM 205 General Chemistry (5)

CHEM 285 Chemical Safety (1)

CHEM 310 Selected Topics (1-5)

CHEM 320 Analytical Chemistry (3)

CHEM 321 Analytical Chemistry Laboratory (2)

CHEM 334 Organic Chemistry I (4)

CHEM 335 Organic Chemistry II (4)

CHEM 336 Organic Chemistry III (4)

CHEM 338 Organic Chemistry I Laboratory (1)

CHEM 339 Organic Chemistry II Laboratory (1)

CHEM 360 Environmental Chemistry (4)

CHEM 361 Environmental Chemistry Lab (1)

CHEM 402 Service Learning In Chemistry (1-3)

CHEM 410 Selected Topics (1-5)

CHEM 411 Inorganic Chemistry (4)

CHEM 412 Inorganic Chemistry Laboratory (1)

CHEM 421 Instrumental Analysis (3)

CHEM 422 Instrumental Analysis Laboratory (2)

CHEM 437 Organic NMR Spectroscopy (2)

CHEM 440 Thermodynamics (4)

CHEM 441 or **PHYS 321** Quantum Mechanics (4)

CHEM 442 Chemical Dynamics (4)

CHEM 443 Thermodynamics Laboratory (1)

CHEM 444 Quantum Mechanics Laboratory (1)

CHEM 445 Chemical Dynamics Laboratory (1)

CHEM 450 Structural Biochemistry (4)

CHEM 451 Metabolic Biochemistry (4)

CHEM 454 Biochemistry Laboratory (2)

2. A minimum grade of "C-" required for each course with an average GPA of 2.00 or more for all courses counting toward the minor.

3. A minimum of 10 hours counting toward the minor must be completed at Eastern Oregon University.

REQUIREMENTS FOR THE MINOR IN ENVIRONMENTAL CHEMISTRY

1. A minimum of 30 graded credits in chemistry and biology as follows:

Required:

CHEM 206 General Chemistry (5)

CHEM 320 Analytical Chemistry (3)

CHEM 321 Analytical Chemistry Laboratory (2)

CHEM 360 Environmental Chemistry (4)

CHEM 361 Environmental Chemistry Lab (1)

Select 15 hours from the courses listed below:

CHEM 204 General Chemistry (5)

CHEM 205 General Chemistry (5)

CHEM 285 Chemical Safety (1)

CHEM 421* Instrumental Analysis (3)

CHEM 422* Instrumental Analysis Laboratory (2)

BIOL 357* General Ecology (4)

BIOL 358* General Ecology Laboratory (1)

*These laboratory courses must be taken as well as the associated lecture courses to be counted as credit towards the environmental chemistry minor.

2. A minimum grade of "C-" required for each course with an average GPA of 2.00 or more for all courses counting toward the minor.

3. A minimum of 10 hours counting toward the minor must be completed at Eastern Oregon University.

REQUIREMENTS FOR THE CONCENTRATION IN PHYSICAL CHEMISTRY

1. A minimum of 23 graded credits in chemistry, physics, and mathematics as follows:

Required:

CHEM 440 Thermodynamics (4)

CHEM 441 Quantum Mechanics (4) and

CHEM 444 Quantum Mechanics Lab (1) or

PHYS 321 Waves & Quantum Theory (5)

CHEM 442 Chemical Dynamics (4)

CHEM 443 Thermodynamics Laboratory (1)

CHEM 445 Chemical Dynamics Laboratory (1)

PHYS 322 Waves and Quantum Theory (5)

Complete 3 hours from the courses listed below:

CHEM 410 Selected Topics in Physical Chemistry (1-5)

PHYS 410 Selected Topics in Chemical Physics (1-5)

MATH 321 Differential Equations (5)

PHYS 343 Experimental Techniques (5)

2. Complete concentration requirements with at least a "C-" in each listed course.

3. Students earning a minor in physics may not earn a concentration in physical chemistry.

4. Students earning a double major or double degree in chemistry and physics may not earn a concentration in physical chemistry.

CHEMISTRY COURSE DESCRIPTIONS

CHEM 101- Intro to Chem*SMI Credits: 4.00

Gen Ed Core-Natural, Math & Info Sciences

Service and general education course covering basic principles of general chemistry. Designed for students without previous chemistry experience. Prerequisite: MATH 095 (or equivalent, may be taken concurrently).

CHEM 101L - Intro Chem Lab Credits: .00

CHEM 102- Intro to Chem*SMI Credits: 4.00

Gen Ed Core-Natural, Math & Info Sciences

Service and general education course covering basic principles of general chemistry and the elements of organic chemistry. Prerequisite: CHEM 101 (or equivalent).

CHEM 102L - Intro Chem Lab Credits: .00

CHEM 103- Intro to Chem*SMI Credits: 4.00

Gen Ed Core-Natural, Math & Info Sciences

Service and general education course providing a survey of biochemistry. Prerequisite: CHEM 102 (or equivalent).

CHEM 103L - Intro Chem Lab Credits: .00

CHEM 105- ChemExcel I Credits: 1.00

This course offers hands on problem solving in topics covered in CHEM 101. Students are expected to work cooperatively in small groups and attend every class session. Prerequisite: Concurrent enrollment in CHEM 101.

CHEM 106- ChemExcel II Credits: 1.00

This course offers hands on problem solving in topics covered in CHEM 102. Students are expected to work cooperatively in small groups and attend every class session. Prerequisite: Concurrent enrollment in CHEM 102.

CHEM 107- ChemExcel III Credits: 1.00

This course offers hands on problem solving in topics covered in CHEM 103. Students are expected to work cooperatively in small groups and attend every class session. Prerequisite: Concurrent enrollment in CHEM 103.

CHEM 110- Selected Topics Credits: 1.00 TO 6.00

Topics designed to meet current needs of students. Specific titles to be selected by the chemistry staff. Prerequisite: None.

CHEM 204- Gen Chemistry*SMI Credits: 5.00

Gen Ed Core-Natural, Math & Info Sciences

Principles of chemistry for chemistry/biochemistry majors and related fields: Topics covered include chemical periodicity, constructing and balancing chemical equations, stoichiometry, thermochemistry and the quantum structure of atoms. Prerequisite: High school chemistry or consent of instructor. MATH 111 (may be taken concurrently) or equivalent.

CHEM 204L - Gen Chem Lab Credits: .00

CHEM 205- Gen Chemistry*SMI Credits: 5.00

Gen Ed Core-Natural, Math & Info Sciences

Principles of chemistry for chemistry/biochemistry majors and related fields: Topics covered include Lewis structures, VSEPR theory, gas laws, interparticle forces, colligative properties, and chemical kinetics. Prerequisite: CHEM 204 or consent of instructor. MATH 112 or equivalent recommended.

CHEM 205L - Gen Chem Lab Credits: .00

CHEM 206- General Chemistry*SMI Credits: 5.00

Gen Ed Core-Natural, Math & Info Sciences

Chemistry of selected metallic, non-metallic elements, and the semi-micro qualitative analysis of those elements. Chemical equilibrium of inorganic systems is also discussed. Prerequisite: CHEM 205 or equivalent.

CHEM 206L - Gen Chemistry Lab Credits: .00

CHEM 210- Selected Topics Credits: 1.00 TO 6.00

Topics designed to meet current needs of students. Specific titles to be selected by the chemistry staff. Prerequisite: Sophomore standing or consent of instructor.

CHEM 285- Chemical Safety Credits: 1.00

A course that emphasizes current, safe practices in the undergraduate chemical laboratory. Designed for students in chemistry and related fields. Provides training in the safe use and disposal methods for chemicals, for containers of chemicals, and in the handling of specialized equipment required for doing chemistry. A required course for our laboratory assistants. Prerequisite: None, but undergraduate experience in chemistry recommended.

CHEM 310- CHEM 310 Credits: 1.00 TO 6.00

Topics designed to meet current needs of students. Specific titles to be selected by the chemistry staff. Prerequisite: Junior standing or consent of instructor.

CHEM 320- Analytical Chemistry Credits: 3.00

Fundamental principles of quantitative analysis with emphasis on selected gravimetric and volumetric methods. An introduction to instrumental methods is included. Prerequisite: CHEM 206 or equivalent. Student must have at least sophomore standing to register for this course.

CHEM 321- Analytical Chem Lab Credits: 2.00

Quantitative analytical laboratory experiments with emphasis on volumetric and a limited number of instrumental methods. Prerequisite: CHEM 320 or concurrent. Student must have at

least sophomore standing to register for this course.

CHEM 334- Organic Chem I Credits: 4.00

Introductory study of the molecular structure, chemical properties and reaction mechanisms of organic substances. Includes problems in organic synthesis. Prerequisite: CHEM 205 or equivalent. Student must have at least sophomore standing to register for this course.

CHEM 335- Organic Chem II Credits: 4.00

Studies of the molecular structure, chemical properties and reaction mechanisms of organic compounds. Includes problems in organic synthesis. Prerequisite: CHEM 334 or equivalent. Student must have at least sophomore standing to register for this course.

CHEM 336- Organic Chem III Credits: 4.00

Studies of the molecular structure, chemical properties and reaction mechanisms of organic and biochemical substances. Prerequisite: CHEM 335 or equivalent. Student must have at least sophomore standing to register for this course.

CHEM 338- Organic Chem I Lab Credits: 1.00

Selected techniques of organic analysis, separation and synthesis. Offers experience in performing organic reactions and in using instruments that pertain to organic compounds. Prerequisite: CHEM 334 or equivalent; Co-requisite: CHEM 335. Student must have at least sophomore standing to register for this course.

CHEM 339- Organic Chem II Lab Credits: 1.00

Selected techniques of organic and biochemical analysis, separation and synthesis. Offers experience in performing organic and biochemical reactions and in using apparatuses and instruments that pertain to organic and biochemistry. Prerequisite: CHEM 335 and 338 or equivalent; Co-requisite: CHEM 336. Student must have at least sophomore standing to register for this course.

CHEM 340- Physical Chemistry Credits: 4.00

The study of physical chemistry from a biochemical perspective. Emphasis on important physical chemistry problems relevant for biochemistry and related majors. Topics covered include thermodynamics, chemical kinetics and spectroscopy. Prerequisite: CHEM 206, MATH 252 or MATH 241, or consent of instructor. Student must have at least sophomore standing to register for this course.

CHEM 360- Environmental Chemistry Credits: 4.00

Introduction to environmental chemistry covering both fundamental chemical principles and societal implications. Emphasis will be placed on air chemistry and air pollution, chemistry of natural waters and water pollution, soils and sediments, and toxicity of organic and inorganic chemicals. Prerequisite: CHEM 206. Student must have at least sophomore standing to register for this course.

CHEM 361- Environmental Chem Lab Credits: 1.00

Laboratory work will cover aspects of sampling, instrumental and automated analysis, and regulatory requirements. Prerequisite: CHEM 360 or concurrent.

CHEM 401- Research Credits: 1.00 TO 3.00

(Capstone) Individual research project selected with and supervised by a member of the chemistry faculty. Prerequisite: Consent of instructor. Student must have at least junior standing to register for this course.

CHEM 402- Service Learning In Chemistry Credits: 1.00 TO 3.00

Students will partner with a chemistry faculty member and a nonprofit or government organization to complete a service project involving the chemical sciences. Prerequisite: Junior or Senior standing or consent of instructor. Student must have at least junior standing to register for this course.

CHEM 405- Reading and Conference Credits: 1.00 TO 6.00

Individual or small group study of a chemistry topic not included in the regular curriculum, supervised by a member of the chemistry faculty. Prerequisite: Consent of instructor. Student must have at least junior standing to register for this course.

CHEM 407- Seminar Credits: 1.00

(Capstone) Individual student selected topics in chemistry are researched thoroughly. This accumulation of research data is then presented in both a professional research paper and an oral presentation. Prerequisite: Senior class standing or consent of instructor. Student must have at least junior standing to register for this course.

CHEM 410- Selected Topics Credits: 1.00 TO 6.00

Topics designed to meet current needs of students. Specific titles to be selected by the chemistry staff. Prerequisite: Senior standing or consent of instructor. Student must have at least junior standing to register for this course.

CHEM 410L - CHEM 410L Credits: .00

Student must have at least junior standing to register for this course.

CHEM 411- Inorganic Chem Credits: 4.00

Chemical bonding, symmetry, coordination chemistry, molecular orbitals, solid state and materials chemistry, descriptive chemistry of transition metals. Prerequisite: CHEM 206. Student must have at least junior standing to register for this course.

CHEM 412- Inorganic Chem Lab Credits: 1.00

Survey of laboratory techniques to study inorganic molecules through synthesis, characterization, and model construction. Prerequisite: CHEM 206; Co-requisite: CHEM 411. Student must have at least junior standing to register for this course.

CHEM 421- Instrumental Analysis Credits: 3.00

The theory and practice of analytical chemistry as applied to instrumental methods of analysis. Advantages and limitation of instrumental methods will be discussed. Prerequisite: CHEM 320, PHYS 223 recommended. Student must have at least junior standing to register for this course.

CHEM 422- Instrumental Analysis Lab Credits: 2.00

Laboratory experiments focus on instrumental methods of analysis, optimization of instrumental parameters and data

analysis. Prerequisite: CHEM 421 or concurrent. Student must have at least junior standing to register for this course.

CHEM 437- Organic NMR Spectroscopy Credits: 2.00

An advanced lecture and laboratory based course focused on the operation of NMR instrumentation and the interpretation of organic compound NMR spectroscopic results. Prerequisite: CHEM 336 and CHEM 339 or equivalent, or consent of instructor. Student must have at least junior standing to register for this course.

CHEM 440- Thermodynamics Credits: 4.00

The study of chemical systems from thermodynamics, equilibrium and phase rule perspectives. Prerequisite: CHEM 206 and MATH 253 or consent of instructor. Student must have at least junior standing to register for this course.

CHEM 441- Quantum Mechanics Credits: 4.00

Introduction to classical waves. Development of the formalism of quantum mechanics. Study of important quantum mechanical models including the harmonic oscillator and the hydrogen atom. Prerequisite: PHYS 223, CHEM 206 and MATH 253 or consent of instructor. Student must have at least junior standing to register for this course.

CHEM 442- Chemical Dynamics Credits: 4.00

Kinetic theory of gases, chemical kinetics in the gas phase and solution phase, reaction mechanisms, symmetry elements, and other physical chemistry topics. Prerequisite: CHEM 206 and MATH 253 or consent of instructor. Student must have at least junior standing to register for this course.

CHEM 443- Thermodynamics Lab Credits: 1.00

Selected experiments to exemplify topics in thermodynamics. Prerequisite: CHEM 440 or concurrent. Student must have at least junior standing to register for this course.

CHEM 444- Quantum Mechanics Lab Credits: 1.00

Selected experiments to exemplify topics in quantum mechanics. Prerequisite: CHEM 441 or concurrent enrollment. Student must have at least junior standing to register for this course.

CHEM 445- Chemical Dynamics Lab Credits: 1.00

Selected experiments to exemplify topics in chemical dynamics. Prerequisite: CHEM 442 or concurrent enrollment. Student must have at least junior standing to register for this course.

CHEM 450- Structural Biochemistry Credits: 4.00

The structures and functions of the major classes of biologically important molecules, and the study of enzyme kinetics and catalysis. Prerequisite: CHEM 336 or equivalent, or consent of instructor. Student must have at least junior standing to register for this course.

CHEM 451- Metabolic Biochemistry Credits: 4.00

Exploration of metabolic pathways in living organisms from a chemical perspective. Specific topics, discussed at the molecular level, are selected from, but not limited to the following: Anabolic and catabolic pathways, electron transport, proton pumping, ATP production and biosignaling. Prerequisite: CHEM 450 Structural Biochemistry. Student must have at least junior standing to register for this course.

CHEM 454- Biochemistry Lab Credits: 2.00

Introduction of standard biochemical laboratory techniques and their application to solving biochemical and biochemically-related problems. Prerequisite: CHEM 450 or equivalent or consent of instructor. Student must have at least junior standing to register for this course.