# Guide to Doctoral Studies in the Department of Applied and Computational Mathematics and Statistics

2015-2016 Academic Year

## 1. Introduction

The doctoral program in Applied and Computational Mathematics and Statistics (ACMS) is designed to train researchers skilled at conducting independent research in applied mathematics, computational mathematics or statistics. The granting of a doctoral degree is recognition that student's mastery of the discipline and research accomplishments meet the standards recognized by the community of professionals in the field.

The program requirements for the doctorate in ACMS are structured to enable students to begin research and coursework in an application area early in their studies. The general features and specific requirements for the doctorate in ACMS are described below. These requirements include coursework, passing written and oral candidacy examinations timed to certify the student's ability to commence doctoral research, and satisfactory completion of a doctoral thesis.

## 2. Course requirements

A doctoral student is required to complete 18 credits of ACMS courses at the graduate level in the first four semesters of study to remain in good standing. Students are encouraged to take courses in other departments to improve their abilities to work on interdisciplinary problems. Students are advised to take three courses in the first semester and at least two courses in the next three semesters. At the beginning of the first four semesters of study, the student must submit for approval by the Director of Graduate Studies (DGS) a list of the courses the student plans to take that semester. The student's advisor must sign this form.

At the discretion of the DGS, at most 6 credits of graduate level courses transferred from another university may be counted toward the required ACMS course work, for a student without a completed master's degree. For a student with a completed master's degree, the DGS will determine the number of transferred credits applied to the required ACMS course work.

## 3. Advisors

Each student in ACMS has a faculty advisor at all stages of his or her studies. The DGS serves as the advisor of each entering student. Before the end of the first year of studies, the student selects a thesis advisor from among the regular or concurrent teaching and research faculty in the ACMS department. This is accomplished by submitting a completed advisor request form to the Department Chair. Approval of the request will be subject to the faculty member's commitment of full academic

year support for the student from external sources after the student's first two years of study. Students are required to attend seminar talks and group meetings to learn about the research of the Department's faculty members.

## 4. Written candidacy examination

Each student must demonstrate a working knowledge of two basic areas approved by the Director of Graduate Studies (DGS). Some possible areas are the material contained in: (1) ACMS 60690 Numerical Analysis I, (2) ACMS 60850 Applied Probability, (3) ACMS 60650 Basic Partial Differential Equations. The material in selected Mathematics courses, e.g., MATH 60210 Basic Algebra I, may also be acceptable. Approval of a course will depend both on the subject matter and the amount of written work required of the students in the course. Obtaining a pass in a course's material may be accomplished by passing the given course with at least a B+ or by passing a separate written examination that covers the syllabus of the course. These examinations are administered at the end of the fall and spring semesters. The written examinations are normally taken at the end of the fall semester of the first year, and must be completed by the end of the first year, except for students transferring from another program.

## 5. Oral candidacy examination

The oral candidacy examination, taken after the written candidacy examinations are completed, focuses on an "advanced" topic. This material, normally taken from advanced research texts or articles, is aimed at preparing the student for thesis research. In any case, the student should begin working on the advanced topic with an advisor, well in advance of the examination, normally before the beginning of the second year. The material to be counted as the advanced topic must have the approval of the adviser and the DGS.

The board of examiners for the oral candidacy examination must have a minimum of three members, but can have a maximum of five. The number of examiners includes the student's advisor. The other members of the examining board are selected by the student and advisor and approved by the DGS. All of the examiners must be tenured or tenure-track faculty members and at least two must be from the ACMS department.

The topic for the oral candidacy examination should be chosen months before the examination. The syllabus for the oral candidacy examination must be made available to all members of the examining board at the time they agree to serve. All examiners should restrict their questions to the advanced topic or other material on the given syllabus. Thus, the syllabus should provide guidance to the examiners.

The oral candidacy examination begins with a presentation by the student lasting between 30 and 40 minutes. This is followed by questions on material from the syllabus. The examination lasts from one and a half to two hours. After the completion of the examination, the examiners vote "pass" or "fail." A vote of "pass" means that, in the eyes of the particular examiner, the student has passed all parts of the examination. On a board of three, two votes are required to pass. On a board of

four, three votes are required to pass. If a department chooses to have five members, four votes are required to pass. The student is informed of the outcome of the examination immediately.

Students are encouraged to take the examination as early as possible. In general, students must take the oral candidacy examination by the end of January in the second year. Exceptions may be made, with the permission of the DGS, for special circumstances. Students who fail the first time may take the examination again, but must in general do so no later than April of the second year. Again, exceptions may be made, with the permission of the DGS. A student who fails the oral examination twice is subject to dismissal.

## 6. Thesis

Thesis research, under the supervision of the thesis director, normally begins after the successful completion of the candidacy examinations. The thesis director is expected to be concerned with the interest and significance of a thesis topic in applied mathematics, computational mathematics, or statistics, with the originality of the research, and with the accuracy and the style of the manuscript. The final draft of the thesis should provide enough background and detail to make for easy reading by a semi-expert in the area, but should also be in a form that can easily be edited and shortened for publication in a peer-reviewed journal.

After the thesis director has approved the thesis, it is submitted to three official readers.  The thesis director and the official readers must be tenured or tenure track faculty and at least two of the readers must be from the ACMS department. The official readers must be approved by the student's advisor and the DGS.  The defense is scheduled after all three official readers have approved the thesis. In approving the thesis, the official readers certify that it is worthy of defense. They may continue to require changes.

The thesis defense is an oral examination on the contents of the thesis and its relation to other work in the same area. The board of examiners for the thesis defense consists of three to five people selected by the student and the student's advisor and approved by the DGS. If the student has a co-advisor, then the board of examiners must consist of at least two additional members. Typically, the board of examiners consists of the thesis director and the official readers.

The examination begins with a 30-50 minute presentation by the Ph.D. candidate, prepared in consultation with the thesis director (who also sets the length). A round of questions by the examiners follows. There may be questions about specific points in the thesis, and also about the importance of the research and what further work it suggests. A thesis defense is public, in the sense that people other than the candidate and the members of the board of examiners may be present for the lecture. Such people leave the room prior to the round of questions. Voting is as for the oral candidacy examination. The candidate is informed of the outcome immediately.

After a successful defense, the candidate may still need to make some minor changes in the thesis. Then the final version of the thesis, signed by the thesis director, is submitted to the Graduate School.

Getting the thesis read and approved, scheduling the thesis defense, making corrections, and having the thesis accepted by the Graduate School is a time-consuming process that requires strict adherence to the timetables set by the Department of ACMS and the Graduate School. The thesis must be submitted to the readers well before the Graduate School deadline for submission of theses. The latter is roughly two months before the graduation date. August graduation entails special difficulties, since there are fewer faculty members available during the summer to serve as official readers.

### 7. Annual report

A student who has been admitted to candidacy is required to submit a written annual report of his or her progress in thesis research. This report, which is limited to two pages in length, must be endorsed by the advisor and submitted to the DGS by the end of the spring semester. The Department uses the annual report to monitor each student's progress towards graduation.

### 8. Residency requirement

The Graduate School requires four consecutive semesters of full-time study.

### 9. Responsible Conduct of Research and Ethics Requirement

As part of its holistic approach to graduate education, The Graduate School requires all Ph.D. students to complete any and all training modules for the Responsible Conduct of Research and Ethics requirements. All students supported by federal grants must be certified in accordance with national guidelines and the policies of the Office of Research. For more information, please visit: http://graduateschool.nd.edu/professional_development/.

### 10. Summary of doctoral student responsibilities

1. At the start of each semester in the first two years of study, submit for approval by the DGS a course selection form, signed by the student's advisor.
2. Identify a thesis advisor and obtain approval of the Department Chair before the end of the first year of studies.
3. Notify the DGS of the intent to sit for the written examination, including the selection of examination subjects, at least two weeks prior to the examination date.
4. Submit for approval by the advisor and DGS the selection of advanced topic for the oral candidacy examination.
5. Submit to each voting member of the oral examination committee the syllabus of material to be covered on the examination
6. Apply for admission to doctoral candidacy with the Graduate school.

7. At the end of each academic year after admission to candidacy, submit to the DGS an annual report on progress in thesis research that is signed by the advisor.
8. Prepare and obtain approval for a doctoral thesis as described above.