

# Chemistry

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## Department Information

- **Department Chair:**  
Gregory Cook, Ph.D.
- **Graduate Coordinator:**  
Svetlana Kilina, Ph.D.
- **Email:**  
svetlana.kilina@ndsu.edu
- **Department Location:**  
Ladd Hall
- **Department Phone:**  
(701) 231-8694
- **Department Web Site:**  
[www.ndsu.edu/chemistry/](http://www.ndsu.edu/chemistry/) (<http://www.ndsu.edu/chemistry/>)
- **Application Deadline:**  
April 15 for fall, October 31 for spring. Spring admissions depend on the availability of fellowships and faculty interests. If there are no spring openings, spring applications are automatically considered for the subsequent fall semester.
- **Credential Offered:**  
Ph.D., M.S.
- **Test Requirement:**  
GRE required from applicants who have not earned a degree in the U.S. (general and subject recommended for domestic students, but not required)
- **English Proficiency Requirements:**  
TOEFL iBT 81 (23 speak; 21 write) – TA, 71 – RA; IELTS 6.5 – TA, 6 – RA; Duolingo 105 - TA, 100 - RA- RA

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## Program Description

The Department of Chemistry and Biochemistry offers programs leading to the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees in Chemistry. At the start of the first year of study, entering graduate students take entrance examinations in analytical, inorganic, organic, and physical chemistry, as well as chemistry and biochemistry. The graduate student progress committee uses these exams for advisory purposes in recommending course work during the first year. As a consequence, programs are individually tailored to the needs of each student. Typically, course work is completed in one to one-and-a-half years for M.S. candidates, and two years for Ph.D. candidates, leaving later years for full-time thesis research. The typical time to complete a graduate degree averages three years for the M.S. degree and approximately five years for the Ph.D.

## Research Opportunities and Infrastructure

The Department of Chemistry and Biochemistry has more than 10 externally funded faculty research programs. Research expenditures have averaged \$1.8 million over the last 10 years, with more than \$2.2 million in the last two years.

All research and most teaching activities within the department occur within three centrally-located buildings, including two connected facilities, Ladd Hall and Dunbar Laboratory, as well as the Quentin Burdick Building, located across the street.

Most departmental offices, classrooms and teaching labs, as well as some research labs are located in Ladd Hall, while Dunbar and the third floor of the Quentin Burdick Building primarily consist of research laboratories. Ladd Hall also houses departmental glass, machine, and electronics shops.

Modern instrumentation is vital to research in the chemical sciences. The quality and quantity of instrumentation within the department has been greatly enhanced in the last few years through aggressive fundraising efforts and university matching support.

The department has recently upgraded its mass spectrometry capabilities to include a Bio-TOF III with accurate mass analysis, ESI and CI ionization; as well as an Esquire 3000 Plus - an Ion trap instrument with MS-MS and proteomics capabilities. A dedicated LC can be integrated with the both the instruments.

The Organic Spectroscopy Laboratory is primarily devoted to maintenance and operation of Nuclear Magnetic Resonance (NMR) spectrometers. The facility includes three modern high-field instruments: Varian 500, 400, and 300 MHz spectrometers. All have multinuclear, 2- D, and variable temperature capabilities, and the 400 MHz instrument has been recently upgraded for solids capabilities. This center also includes the departmental FTIR.

The Materials Characterization Laboratory houses the departmental crystallography facilities including a Bruker single crystal CCD X-ray diffractometer with low temperature capabilities, a Philips MPD (Multi- Purpose Diffractometer), two Philips X-ray powder diffractometers, and a KeveX X-ray fluorescence unit. CHN Elemental analysis, thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), and differential thermal analysis (DTA) are also available.

The Center for Protease Research - Core Biology Facility is a new facility housing equipment and technical personnel for performing bioassay, cell and tissue culture, and molecular biology experiments. For bioassays, the facility has a fluorimeter capable of top or bottom reading and the capability to handle both 96- and 384-well plates. For sample preparation, researchers can utilize cell and tissue culture capabilities such as flow hoods and culture chambers. In addition, RT-PCR and FPLC protein purification technology is available.

The chemistry library, located in Ladd Hall, provides graduate students and faculty with convenient 24-hour access to more than 200 journals and approximately 10,000 volumes. Literature searching via SciFinder is supported.

Prospective students are encouraged to visit the Department of Chemistry and Biochemistry website (<http://www.ndsu.edu/chemistry/>) for the latest descriptions of research programs and instrumentation.

The graduate programs in chemistry are open to all qualified graduates of universities and colleges of recognized standing. To be admitted with full standing to the program, the applicant must meet the Graduate School's admission requirements, have adequate preparation for the study of chemistry at the graduate level, and show potential to undertake advanced study and research as evidenced by academic performance and experience.

## Financial Assistance

The student must first apply to the Graduate School and be accepted in full or conditional status before he/she is eligible for an assistantship in the Department of Chemistry and Biochemistry.

Graduate students in the Department of Chemistry and Biochemistry are supported during both the academic year and during summer months by either teaching assistantships (TA) or research assistantships (RA). As of the 2014-2015 academic year, the standard stipend is \$22,000 per year for both RAs and TAs. University tuition (no fees) is waived for all TAs and RAs in good academic standing.

## Master of Science

The Master of Science program requires the completion of a total of 30 graduate semester credits with an overall GPA of 3.0 or better. This total is comprised of both class work and research credit, but must consist of at least 16 semester credits from letter-graded course work.

Code	Title	Credits
<b>Required Courses</b>		
CHEM 720	Introduction to Chemical Research	2
CHEM 790	Graduate Seminar (second year seminar)	1
or BIOC 790	Graduate Seminar	
UNIV 720	Scientific Integrity	1
CHEM 790	Graduate Seminar (defense seminar)	1
or BIOC 790	Graduate Seminar	
Didactic Credits (601-689, 691; 700-789, 791; 800-889 and 891)		16 *
CHEM 798	Master's Thesis	6-10
or BIOC 798	Master's Thesis	
<b>Total Credits Required</b>		<b>30</b>
<b>As part of total semester credits, the following departmental courses are recommended for students based on discipline:</b>		
<b>Analytical</b>		
CHEM 632	Analytical Chemistry II	3
CHEM 730	Separations	2
CHEM 732	Advanced Survey of Analytical Chemistry	4
CHEM 736	Mass Spectrometry	2
<b>Biochemistry and Molecular Biology</b>		
BIOC 673	Methods of Biochemical Research	3
BIOC 674	Methods of Recombinant DNA Technology	3
BIOC 701	Comprehensive Biochemistry I	4
BIOC 702	Comprehensive Biochemistry II	4
<b>Inorganic</b>		
CHEM 724	Chemical Applications of Group Theory	1

CHEM 725	Advanced Survey of Inorganic Chemistry	3
CHEM 727	Organometallic Chemistry	3
CHEM 728	Physical Methods for Chemical and Biomolecular Research	2
CHEM 744	Organic Spectroscopy	2
<b>Organic</b>		
CHEM 741	Physical Organic Chemistry I	4
CHEM 742	Physical Organic Chemistry II	2
CHEM 744	Organic Spectroscopy	2
CHEM 745	Organic Synthesis	4
<b>Physical</b>		
BIOC 665		
CHEM 760	Statistical Thermodynamics	4
CHEM 763	Kinetics	2
CHEM 764	Dynamics	2

\* A minimum of 10 must be from courses numbered 701-789; 791 or 800-889; 891

## Doctor of Philosophy

The Ph.D. program requires the completion of a total of 90 graduate semester credits with an overall GPA of 3.0 or better. This total is comprised of both class work and research credit, but must consist of at least 27 semester credits from letter-graded course work.

Code	Title	Credits
<b>Required Didactic Courses</b>		
CHEM 720	Introduction to Chemical Research	
UNIV 720	Scientific Integrity	
CHEM 725	Advanced Survey of Inorganic Chemistry	
CHEM 732	Advanced Survey of Analytical Chemistry	
CHEM 741	Physical Organic Chemistry I	
CHEM 759	Advanced Survey of Physical Chemistry	
<b>Required Non-Didactic Courses</b>		
CHEM 790	Graduate Seminar (second year seminar)	
CHEM 790	Graduate Seminar (proposal seminar)	
CHEM 790	Graduate Seminar (defense seminar)	
CHEM 899	Doctoral Dissertation ( Number of research credits determined by student and supervisory committee)	
Additional credits numbered 601 - 689, 691, 700 - 789 and 791 may also count toward the 90 credit total required by the College of Graduate and Interdisciplinary Studies if approved by the student's advisory and examination committee.		
Total Credits		90

\* A student matriculating with a master's degree, including one earned at an international institution, must earn not fewer than 60 graduate credits at NDSU. These credits must include the 19 listed above under Required Didactic Courses. Courses numbered 601-689 may be used for the Plan of Study as long as they have not been taken in an undergraduate or previous graduate program. Approved courses are Department of Chemistry & Biochemistry 625, 626, 627, 628, 630, and 676.

## ADDITIONALLY, The following departmental courses ARE available for students; CONSULT WITH COMMITTEE FOR RECOMMENDATIONS:

Code	Title	Credits
<b>Analytical</b>		
CHEM 632	Analytical Chemistry II	3
CHEM 730	Separations	2
CHEM 736	Mass Spectrometry	2
<b>Biochemistry and Molecular Biology</b>		
BIOC 673	Methods of Biochemical Research	3

BIOC 674	Methods of Recombinant DNA Technology	3
BIOC 701	Comprehensive Biochemistry I	4
BIOC 702	Comprehensive Biochemistry II	4
<b>Inorganic</b>		
CHEM 724	Chemical Applications of Group Theory	1
CHEM 727	Organometallic Chemistry	3
CHEM 728	Physical Methods for Chemical and Biomolecular Research	2
CHEM 744	Organic Spectroscopy	2
<b>Organic</b>		
CHEM 742	Physical Organic Chemistry II	2
CHEM 744	Organic Spectroscopy	2
CHEM 745	Organic Synthesis	4
<b>Physical</b>		
CHEM 665	Survey of Physical Chemistry	4
CHEM 760	Statistical Thermodynamics	4
CHEM 763	Kinetics	2
CHEM 764	Dynamics	2
CHEM 676	Introduction to Computational Quantum Chemistry	3

Each student chooses a thesis adviser within six months of beginning graduate school. As this is one of the most important decisions made in graduate school, students are strongly urged to visit multiple faculty members to discuss research opportunities. In addition, faculty seminars during the fall semester are designed to acquaint new students with the available research programs.

By the end of the first academic year, each student selects an advisory and examination committee, which consists of the thesis adviser, two other faculty members in the chemistry department, and one faculty member from a department outside the Department of Chemistry and Biochemistry.

Admission to candidacy for the Ph.D. degree is accomplished by satisfying three requirements:

1. satisfactory performance in course work with a minimum 3.0 grade point average,
2. satisfactory performance in comprehensive examinations taken by the end of the 4th semester, and
3. satisfactory defense of an original research proposal on a topic approved by the student's advisory committee.

The defense of this proposal must occur at least eight months prior to the final oral examination. Following completion of dissertation research, the candidate must complete a written dissertation and an oral presentation to the department and advisory committee.

**Uwe Burghaus, Ph.D.**

Free University of Berlin, 1995

Postdoctoral, University of Genoa, Italy, 1995-1997

Research Area: Surface Physical Chemistry

**Gregory R. Cook, Ph.D.**

Michigan State University, 1993

Postdoctoral, Stanford University, 1994-1996

Research Area: Synthetic Organic Chemistry

**John F. Hershberger, Ph.D.**

Yale University, 1986

Postdoctoral, Columbia University, 1986-1989

Research Area: Experimental Physical Chemistry, Laser Kinetics

**Denley Jacobson, Ph.D.**

Purdue University, 1984

Postdoctoral, California Institute of Technology, 1984-1986

Research Area: Gas Phase Ion Chemistry

**Svetlana Kilina, Ph.D.**

University of Washington, Seattle 2007

Los Alamos National Lab, 2007-2010

Research Area: Computational Chemistry

**Alexey Leontyev, Ph.D.**

University of Northern Colorado, 2015  
Research Area: Chemistry Education and Assessment

**Guodong Liu, Ph.D.**

Hunan University, 2001  
Postdoctoral, New Mexico State University, 2002-2004;  
Postdoctoral, Pacific Northwest National Laboratory, 2004-2006  
Research Area: Nanotechnology and Biological Sensing

**James Nyachwaya, Ph.D.**

University of Minnesota, 2012  
Research Area: Chemistry / STEM Education

**Seth C. Rasmussen, Ph.D.**

Clemson University, 1994  
Postdoctoral, University of Oregon, 1995-1999  
Research Area: Inorganic/Organic Materials Chemistry, Chemical History

**Kenton R. Rodgers, Ph.D.**

University of Iowa, 1988  
Postdoctoral, Princeton University, 1989-1993  
Research Area: Inorganic and Bioinorganic Chemistry

**Mukund P. Sibi, Ph.D.**

City University of New York, 1980  
Postdoctoral, Dartmouth College, 1980-1982; University of Waterloo, 1982-1985  
Research Area: Synthetic Organic Chemistry; Natural Products

**Wenfang Sun, Ph.D.**

Institute of Photographic Chemistry, Chinese Academy of Sciences, 1995  
Postdoctoral, University of Alabama, Birmingham, 1997-1999  
Research Area: Organic Materials Chemistry

**Pinjing Zhao, Ph.D.**

Cornell University, 2003  
Postdoctoral, Yale University, 2004-2006; University of Illinois at Urbana-Champaign, 2006-2007  
Research Area: Inorganic and Organometallic Chemistry