**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 (with paths in analytical, inorganic, organic, and physical chemistry) 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 (with paths in analytical, inorganic, organic, and physical chemistry) 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. Applicants are to submit GRE scores as a part of their admission application. 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: [http://www.gradschool.unh.edu/pff.php](http://www.gradschool.unh.edu/pff.php).

**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](https://ceps.unh.edu/chemistry/chemistry-graduate-programs)

**Programs**

- Chemistry (Ph.D.) (http://catalog.unh.edu/graduate/programs-study/chemistry/chemistry-phd)
- Chemistry: Chemistry Education (Ph.D.) (http://catalog.unh.edu/graduate/programs-study/chemistry/chemistry-education-phd)
- Chemistry (M.S.) (http://catalog.unh.edu/graduate/programs-study/chemistry/chemistry-ms)

**Courses**

**Chemistry (CHEM)**

**CHEM 800 - Chemistry Teaching Seminar**

*Credits: 1*

Introduction for graduate students to their role as chemistry teaching assistants: professional responsibilities, safety, and ethics; theory-based teaching, learning, and assessment; reflective practice. Pre-semester sessions and periodic seminars during semester. Cr/F.

**CHEM 802 - Critical and Creative Thinking for Chemists**

*Credits: 1*

Students prepare two proposals, one based on their research and a second based on an original idea. They develop critical thinking skills by critiquing proposals from other students. Lectures discuss topics relative to research proposal development including presentation, coming up with new ideas, keeping up with the chemical literature and research costs.

**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.

**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.
CHEM 862 - Instrumental Methods of Chemical Analysis  
Credits: 3  
Theory, instrumentation, and application of methods such as atomic absorption, coulometry, emission spectrophotography, gas and liquid chromatography, IR and UV-VIS absorption spectrophotometry, and mass spectrometry to chemical analysis. Prereq: quantitative analysis; physical chemistry as a pre- or co-requisite/ or permission.

CHEM 874 - Inorganic Chemistry  
Credits: 3  
Intermediate level overviews of modern inorganic chemistry including structure, bonding, and reactivity. Prereq: organic chemistry; physical chemistry; or permission.

CHEM 876 - Physical Chemistry III  
Credits: 3  
Application of quantum theory to atomic electron structure, spectroscopy, and molecular structure.

CHEM 895 - Special Topics  
Credits: 2-4  
New or specialized topics not covered in regular course offerings. May be repeated. Prereq: permission. Lab. (Not offered every year.)

CHEM 899 - Thesis/Problems  
Credits: 1-10  
Conferences, library, and experimental work in some field of chemistry. May be repeated to a maximum of 10 credits. Cr/F.

CHEM 902 - Theoretical Organic Chemistry II  
Credits: 3  
A continuation of CHEM 901. (Not offered every year.)

CHEM 903 - Advanced Inorganic Chemistry I  
Credits: 3  
Survey of important advanced topics in concepts of modern inorganic chemistry.

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.)

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.)

CHEM 911 - Synthetic Organic Chemistry I  
Credits: 4  
Fundamentals of synthetic organic methodology and applications in multiple syntheses. Fourth hour recitation session.

CHEM 917 - Special Topics in Organic Chemistry  
Credits: 2-4  
Advanced courses dealing with specialized sub-disciplines of organic chemistry. (Not offered every year.)

CHEM 918 - Special Topics in Organic Chemistry  
Credits: 2-4  
Advanced courses dealing with specialized sub-disciplines of organic chemistry. (Not offered every year.)

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.

CHEM 926 - Physical Chemistry of Condensed Phases  
Credits: 3  
Thermodynamics and kinetics of molecules and ions in solution and at interfaces.

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.

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. Prereq: CHEM 935 or permission. (Not offered every year.)

CHEM 933 - Chemical Separations  
Credits: 3  
The use of various separation techniques prior to analysis; separations as methods of analysis. Prereq: CHEM 934 or permission. (Not offered every year.)

CHEM 934 - Chemical Equilibria  
Credits: 3  
Formulation and solution of chemical equilibrium problems of relevance to analytical chemistry. (Not offered every year.)

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.

CHEM 947 - Inorganic Biochemistry  
Credits: 3  
Introduction to the inorganic chemistry and biochemistry of the interactions of metals with proteins, nucleic acids, and other biomolecules. Relevant small metal complexes (model compounds) and synthetic chelating agents are also covered. Prereq: CHEM 903 or permission. (Offered every other year.)

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. Cr/F.

CHEM 992 - Graduate Writing Portfolio  
Credits: 1  
A graduate course for Chemistry Master of Science students to acquire and practice appropriate professional data documentation and writing skills. Cr/F.
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. Sections of the course may be taken to a total of 12 credits. (Not offered every year.)

CHEM 996 - Colloquium  
Credits: 1-4  
A) Inorganic Chemistry; B) Organic Chemistry; C) Theoretical Organic Chemistry; D) Physical Chemistry; E) Analytical Chemistry; F) Chemical Education. Sections of the course may be taken to a total of 12 credits. (Not offered every year.)

CHEM 997 - Seminar  
Credits: 1  
Presentation and discussion of recent investigations in chemistry. Cr/F.

CHEM 998 - Seminar  
Credits: 1  
Presentation and discussion of recent investigations in chemistry. Cr/F.

CHEM 999 - Doctoral Research  
Credits: 0  
Cr/F.

Faculty

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