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. Consequently, 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. students, leaving later years for full-time thesis or dissertation 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 is a research intensive department with funded research programs spanning areas from materials to medicine. External research grants from the National Science Foundation, National Institutes of Health as well as many other public and private agencies support the graduate programs in the department.

All research and most teaching activities within the department occur within two centrally-located buildings. Sugihara Hall, a 100,000 square foot modern research facility, was opened in January 2022 to house the department offices, core instrument facilities and research labs. Research is also carried out in the Quinten Burdick building directly across the street from Sugihara Hall.

The department facilities house both teaching and research labs, glassblowing facilities, as well as stockroom and multiuser equipment for the campus. 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 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. The department also has modern 400 and 500 MHz Nuclear Magnetic Resonance (NMR) spectrometers for research with specialized capabilities for both small molecule analysis and protein NMR. The Materials Characterization Laboratory houses the departmental X-ray crystallography facilities and a brand new Analytical Ultracentrifuge. In addition to materials characterization, a Core Biology Facility that serves multiple users is housed within the department for performing bioassays, cell and tissue culture work, and molecular biology experiments. The facility has 96- and 384-well plate fluorimeters, culture changers, flow hoods, RT-PCR and FPLC protein purification instrumentation. All core facilities are staffed with highly trained technical staff for scientific consultation and training.

Prospective students are encouraged to visit the Department of Chemistry and Biochemistry website for contact and more information.

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 by either teaching assistantships (TA) or research assistantships (RA). The standard stipend is $22,000 per year for both Research Assistants (RA) and Teaching Assistants (TA). In addition to the stipend, graduate assistants in good standing receive a graduate tuition waiver. Tuition waivers cover base tuition for NDSU graduate credits. Students are responsible for differential tuition, student fees, and tuition for non-graduate level credits taken or Cooperative Education credits.

Master of Science
The Master of Science program requires the completion 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 include at least 16 semester credits of didactic course work (https://catalog.ndsu.edu/graduate/graduate-school-policies/).

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM 720</td>
<td>Introduction to Chemical Research</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 790</td>
<td>Graduate Seminar (second year seminar)</td>
<td>1</td>
</tr>
<tr>
<td>or BIOC 790</td>
<td>Graduate Seminar</td>
<td>1</td>
</tr>
<tr>
<td>UNIV 720</td>
<td>Scientific Integrity</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 790</td>
<td>Graduate Seminar (defense seminar)</td>
<td>1</td>
</tr>
<tr>
<td>or BIOC 790</td>
<td>Graduate Seminar</td>
<td>1</td>
</tr>
<tr>
<td>Didactic Credits (601-689, 691; 700-789, 791; 800-889 and 891)</td>
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<tr>
<td>CHEM 798</td>
<td>Master's Thesis</td>
<td>6-10</td>
</tr>
<tr>
<td>or BIOC 798</td>
<td>Master's Thesis</td>
<td>6-10</td>
</tr>
<tr>
<td>Total Credits Required</td>
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</table>

As part of total semester credits, the following departmental courses are recommended for students based on discipline:

**Analytical**
- CHEM 632 Analytical Chemistry II 3
- CHEM 730 Separations 2
- CHEM 732 Advanced Survey of Analytical Chemistry 4
- CHEM 736 Mass Spectrometry 2

**Biochemistry and Molecular Biology**
- 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

**Inorganic**
- 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

**Organic**
- CHEM 741 Physical Organic Chemistry I 4
- CHEM 742 Physical Organic Chemistry II 2
- CHEM 744 Organic Spectroscopy 2
- CHEM 745 Organic Synthesis 4

**Physical**
- BIOC 665 Statistical Thermodynamics 4
- CHEM 760 Statistical Thermodynamics 4
Chemistry

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 90 graduate semester credits, post-baccalaureate, with an overall GPA of 3.0 or better. This total must comprise credits from both didactic and non-didactic work. Non-didactic credits must include those earned in research and seminars. The didactic credits (https://catalog.ndsu.edu/graduate/graduate-school-policies/) must total at least 19 for the required courses listed below.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td><strong>Required Didactic Courses</strong></td>
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<tr>
<td>CHEM 720</td>
<td>Introduction to Chemical Research</td>
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<tr>
<td>UNIV 720</td>
<td>Scientific Integrity</td>
<td></td>
</tr>
<tr>
<td>CHEM 725</td>
<td>Advanced Survey of Inorganic Chemistry</td>
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<tr>
<td>CHEM 732</td>
<td>Advanced Survey of Analytical Chemistry</td>
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<tr>
<td>CHEM 741</td>
<td>Physical Organic Chemistry I</td>
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<tr>
<td>CHEM 759</td>
<td>Advanced Survey of Physical Chemistry</td>
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<tr>
<td><strong>Required Non-Didactic Courses</strong></td>
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</tr>
<tr>
<td>CHEM 790</td>
<td>Graduate Seminar (second year seminar)</td>
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<tr>
<td>CHEM 790</td>
<td>Graduate Seminar (proposal seminar)</td>
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</tr>
<tr>
<td>CHEM 790</td>
<td>Graduate Seminar (defense seminar)</td>
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<tr>
<td>CHEM 899</td>
<td>Doctoral Dissertation (Number of research credits determined by student and supervisory committee)</td>
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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:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td><strong>Analytical</strong></td>
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</tr>
<tr>
<td>CHEM 632</td>
<td>Analytical Chemistry II</td>
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<tr>
<td>CHEM 730</td>
<td>Separations</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 736</td>
<td>Mass Spectrometry</td>
<td>2</td>
</tr>
<tr>
<td><strong>Biochemistry and Molecular Biology</strong></td>
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<td></td>
</tr>
<tr>
<td>BIOC 673</td>
<td>Methods of Biochemical Research</td>
<td>3</td>
</tr>
<tr>
<td>BIOC 674</td>
<td>Methods of Recombinant DNA Technology</td>
<td>3</td>
</tr>
<tr>
<td>BIOC 701</td>
<td>Comprehensive Biochemistry I</td>
<td>4</td>
</tr>
<tr>
<td>BIOC 702</td>
<td>Comprehensive Biochemistry II</td>
<td>4</td>
</tr>
<tr>
<td><strong>Inorganic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 724</td>
<td>Chemical Applications of Group Theory</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 727</td>
<td>Organometallic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 728</td>
<td>Physical Methods for Chemical and Biomolecular Research</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 744</td>
<td>Organic Spectroscopy</td>
<td>2</td>
</tr>
<tr>
<td><strong>Organic</strong></td>
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<td></td>
</tr>
<tr>
<td>CHEM 742</td>
<td>Physical Organic Chemistry II</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 744</td>
<td>Organic Spectroscopy</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 745</td>
<td>Organic Synthesis</td>
<td>4</td>
</tr>
</tbody>
</table>
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 supervisory 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 supervisory committee.

Philip Bouджouk, Ph.D.
University of Wisconsin, 1971
Postdoctoral, UC Davis, 1971-1973
Research Area: Main Group Organometallic Chemistry, Materials

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

Dmitri Kilin, Ph.D.
Chemnitz University of Technology, 2000
Research Area: Computational Chemistry of Materials, Theoretical Physical 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

Gudrun Lukat-Rodgers, Ph.D.
Iowa State University, 1985
Postdoctoral: University of Iowa, 1985-1988
Postdoctoral: Princeton University, 1989-1993
Research Area: Bioinorganic Chemistry

James Nyachwaya, Ph.D.
University of Minnesota, 2012
Research Area: Chemistry / Discipline Based Education Research

Alexander Parent, Ph.D.
Yale University, 2013
Research Area: Inorganic/Organic Chemistry, Green Chemistry

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
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

Zhongyu Yang, Ph.D.
University of Pittsburgh, 2010
Research Area: Bioanalytical chemistry; Biophysics; Electron Paramagnetic Resonance Spectroscopy

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