



## CHEMISTRY

### CHEMISTRY AND BIOCHEMISTRY 2013–2014

#### Why study chemistry at the University of Denver?

Consider the advantages:

- Excellent, research-active faculty
- Small classes, personal attention
- First-rate teaching facilities
- Modern, state-of-the-art equipment

At the University of Denver, we offer the training and amenities to energize your graduate experience and help you develop into a professional scientist.

The Department of Chemistry and Biochemistry at the University of Denver offers programs leading to MA, MS or PhD degree in chemistry.

Our faculty members actively involve students in research programs supported with more than \$1.5 million in annual funding from federal agencies, state governments and private industries. In our programs, you will enjoy the benefits of a friendly, personalized learning environment that offers nationally competitive and extremely productive research opportunities.

The Department of Chemistry and Biochemistry has much to offer a graduate student: close and frequent student-faculty interaction; an integrated program of courses; and excellent equipment and facilities including 500 MHz NMR, single-crystal X-ray diffraction, multiple EPR spectrometers, ICP-mass spectrometer, photon counting lifetime fluorescence, nanosecond laser flash photolysis, aerosol particle monitoring spectrometer, and fluorescence microscopy.

Faculty research interests encompass biophysical, organic, analytical and environmental chemistry and biochemistry. The department's relatively small size allows a broader, more interdisciplinary approach than in large departments. Our instructional format merges traditional disciplines into interdisciplinary courses that more closely reflect current trends in chemistry.

Degree Requirements

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Faculty

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Course Description

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UNIVERSITY of  
DENVER

Department of Chemistry and  
Biochemistry

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Denver, CO 80208

303-871-2435

<http://www.chemistry.du.edu>

## Master of Arts in Chemistry

The MA degree is intended primarily to meet the needs of students working full time in industry or in secondary education who are seeking an advanced degree with only a small research component. The primary difference between the MA and the MS is that a research thesis is required for the MS degree.

### Credit-Hour Requirements

A minimum of 45 credit hours (of which a minimum of 35 hours must be earned at the University of Denver).

### Course Requirements

The graduate core curriculum must be completed with a GPA of 3.0 or better. If it is appropriate, and approved by the graduate committee, other graduate courses may be substituted for part of the graduate core curriculum.

### Independent Study and/or Research

A minimum of six credit hours of independent study and/or independent research approved by the student's advisory committee must be completed.

### Courses in Other Departments

A minimum of 35 credit hours must be taken in courses offered by the Department of Chemistry and Biochemistry. As many as 10 credit hours may be taken in science-related 3000- to 4000-level courses approved by the student's advisory committee.

### Seminars

All students in the MA degree program must present a technical seminar (CHEM 4900).

### Required Courses

#### Chemical systems (three-quarter sequence)

CHEM 3110 Chemical Systems I

CHEM 3120 Chemical Systems II

CHEM 3130 Chemical Systems III

#### Molecular structure and energetics (two-quarter sequence)

CHEM 3310 Molecular Structure and Energetics I

CHEM 3320 Molecular Structure and Energetics II

#### Biochemistry (two-quarter sequence)

CHEM 3811 or 3831 Biochemistry/Proteins

CHEM 3812 Biochemistry/Membranes and Metabolism

### Analytical

CHEM 3220 Advanced Analytical Chemistry

### One advanced topic course or additional research credits

CHEM 4xxx or others if preapproved by the graduate committee

### Independent study and/or independent research (minimum six quarter hours, repeats allowed)

CHEM 4991 Independent Study, CHEM 4995 Independent Research

## Master of Science in Chemistry

The MS degree is intended for students who want an advanced degree in chemistry primarily for the purpose of better preparation to conduct research or to fill higher-level industrial chemist positions.

### Credit Hour Requirements

A minimum of 45 credit hours (of which a minimum of 35 hours must be earned at the University of Denver).

### Course Requirements

The graduate core curriculum must be completed with a GPA of 3.0 or better.

### Seminars

All students in the MS program must present one departmental "non-thesis" seminar (CHEM 4900), in addition to the thesis seminar.

### Thesis

A thesis of publishable quality must be completed. A summary of the thesis is presented in an oral defense. The thesis defense committee will consist of a minimum of two faculty members from the Department of Chemistry and Biochemistry and an outside chair.

### Required Courses

#### Chemical systems (three-quarter sequence)

CHEM 3110 Chemical Systems I

CHEM 3120 Chemical Systems II

CHEM 3130 Chemical Systems III







**Lawrence J. Berliner**  
Professor  
PhD, Stanford University

**Bryan Cowen**  
Assistant Professor  
PhD, Yale University

**Gareth R. Eaton**  
Professor  
PhD, Massachusetts Institute of Technology

**Sandra S. Eaton**  
Professor and Department Chair  
PhD, Massachusetts Institute of Technology

**Julanna V. Gilbert**  
Associate Professor and Director of the Center for  
Teaching and Learning  
PhD, University of Colorado

**Peter Harrington**  
Lecturer  
PhD, Princeton University

**J. Alex Huffman**  
Assistant Professor  
PhD, University of Colorado, Boulder

**Michelle K. Knowles**  
Assistant Professor  
PhD, University of Oregon

**Candace Kristensson**  
Lecturer  
PhD, University of Utah

**Andrei G. Kutateladze**  
Professor  
PhD, Moscow State  
University

**Brian J. Majestic**  
Assistant Professor  
PhD, University of Wisconsin, Madison

**Martin Margittai**  
Assistant Professor  
PhD, Freie Universität, Berlin

**Keith E. Miller**  
Assistant Professor  
PhD, University of Washington

**Balasingam Murugaverl**  
Lecturer/Lab Coordinator PhD, University of Denver

**Scott D. Pegan**  
Assistant Professor  
PhD, University of California, San Diego

**Byron W. Purse**  
Assistant Professor  
PhD, The Scripps Research Institute

**Dwight M. Smith**  
Research Professor and Chancellor Emeritus  
PhD, Pennsylvania State University

**Donald H. Stedman**  
Research Professor  
PhD, University of East Anglia

**CHEM 3110 Chemical Systems I (3 qtr. hrs.)**

Advanced discussion of modern concepts of organic chemistry; bonding, stereochemistry, reaction mechanisms. Prerequisites: CHEM 2453 and equivalent of one year of physical chemistry.

**CHEM 3120 Chemical Systems II (3 qtr. hrs.)**

Interpretation of trends in the chemistry of the elements in terms of orbital interactions. Most examples will be taken from the third row transition metals and the boron and carbon groups. Prerequisites: CHEM 2131, 3310 and 3110.

**CHEM 3130 Chemical Systems III (3 qtr. hrs.)**

Advanced-level physical biochemistry course intended for advanced-level undergraduates and graduate students. Focuses on kinetic, thermodynamic and dynamic aspects of biopolymers; delineates the relationship of these properties to the mechanism and function of biological macromolecules. Prerequisites: CHEM 3811, 3812, 3813, 3610 or the equivalent.

**CHEM 3220 Advanced Analytical Chemistry (3 qtr. hrs.)**

Principles of chemical instrumentation applied to analytical measurements; principles, instrumentation and applications of spectrometric and chromatographic measurements. Prerequisites: CHEM 2011 and 3621, or the equivalent.

**CHEM 3310 Structure and Energetics I (3 qtr. hrs.)**

Fundamentals of quantum chemistry, and introduction to symmetry and molecular structure of small and large systems. Prerequisite: one year of physical chemistry.

**CHEM 3320 Structure and Energetics II (3 qtr. hrs.)**

Computational methods in chemistry. Prerequisites: CHEM 3310, one year of physical chemistry.

**CHEM 3410 Atmospheric Chemistry (3 qtr. hrs.)**

The concepts of equilibrium thermodynamics, kinetics, and photochemistry will be applied to understanding atmospheric processes. Covers urban air pollution in detail with focus on primary pollutants. Also covers stratospheric chemistry with focus on ozone chemistry and the chemistry of climate change. Prerequisites: CHEM 2011, 2041, 2131, 2453, and 2463, or instructor's permission.

**CHEM 3411 Aquatic Chemistry (3 qtr. hrs.)**

The circulation of the oceans and their chemical make-up. 'Classical water pollution problems' like biological oxygen demand and turbidity are discussed. Also presented: aquifer structure and flow, ground water chemistry, pollutant partitioning between stationary and mobile phases, heterogeneous surface chemistry, and the detection of trace contaminants. Prerequisites: CHEM 2011, 2041, 2131, 2453, 2463 or instructor's permission.

**CHEM 3412 Environmental Chemistry & Toxicology (3 qtr. hrs.)**

A survey of environmental toxicology concepts: animal testing, dose-response data, epidemiology, risk assessment. The course includes ecotoxicology, focusing on the alteration of biological and chemical systems beyond the simple response of an individual to an environmental chemical. Prerequisites: CHEM 2011, 2041, 2131, 2453, 2463 or instructor's permission.

**CHEM 3610 Physical Chemistry I (3 qtr. hrs.)**

Fundamentals of thermodynamics, including phase and reaction equilibria, properties of solutions, and electrochemistry needed for advanced study in life sciences and for Physical Chemistry II and III. May be taken for graduate credit by non-chemistry majors. Prerequisites: CHEM 2011, calculus and physics.

**CHEM 3620 Physical Chemistry II (3 qtr. hrs.)**

Fundamentals of quantum chemistry, including theories of atomic and molecular structure and spectroscopy. May be taken for graduate credit by nonchemistry majors. Prerequisite: CHEM 3610 or instructor's permission.

**CHEM 3621 Physical Chemistry III (3 qtr. hrs.)**

Fundamentals of kinetic theory and statistical mechanics. May be taken for graduate credit by nonchemistry majors. Prerequisite: CHEM 3620.

**CHEM 3703 Topics in Organic Chemistry (3 qtr. hrs.)**

May include organic photochemistry, organic synthesis, organic electrochemistry or natural products. May be repeated for credit. Prerequisites: CHEM 2453 or equivalent and others depending on topic.

**CHEM 3705 Topics in Biochemistry (3 or 4 qtr. hrs.)**  
May include physical techniques for exploring biological structure, biological catalysis, and selected fields within biochemistry taught from original literature. May be repeated for credit. Prerequisites: CHEM 3811, 3812, 3813.

**CHEM 3811 Biochemistry-Proteins (3 qtr. hrs.)**  
Protein structure and function, starting with the building blocks and forces that drive the formation of protein structure and the basic concepts of protein structure, and continuing with enzyme catalysis, kinetics, and regulation. Prerequisites: CHEM 2453 and 2011, or instructor permission.

**CHEM 3812 Biochemistry-Membranes/Metabolism (3 qtr. hrs.)**  
Membranes and membrane mediated cellular processes, energy and signal transduction, and metabolic/biosynthetic pathways. Prerequisite: CHEM 3811.

**CHEM 3813 Biochemistry-Nucleic Acids (3 qtr. hrs.)**  
Molecular processes underlying heredity, gene expression and gene regulation in prokaryotes and eukaryotes. Prerequisite: CHEM 2453.

**CHEM 3831 Advanced Protein Biochemistry (3 qtr. hrs.)**  
This advanced biochemistry course provides fundamental insights into the chemistry and physics of proteins. It will investigate how amino acids form proteins with highly complex three dimensional structures and how these structures mediate function. Topics will range from protein folding to enzyme kinetics and will emphasize basic principles. Prerequisites: CHEM 2453, 3610 or equivalent.

**CHEM 3991 Independent Study (1 to 10 qtr. hrs.)**  
May be repeated for credit.

**CHEM 3992 Directed Study (1 to 10 qtr. hrs.)**

**CHEM 3995 Research in Chemistry (1 to 10 qtr. hrs.)**  
Research project conducted under guidance of a faculty member. Credit hours and projects arranged on an individual basis. May be repeated for credit.

**CHEM 4400 Adv. Topics: Organic Chemistry (3 qtr. hrs.)**  
Physical organic chemistry; reaction mechanisms, structure reactivity relationships, kinetics, photochemistry, molecular orbital theory, etc.; current literature. May be taken for credit more than once.

**CHEM 4900 Chemistry Seminar (1 qtr. hrs.)**  
Weekly presentations of research in progress and of current literature by outside speakers, faculty and graduate students.

**CHEM 4991 Independent Study (1 to 10 qtr. hrs.)**

**CHEM 4992 Directed Study (1 to 10 qtr. hrs.)**

**CHEM 4995 Independent Research (1 to 10 qtr. hrs.)**

**CHEM 5991 Independent Study (1 to 10 qtr. hrs.)**

**CHEM 5995 Independent Research (1 to 10 qtr. hrs.)**

## For More Information

A complete description of the program's official offerings and requirements is available from the department at <http://www.du.edu/nsm/departments/chemistryandbiochemistry/>.

The University of Denver is an Equal Opportunity institution. We admit students of any race, color, national and ethnic origin to all the rights, privileges, programs and activities generally accorded or made available to students at the University. The University of Denver does not discriminate on the basis of race, color, national and ethnic origin in administration of our educational policies, admission policies, scholarship and loan programs, and athletic and other university-administered programs. University policy likewise prohibits discrimination on the basis of age, religion, disability, sex, sexual orientation, gender identity, gender expression, marital status or veteran status. Inquiries concerning allegations of discrimination based on any of the above factors may be referred to the University of Denver, Office of Diversity and Equal Opportunity.