

# DEPARTMENT OF CHEMISTRY

(330) 941-3663

The Bachelor of Science degree is recommended for those students who plan to make a career in chemistry. A recommended program that meets the standards of the American Chemical Society is provided below. The Bachelor of Arts degree is recommended for those who plan to go into a medical, pre-pharmacy, or dental field and for those who plan to enter business or secondary education careers related to chemistry. The required courses for a BS degree with a major in chemistry are listed in the BS curriculum. The courses required for a BA degree are those listed in the BA curriculum below. Chemistry majors may not count CHEM 1500 Chemistry in Modern Living toward the major. These degrees may be earned in eight semesters if students average 16 hours per semester.

## Learning Outcomes

The undergraduate student learning outcomes for the major in chemistry are as follows:

- Students will demonstrate independent and critical thinking.
- Students will understand the fundamentals of modern chemical instrumentation.
- Students will understand the basic principles of the chemical disciplines included in their curriculum.
- Students will effectively communicate their ideas both orally and in writing.

Students in pre-professional programs such as pre-optometry may obtain appropriate curricula and advisement in the Department of Chemistry.

The segments of chemistry courses extending through two semesters must be taken in sequence unless otherwise indicated.

Eye protection and lab coats must be worn in chemistry laboratories at all times.

Each student majoring in chemistry will be assigned a faculty advisor by the department. The advisor will discuss the overall curriculum necessary for a degree in chemistry and will assist the student in the preparation of a suitable course sequence and choice of a minor or minors.

All chemistry majors are urged to consult their advisors regularly to avoid curricular problems.

In both of the following curricula, the electives must satisfy the general requirements for the degree sought (see Degree Requirements). Foreign Language is required through 2600 level of all BA degrees.

## Combined BS/MS Program In Chemistry

This is a five-year program. Prospective students seeking admission to the program may submit an application to the Department of Chemistry during their senior year in high school. Students in the program start graduate studies after three years. They will normally receive the BS degree in chemistry after three years and the MS degree after five years.

## Combined BS/MD Program

This is a six- or seven-year program open to graduating high school seniors; however, if a student has already graduated from high school and has taken no coursework for college-level credit, she or he is still eligible to apply to the program. After two to three years of college-level credit, students in the program are then eligible for admission to the second, or medical school, phase. Each student successfully completing the program will be awarded the BS degree in combined science from Youngstown State University and the MD degree from the Northeast Ohio Medical University (NEOMED). For more information,

visit the Northeast Ohio Medical University ([http://www.neomed.edu/?utm\\_expid=64530711-4.7Vb\\_qmJPQDScjbENRAH37w.0&utm\\_referrer=http%3A%2F%2Fsearch.yahoo.com%2F\\_ylt%3DA0LEVvYthiNXRRkAVg4nnlIQ%3B\\_ylu%3DX3oDMTByOHZyb21tBGNvbG8DYmYxBHBvcwMxBZH0aWQDBHNiYwNzcg-%2FRV%3D2%2FRE%3D1461974701%2FRO%3D10%2FRU%3Dhttp%253a%252f%252fwww.neomed.edu%252f%2FRK%3D0%2FRS%3DmggNe3po.aLxL\\_73uE9yQIU\\_b4A-](http://www.neomed.edu/?utm_expid=64530711-4.7Vb_qmJPQDScjbENRAH37w.0&utm_referrer=http%3A%2F%2Fsearch.yahoo.com%2F_ylt%3DA0LEVvYthiNXRRkAVg4nnlIQ%3B_ylu%3DX3oDMTByOHZyb21tBGNvbG8DYmYxBHBvcwMxBZH0aWQDBHNiYwNzcg-%2FRV%3D2%2FRE%3D1461974701%2FRO%3D10%2FRU%3Dhttp%253a%252f%252fwww.neomed.edu%252f%2FRK%3D0%2FRS%3DmggNe3po.aLxL_73uE9yQIU_b4A-)).

For more information about the department, visit the **Department of Chemistry**.

### Chair

**Timothy R. Wagner**, Ph.D., Chair

### Professors

**Ganesaratnam K. Balendiran**, Ph.D., Professor

**Larry S. Curtin**, Ph.D., Associate Professor

**Douglas T. Genna**, Ph.D., Assistant Professor

**Allen D. Hunter**, Ph.D., Professor

**John A. Jackson**, Ph.D., Associate Professor

**Brian D. Leskiw**, Ph.D., Associate Professor

**Clovis Linkous**, Ph.D., Professor

**Sherri R. Lovelace-Cameron**, Ph.D., Professor

**Peter Norris**, Ph.D., Professor

**Michael A. Serra**, Ph.D., Associate Professor

**Josef B. Simeonsson**, Ph.D., Professor

**Nina V. Stourman**, Ph.D., Associate Professor

**Timothy R. Wagner**, Ph.D., Professor

## Majors

- BS in Chemistry (<http://catalog.yzu.edu/archives/2016-2017/undergraduate/colleges-programs/college-science-technology-engineering-mathematics/department-chemistry/bs-chemistry>)
- BA in Chemistry (<http://catalog.yzu.edu/archives/2016-2017/undergraduate/colleges-programs/college-science-technology-engineering-mathematics/department-chemistry/ba-chemistry>)
- BS in Biochemistry (<http://catalog.yzu.edu/archives/2016-2017/undergraduate/colleges-programs/college-science-technology-engineering-mathematics/department-chemistry/biochemistry-major/#newitemtext>)

## Minors

- Chemistry Minor (<http://catalog.yzu.edu/archives/2016-2017/undergraduate/colleges-programs/college-science-technology-engineering-mathematics/department-chemistry/chemistry-minor>)

### CHEM 1500 Chemistry in Modern Living 3 s.h.

Introduction to basic chemical concepts, the scientific method, and the impact of chemistry on human life and society. Examples may include water treatment, air quality, plastics, drugs, cosmetics, energy resources, food, and the chemical basis of life. Not intended for Chemistry majors.

**Gen Ed:** Natural Science.

**CHEM 1500L Chemistry in Modern Living Laboratory 1 s.h.**

Introduction to basic laboratory techniques designed to supplement CHEM 1500. Three hours per week.

**Concurrent with:** CHEM 1500.

**CHEM 1501 An Introduction to Chemistry 3 s.h.**

Metric units, dimensional analysis, chemical nomenclature, the mole concept, chemical stoichiometry. Emphasis on problem solving and the mathematics required for success in the study of chemistry. For students without high school chemistry and others needing preparation for CHEM 1505 or CHEM 1515. Three hours lecture, no laboratory.

**Prereq.:** MATH 1505 or MATH 1507 or one unit each of high school algebra and geometry.

**CHEM 1505 Allied Health Chemistry 1 3 s.h.**

Introduction to the principles of chemistry including atomic structure, bonding, nomenclature, chemical calculations, chemical reactions, gas laws, solutions, acids and bases, and equilibrium. Intended for majors in allied health and other applied sciences. Two hours lecture, three hours lab-discussion.

**Prereq.:** CHEM 1501 or equivalent, MATH 1505 or MATH 1507 or equivalent.

**Concurrent** CHEM 1505L.

**Gen Ed:** Science Substitute.

**CHEM 1505L Allied Health Chemistry 1 Laboratory 0 s.h.**

Allied Health Chemistry 1 Laboratory.

**CHEM 1505R Recitation for Allied Health Chemistry 1 1 s.h.**

Discussion and problem solving exercises to complement and enhance study in CHEM 1505.

**Concurrent with:** CHEM 1505.

**CHEM 1506 Allied Health Chemistry 2 3 s.h.**

Fundamentals of organic and biological chemistry including applications to the human organism. Two hours lecture, three hours lab-discussion.

**Prereq.:** CHEM 1505.

**Concurrent:** CHEM 1506L.

**Gen Ed:** Science Substitute.

**CHEM 1506L Allied Health Chemistry 2 Laboratory 0 s.h.**

Allied Health Chemistry 2 Laboratory.

**CHEM 1506R Recitation for Allied Health Chemistry 2 1 s.h.**

Discussion and problem solving exercises to complement and enhance study in CHEM 1506.

**Concurrent with:** CHEM 1506.

**CHEM 1515 General Chemistry 1 4 s.h.**

An introduction to the fundamental principles of chemistry, including measurement and calculation; chemical stoichiometry; the properties of gases; atomic and molecular structure; bonding; thermochemistry; and periodic properties. Intended for majors in the natural sciences and engineering. Three hours lecture, three hours lab-discussion.

**Prereq.:** CHEM 1501 or equivalent; MATH 1513 or equivalent.

**Concurrent:** CHEM 1515L; CHEM 1515R if major or repeating CHEM 1515.

**Gen Ed:** Science Substitute.

**CHEM 1515L General Chemistry 1 Laboratory 0 s.h.**

General Chemistry 1 Laboratory.

**CHEM 1515R Recitation for General Chemistry 1 1 s.h.**

Discussion and problem solving based on current material in CHEM 1515.

**Concurrent with:** CHEM 1515.

**CHEM 1516 General Chemistry 2 4 s.h.**

A continuation of the study of the principles of chemistry, including solution properties; acids and bases; chemical equilibrium; thermodynamics; reaction kinetics; and electrochemistry. Intended for majors in the natural sciences and engineering. Three hours lecture, three hours lab-discussion.

**Prereq.:** "C" or better in CHEM 1515; Concurrent: CHEM 1516L; CHEM 1516R if major or repeating CHEM 1516.

**Gen Ed:** Science Substitute.

**CHEM 1516L General Chemistry 2 Laboratory 0 s.h.**

General Chemistry 2 Laboratory.

**CHEM 1516R Recitation for General Chemistry 2 1 s.h.**

Discussion and problem solving based on current material in CHEM 1516.

**Concurrent with:** CHEM 1516.

**CHEM 2602 African and African-American Contributions to Science 3 s.h.**

Introduction to basic science concepts, the scientific method, and the impact of chemistry as a central science on society. Examples include works of African-American scientists.

**CHEM 2604 Quantitative Analysis 5 s.h.**

Chemical equilibrium, stoichiometry, theory of errors, and volumetric and gravimetric procedures as applied to quantitative determinations. Introduction to electroanalytical, chromatographic and spectrophotometric methods.

Emphasis on development of technique. Three hours lecture, six hours lab.

**Prereq.:** CHEM 1516.

**CHEM 2604L Quantitative Analysis Laboratory 0 s.h.**

Quantitative Analysis Laboratory.

**CHEM 2650 Introduction to Undergraduate Research 1-2 s.h.**

Introduction to the methods of chemical research under the direction of a faculty member. May include literature search and analysis, instructional laboratory development, and/or original basic or applied research. May be repeated to a maximum of 4 s.h.

**Prereq. or concurrent:** CHEM 1516 and approval of department chairperson.

**CHEM 3719 Organic Chemistry 1 4 s.h.**

Organic compounds, reactions and theories. Typical preparations and procedures of analysis. Three hours lecture, three hours lab-discussion.

**Prereq.:** "C" or better in CHEM 1516.

**CHEM 3719L Organic Chemistry 1 Laboratory 0 s.h.**

Organic Chemistry 1 Laboratory.

**CHEM 3719R Organic Chemistry Recitation 1 1 s.h.**

An introduction to the preparation and analysis of organic compounds. Discussion of CHEM 3719 material and approaches to problem solving. Required for chemistry majors.

**Concurrent with:** CHEM 3719.

**CHEM 3720 Organic Chemistry 2 4 s.h.**

Organic compounds, reactions and theories. Typical preparations and procedures of analysis. Three hours lecture, three hours lab-discussion.

**Prereq.:** "C" or better in CHEM 3719.

**CHEM 3720L Organic Chemistry 2 Laboratory 0 s.h.**

Organic Chemistry 2 Laboratory.

**CHEM 3720R Organic Chemistry Recitation 2 1 s.h.**

An introduction to the preparation and analysis of organic compounds. Discussion of CHEM 3720 material and approaches to problem solving. Required for chemistry majors.

**Concurrent with:** CHEM 3720.

**CHEM 3729 Inorganic Chemistry 3 s.h.**

Fundamental principles underlying the structure, bonding, and properties of the elements and molecular, solid state, and coordination compounds.

**Prereq. or concurrent:** CHEM 3739.

**CHEM 3739 Physical Chemistry 1 4 s.h.**

Principles and applications of thermodynamics and kinetics to chemical systems. Three hours lecture, three hours lab-discussion.

**Prereq.:** "C" or better in CHEM 3720, PHYS 2611, PHYS 2611L, MATH 1572.

**CHEM 3739L Physical Chemistry 1 Laboratory 0 s.h.**

Physical Chemistry 1 Laboratory.

**CHEM 3740 Physical Chemistry 2 4 s.h.**

Principles and applications of quantum mechanic and statistical thermodynamics to chemical systems. Three hours lecture, three hours lab-discussion.

**Prereq.:** "C" or better in CHEM 3739; MATH 2673.

**CHEM 3740L Physical Chemistry 2 Laboratory 0 s.h.**

Physical Chemistry 2 Laboratory.

**CHEM 3764 Chemical Toxicology 3 s.h.**

Introduction to the clinical, forensic, industrial, and environmental aspects of chemical toxicology. Therapeutic and toxic limits of drugs. Actions, controls and treatment of poisons and environmental agents.

**Prereq.:** CHEM 3720.

**CHEM 3785 Biochemistry 1 3 s.h.**

Structure and properties of biomolecules, including proteins, lipids, carbohydrates and nucleic acids. Introduction to glycolysis metabolic pathway.

**Prereq.:** CHEM 3720.

**CHEM 3785L Biochemistry Laboratory 1 s.h.**

Analysis and separation techniques of biochemistry. Three hours lab-discussion.

**Prereq. or concurrent:** CHEM 3785.

**CHEM 3786 Biochemistry 2 3 s.h.**

Intermediary metabolism and biochemical information pathways.

**Prereq.:** CHEM 3785.

**CHEM 3790 Undergraduate Seminar 1 s.h.**

Students participate in departmental seminars and present a seminar to the class. May be repeated once.

**Prereq. or concurrent:** CHEM 2604 and CHEM 3720.

**CHEM 4850 Chemistry Research 1 s.h.**

Research planning, design, and execution including literature survey techniques, proposal writing, and critical scientific analysis. The student gives an oral presentation of a research proposal for CHEM 4850L, or on another topic as approved by the instructor.

**Prereq.:** CHEM 2604 or CHEM 3719 and approval of department chairperson.

**Gen Ed:** Capstone.

**CHEM 4850L Chemistry Research Laboratory 2-3 s.h.**

Research participation under the direction of a faculty member. The student prepares an acceptable written report on the completed project. May be repeated to a maximum of 5 s.h.

**Prereq. or concurrent :** CHEM 4850 and approval of department chairperson.

**Gen Ed:** Capstone.

**CHEM 4860 Regulatory Aspects of Industrial Chemistry 1 s.h.**

Roles and responsibilities of industrial chemists. Industrial hygiene and safety. Industrial chemical processes, their waste products, their environmental effects, and the treatment of pollutants. Governmental regulations relating to waste disposal, product safety, occupational safety, resource conservation, environmental protection, and problems of awareness and compliance.

**Prereq.:** CHEM 3720.

**CHEM 4891 Special Topics 1-3 s.h.**

Topics selected by the faculty from fields of current research interest or of special emphasis. May be repeated with different topics.

**CHEM 5804 Chemical Instrumentation 4 s.h.**

The theoretical foundations of instrumental procedures and the use of instruments in analytical work. Two hours lecture, six hours lab.

**Prereq.:** CHEM 3739.

**CHEM 5804L Chemical Instrumentation Laboratory 0 s.h.**

Chemical Instrumentation Laboratory.

**CHEM 5821 Intermediate Organic Chemistry 3 s.h.**

An intermediate treatment of organic chemistry building on the principles introduced at the sophomore level. Emphasis on curved arrow notation in mechanism and the planning of organic syntheses. Structural analysis of organic compounds using NMR, IR and MS and the application of structural knowledge to questions of mechanism.

**Prereq.:** CHEM 3720.

**CHEM 5822 Advanced Organic Laboratory 4 s.h.**

An advanced approach to the applications of organic chemistry in the laboratory. Synthesis and purification of organic molecules using modern techniques, structure elucidation using spectroscopic techniques. Lecture discussion includes use of instrumentation, planning of practical syntheses, use of the primary chemical literature and safety in the laboratory. Two hours lecture, six hours lab.

**Prereq.:** CHEM 3720.

**CHEM 5822L Advanced Organic Laboratory 0 s.h.**

Advanced Organic Laboratory.

**CHEM 5830 Intermediate Inorganic Chemistry 2 s.h.**

Reactions and descriptive chemistry of transition metal, organometallic, and main-group compounds.

**Prereq.:** CHEM 3729, CHEM 3740 (may be concurrent).

**CHEM 5831 Inorganic Chemistry Laboratory 2 s.h.**

Preparation of typical inorganic compounds and their characterization. Six hours lab-discussion.

**Prereq. or concurrent:** CHEM 3729 and CHEM 3739.

**CHEM 5832 Solid State Structural Methods 3 s.h.**

The determination of structures of biological, organic, and inorganic materials in the solid state. Introduction to the crystalline state, defects, diffraction of waves, powder and single crystal diffraction methods of neutron and x-ray analysis, electron microscopy, and solid state NMR. Two hours lecture, three hours lab.

**Prereq.:** CHEM 3729.

**CHEM 5832L Solid State Structural Methods Laboratory 0 s.h.**

Solid State Structural Methods Laboratory.

**CHEM 5836 Quantum Chemistry 3 s.h.**

Basic principles of quantum chemistry, with applications to problems in molecular structure, spectroscopy and thermodynamics.

**Prereq.:** CHEM 3740.

**CHEM 5861 Polymer Science 1: Polymer Chemistry and Plastics 3 s.h.**

Preparation, characterization, structure-property relationships, morphology, and uses of the major commercial polymers. Two hours lecture, three hours lab.

**Prereq.:** CHEM 3739.

**CHEM 5861L Polymer Science 1: Polymer Chemistry and Plastics Laboratory 0 s.h.**

Polymer Science 1: Polymer Chemistry and Plastics Laboratory.

**CHEM 5862 Polymer Science 2: Polymer Rheology, Processing, and Composites 3 s.h.**

Polymer rheology, processing methods, and materials characterization. The effects of additives and the major classes of thermoplastic, thermoset, elastomeric, and composite materials. Two hours lecture, three hours lab.

**Prereq.:** CHEM 5861 or consent of the chairperson.

**CHEM 5862L Polymer Science 2: Polymer Rheology, Processing, and Composites Laboratory 0 s.h.**

Polymer Science 2: Polymer Rheology, Processing, and Composites Laboratory.

**CHEM 5876 Enzyme Analysis 2 s.h.**

Advanced biochemistry laboratory focusing on the methods of enzyme purification and characterization. One hour lecture, two hours lab.

**Prereq.:** CHEM 3785 or equivalent and CHEM 3785L or equivalent.