

# Department of Mathematics

## General Information On Graduate Programs

August 2019

The general requirements for advanced degrees are in the Graduate Studies Bulletin, which may be found online at <http://bulletin.unl.edu>. This document describes some (but not all) of these general requirements, but the main focus is on additional requirements imposed by the Department of Mathematics (hereafter called “the Department”). Inquiries may be directed to the Graduate Chair.

All new graduate students are initially assigned a faculty advisor from the Graduate Advisory Committee (GAC). Students may change advisors at any time during their program, and if they do so they should notify the Graduate Chair and all affected parties of the change.

Requirements for a degree in the graduate program in Mathematics include both coursework and exams, described below. Graduate exams are given during two examination periods per year—in January and May-June. Specific dates are announced by the Graduate Exam Coordinator.

Specific Mathematics Department recommendations for courses are listed on Advising Form, which may be found on the Department website at

<http://www.math.unl.edu/graduate/> .

**Graduate Faculty Members:** *Professors:* Avalos, Avramov, Brittenham, Deng, Don-sig (Department Vice Chair), Foss, Harbourne, Hermiller (Department Graduate Chair), Ledder, Lewis, Marley (Department Chair), Pitts, Radcliffe, Rammaha, Rebarber (Interim Department Graduate Chair), J. Walker, M. Walker; *Associate Professors:* Cohn, Kelley, Y. Lai, Radu, Tenhumberg; *Assistant Professors:* Du, Jin, T. Lai, Larios, Pérez-Giménez, Schafhauser, Seceleanu, Zupan; *Research Associate Professor:* Smith; *Assistant Professor of Practice:* Wakefield

**Graduate Faculty Associates:** *Assistant Professors of Practice:* Brummer, Homp

## MASTER’S DEGREES

**Master of Science & Master of Arts:** The Department offers Master’s Degrees (MS or MA) in Mathematics. The requirements for the two degrees are identical.

**Master of Science (Arts) for Teachers:** The MScT and MAT programs are designed for persons who are or will be teaching secondary mathematics. The possession of a valid secondary mathematics teaching certificate is a prerequisite to the award of the degree. For details on the program contact the Chair of the MAT-MScT Committee (Wendy Smith, [wsmith5@unl.edu](mailto:wsmith5@unl.edu)).

## Master's Degree Options

There are three options for the Master's Degree. Each option requires a total of 36 hours of coursework. Some of this coursework must be in **graduate-only** courses, which are defined to be 900-level courses or 800-level courses without a 400-level counterpart. (Generally, these courses are marked with asterisks in the Graduate Studies Bulletin.) All three options *allow* a minor, and Option 2 *requires* a minor. The choice of minor area must be approved by the student's advisor.

**Option 1** requires a thesis. The program must include 6–10 hours of Math 899 and at least 8 hours of graduate-only coursework. A member of the Graduate Faculty must act as thesis advisor.

**Option 2** requires a minor. Students may take a minor in any area offering the Master's Degree outside the Department. Of the 36 hours required, at least 18 must be in Mathematics and at least 9 must be in the minor. The program must include at least 12 hours of graduate-only coursework. Option 2 is not intended for students who expect to pursue a Ph.D.

**Option 3** is designed for students intending to pursue a Ph.D. and requires neither a thesis nor a minor. It may be taken with an area of specialization in Pure Mathematics or Applied Mathematics. The program must include at least 18 hours of graduate-only coursework.

## The Master's Exam

The Master's Exam (called the "Master's Comprehensive Exam" in the Graduate Studies Bulletin) is required by the Graduate College. The Master's Exam is designed to ensure a breadth of knowledge in mathematics. Students satisfy the requirements for the Master's Exam by completing one of options (A), (B), or (C) described below. In addition, students following the plan for an Option 2 MA/MS may be required by the minor department to take a Master's Exam in the minor area (but in practice this third exam is often waived). Students pursuing a Master's in Teaching (MAT) are required to use option (C). A student who writes and successfully defends a Master's thesis for an Option 1 Master's (described in the Graduate Studies Bulletin) will automatically satisfy all requirements of option (C) below.

- (A) Receive a grade of 'P' on at least two components of the Ph.D. qualifying exam.
- (B) Pass the final exam and earn a grade of at least 'B' in each of four courses chosen by the student from the following list of core courses: Math 817, 818, 825, 826, 830, 831, 850, 852, 871, 872. The last day of the semester in which the student receives the fourth 'B' will be the date on which the student passes the Master's Comprehensive Exam.

- (C) Take a two-part exam administered by a faculty committee consisting of at least three faculty members. (The committee is the MAT committee for MAT students; for Master's students not in the MAT program, the committee consists of a chair selected by the student and two other faculty members selected by the student and the chair.)

**Part I** is a take-home written exam, which itself has two parts. In Part IA) the committee will select three questions from at least two different courses the candidate has taken. Part IB) is an expository paper on a mathematical topic, including proofs or examples as appropriate. As general guidelines, the responses to the questions in Part IA) might be between 5 and 10 pages in length, while the paper in Part IB) should be at least 8-10 pages.

**Part II** is an oral presentation of about 20 minutes based on the work in Part IB) to his/her committee. Following the presentation, the committee will ask questions designed to probe the candidate's depth of understanding of the topic. The committee may also ask questions related to Part IA) if the committee feels this is appropriate. Passing is determined by the committee.

## Administrative Procedures for the Master's Degree

1. The Memorandum of Courses must be filed with the Math Department (who will file it with Graduate Studies on the student's behalf) before completion of eighteen hours of graduate credit. The form is required for candidacy and should be completed in consultation with the student's advisor.
2. Application for advanced degree online via MyRED at <http://registrar.unl.edu/online-graduation-application>, at the outset of the semester or session in which graduation is planned.
3. The Master's Exam cannot be completed more than 24 months prior to receipt of the degree. The student and the advisor should jointly determine the appropriate time to take the written exam.
4. The Final Exam Report must be filed with the Math Department (who will file it with Graduate Studies on the student's behalf) four weeks prior to the deadline for filing the final report for the degree.

## Course Requirements

There are no specific course requirements for the Master's Degree.

## THE PH.D. DEGREE

The Mathematics Department offers both a major and minor in mathematics for Ph.D. students. The term "Ph.D. program" used below refers to the major. Also, the Mathematics

Department, together with the Department of Computer Science and Engineering, offers a joint Mathematics/Computer Science Ph.D. The joint Math-Computer Science program is not described in this document; details are available by writing to the Graduate Chair at [mathgraduateprograms@unl.edu](mailto:mathgraduateprograms@unl.edu).

**Ph.D. Minor:** Ph.D. students from disciplines other than mathematics who wish to obtain a minor in mathematics must have a Mathematics faculty member on their Supervisory Committee and must take at least 15 credit hours of courses in the mathematics department, with at least 6 hours in courses graduate-only courses (i.e. 900-level courses or 800-level courses without a 400-level counterpart.) Students obtaining a minor in mathematics are strongly encouraged, but not required, to include at least two courses from the following list of core courses: Math 817, 818, 825, 826, 830, 831, 850, 852, 871, 872.

**Ph.D. Major:** The Ph.D. program requires completion of some course requirements, a **Qualifying Exam**, a **Ph.D. Comprehensive Exam** and a **Final Oral Exam**. The Ph.D. requires 90 hours of graduate credit, including a dissertation. At least 45 hours must be completed at UNL after the filing of the program of studies. The Ph.D. program will normally include at least 12 hours and at most 55 hours of dissertation research. (In Mathematics, 20–25 hours is typical.)

## Qualifying for the Ph.D. Program

Entrance into the Department's Ph.D. program is determined by the Ph.D. Qualifying Exam and by successful completion of the course requirements.

### Ph.D. Course Requirements

Each student must complete, with grades of B or better, at least three two-course sequences. At least one of the sequences must be from Group A below and at least one must be from Group B below.

#### Group A

Math 825-826 (analysis)

Math 830-831(differential equations)

#### Group B

Math 817-818 (algebra)

Math 850-852 (discrete mathematics)

Math 871-872 (topology)

Students should note that many supervisory committees will require students to take additional sequences from the list above.

### The Ph.D. Qualifying Exam

Each student must pass, at the qualifying (Q) level, two subject exams; together these two exams constitute the Ph.D. Qualifying Exam. Subject exams are offered in each of the five areas listed in part I above.

The general policies for the Qualifying Exam are as follows:

1. During any examination period the student may take one or more subject exams.
2. Scores on individual subject exams are valid for two years; a student need not retake a subject exam on which he or she earned a qualifying (Q) score, subject to the two-year limitation.
3. Students taking the Master's Exam need not retake subject exams on which they received a "Q" but may count such exams towards the Ph.D. Qualifying Exam requirement.
4. The decision on whether a student has qualified for the Ph.D. program rests with the GAC and is dependent upon both coursework (as described above) and the Ph.D. Qualifying Exam. These decisions, along with each student's scores (Q – qualify, P – pass or F – fail) on individual subject exams will be reported to the full Graduate Faculty at the end of each examination period.
  - (a) If a student has earned a "Q" on two subject exams, then the student shall be declared to have completed the Ph.D. Qualifying Exam.
  - (b) The GAC will make every effort to inform the candidate, within a period of four weeks from the last day of an examination period, of its decision.
5. Each subject exam is designed to be completed in three hours, though students are permitted five hours to work it.
6. For students transferring to UNL from other graduate programs, the GAC has the authority to accept exams taken at other universities.

## **Timeline**

Each student is encouraged to complete the course requirements and the qualifying exam requirements by the end of the second year of graduate study. In particular, it is expected that students will complete the course requirements during the first two academic years, and it is hoped that students will complete the Ph.D. Qualifying Exam by June following the second year. Reappointment for a fourth year of graduate study will not be possible for students who have not completed both the course requirements and the qualifying exam requirements by February of the third year.

## **Substitutions**

Students may, with permission of the GAC, substitute a comparable 900-level sequence for any of the 800-level sequences listed above. In addition, if a student takes a core sequence listed above and then scores at the qualifying level on the associated qualifying exam, then that student will be considered to have fulfilled that third of the coursework requirement (even if the course grades were not at the required level).

## PH.D. COMPREHENSIVE EXAM

The student's Ph.D. Supervisory Committee will determine the timing and the content of the Ph.D. Comprehensive Exam. The Supervisory Committee is required to follow Graduate College rules regarding the Comprehensive Exam, which may be found online at <https://catalog.unl.edu/graduate-professional/graduate/degrees/doctoral/>. In particular, the Comprehensive Exam *must* include a written portion and *may*, at the discretion of the Supervisory Committee, include an oral portion.

Typical Comprehensive Exams in the Mathematics Department consist of two parts; common formats for components of the exam include a written exam, an oral exam, or a research proposal. Comprehensive Exams are usually administered by the end of the third year of graduate study.

The decision as to whether the student has passed the Comprehensive Exam, and if not, which part(s) of the exam must be repeated, rests with the Supervisory Committee.

### Additional Ph.D. Requirements

**Course Requirements for the Ph.D. Degree:** The Mathematics Department does not have specific course requirements beyond those listed above as being required for students to qualify for the Ph.D. program and those imposed by the Graduate College. However, each student is required to consult with his or her advisor and to complete Form  $\varepsilon$  each semester until a supervisory committee is formed.

**Seminar Participation:** Seminars and colloquia are a valuable part of a student's training. Regular participation in all departmental colloquia and seminars in the student's area of interest is expected of all Ph.D. candidates. The student's advisor will help direct the seminar participation.

**Other Requirements:** The Supervisory Committee may, at its discretion, include other requirements in the student's Ph.D. program. This includes, but is not limited to, additional courses in mathematics or another subject, additional readings, or a language exam. Each student should consult with their Supervisory Committee about this and other details of their program.

**Final Oral Exam:** After a student completes a Ph.D. dissertation there is a final oral exam. This exam, often called a "thesis defense", is open to the public. Complete details of the final examination procedure are in the Graduate Studies Bulletin.

### Administrative Procedures for the Ph.D.

1. Before a student has earned 45 credit hours, the student forms a Ph.D. Supervisory Committee. The student must choose an Advisor, who will chair the Supervisory Committee and direct the dissertation. A form listing the Ph.D. Supervisory Committee must be filed with the Math Department (who will file it with Graduate Studies on

the student's behalf).

2. A Program of Studies form must be filed with the Math Department (who will file it with Graduate Studies on the student's behalf) before the student has earned 45 credit hours; this form is completed with the advice and consent of the student's Supervisory Committee. The Program of Studies must be filed the same semester that the Supervisory Committee is established.
3. Once a student has passed the Ph.D. Comprehensive Exam and satisfied any additional requirements specified by their Supervisory Committee, the student must file the Admission to Candidacy form with the Math Department (who will file it with Graduate Studies on the student's behalf). This form must be filed no later than seven months prior to graduation.
4. The GAC has the authority to grant waivers of graduate degree requirements for transfer students and in other exceptional cases.
5. At the end of each academic year GAC will report to the Graduate Faculty on all actions taken by the GAC, and, in particular, on any waivers granted.