Department of Mathematics

General Information On Graduate Programs

(Revised July 2006)

The general requirements for advanced degrees are in the Graduate Studies Bulletin (pages 12–13 for the Masters Degree and pages 14–16 for the Ph.D.). This pamphlet 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 (David Pitts, dpitts@math.unl.edu).

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

Requirements for a degree in the graduate program in Mathematics include both coursework and exams, described in detail below. Graduate exams are given during two examination periods per year—in January and June. Specific dates are announced by the Graduate Exam Coordinator (Mohammad Rammaha, rammaha@math.unl.edu). Coursework requirements are described in the Graduate Studies Bulletin, with some specific information in this document.

Graduate Faculty: *Professors*: Avalos, Avramov, Deng, Dunbar, Erbe, Harbourne, Lewis, Logan, Meakin (Department Chair), Orr, Peterson, Pitts (Graduate Chair), Rammaha, Rebarber, Shores, Skoug, J. Walker, M. Walker (Graduate Recruiting Chair), R. Wiegand, S. Wiegand, Woodward; *Associate Professors*: Brittenham, Chouinard, Cohn, Donsig, Hermiller, Hines, Iyengar, Ledder, Marley, Radcliffe (Department Vice-Chair), ; *Assistant Professors*: Foss, Loladze, Radu; *Adjunct Professors/Courtesy Appointments*: Bahar, Fowler, Levy; *Emeritus Faculty*: Chivukula, Jackson, Johnson, Kramer, Leavitt, Meisters, Mesner, Mientka, Saxena, Thornton, Zechmann.

MASTERS DEGREE

Master of Science & Master of Arts: The Department offers Masters 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 (David Fowler, dfowler@unlserve.unl.edu).

Masters Degree Options

There are three options for the Masters 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 Masters 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 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 Masters Exam

The Masters Exam (called the "Masters Comprehensive Exam" in the Graduate Studies Bulletin) is required by the Graduate College. The Masters 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 Option II may be required by the minor department to take a Masters Exam in the minor area (but in practice this third exam is often waived). Students pursuing a Masters in Teaching (MAT) are required to use option (C). A student who writes and successfully defends a Master's thesis for an Option I Masters (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. One of the components must be either: the analysis (825-826), the algebra (817-818) or the applied mathematics (842-843) exam. This option is designed for students whose degree objective is the PhD, but who also wish a Master's degree.

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, 842, 843, 847, 850, 852, 970. The last day of the semester in which the student receives the fourth 'B' will be the date on which the student passes the 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 Masters 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 1A) the committee will select three questions from at least two different courses the candidate has taken. Part 1B) is an expository paper on a mathematical topic, including proofs or examples as appropriate. As general guidelines, the responses to the questions in Part 1A) might be between 5 and 10 pages in length, while the paper in Part 1B) 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 Masters Degree

1. The Memorandum of Courses must be filed in the Graduate College 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 a Masters Degree must be filed at the Graduation Services Office (109 Adm) at the outset of the semester or session in which graduation is planned.
3. The Masters 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 in the Graduate Office four weeks prior to the deadline for filing the final report for the degree.

Course Requirements: There are no specific course requirements for the Masters 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 Marilyn Johnson at mjohnson11@math.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 16 hours of credit of courses in the mathematics department, with at least 6 hours in courses only open to graduate students. 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, 842, 843, 847, 850, 852, 970.

Ph.D. Major: The Ph.D. program requires 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.) In addition there are specific Course Requirements and a Language Requirement.

The Ph.D. Qualifying Exam

Entrance into the Department's Ph.D. program is determined by the Ph.D. Qualifying Exam. The exam has three three-hour parts. The same exams serve as parts of both the Masters Exam and the Ph.D. Qualifying exam, though qualifying for the Ph.D. program requires a higher level of performance than passing at the Masters level.

The qualifying exam consists of three exams over three subject areas approved by the Graduate Advisory Committee (GAC). Normally each exam should be over the material covered in two courses that form a single coherent body of work. At least two of the exams must be over two of the following three sequences, 817-818; 825-826; 842-843. (The algebra (817–818) and analysis (825–826) exams are described earlier, in the section on the Masters Exam.) If a student expresses interest in pursuing a Ph.D. in an area that will require a substantial body of knowledge in another discipline, the GAC may approve taking the "third area exam" in a discipline outside the department.

General Policies for the Ph.D. Qualifying exam

(a) During any examination period the student may take one or more parts of the Ph.D. Qualifying Exam.

(b) Scores on parts of the Ph.D. Qualifying Exam are valid for two years; a student need not retake a part of the Exam on which he or she earned a qualifying (Q) score, subject to the two-year limitation.

(c) A student is expected to complete the Ph.D. Qualifying Exam during at most five consecutive exam periods (a span of two years). Exceptions may occasionally be granted by approval of the GAC.

(d) Students taking the Masters Exam may subsequently fulfill the requirements of the Ph.D. Qualifying Exam by taking the appropriate third exam, subject to the time limitations (b) and (c).

(e) The decision on whether a student has qualified for the Ph.D. program rests with the GAC. These decisions, along with each student's scores (Q – qualify, P – pass or F – fail) on individual components of the Qualifying Exam will be reported to the full Graduate Faculty at the end of each examination period.

i) If a student has earned a "Q" on all three parts of the exam, then the student shall qualify for the Ph.D. program.

ii) In other cases the GAC is empowered to consider, in its decision, both the total examination performance and the student's overall performance as a graduate student.

iii) The GAC is to inform the candidate, within a period of three weeks from the last day of the exam, of its decision.

(f) For students transferring to UNL from other graduate programs, the GAC has the authority to accept exams taken at other universities.

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 GAC serves as the default Ph.D. Supervisory Committee for students who have qualified for the Ph.D. program but have not yet formed a Ph.D. Supervisory Committee. By common agreement of the Graduate Faculty, the Ph.D. Comprehensive Exam will consist at least of the following parts.

Part 1: One of the following:

(a) A four-hour written exam in algebra over the material usually covered in Math 901-902. Recent text: Lang, Algebra. Additional References: Hungerford, Algebra; Kaplansky, Fields and Rings.

(b) A four-hour written exam in analysis based on the material usually covered in Math 921-922. Recent text: Royden, Real Analysis. Additional Reference: Rudin, Real and Complex Analysis.

Part 2: A four-hour written exam or a two-hour oral exam administered by the Supervisory Committee, to test the student's breadth of understanding of the field of knowledge of which his/her special subject is a part.

A student who has used a course sequence (e.g. Math 901-902 or Math 921-922) to complete a portion of the Qualifying Examination cannot use it again as a portion of the Comprehensive Examination.

A student may fulfill both Part 1 and Part 2 by completing both (a) and (b) under Part 1.

General Policies for the Ph.D. Comprehensive Exam

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

(b) Standard exams (e.g., the four-hour written exams in algebra and analysis) will be offered in January and June. In some cases, specialized exams may be administered by the Supervisory Committee, and the scheduling of these specialized exams might be more flexible.

(c) A student should pass all components of the Comprehensive Exam within a single seven-month period. Exceptions may occasionally be granted by the Supervisory Committee.

Additional Ph.D. Requirements

Course Requirements for the Ph.D. Degree: All Ph.D. students must have course work in Algebra and Analysis (either at UNL or at another institution) equivalent to what we teach in 817-818 and 825-826. The GAC is charged with review and approval of the appropriate course work from other institutions. Students who obtain a qualifying score on the algebra (respectively, analysis) qualifying exam will automatically be declared to have satisfied the algebra (respectively, analysis) course requirement.

Each student must include either a topology course or a numerical analysis course on his or her Program of Study. (These course requirements may be transferred from other programs upon recommendation by the Ph.D. Supervisory Committee. Note that Math 840 cannot be used for credit toward a degree in the Department of Mathematics and Statistics.)

Each Ph.D. student must take two of the following three sequences, earning an average grade of at least a B+ in each sequence:

Math 901–902 Math 921–922 Math 932–933

If a student completes the required sequences with an average grade below B+ on any sequence, his or her Supervisory Committee shall require the student either to repeat certain courses, to take additional courses, or to administer extra written exam(s) in area(s) where weakness is felt. Note: Students who expect to pursue a college or university teaching career should plan to take all three of the sequences listed above, as well as both topology and numerical analysis.

Ph.D. Language Requirement: The language requirement for students in Mathematics is reading ability of one foreign language, selected from French, German, or Russian. Competence may be demonstrated in one of the following three ways:

A. Passing an exam in the language administered by the Foreign Language Committee of the Mathematics Department.

B. Completion of at least one advanced course (at the level of French 202, German 202, or Russian 202 or beyond) in the language with a grade of B or above. (See the section "Language Research Tool Requirement" in the Graduate Studies Bulletin.)

C. Passing the Educational Testing Service exam as administered at the University of Nebraska or as administered at another university (with a grade of 500 or more).

The Language Requirement must be completed at least seven months before the date of the Final Oral Exam (described below).

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.

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 Graduate Studies Office.

2. A Program of Studies form must be filed with the Graduate Studies Office before the student has earned 45 credit hours; this form is completed with the advice and consent of the student's Supervisory Committee.

3. Once a student has passed the Ph.D. Comprehensive Exam and satisfied the language requirement, the student must file the Admission to Candidacy form with the Graduate Studies Office. This form must be filed no later than seven months prior to graduation.

4. 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.