The Department of Mathematics offers graduate study leading to the degrees of Master of Science (M.S.) and Doctor of Philosophy (Ph.D.). Advanced work may be specialized among the following areas:

- algebra, including algebraic geometry, commutative algebra, and homological algebra
- analysis, including approximation theory, ergodic theory, harmonic analysis, and operator algebras
- applied mathematics, mathematical biology, differential equations, dynamical systems, neural networks
- combinatorics and graph theory
- geometry/topology, including differential geometry, geometric group theory, and symplectic topology

After passing their preliminary examinations, students are strongly urged to attend research seminars and discuss research opportunities with faculty members. By the end of their second semester, students select a supervisory committee and develop a plan of study specifying how all degree requirements are to be met. One philosophical tenet of the Department of Mathematics graduate program is that each mathematics graduate student will be well grounded in at least two foundational areas of mathematics. To this end, each student's background will be assessed, and the student will be directed to the appropriate level of study.

The Department of Mathematics graduate program is open to all qualified graduates of universities and colleges of recognized standing. In addition to the Graduate College requirements (http://catalog.ndsu.edu/graduate/admission-information/), applicants must:

- have earned a cumulative grade point average (CGPA) of at least 3.0 or equivalent in all advanced mathematics courses at the baccalaureate level and
- meet the English proficiency requirements (http://catalog.ndsu.edu/graduate/admission-information/#internationalapplicantstext) for applicants.

Financial Assistance

Teaching assistantships and a small number of research assistantships are available. In addition to the stipend, graduate assistants receive a graduate tuition waiver. Tuition waivers cover base tuition for NDSU graduate credits only. Students are responsible for differential tuition, student fees, and tuition for non-graduate level credits taken or Cooperative Education credits.

To be eligible for a teaching assistantship, students must follow the English Language Proficiency Procedure for Graduate Teaching Assistants (https://catalog.ndsu.edu/graduate/graduate-school-policies/english-language-proficiency-procedure/#text) and be admitted in full-standing. In certain situations, students in conditional status may be eligible for assistantships.

Assistantship applications will be considered at any time. However, opportunities are improved for those received by March 1 preceding the fall semester of intended enrollment.

At least one year of academic work must be spent in residence at NDSU in fulfilling graduate requirements for each graduate degree earned. The M.S. customarily takes two years to complete: the Ph.D. usually last three years beyond the master's. Students must maintain a cumulative GPA of at least 3.0 throughout their graduate career.
Master of Science

The Master of Science degree is offered in two options: the Plan A Thesis Option or the Plan B Comprehensive Study Option. The Thesis Option emphasizes research and preparation of a scholarly thesis, whereas the Comprehensive Study Option emphasizes a broader understanding of a major area of mathematics.

Departmental Requirements

At least 30 credit hours in approved graduate-level mathematics course work, depending on the degree option.

1. Thesis Option: At least 6 credit hours of MATH 798 Master’s Thesis, in addition to at least 18 credit hours in courses numbered 700-789. These 18 credit hours must include six foundational courses. A grade of Master’s Pass in two of the written preliminary examinations offered by the department. A thesis paper written under the supervision of a faculty member and defended at an oral examination administered by the student’s supervisory committee.

2. Comprehensive Study Option: At least 2 credit hours of MATH 797 Master’s Paper in addition to at least 24 credit hours in courses numbered 700-789. These 24 credit hours must include six foundational courses. Subject to the approval of the supervisory committee, at most 6 of the required 30 credits may be earned in 600-level mathematics courses or in courses outside the Mathematics department. A grade of Master’s Pass in two of the written preliminary examinations offered by the department. An expository paper written under the supervision of a faculty member and defended at an oral examination administered by the student’s supervisory committee.

3. Exam Only Option: At least 30 credit hours in approved graduate-level mathematics course work. At least 21 credit hours in courses numbered 700-789, 800-889. These 21 credit hours must include six foundational courses. Subject to the approval of the supervisory committee, at most 6 of the required 30 credits may be earned in 600-level mathematics courses or in courses outside the Mathematics Department. A grade of Ph.D. Pass in four of the written preliminary examinations offered by the department, and a passing grade in a preliminary oral examination administered by the student's supervisory committee after completion of the written preliminary examinations.

Timelines

Per departmental policy candidate has three calendar years from the time of enrollment in the Graduate College to complete the Master's degree. Extensions may be granted after review and approval by the graduate committee.

Doctor of Philosophy

The Doctor of Philosophy degree is awarded in recognition of high scholarly attainment as evidenced by a period of successful advanced study, the satisfactory completion of prescribed examinations, and the development of an acceptable dissertation covering a significant, original aspect of mathematics.

<table>
<thead>
<tr>
<th>Code</th>
<th>Foundational Courses</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>Algebra</td>
<td>MATH 720</td>
<td>Algebra I</td>
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<tr>
<td></td>
<td>MATH 721</td>
<td>Algebra II</td>
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<td></td>
<td>MATH 726</td>
<td>Homological Algebra</td>
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<td>Analysis</td>
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<td></td>
<td>MATH 754</td>
<td>Functional Analysis</td>
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<td></td>
<td>MATH 756</td>
<td>Harmonic Analysis</td>
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<td>Applied Mathematics</td>
<td>MATH 760</td>
<td>Ordinary Differential Equations I</td>
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<td>MATH 784</td>
<td>Partial Differential Equations I</td>
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<td>Combinatorics</td>
<td>MATH 736</td>
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<td>MATH 737</td>
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<td>Geometry/Topology</td>
<td>MATH 746</td>
<td>Topology I</td>
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<td>MATH 747</td>
<td>Topology II</td>
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<td>Graduate Seminar</td>
<td>MATH 790</td>
<td>Graduate Seminar</td>
<td>3</td>
</tr>
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</table>
Doctoral Research

### MATH 899 Doctoral Dissertation

- Subject to the approval of the supervisory committee, at most 12 of the required 42 credit hours may be earned in 600-level mathematics courses or in courses outside the Mathematics Department. Credits used to satisfy the requirements of a master’s degree at NDSU may be included in the 90 credits hours required for the doctoral degree.
- Ph.D. A student entering the doctoral program with a master’s degree from another institution need only complete 60 credit hours to complete the Ph.D. degree. Half of these 60 credits must be in courses numbered 700-789.
- A grade of Ph.D. Pass in four written preliminary examinations offered by the department.
- A passing grade in a preliminary oral examination administered by the student's supervisory committee after completion of the Preliminary Examinations.
- A dissertation consisting of a written presentation of original and significant research completed by the student under the supervision of a faculty member and defended at an oral examination administered by the candidate's supervisory committee.

### Timelines

Ph.D. students have through the January Preliminary Exams during their third year in the program to demonstrate proficiency in basic areas of mathematics by passing the written Preliminary Examinations. In the Spring semester of the third year the department committee will meet to discuss any candidates who have not completed their written preliminary examinations and make one of three recommendations:

1. If the students have earned a master's pass on two exams, then they will be granted an additional year in the program to complete a Master's degree. Whether they are able to complete the Master's degree or not they will be removed from the program after the additional year.
2. If the committee determines that the student is not making adequate progress, the student's funding (if any) will terminate at the end of the academic year, and they will have one year to complete a Master's degree. Whether they are able to complete the Master's degree or not they will be removed from the program after the additional year.
3. If the committee determines that an extension of the timeline is appropriate, then written notice will be given outlining what the student must accomplish by a specified date to continue receiving funding and/or remain in the program.

**Azer Akhmedov, Ph.D.**
Yale University, 2004
Research Interests: Group Theory, Low Dimensional Topology

**Maria Angeles Alfonseca, Ph.D.**
Universidad Autonoma de Madrid, Spain, 2003
Research Interests: Fourier Analysis, Partial Differential Equations

**Nikita Barabanov, Ph.D.**
University of Kiev, 1979
Research Interests: Differential Equations, Control Theory, Optimization, Neural Networks

**Jason Boynton, Ph.D.**
Florida Atlantic University, 2006
Research Interests: Algebra

**Catalin Ciuperca, Ph.D.**
University of Kansas, 2001
Research Interests: Commutative Algebras, Algebraic Geometry

**Dogan Comez, Ph.D.**
University of Toronto, 1983
Research Interest: Ergodic Theory, Measureable Dynamics, Operator Theory

**Josef Dorfmeister, Ph.D.**
University of Minnesota, 2009
Research Interests: Symplectic Topology

**Torin Greenwood, Ph.D.**
University of Pennsylvania, 2015
Research Interests: Combinatorics

**Friedrich Littmann, Ph.D.**
University of Illinois, Urbana-Champaign, 2003
Research Interests: Approximation Theory, Analytic Number Theory
Artem Novozhilov, Ph.D.
Moscow State University of Communication Means, 2002
Research Interests: Mathematical Biology

Tim Ryan, Ph.D.
University of Illinois at Chicago, 2016
Research Interests: Algebraic Geometry

Janet Page, Ph.D.
University of Illinois at Chicago, 2018
Research Interests: Commutative Algebra and Algebraic Geometry

Jessica Striker, Ph.D.
University of Minnesota, 2008
Research Interests: Enumerative, Algebraic, Geometric and Bijective Combinatorics

Abraham Ungar, Ph.D.
Tel-Aviv University, 1973
Research Interests: Differential Equations, Integral Transforms, Wave Propagation, Special Relativity