

Graduate Handbook of the Mathematics Department

North Dakota State University
December 3, 2020

Graduate Program Policies and Handbook

1 Graduate Committee

Voting members of the Graduate Committee are the Graduate Recruiting Chair and the four graduate members at-large. Non-voting members are the Chair of the Department and Associate Chair. The Graduate Recruiting Chair will be appointed by the Chair of the Department. The graduate members at-large are elected for two-year terms at a regular meeting of the Department. The terms will begin in January and will alternate so that each year two members carry over.

The duties of the Graduate Recruiting Chair include chairing the Graduate Committee, working with the Chair to coordinate and recruit for TA and TF positions and departmental graduate student awards, and organizing the orientation for new TAs which occurs prior to the fall semester. Duties of the Graduate Committee as a whole include selection of recipients for financial aid, recommending admission to graduate study, advising new TAs who have not yet selected an advisor, assisting the Graduate Recruiting Chair in the orientation sessions as needed, and recommending and enforcing policies regarding the graduate program.

2 General Information

The Master of Science degree is offered in three options: the Thesis Option, the Comprehensive Study Option, or the Exam Only Option. The Thesis Option emphasizes research and preparation of a scholarly thesis. The Comprehensive Study Option emphasizes a broader understanding of a major area of mathematics. The Exam Only Option is for students who are enrolled in the Ph.D. program.

3 Master's Degree Programs

The Master of Science degree is offered in three options: the Thesis Option, the Comprehensive Study Option, or the Exam Only Option. The Thesis Option emphasizes research and preparation of a scholarly thesis. The Comprehensive Study Option emphasizes a broader understanding of a major area of mathematics. The Exam Only Option is for students who will continue to earn a Ph.D. in the program.

3.1 Departmental Requirements for Thesis Option or Comprehensive Study Option

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

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, 800-889. These 18 credit hours must include six foundational courses as described in Subsection 5.1.

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, 800-889. These 24 credit hours must include six foundational courses as described in Subsection 5.1.

Subject to the approval of the supervisory committee, at most 6 of the required 30 credits may be earned in 600-level mathematics courses (excluding 620, 621, 650, and 651) or in courses outside the Mathematics Department.

2. A grade of Master's Pass in two of the written preliminary examinations offered by the department. See Subsection 5.5.

3. A thesis or expository paper written under the supervision of a faculty member and defended at an oral examination administered by the student's supervisory committee. See Subsection 5.6.

3.2 Departmental Requirements for Exam Only Option

1. At least 30 credit hours in approved graduate-level mathematics course work. At least 3 credit hours of Math 899 (Doctoral Dissertation), in addition to at least 21 credit hours in courses numbered

700-789, 800-889. These 21 credit hours must include six foundational courses as described in Subsection 5.1.

Subject to the approval of the supervisory committee, at most 6 of the required 30 credits may be earned in 600-level mathematics courses (excluding 620, 621, 650, and 651) or in courses outside the Mathematics Department.

2. A grade of Ph.D. Pass in four of the written preliminary examinations offered by the department. See Subsection 5.5.

3. A passing grade in a preliminary oral examination administered by the student's supervisory committee after completion of the written preliminary examinations. See Subsection 5.5.

4. See Subsection 4.3 for notes about this option.

3.3 Departmental Requirements for MS Double-Major (Thesis Option or Comprehensive Study Option Only)

1. At least 24 credit hours in approved graduate-level course work, depending on the degree option.

Thesis Option:

At least 3 credit hours of Math 798 (Master's Thesis), in addition to at least 15 credit hours in courses numbered 700-789, 800-889. These 15 credit hours must include four foundational courses as described in Subsection 5.1.

Comprehensive Study Option:

At least 1 credit hour of Math 797 (Master's Paper), in addition to at least 18 credit hours in courses numbered 700-789, 800-889. These 18 credit hours must include four foundational courses as described in Subsection 5.1.

Subject to the approval of the supervisory committee, at most 6 of the required 40 credits may be earned in 600-level mathematics courses (excluding 620, 621, 650, and 651) or in courses outside the Mathematics Department.

2. A grade of Master's Pass in two of the written preliminary examinations offered by the department. See Subsection 5.5.

3. A thesis or expository paper written under the supervision of a faculty member and defended at an oral examination administered by the student's supervisory committee. See Subsection 5.6. In addition to that, the research is to be interdisciplinary (as required by graduate school policy) and one of the co-chairs of the supervisory committee must be a faculty member of the Department of Mathematics.

3.4 Timelines

A student has three calendar years from the time of enrollment in the Graduate School to complete the Master's degree. Extensions may be granted after review and approval by the Graduate Committee, subject to Graduate School Policy.

4 Doctoral Degree Program

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.

4.1 Departmental Requirements

1. A total of at least 90 credit hours in approved graduate-level mathematics course work, including:
(a) At least 42 credit hours in courses numbered 700-789, 800-889 or as approved by the supervisory committee. These 42 credit hours must include six foundational courses as described in Subsection 5.1. The advisor should in consultation with the Chair of the Graduate Committee ensure that the 42 credit hours contain a broad spectrum of courses (at least 12 credit hours) outside the student's area of emphasis as well as depth in a specific area of mathematics.

(b) At least 3 credit hours of Math 790 (Graduate Seminar), excluding the following: First Year Graduate Seminar, Professional Development Seminar, and any preliminary examination "boot camps".

(c) At least 6 credit hours of 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 (excluding 620,621, 650, and 651) 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 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, 800-889.

2. A grade of Ph.D. Pass in four of the written preliminary examinations offered by the department. See Subsection 5.5.

3. A passing grade in a preliminary oral examination administered by the student's supervisory committee after completion of the written preliminary examinations. See Subsection 5.5.

4. 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. See Subsection 5.6.

5. A dissertation video describing the candidate's research, evaluated by the candidate's supervisory committee. See Subsection 5.8.

4.2 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:

- 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.
- 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.
- 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.

Advisors are strongly encouraged to meet with the student in the Spring of the second year to discuss progress and develop an action plan for the student to successfully complete their written preliminary examinations in a timely fashion.

A student advances to candidacy after completion of the oral preliminary examination. All students must advance to candidacy by August 31 after their fourth academic year of study. Extensions may be granted after review and approval by the Graduate Committee, subject to Graduate School Policy. Any decisions that end in the removal of a student from the program are subject to appeal consistent with Graduate School Policy.

4.3 Procedures for M.S. by Exam

Ph.D. students that advance to candidacy may be eligible to earn an M.S. degree by exam; see Subsection 3.2 for requirements. Interested students should choose the Ph.D. + Masters option from the drop down menu on the Doctoral Degree Plan of Study and on the Request to Schedule Examination. After students have completed the M.S. requirements, they should complete the Exit Survey and the Degree Application. A link to these items will be emailed to them by the Graduate School. Students exercising this option will be eligible to participate in commencement ceremonies for the M.S. and Ph.D. separately.

5 Policies on Graduate Degrees

5.1 Foundational Courses

These courses teach fundamental concepts needed for breadth and for preparation to conduct research in a particular area. Choosing from the following lists, students have two options:

Algebra: (1) MATH 720, 721; (2) MATH 720, 726

Analysis: (1) MATH 750, 754; (2) MATH 750, 756

Applied Mathematics: (1) MATH 760, 784

Combinatorics: (1) MATH 736, MATH 737

Geometry/Topology: (1) MATH 746, 747

Option 1: Graduate students must pass three foundational sequences. Students may choose one sequence each from three of the above four lists.

Option 2: Graduate students must pass two foundational sequences plus two additional foundational courses. Students may choose one sequence each from two of the above four lists. Students will then choose one course each from the two remaining lists.

For students pursuing an MS double-major, the options are as follows:

Option 1: Graduate students must pass two foundational sequences. Students may choose one sequence each from two of the above four lists.

Option 2: Graduate students must pass one foundational sequence plus two additional foundational courses. Students may choose one sequence from one of the above four lists.

Students will then choose one course each from two of the remaining lists.

5.2 Supervisory Committee

Every entering graduate student will be assigned a designated member of the Graduate Committee who will advise them until the student has selected a research advisor. Prior to completing or immediately following completion of the written portion of the preliminary examinations the student will take on a major advisor who will supervise the student's research and preparation of a disquisition (thesis, expository paper, or dissertation). The student in consultation with the major advisor, and the Graduate Committee, will appoint a supervisory committee consisting of members of the NDSU Graduate Faculty and other qualified experts in the field. The supervisory committee must include at least one Graduate Faculty member (not counting the major advisor) from the department, an NDSU Graduate Faculty member from outside the department who may be appointed by the Graduate School, and at least one other faculty member (NDSU or otherwise) in the cognizant field.

For students pursuing an MS double-major, the supervisory committee must conform to requirements of the Graduate School and must contain at least one member of the Graduate Faculty from Mathematics.

5.3 Plan of Study

A plan of study will be prepared by the student and major advisor no later than the semester immediately following the appointment of the supervisory committee. The plan of study must be approved by the student's supervisory committee, the chair of the graduate committee, the Department Chair, the Dean of the College of Science and Mathematics, and the Dean of the Graduate School. In preparing the plan of study the student should include courses which they plan to take in the future. The date in the plan of study for these courses should read "pending" if not known. The chair of the Graduate Committee, the Chair, and the supervisory committee must be promptly informed of any changes in the student's program.

5.4 Graduate Writing

Graduate students must be able to communicate effectively. An important aspect of effective communication is clear and grammatically correct writing. To help graduate students achieve this goal the following are required of faculty and students. A portion of grades for assignments in courses should focus on the written exposition. Instructors should provide feedback to the students concerning the writing in the graded assignments. In reading disquisitions all supervisory committee members shall ensure that the exposition is clear and grammatically correct. Advisors shall encourage students to take advantage of writing resources available to graduate students, including the Center for Writers and meetings with the Disquisitions Editor.

5.5 Preliminary Examinations

The written preliminary examinations are offered two times per year – in January and August. Examinations are given in Algebra, Analysis, Applied Mathematics, Combinatorics, and Geometry/Topology. Scores on the exams are given as Fail, Master's Pass, and Ph.D. Pass. Copies of previous examinations and exam syllabi are made available on the Mathematics Graduate Program website.

Written preliminary examinations will be coordinated by the Graduate Committee. Writing and grading each examination will be the responsibility of the most recent instructor of a related foundational course and the current instructor of a related foundational course. The Graduate Committee may alter these responsibilities, as necessary.

The following preliminary exams are offered. The student must pass four written examinations – at most three from Group 1.

Group 1: MATH 720, MATH 750, MATH 760, MATH 746, MATH 736.

Group 2: Either MATH 721 or MATH 726 (but not both), either MATH 754 or MATH 756 (but not both), MATH 784, MATH 747, MATH 737.

The exams are based on one-semester course material that is covered in the courses listed, and on material from undergraduate prerequisites. Each exam will be 2 hours long.

The Ph.D. oral examination is administered by the student's supervisory committee after completion of the written preliminary examinations. The oral examination shall include the following items:

- student description of appropriate background material and plans for the dissertation research, and
- questions from the committee about background material (possibly to include questions about graduate courses, up to four courses total) and research plans.

The format for the oral examination and the supervisory committee's expectations for the examination shall be agreed upon by the supervisory committee and the student before the examination, primarily decided by the student and the major advisor. For instance, this shall include the following.

- Expectations of background material to be presented (e.g., which coursework, textbooks, monographs, or research papers), level of detail of research plan, length of presentation (e.g., 20 minutes), format of presentation (e.g., board or beamer), etc. shall be agreed upon explicitly.
- Relevant materials (textbooks, monographs, research papers, etc.) from the preceding item will be made available to the committee and the student well in advance of the examination.
- The supervisory committee may or may not require the student to provide a written outline of the research plan before the examination. If such an outline is required, the supervisory committee will specify the format of the outline and will specify a deadline for submitting the outline that provides appropriate time for preparation of the outline and appropriate time for the supervisory committee to read it before the examination.
- The supervisory committee is not expected to provide their questions to the student before the examination. However, the supervisory committee is required to limit its questions to the agreed upon material. Of course, certain coursework material is naturally required as a prerequisite for any significant research. Accordingly, some questions about course material may be asked, even if the examination does not include specific courses. However, in such a situation, the questions must be appropriate and relevant to the agreed upon material, and they shall not be the primary focus of the examination.
- If the committee chooses to ask questions about courses, the courses must be agreed upon explicitly before the examination. The examination courses should not include courses from the student's written preliminary examinations; exceptions may be granted by the chair of the Graduate Committee, in exceptional cases.

- The examination should last approximately two hours, with reasonable variation for individual situations. It is the major advisor's responsibility to ensure that the actual length of the examination is appropriate. Preparation for this in advance is crucial.
 - For instance, if the examination will include questions about courses, then the background and research presentation needs to be reasonably short, and the committee members must be given specific timeframes for their questions.
 - On the other hand, if the examination will not include questions about courses, then the presentation and/or question sessions shall be appropriately longer.
 - The presentation portion of the exam should last no longer than one hour, to allow at least one hour for questions.

5.6 Disquisitions

Writing a disquisition is considered the capstone experience of a student's graduate career. At the Master's level the disquisition is either a thesis or an expository paper. A Master's thesis emphasizes original research and the ability to analyze mathematical data. An expository paper emphasizes a broad understanding of a general area of mathematics. A disquisition for an MS double-major must contain significant mathematics content. At the Ph.D. level the disquisition is called a dissertation. A dissertation must show originality and demonstrate the student's capacity for independent research; it must embody results of research which constitute a contribution to mathematical knowledge.

Disquisitions reflect not only on the student but also on the Graduate Program. As such they should be mathematically correct, utilize proper grammar and syntax, and adhere to the style format accepted by the Graduate School. The approved style for disquisitions is described in the booklet *Guidelines for the Preparation of Disquisitions* available from the Graduate School. Students are strongly encouraged to use LaTeX for preparation of their disquisition.

Any student wishing to write a disquisition under the direction of someone who is not a regular faculty member of the Mathematics Department must first obtain written approval from the chair of the Graduate Committee and the Graduate School. The student must have passed the written preliminary examination requirements as well as the language requirements before requesting approval. To support the request for approval, the student must provide to the chair of the Graduate Committee a written statement describing the proposed disquisition areas and the reasons for: (i) working with someone from outside the department and (ii) not working with someone in the department. The proposed disquisition advisor must also provide a current curriculum vitae. In the event that approval is given, at least three members of the supervisory committee must be from the Department of Mathematics.

5.7 Defense of the Disquisition

A graduate student must defend their disquisition in an examination open to the public. This examination should open with a presentation by the student of the mathematical content of the disquisition. When the public portion of the defense is completed the supervisory committee may further question the student with regards to the disquisition. The defense of a disquisition is not the forum for questions relating to coursework.

5.8 Dissertation Video

A Ph.D. student should be able to convey aspects of his/her research to non-specialists and non-mathematicians. Ph.D. students are required to create a 2—3 minute video summarizing the results of their dissertation research for a lay audience. The video should be produced during the student's final semester of study, to be shown during the dissertation defense. The student's supervisory committee is solely responsible for evaluating the video.

In preparation for the video production, students are required to participate in a dissertation video workshop organized by the Graduate School, which will be offered several times each semester and during the summer. Students should attend the workshop either the semester before they expect to defend or during the semester when they will defend. Students will record their video on campus with ITS assistance. Videos will be housed through the NDSU Libraries' Digital Repository. Students will

have the choice to sign a release form allowing NDSU to make their video available publicly, e.g., for recruitment. If a student declines to sign the release form, NDSU and the Mathematics Department cannot use the video in any way.

5.9 Colloquia

The Mathematics Department regards colloquium lectures to be an integral part of graduate education, and graduate students are expected to attend these lectures.

6 Teaching Assistants

Most of the graduate students in the department are supported during the academic year through Graduate Teaching Assistantships or Graduate Teaching Fellowships. Often there is some money available for graduate students to teach in the summer to supplement their income. Descriptions of the various types of support follow. See also Section 9.3.

6.1 Teaching Assistantships:

A teaching assistantship is a 9-month appointment available to graduate students. Graduate assistants are given teaching duties consonant with their experience. A stipend, as well as a tuition waiver, is provided to compensate the student for their work. The typical duties of a teaching assistant may include: tutoring in the Math Tutor Room, grading for courses in the department, leading recitation sections of calculus, and teaching courses in the department.

While the individual teaching duties will vary it is expected that a teaching assistant will spend no more than 18 hours a week on their teaching duties. If teaching duties exceed 18 hours per week the teaching assistant should meet with the Associate Chair to resolve this problem.

Teaching assistantships are renewable provided that progress in the graduate program and that a progression toward quality teaching is ongoing.

6.2 Teaching Fellowships:

Teaching fellowships are 9-month appointment available to graduate students. Teaching fellows are given increased teaching duties and a larger stipend. Teaching fellows are generally more advanced graduate students with significant teaching experience. As with a teaching assistantship, teaching fellows must demonstrate progress in the graduate program and continue an ongoing progression toward quality teaching.

While the individual teaching duties will vary it is expected that a teaching fellow will spend no more than 20 hours a week on their teaching duties. If teaching duties exceed 20 hours per week the teaching fellow should meet with the Associate Chair to resolve this problem.

To be eligible for a teaching fellowship a graduate student must have completed their written preliminary examinations and taught at least one course in which they were the primary instructor. Teaching assistants may apply to be teaching fellows when they have satisfied the eligibility requirements. However this designation is not guaranteed. Applications should be submitted to the chair of the Graduate Committee. Selection of an applicant as a teaching fellow is based on: letters of support, excellence in teaching, excellence as a graduate student, and the needs of the department. Selection is done by the Mathematics Department Graduate Committee based on the needs of the department. The designation of teaching fellows may be removed from a graduate student if the performance as a graduate teaching fellow is not satisfactory.

6.3 Summer Teaching

Summer teaching duties are often available for graduate students. These duties will often be in courses that are normally taught only by faculty in the regular semester. Summer teaching is seen as a way to expand a graduate student's experience in the classroom. Summer teaching assignments are based on the needs of the department and the needs of the graduate students involved.

7 Policies on Graduate Student Teaching

7.1 Spring/Fall Enrollment

Teaching assistants are expected to be enrolled at a full time level in the semester for which they are teaching. For students who have not passed their written preliminary examinations it is expected that teaching assistants will enroll in three graduate courses (two of which must be 3-credit courses) each semester. Exceptions to this three-course rule can be granted by the Chair.

7.2 Supervision

Whether teaching a course on their own, or leading a recitation it is expected that graduate students will be supervised in their teaching. Graduate students who are teaching are expected to provide a copy of their syllabus to their supervisor at least three days before classes begin. Teaching assistants and fellows should also provide copies of their examinations to their supervisor at least one week before the examination is scheduled. Prior to submitting final grades graduate students should discuss them with the supervisor. Any irreconcilable conflicts between graduate students and supervisors should be referred to the Chair of the Department.

8 General Policies

8.1 Academic Honesty

Each graduate student in the Mathematics Department is expected to conform to the highest standards of academic honesty in all classwork, homework, examinations, research, and writing. They must also conform to the highest standards of professional behavior in teaching. Any violation of this policy will result in penalties such as lowered grades, loss of financial support, and/or dismissal from the graduate program. A letter to the Department describing the violation and the penalty assigned must document each punitive action taken. A copy of the letter must be sent to the affected student. Each punitive action may be appealed through the following channels, in order: the Graduate Committee, the Department Chair, the Dean of the College of Science and Mathematics, and the Dean of the Graduate School. See NDSU Policies 326 and 335.