

CHEMISTRY (CHEM)

Degrees Offered: Ph.D., M.S.

This program is offered in Durham.

The Chemistry Department combines the personal contact that you would find at a small college with a research profile that you would find at a research-intensive institution. We are the only department that has existed for the entire history of UNH and we have a long-standing tradition of achievement in the molecular sciences. We aspire to be a place of educational, professional, and personal transformation, where young scientists work along side faculty members, participating in the process of discovering new knowledge about the molecular world. Students of chemistry receive a high quality, broad-based education in an atmosphere of close cooperation between faculty and students, between research and teaching, and between chemistry and other disciplines. Our graduate program is open to talented, qualified students who are eager to deepen their knowledge of Chemistry and who wish to contribute to its growth.

Graduate Degree Programs and Paths:

- Paths to both the M.S. and Ph.D. degrees have firm coursework foundations in Chemistry's traditional sub-disciplines, but are rooted in the interdisciplinary research projects of our Faculty.
- The M.S. program provides students with the opportunity to develop a high degree of proficiency in a specialized research area. The program builds a solid foundation for careers in industry or teaching, for further graduate or professional school, or for those who would like to strengthen their Chemistry knowledge.
- The Ph.D. program prepares students for careers in science as researchers and educators by expanding their knowledge of the discipline while developing their ability for critical analysis, creativity, and independent study. Graduates are well placed for careers as professional chemists in industry, academia, government, and related areas.
- The Ph.D. (Option in Chemistry Education) program is designed for students who plan a career at the interface of Science and Education (e.g. discipline-based education research, educational program assessment, STEM curriculum design, chemistry teaching, etc.).

Admission Requirements

Admission to the master of science and the doctor of philosophy degrees is based upon a strong undergraduate record and requires satisfactory work in the usual undergraduate courses in inorganic chemistry, analytical chemistry, organic chemistry, and physical chemistry, as well as the normal supporting courses in mathematics and physics. Entering graduate students are expected to take proficiency examinations in chemistry to ensure they begin their graduate work at the appropriate level. These examinations will be offered the week prior to the opening of the Fall semester during the Department of Chemistry's graduate student orientation week.

Interdisciplinary Programs in Chemistry

Graduate students in chemistry may elect to enter one of the interdisciplinary programs offered jointly with the chemistry department and other departments. In these programs, the graduate student, with the advice of the guidance committee, elects courses in chemistry and in the related disciplines, and writes the dissertation on a research problem appropriate to the interdisciplinary research. Students interested in

these programs should contact the Graduate Coordinator for further information.

Preparing Future Faculty (PFF)

Students who desire a career in college-level teaching will follow their regular degree program in addition to meeting the university's PFF requirements. Please see the PFF website for more information: <https://gradschool.unh.edu/graduate-student-resources/events-professional-development>.

Teaching Experience

All chemistry Doctoral and Master of Science degree candidates will obtain some teaching experience during their program.

<https://ceps.unh.edu/chemistry/chemistry-graduate-programs>

Programs

- [Chemistry \(Ph.D.\)](#)
- [Chemistry: Chemistry Education \(Ph.D.\)](#)
- [Chemistry \(M.S.\)](#)

Courses

Chemistry (CHEM)

CHEM 800 - Introduction to Chemistry Teaching and Research Practices Credits: 1

Introduction to professional responsibilities, safety, and ethics of teaching and research. Theory-based teaching, learning, and assessment, and reflective practice. Departmental research overview and seminar participation. Pre-semester sessions and periodic seminars during semester.

Grade Mode: Graduate Credit/Fail grading

CHEM 801 - Modern Tools for Researchers in the Chemical Sciences Credits: 1

Series of professional development workshops on essential research skills, including intellectual property, literature searching and management, data management, building individual development plan and ethical concerns in chemistry.

Grade Mode: Graduate Credit/Fail grading

CHEM 802 - Critical Thinking for Chemists Credits: 1

Students begin writing their Thesis Research Proposal document and participate in structured peer-review of evolving drafts. They also participate in a claim-and-question process in which peers challenge claims made in the document and authors explain them. The activities prepare students to present and discuss their proposal with their committee after the end of the semester.

Prerequisite(s): CHEM 801 with a minimum grade of D-.

Grade Mode: Graduate Credit/Fail grading

CHEM 803 - Creative Thinking for Chemists**Credits:** 1

Students engage in a specific focus on the creative process in scientific research and the formal processes of research proposal development by inspection of existing proposals, discussion of grant agency functions, and developing an original research idea that undergoes a mock panel review.

Prerequisite(s): CHEM 802 with a minimum grade of D-.**Grade Mode:** Graduate Credit/Fail grading**CHEM 808 - Spectroscopic Investigations of Organic Molecules****Credits:** 3

Identification and structural analysis of chemical compounds by selected instrumental methods. Typical topics include proton and carbon-13 NMR spectroscopy, IR and UV spectroscopy, and mass spectrometry.

Grade Mode: Letter Grading**CHEM 840 - Chemical Biology****Credits:** 3

How does the COVID vaccine work? What is an antibody conjugate? What is bioconjugation? How do we see mRNA in living cells? How do we evolve enzymes? Chemical Biology is the interdisciplinary study of the chemical and chemical reactions involved to probe, manipulate, and control biological systems in vitro and in vivo. This course is designated for biologists, chemists, and engineers who want to understand cutting-edge and relevant research techniques used in modern medicine.

Prerequisite(s): (CHEM 547 with a minimum grade of D- and CHEM 548 with a minimum grade of D-) or (CHEM 651 with a minimum grade of D- and CHEM 652 with a minimum grade of D-).

Grade Mode: Letter Grading**CHEM 855 - Advanced Organic Chemistry****Credits:** 3

An overview of organic chemistry at the intermediate levels. Aspects of synthetic organic chemistry and physical organic chemistry, including stereochemistry, are covered.

Grade Mode: Letter Grading**CHEM 862 - Advanced Chemical Analysis Instrumentation****Credits:** 3

Theory, instrumentation, and application of methods to qualitative identification and quantitative measurement of trace chemical substances including environmental pollutants. Includes methods of such as atomic spectroscopy, gas and liquid chromatography, IR and UV-VIS spectrophotometry, electrochemistry, fluorescence, mass spectrometry, X-ray techniques.

Grade Mode: Letter Grading**CHEM 874 - Inorganic Chemistry****Credits:** 3

Intermediate level overviews of modern inorganic chemistry including structure, bonding, and reactivity. Coursework in organic chemistry and physical chemistry required.

Grade Mode: Letter Grading**CHEM 876 - Physical Chemistry III****Credits:** 3

Application of quantum theory to atomic electron structure, spectroscopy, and molecular structure.

Grade Mode: Letter Grading**CHEM 895 - Special Topics****Credits:** 2-4

New or specialized topics not covered in regular course offerings. May be repeated. Lab. (Not offered every year.)

Grade Mode: Letter Grading**CHEM 899 - Thesis/Problems****Credits:** 1-10

Conferences, library, and experimental work in some field of chemistry.

Repeat Rule: May be repeated for a maximum of 10 credits.**Grade Mode:** Graduate Credit/Fail grading**CHEM 902 - Theoretical Organic Chemistry II****Credits:** 3

A continuation of CHEM 901. (Not offered every year.)

Grade Mode: Letter Grading**CHEM 903 - Advanced Inorganic Chemistry I****Credits:** 3

Survey of important advanced topics in concepts of modern inorganic chemistry.

Grade Mode: Letter Grading**CHEM 904 - Advanced Inorganic Chemistry II****Credits:** 3

Overview of current trends in inorganic research, including transition metal reactions and mechanisms and organometallic chemistry. (Not offered every year.)

Grade Mode: Letter Grading**CHEM #905 - Advanced Physical Chemistry I****Credits:** 3

Introduction to topics in quantum mechanics and group theory, which form the background of all areas of modern chemistry. (Not offered every year.)

Grade Mode: Letter Grading**CHEM 911 - Synthetic Organic Chemistry I****Credits:** 4

Fundamentals of synthetic organic methodology and applications in multiple syntheses. Fourth hour recitation session.

Grade Mode: Letter Grading**CHEM #917 - Advanced Special Topics****Credits:** 2-4

Advanced courses dealing with specialized sub-disciplines in chemistry. (Not offered every year.)

Grade Mode: Letter Grading**CHEM 918 - Advanced Special Topics****Credits:** 2-4

Advanced courses dealing with specialized sub-disciplines in chemistry. (Not offered every year.)

Grade Mode: Letter Grading**CHEM 925 - Surface Chemistry****Credits:** 3

Bulk and surface structure of solids, experimental methods of surface characterization, molecule-surface interactions, principles of homogeneous and heterogeneous catalysis. This course typically discusses adsorption/desorption kinetics, surface reaction mechanisms, adsorption isotherms, volcano plots, zeolite catalysis, applications to renewable energy, photovoltaics, nanoscience, all from a chemical standpoint.

Grade Mode: Letter Grading**CHEM 927 - Chemical Kinetics and Reaction Dynamics****Credits:** 3

The course reviews macroscopic chemical kinetics, then investigates the microscopic origins of rate laws. Scattering theory. Transition state theory. Unimolecular and bimolecular reactions.

Grade Mode: Letter Grading

CHEM 930 - Advanced Optical Methods**Credits:** 3

Techniques of chemical identification and analysis utilizing optical instrumentation from the standpoint of theory and application. Topics include UV-visible absorption, luminescence, atomic spectroscopy, IR, NMR, x-ray methods, and mass spectrometry. (Not offered every year.)

Grade Mode: Letter Grading**CHEM #933 - Chemical Separations****Credits:** 3

The use of various separation techniques prior to analysis; separations as methods of analysis. (Not offered every year.)

Grade Mode: Letter Grading**CHEM 934 - Chemical Equilibria****Credits:** 3

Formulation and solution of chemical equilibrium problems of relevance to analytical chemistry. (Not offered every year.)

Grade Mode: Letter Grading**CHEM 935 - Advanced Analytical Chemistry****Credits:** 3

Advanced analytical chemical methods, including: potentiometry and voltammetry, X-ray fluorescence, electron spectroscopy, scanning electron microscopy and modern methods of mass spectrometry.

Grade Mode: Letter Grading**CHEM 991 - Graduate Presentation Portfolio****Credits:** 1

A graduate course for Chemistry Master of Science students designed to provide them with expertise in preparing, organizing, and giving research presentations.

Grade Mode: Graduate Credit/Fail grading**CHEM 992 - Graduate Writing Portfolio****Credits:** 1

A graduate course for students to acquire and practice appropriate professional data documentation and writing skills.

Grade Mode: Graduate Credit/Fail grading**CHEM 995 - Colloquium****Credits:** 1-4

A) Inorganic Chemistry; B) Organic Chemistry; C) Theoretical Organic Chemistry; D) Physical Chemistry; E) Analytical Chemistry; F) Chemical Education. (Not offered every year.)

Repeat Rule: May be repeated for a maximum of 12 credits.**Grade Mode:** Letter Grading**CHEM 997 - Seminar****Credits:** 1

Presentation and discussion of recent investigations in chemistry.

Grade Mode: Graduate Credit/Fail grading**CHEM 998 - Seminar****Credits:** 1

Presentation and discussion of recent investigations in chemistry.

Grade Mode: Graduate Credit/Fail grading**CHEM 999 - Doctoral Research****Credits:** 0

Doctoral Research.

Grade Mode: Graduate Credit/Fail grading**Special Fee:** Yes

Faculty

See <https://ceps.unh.edu/directory/all> for faculty.