

UNIVERSITY FACULTY SENATE FORMS

Academic Program Approval

This form is a routing document for the approval of new and revised academic programs. Proposing department should complete this form. Detailed instructions for the proposal should be followed. A [checklist](#) is available to assist in the preparation of a proposal. For more information, call the Faculty Senate Office at 831-2921.

Submitted by: Francisco-Javier SAYAS

Department: Mathematical Sciences

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Date: February 2, 2016

Action: Change in Graduate Program (preliminary examinations)

(Example: add major/minor/concentration, delete major/minor/concentration, revise major/minor/concentration, academic unit name change, request for permanent status, policy change, etc.)

Effective term: 16F if possible

(use format 04F, 05W)

Current degree MS

(Example: BA, BACH, BACJ, HBA, EDD, MA, MBA, etc.)

Proposed change leads to the degree of: MS

(Example: BA, BACH, BACJ, HBA, EDD, MA, MBA, etc.)

Proposed name: NA

Proposed new name for revised or new major / minor / concentration / academic unit
(if applicable)

Revising or Deleting:

Graduate Program Policy statement change: _____

(Must attach your Graduate Program Policy Statement)

Graduate Program of Study: Applied Mathematics: PHD

(Example: Animal Science: MS Animal Science: PHD Economics: MA Economics: PHD)

Note: all graduate studies proposals must include an electronic copy of the Graduate Program Policy Document, either describing the new program or highlighting the changes made to the original policy document.

List new courses required for the new or revised curriculum. How do they support the overall program objectives of the major/minor/concentrations)?

(Be aware that approval of the curriculum is dependent upon these courses successfully passing through the [Course Challenge](#) list. If there are no new courses enter "None")

[No new courses]

Supply support letter from the Library, Dean, and/or Department Chair if needed

(all new majors/minors will need a support letter from the appropriate administrator.)

[No new degree]

Supply a resolution for all new majors/programs; name changes of colleges, departments, degrees; transfer of departments from one college to another; creation of new departments; requests for permanent status. [See example of resolutions.](#)

[Not relevant]

Explain, when appropriate, how this new/revised curriculum supports the 5 goals of undergraduate education: <http://www2.udel.edu/gened/>

[Not relevant]

Identify other units affected by the proposed changes:

(This would include other departments/units whose courses are a required part of the proposed curriculum. Attach permission from the affected units. If no other unit is affected, enter "None")

The modification does not affect other units.

Describe the rationale for the proposed program change(s):

(Explain your reasons for creating, revising, or deleting the curriculum or program.)

The recent APR committee report (and the subsequent departmental response) identified some weaknesses in the Math/Applied Math graduate program, specifically in how the course structure affects the students leaving with a MS degree. An ad hoc department committee singled out the structure of the preliminary examinations as a bottleneck that did not allow students to clarify their situation until their third semester of study.

The existing format contains two exams, one of which involves much more content than the other (about double). Typically students have not finished the coursework needed for these exams until the end of the first year, and those who fail the exams the first time do not have a final decision about their chance to stay in the program until the end of the third semester of study.

The new format proposes a two tier system. The first tier consists of two exams based on material that is offered in fall courses every academic year. The second tier gives a choice of two exams out of a list of five different topics. It is expected that the first tier exams will clarify the student's situation in the department at the end of the first year of study. Students failing these exams will be automatically rerouted to the MS program, allowing them to choose the coursework thinking of job opportunities in the short term. The second tier emphasizes a core structure to the program.

Program Requirements:

(Show the new or revised curriculum as it should appear in the Course Catalog. If this is a revision, be sure to indicate the changes being made to the current curriculum and **include a side-by-side comparison** of the credit distribution before and after the proposed change.) [See example of side by side.](#)

ROUTING AND AUTHORIZATION: (Please do not remove supporting documentation.)

Department Chairperson _____ Date _____

Dean of College _____ Date _____

(By signing above, the Dean confirms that their college policies and bylaws have been followed correctly during consideration of the request described in this form.

The approval actions that were taken at the college level were (check all that apply) :

_____ college faculty vote; _____ college curriculum approval _____ college senate approval

Chairperson, College Curriculum Committee _____ Date _____

Chairperson, Senate Com. on UG or GR Studies _____ Date _____

Chairperson, Senate Coordinating Com. _____ Date _____

Secretary, Faculty Senate _____ Date _____

Date of Senate Resolution _____ Date to be Effective _____

Registrar _____ Program Code _____ Date _____

Vice Provost for Academic Affairs & International Programs _____ Date _____

Board of Trustee Notification _____ Date _____

Revised 9/22/2015/khs

Checklist for Curriculum Proposals

___ 1. Are all **signatures on the hard copy of the proposal**? YES

___ 2. Is the **effective date** correct? YES (Proposed Fall 2016 - If too late, the changes can be implemented in Fall 2017)

___ 3. Is the **rationale** for the proposal consistent with the changes proposed? YES

___ 4. Does the proposed **number of credits** match the stated number? [NO CHANGES]

___ 5. Have affected units been identified and contacted? Are required **support letters** attached? [THE CHANGES DO NOT AFFECT OTHER UNITS]

___ 6. Is a **resolution** necessary? If so, is it attached?

(Necessary for: establishing a major; disestablishing a major; a name change to any program with permanent status; a name change to a department or college; a transfer or creation of any department; request for permanent status).

[NOT NEEDED]

___ 7. Are all **courses (required or referenced)** in the UDSIS Inventory or in the approval process?

[YES. NO CHANGES TO CURRENT PROGRAM]

___ 8. Are all **university requirements** correctly specified?

___ A. Breadth requirements.

___ B. Multicultural requirement.

___ C. Writing requirement.

___ D. DLE requirement.

[N.A.]

___ 9. Are all **college requirements** correctly specified?

[N.A.]

___ 10. Is a side-by-side comparison provided?

YES. THE DOCUMENT IS COLOR-CODED AND THE NEW VERSION IS CLEARLY SET TO BE COMPARED WITH THE OLD VERSION.

Graduate Programs in the Department of Mathematical Sciences

Last updated and approved by the faculty: May 2013

1. History and Overview	1
2. Admission	2
3. Academic Regulations	3
3.1. Requirements for the M.S. in Mathematics and Applied Mathematics	3
3.2. Requirements for the Ph.D. in Mathematics and Applied Mathematics	5
4. Assessment.....	12
4.1. Learning objectives.....	12
4.2. Assessment Plan.....	12
5. Financial Aid.....	13
5.1. Support for student travel.....	14
5.2. Summer support.....	14
6. Teaching for the department	15
7. Miscellaneous information.....	16

1. History and Overview

Mathematics was present at the University of Delaware from the start. The founder of the university, Francis Alison, wrote of his new school in 1768, “The Languages are carefully taught, along with arithmetic, geometry, practical branches of mathematics, and logic.” By 1773, the fledgling academy employed two professors--a philosopher and a mathematician. By 1826, the department structure had arrived at U.D., with a separate room set aside for a “Mathematical and English Department.” In 1832, mathematics became part of a new department of “Mathematics and the Natural Sciences.” Over the next century, both the university and the department underwent significant growth, but it wasn't until the late 1950's that doctoral programs were established at the University of Delaware. In 1965, the Department of Mathematical Sciences created the seventh doctoral program hosted by the university. By 1969, the department had awarded its first Ph.D. degree.

Over the last forty years, well over one hundred students have received doctoral degrees in Mathematics or Applied Mathematics from the University of Delaware. Graduates from our program have gone on to prestigious postdoctoral positions at institutions such as Oxford University, the University of Arizona, and the University of Minnesota. They hold or have held academic positions worldwide and they work in industry, commerce, and government, at organizations such as DuPont, Amazon, and the National Security Agency. Today, with active research groups in numerous areas of pure and applied mathematics, the department continues to train high-quality mathematics researchers destined to impact the future of mathematics and its applications worldwide.

The Department of Mathematical Sciences offers programs of study leading to Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees in Applied Mathematics and Mathematics. The department also offers a 4+1 BS/MS program allowing students to complete both a Bachelor of Science and Master of Science degree in five years of full-time study. Requirements for the degrees in the various programs are detailed in Section 3. Many areas of mathematics and its applications are included among the research interests of the faculty of the department. The department offers a wide range of regularly scheduled seminars and colloquia, including the Hallenbeck Graduate Student Seminar, Rees Distinguished Lecturers, and numerous seminar series organized by the faculty around research interests in the department. Students should attend the Graduate Student Seminar each week and departmental colloquia, in addition to sampling other available seminars during their first year. By the second year of study, doctoral students should have become a regular attendee at one or more research-oriented department seminars.

2. Admission

Admission to the graduate programs in Applied Mathematics and Mathematics is open to students who have completed the equivalent of a baccalaureate degree in mathematics or related fields, and who have a sound preparation in linear algebra and advanced calculus. On a 4.0 system, applicants should have a GPA of at least 2.5 and an average of at least 3.0 in mathematics and related areas. Applicants who have completed an advanced degree must have done so with a GPA of at least 3.0. In addition, applicants must take the GRE General Test and one GRE Subject Test. It is not required that the GRE Subject Test be in mathematics.

To be eligible for admission, students from a country where English is not a primary language must demonstrate proficiency in English by meeting at least one of the following criteria:

- Score at least 600 on the paper-based TOEFL exam.
- Score at least 100 on the TOEFL iBT, with a minimum score of 20 in each section.
- Score at least 7.5 on the IELTS with a minimum score of 6.0 in each subsection.

Admission to the graduate program is competitive. Those who meet stated requirements are not guaranteed admission, nor are those who fail to meet all of those requirements necessarily precluded from admission if they offer other appropriate strengths.

Students who wish to be admitted to the 4+1 B.S./M.S. program should submit an application during their junior year of academic study toward an undergraduate degree at the University of Delaware. Such students must be enrolled in a Bachelor of Science degree program administered by the Department of

Mathematical Sciences. At a minimum, the applicant must have a cumulative GPA of 3.2 and a GPA of 3.4 in their undergraduate major. The applicant must have completed at least two mathematics courses at or above the 400 level. Two letters of recommendation from University of Delaware faculty and academic transcripts must be submitted. Neither the GRE nor the TOEFL exam is required. Meeting minimum requirements is not a guarantee of admission. Similarly, those who fail to meet minimum requirements are not precluded admission if they offer other appropriate strengths.

3. Academic Regulations

The authority for administering the program rests with the Graduate Studies Committee. The Director of Graduate Studies serves as academic advisor to all students until such time as a supervisor for the thesis or dissertation is selected. New students, as part of the orientation program, will meet with the Director of Graduate Studies to plan their first year of study in the program.

Before each semester, you must obtain your advisor's permission to register for courses. During advisement, you will be given help with course selection based your interests and record. You will have a progress sheet on which the courses taken, grades, and progress toward the degree are noted. The department is committed to providing individualized attention and guidance to every student in the program. If at any time you have concerns, questions, or difficulties, you are encouraged to discuss them with the Director.

In making your plan of study, you should pay particular attention to the timing of course offerings and your background and interests. It is not unusual that you may want to change your plan as your experience in the department grows. Nevertheless, having even a tentative plan will serve to ensure a timely completion of your goals. You should consult Section 3.2.5 often to ensure that you continue to make satisfactory progress.

Transfer of credit from other U.S. institutions is available only for courses at the graduate level that have not counted towards the requirements of any other academic degree. Permission is required from the student's advisor and the Chair of the department. A form and instructions are available from the website of the Graduate Office. Transfers of credit should be requested in a timely manner so that the student's plan of study is clear. Transfer of credit from non-U.S. institutions is generally not possible.

3.1. Requirements for the M.S. in Mathematics and Applied Mathematics

The M.S. degree in Mathematics or Applied Mathematics can be earned through one of two options: 30 credits of graduate level coursework; or 24 credits of graduate level coursework, six credits for research and thesis in the final semester, and a successfully completed and defended Master's thesis.

3.1.1. Coursework

To be eligible for the degree, an M.S. candidate (including 4+1 B.S./M.S. students) must complete 30 credits of course work beyond the Bachelor's degree, subject to all of the following conditions except where granted a waiver after petition to the Graduate Studies Committee. Credit hours for which the grade is below C-minus do not count toward a graduate degree.

1. Coursework must be at or above the 600 level and exclusive of courses that the catalog designates as not counting towards mathematics graduate degrees.

2. A maximum of 3 credits of course work at the 600 level or above in non-MATH courses may be applied.
3. A maximum of 3 credits may be from a reading course (MATH 870).
4. For students who select the thesis option for the M.S., the 30 credit total must include 3 credit hours of research (MATH 868) and 3 credit hours of thesis (MATH 869), leading to a successfully defended Master's Thesis. Note that MATH 869 is normally taken for 6 credits. See Section 3.1.2.

Students in the 4+1 B.S./M.S. program may count up to six credits of coursework in the mathematical sciences, at or above the 600 level and not otherwise restricted by the catalog, toward both their B.S. and M.S. degrees.

3.1.2. Thesis (option for the M.S. degree)

The purpose of this option is to assess the student's ability to conduct and report original research on a particular area within the field of specialization and/or synthesize and critically analyze important issues in the field of specialization. The particular form of the thesis project (e.g., report of original research or critical review of and exposition on the literature) will be determined by the student in consultation with his or her thesis advisor and the Thesis Committee.

The Thesis Committee shall consist of three faculty and is chaired by the advisor. It is not required that a member of this committee be from outside the department. After the topic(s) and project format have been determined, the student will have a maximum of one year to complete the written thesis (typically 50 to 60 pages).

The student is responsible for following the Graduate Office deadlines and procedures relating to the thesis, defense, and application for the degree. An oral defense will be scheduled following the Thesis Committee's evaluation of the thesis. This defense will be open to the academic community.

3.1.3. Timetable and satisfactory progress

All students are subject to the regulations of the Office of Graduate and Professional Education. The OGPE sets specific policies regarding probationary status and satisfactory progress. In particular, a student must maintain a cumulative GPA of 3.0 or better or risk dismissal. A student must have a cumulative GPA of 3.0 or better in order to receive a graduate degree.

In addition to the Graduate Office regulations, the following regulations are specific to the Department of Mathematical Sciences. Except where noted otherwise, students seeking a waiver of any these regulations must petition the Graduate Studies Committee.

1. Students receiving financial support through Graduate Assistantships (GA), Research Assistantships (RA), Teaching Assistantships (TA), or departmental or university fellowships must observe the following course registration conditions each semester until reaching sustaining (candidacy) status:

- a) A minimum of nine credits of graded coursework (not as “listener”) is required. The sole routine exception is for students in the last semester, who may register for a minimum of six credits.
 - b) No more than nine credits of graded coursework may be taken without the permission of the Graduate Director. Students are permitted to register as “listener” for up to three credits beyond the nine graded credits.
2. Students receiving financial support through Graduate Assistantships (GA), Research Assistantships (RA), Teaching Assistantships (TA), and departmental or university fellowships may not be enrolled in any other degree program, at the University of Delaware or elsewhere, while receiving such support.
 3. Students receiving support through Graduate Assistantships or Teaching Assistantships must perform all required duties satisfactorily, as determined by the Associate Chair of the department or his/her designee.

Satisfactory progress for the M.S. degree is defined as meeting all minimum registration and grade requirements. Those who wish to take the thesis option should have selected a thesis advisor and Thesis Committee before the start of the fourth semester of study.

Full-time students should meet the requirements for the M.S. after four semesters of study. Financial aid is normally not extended to terminal M.S. students past four semesters.

3.2. Requirements for the Ph.D. in Mathematics and Applied Mathematics

An outline of the degree requirements for the Ph.D. is as follows.

1. Meet the coursework requirement (section 3.2.1).
2. Pass the Preliminary Examination requirement (section 3.2.2).
3. Select a Dissertation Committee and pass the Candidacy Examination (see section 3.2.3).
4. Complete two semesters of experience in teaching undergraduate students, either as teaching assistant or as instructor of record.
5. Complete 9 credits of MATH 969 (Doctoral Dissertation). These credits are not included in the coursework requirement.
6. Complete and successfully defend a dissertation (section 3.2.4).

3.2.1. Coursework

There are two options for the coursework requirement: *standard* and *accelerated*.

3.2.1.1. Standard requirement

Complete 48 credits, subject to the following conditions:

1. At least 42 credits in MATH courses at the 600 level or above, exclusive of courses designated in the catalog as not counting towards graduate degrees in mathematics.
2. A maximum of 27 credits of MATH courses at the 600 level.
3. A maximum of 12 credits total from MATH 868 (Research) and MATH 870 (Reading) combined.
4. A maximum of 6 credits at the 600 level or above in non-MATH courses, unless special permission is granted in advance by the Graduate Committee.

These coursework requirements are a superset of those for the Master's degree. An M.S. degree is awarded once the requirements for it have been met.

3.2.1.2. Accelerated requirement

This option is available only to those who enter the program with a Master's degree in Mathematics or Applied Mathematics. To qualify for the accelerated coursework requirement, the student must successfully complete the entire Preliminary Exam requirement (section 3.2.2) before the start of the first semester (that is, by passing all required exams on the first possible date). Such an attempt at the exams counts as one of the student's regular allowed attempts.

Upon successful completion of the accelerated Preliminary Exam requirement, the accelerated course requirement is 30 credits, subject to the following conditions.

1. **MATH 600, MATH 602, and MATH 672 may not be counted towards the requirement.**
2. At least 24 credits of MATH courses at the 600 level or above, exclusive of courses designated in the catalog as not counting towards graduate degrees in mathematics.
3. A maximum of 9 credits of MATH courses at the 600 level.
4. A maximum of 12 credits total from MATH 868 (Research) and MATH 870 (Reading) combined.
5. A maximum of 3 credits at the 600 level or above in non-MATH courses, unless special permission is granted in advance by the Graduate Committee.

New version

3.2.1.2. Accelerated requirement

To qualify for the accelerated coursework requirement, the student must successfully complete the first tier of the Preliminary Requirement (section 3.2) before the start of the first semester (that is, by passing all required exams on the first possible date). Such an attempt at the exams counts as one of the student's regular allowed attempts. Additionally, the student must complete the second tier before the start of the third semester.

The accelerated course requirement is 30 credits, subject to the following conditions:

1. MATH 600 and MATH672 may not be counted towards the requirement.
2. [continues without change]

3.2.2. Preliminary Examination

All students who wish to obtain a Ph.D. degree must take a written examination called the Preliminary Examination. The Preliminary Examination contains two subject areas: Real and Complex Analysis, which covers material from MATH 600 and MATH 602, and either Linear Algebra, which covers material from MATH 672, or Numerical Linear Algebra, which covers material from MATH 612. Note that material outside the course syllabus may be on the syllabus for the exam.

The Preliminary Exam is given twice each year, generally in the weeks just before the start of the fall and spring semesters. The Preliminary Exam requirement must be successfully met by the beginning of the fourth semester of study. Providing it is before the beginning of the fourth semester, a student may take each subject area of this exam up to two times. Only the area not passed needs to be repeated. Students who fail to pass both subject areas of the Preliminary Exam by the beginning of the fourth semester will not be permitted to become a PhD candidate and may lose financial aid support after the fourth semester. However, such students are still eligible for the M.S. degree.

The syllabus to be covered by each examination, including suggested references, is kept by the department and available on the web and by request. You may obtain copies of past examinations and the syllabus from the Graduate Program Secretary.

3.2.2. Preliminary Requirement

All students who wish to obtain a PhD degree must complete the Preliminary Requirement. The Preliminary Requirement is divided into two tiers, each of which contains two individual written exams. The first tier exams are Linear Algebra (with material from MATH 672 and its prerequisites) and Analysis (with material from MATH 600 and multivariable calculus). The second tier exams are to be chosen from the following list: Advanced Analysis (MATH 602), Numerical Methods (MATH 611), Applied Mathematics (MATH 617), Stochastic Processes (MATH 631), and Algebra (MATH 650).

There will be two exam *periods* a year, usually in the weeks immediately before the start of the fall and spring semesters.

Each exam can be taken at most twice. The maximum number of second tier exams that can be attempted over all periods is four. In any one period, students can take at most two exams of the first tier and two exams of the second tier, except when they have already passed one exam in the second tier, in which case they may only take one exam of the second tier.

The first tier of the Preliminary Requirement must be completed by the beginning of the third semester of study. The second tier of the Preliminary Requirement must be completed by the beginning of the fourth semester of study.

A student who fails the same individual exam twice or fails to complete each tier of the Preliminary Requirement by the respective deadline will not be permitted to become a PhD candidate and may lose financial support after the fourth semester. However, such students are still eligible for the MS degree.

For a student entering the program in the spring semester, the Graduate Director, in consultation with the student, will determine the calendar for the Preliminary Requirement.

The syllabus to be covered by each examination, including suggested references, is kept by the department and available on the web and by request. You may obtain a copies of past examinations and the syllabus from the Graduate Program Secretary. Note that material outside the course syllabus may be on the syllabus for the exam.

3.2.3. Candidacy Examination

The purpose of the Candidacy Examination is to assess the student's readiness to undertake and complete a research project for the doctoral thesis. Each student must pass the Candidacy Examination by the beginning of his or her sixth semester of study. For students using the accelerated coursework requirement, the Candidacy Exam should be completed before the start of the fourth semester. After passing the exam, students are encouraged to pursue Admission to Candidacy with the Office of Graduate Studies. A student who fails the Candidacy Examination twice will be eligible for the M.S. degree but not the Ph.D.

Prior to taking the Candidacy Examination, the student must choose a PhD advisor and research area. The Examination consists of two parts: (1) a public presentation (not to exceed 30 minutes) about the research area, including a summary of a relevant published paper, and (2) an oral examination (not to exceed two hours) by members of the student's Examining Committee.

The student should take the following steps to organize a Candidacy Examination and is advised to allow ample time for the process.

1. Contact four faculty members to act as an Examining Committee. The thesis advisor must be the Chair of the committee. The choices of committee members should be discussed with the thesis advisor.
2. Complete and submit the Candidacy Exam Proposal at least eight weeks before the requested examination date (or two weeks before a second attempt). The proposal must include:
 - a) Date of the exam.
 - b) A list of up to ten specific topics relevant to the student's research area, to be used as a guide to the oral examination. Typically these will be topics chosen from the catalog descriptions or syllabi of the courses taken by the student.
 - c) Full reference (author, title, publication data) of the research paper that will be presented by the student.
 - d) Names and signatures of the thesis advisor and all other members of the Examining Committee.
3. Receive approval or a request for revisions from the Graduate Studies Committee. Only after the Graduate Studies Committee has approved the proposal may the exam take place. The scheduling and composition of the Examination will be announced to the faculty.

Once the Examination has taken place, each member of the Examining Committee shall report the results, including a recommendation of Pass or Fail with written justification, to the Director of Graduate Studies within two business days.

A decision on the outcome of the Examination is the responsibility of the Graduate Studies Committee. Following a failed attempt at the exam, a student is permitted a second attempt. The same procedures should be followed. The research advisor, research area, Examining Committee, and published paper for presentation should all be identical to those for the first attempt; changes will be made only after petition to and at the discretion of the Graduate Studies Committee.

3.2.4. Dissertation

Students must select a dissertation advisor before completing the Candidacy Examination. The dissertation advisor will guide the preparation for the examination, including selection of the examining committee. Notify the Graduate Studies assistant when you have selected a dissertation advisor, or to change your selection at any time prior to filing the Recommendation to Candidacy form.

The dissertation is expected to reflect the results of original, significant research written in a literate and scholarly manner worthy of publication. The student must defend his or her dissertation before a Dissertation Committee consisting of the student's dissertation adviser and no less than three and no more than five additional members. One member of the Dissertation Committee must be from a different academic unit, or from outside of the University of Delaware. This committee must be designated, with members' signatures, on the Recommendation to Candidacy form. The form must be filed again if the student wishes to change the Dissertation Committee.

The student is responsible for following the Graduate Office deadlines and procedures relating to the dissertation, defense, and application for the degree. The time, date, and place of the oral defense will be announced to the faculty, and the defense will be open to the academic community.

3.2.5. Timetable and satisfactory progress

All students are subject to the regulations of the Office of Graduate and Professional Education. The OGPE sets specific policies regarding probationary status and satisfactory progress. In particular, a student must maintain a cumulative GPA of 3.0 or better or risk dismissal. A student must have a cumulative GPA of 3.0 or better in order to receive a graduate degree.

In addition to the Graduate Office regulations, the following regulations are specific to the Department of Mathematical Sciences. Except where noted otherwise, students seeking a waiver of any these regulations must petition the Graduate Studies Committee.

1. Students receiving financial support through Graduate Assistantships (GA), Research Assistantships (RA), Teaching Assistantships (TA), or departmental or university fellowships must observe the following course registration conditions each semester until reaching sustaining (candidacy) status:
 - a) A minimum of nine credits of graded coursework (not as “listener”) is required.
 - b) No more than nine credits of graded coursework may be taken without the permission of the Graduate Director. Students are permitted to register as “listener” for up to three credits beyond the nine graded credits.
2. Students receiving financial support through Graduate Assistantships (GA), Research Assistantships (RA), Teaching Assistantships (TA), and departmental or university fellowships may not be enrolled in any other degree program, at the University of Delaware or elsewhere, while receiving such support.
3. Students receiving support through Graduate Assistantships or Teaching Assistantships must perform all required duties satisfactorily, as determined by the Associate Chair of the department or his/her designee.

In addition to the regulations above, a timeline for satisfactory progress toward the Ph.D. is as follows.

Standard coursework option:

1. Pass the Preliminary Examination (both subjects) and file a Change of Classification form before the beginning of the fourth semester of study.
2. Complete the coursework requirements of the M.S. degree by the end of the fourth semester of study. The M.S. degree will be awarded at this time.
3. Select a dissertation advisor and Dissertation Committee, file a plan for the Candidacy Examination, and successfully complete the Candidacy Examination before the start of the sixth semester of study.
4. Submit the Recommendation to Candidacy form and complete 9 credits of MATH 969.

5. Once you have completed MATH 969, you are released from minimum course enrollment requirements. Instead, you will be enrolled in Doctoral Sustaining (UNIV 999). A student must be registered in the semester in which the degree is awarded.

New version

Standard coursework option:

1. Pass the first tier of the Preliminary Requirement before the beginning of the third semester of study.
2. Pass the second tier of the Preliminary Requirement and file a Change of Classification form before the beginning of the fourth semester of study.
3. [continues as it was]

Accelerated coursework option:

1. Pass the Preliminary Examination (both subjects) and file a Change of Classification form at the start of the first semester of study.
2. Complete the coursework requirements of the M.S. degree by the end of the second semester of study. The M.S. degree will be awarded at this time.
3. Select a dissertation advisor and Dissertation Committee, file a plan for the Candidacy Examination, and successfully complete the Candidacy Examination before the start of the fourth semester of study.
4. Submit the Recommendation to Candidacy form and complete 9 credits of MATH 969.
5. Once you have completed MATH 969, you are released from minimum course enrollment requirements. Instead, you will be enrolled in Doctoral Sustaining (UNIV 999). A student must be registered in the semester in which the degree is awarded.

New version

Accelerated coursework option:

1. Pass the first tier of the Preliminary Requirement before the start of the first semester of study.
2. Pass the second tier of the Preliminary Requirement before the start of the third semester of study.
3. [continues as it was]

[NOTE, not to be included in text. Item #2 in the old version was an oversight. The accelerated requirement only affects the PhD programs and is prepared for students with a MS degree when accepted to the program.]

All students are reviewed for satisfactory progress by the Graduate Director after each semester. A student who, in the determination of the Graduate Director, is not making satisfactory progress may receive a suspension or termination of financial support, suspension of registration status, or dismissal from the program. Students may appeal the Director’s decision to the rest of the Graduate Committee and then to the Chair of the department.

4. Assessment

All graduate programs in the Department of Mathematical Sciences are designed to take high-quality students, with a strong background in mathematics, and transform them into full-fledged practitioners of the discipline of mathematics. For students seeking the M.S. we seek to broaden and deepen their knowledge of mathematics and properly train them for a mathematics related career. For students seeking the Ph.D. we again seek to broaden and deepen their knowledge of mathematics and also to train them as practitioners so that they may impact the discipline in a deep and meaningful way.

4.1. Learning objectives

Our program focuses on five key learning objectives, or outcomes. These are:

- Graduates should be able to conduct original, quality research in particular area of specialization.
- Graduates should be able to synthesize and critically analyze important issues in their field and understand and appreciate how their work fits into the larger body of science.
- Graduates should be able to communicate mathematical proofs, ideas, and concepts orally.
- Graduates should be able to communicate mathematical proofs, ideas, and concepts in writing.
- Graduates should be able to demonstrate both breadth and depth of mathematical knowledge.

4.2. Assessment Plan

In order to ensure that our graduate programs are meeting the objectives stated above, our learning outcomes are continually monitored. Changes resulting from this assessment are implemented periodically. For each of the five learning objectives, we rely upon a variety of direct and indirect measurement tools. A sample is listed below for each objective.

Objective	Information sources	Measuring instruments
Are graduates conducting original, high quality research within their field of specialization?	Student thesis or dissertation, student publications, and conference presentations.	Rubrics that quantify student research work for a thesis, dissertation, or conference presentation. Results are used to compare and contrast student work.
Are students able to synthesize and critically analyze important issues in their field and understand and appreciate how	Student theses, oral candidacy examinations, and oral theses defenses.	Rubric used by faculty serving on thesis committees.

their work fits into the larger body of science?		
Are students able to communicate mathematical proofs, ideas, and concepts orally?	Student evaluations of their performance as teaching assistants, oral candidacy examinations, oral theses defenses, talks in the Graduate Student Seminar, and talks at conferences.	Rubrics for oral communication used by faculty for student presentations and a teaching observation form.
Are students able to communicate mathematical proofs, ideas, and concepts in writing?	Preliminary examinations, publications by students and a written thesis.	Common rubric for evaluating student writing.
Are students able to demonstrate both breadth and depth of mathematical knowledge?	Results of preliminary examinations, results of oral candidacy examinations, and theses defenses.	Rubric to evaluate preliminary examinations, candidacy examinations, and faculty feedback on these examinations.

5. Financial Aid

Financial aid for study in the department takes several forms, including Research Assistantships, Departmental and University Fellowships, Teaching Assistantships, Graduate Assistantships, and Tuition Scholarships. These forms of financial aid are awarded by the department on a yearly basis. Continuation of financial support is not automatic; it is dependent upon maintaining satisfactory progress, as defined in Section 3.2.5. All students receiving support of any kind may be required to perform assigned supplemental tasks, such as proctoring of examinations.

All students on departmental or university funding (that is, exclusive of Research Assistantships, external fellowships, and non-departmental Teaching Assistantships) receive the same stipend for fall and spring semesters, at an amount set by the Graduate Director not less than the university's minimum.

The department encourages students to compete for nationally advertised graduate fellowships. Information on what fellowships are currently available can be obtained from the Graduate Studies assistant. It is expected that all graduate students prepare themselves for classroom teaching. All new students are required to participate in the university's TA Conference and in the department's TA training program, both of which take place in the week before the start of fall classes. In addition, new teaching assistants are required to attend teaching workshops and other training sessions when scheduled by the department.

For foreign students, preparation for classroom duties includes mandatory participation in the English Language Institute (ELI) training in the month before the fall or spring term, as appropriate. ELI must certify that a foreign student has a sufficient command of English and teaching basics (Category II based

on SPEAK and UDIA scores) before the Department can make a classroom assignment. It is departmental policy that no foreign student be supported more than two semesters without being certified for classroom assignments by ELI.

5.1. Support for student travel

The department encourages graduate students to attend national meetings and workshops and supports this by providing funding for student travel. Students should note that additional funds are often available from the Office of Graduate & Professional Studies, their dissertation advisers, and other travel fellowship opportunities.

Students who have met the Preliminary Examination requirement (Section 3) and who receive financial aid are eligible for \$500 of travel support. Those who have moved into sustaining student status are eligible for an additional \$500. It is not necessary to use the first travel award amount before becoming eligible for the additional amount.

Guidelines for use of these funds are as follows:

1. The student must have completed the relevant examination requirement(s) before applying for the use of travel funds.
2. The student must be registered as a full-time student in good standing in the department's graduate program for at least the two consecutive semesters before the time period in which travel is to occur.
3. The student's stipend must be paid by departmental or university sources at the time of application for the use of travel funds.
4. Travel must be fully completed before the completion of the terminal degree to be granted by the department.
5. The student must use the travel money to pay the costs associated with attending scientific meetings or other educational or academic events.
6. The student must fill out a travel approval form obtained from the Graduate Studies secretary. The form must be completed and approved before travel commences. In no case will students be reimbursed for travel without prior approval of this form.
7. The Director of Graduate Studies makes the decision to approve every travel request.

The Office of Graduate & Professional Education offers matching travel funds that students are advised to apply for. Students may be eligible to receive additional funds from the department to visit their undergraduate school (in North America) to help recruit new graduate students, or for extraordinary additional opportunities. Requests for these funds should be made to the Graduate Director.

5.2. Summer support

Graduate student contracts for teaching assistantships and fellowships are for fall and spring semesters. (Research assistantships and external fellowships may be negotiated differently.) There are typically opportunities for summer teaching and research contracts. In addition the department offers summer support as follows:

1. Continuing students with financial support who have completed the first year of full-time study in the department's graduate program are eligible for summer support at the rate specified in their offer letter. These funds are not available to 4+1 B.S./M.S. students. Students are expected to be in residence during a six-week period (typically, the first summer session) and meet any other

expectations set by the Graduate Studies Committee. Students may request to have this summer stipend postponed until the second summer.

2. Students who have met the Candidacy Examination requirement (Section 4) are eligible for an additional six weeks of summer support at the current rate determined by the department.
3. Students receiving either type of stipend may not teach, receive funding for research, or be otherwise employed during the time period for which they are receiving the stipend.

6. Teaching for the department

Two semesters of in-classroom teaching, including both teaching assistant (TA) and instructor assignments, are a requirement for the Ph.D. The department teaches a substantial fraction of all undergraduate students on campus each year and expects a high level of performance from all who contribute. Keep in mind that satisfactory progress towards your degree includes acceptable performance of all required duties.

All teaching is assigned and overseen by the Associate Chair of the department, who maintains a detailed description of duties and expectations for TAs. Contact the Associate Chair if you have not received a copy of those guidelines. Course instructors and coordinators also play important roles in TA oversight.

Some courses, including many of those that use TAs, are taught in a lecture/discussion format. The TA duties in such a course often include running one or more discussion sessions each week for relatively small numbers of students. Other TA duties might include grading homework, holding office hours, proctoring and grading exams, answering email questions, and more. **It is the TA's responsibility to determine and follow the instructor's specific expectations for each section assigned.**

Plan to be on campus during the entire semester for your teaching assignment, except for official breaks in the academic calendar. Absences during the semester must have authorization from the Associate Chair *in advance*. **Never schedule a long departure from Newark before the last day of the final exam period.** You must attend all the classroom meetings and office hours that you are required to conduct. Notify the department staff as soon as possible if you must miss a section meeting or office hours due to illness or emergency.

Your contract states that you may be required to perform up to 20 hours of work per week as a TA. In addition to the activities listed above, you will need to budget time for preparation and for thoughtful development of your teaching. You may also be required to proctor exams in other courses by the Associate Chair. If you are consistently devoting more than 20 hours per week to your TA duties, first speak with your supervising instructor(s) or course coordinators, and then speak with the Associate Chair if the situation still cannot be resolved.

Students who perform TA duties well may get opportunities to teach as instructor of record during Winter or Summer sessions. These assignments are made by the Associate Chair. If you are instructor for a section that has fewer than ten students after the first meeting, notify the Associate Chair immediately.

In addition to offering extra income, instructor assignments should be seen as critical professional development opportunities. You may need to show a proven track record of development in your teaching

to obtain an academic job. Consider requesting a classroom observation from faculty or the campus' teaching effectiveness center.

7. Miscellaneous information

Contact information. Please be sure that your phone number and local address, and an emergency contact phone number, are on file with the university or Graduate Studies secretary. Keep this information up to date at all times.

Class supplies. TA classroom supplies (as opposed to personal supplies) may be secured from the workroom supply cabinet. These supplies are for the classes you are *teaching*, not the classes you are *taking*.

Computer accounts. As students you are automatically given a university email account (udel.edu address). For instructions on activating the account, see www.udel.edu/help. You will also get a departmental network account and email address (math.udel.edu address). See the computing staff in Ewing to sign up for your account, and to ask questions about other available computing resources for specialized research needs. *It is important that you check both the udel.edu and the math.udel.edu accounts for communications about university and departmental business.* One recommended method is to have one of the accounts automatically forward all incoming email to your preferred account. Use your computer account responsibly and for work-related tasks only, or your computer account may be limited or revoked.

Typing of tests. Department staff do *not* type or typeset exams or any other materials for students.

Keys. The keys issued to you will be for your office in Ewing Hall and outside entrances to Ewing Hall. Your office key opens Ewing public areas: work room, computer terminal room, and the conference room.

Pay. You are paid twice monthly, on the 15th and the last day of the month. In order to receive your first check, you will need to fill out a W--4 form and an I--9 form for tax purposes. Foreign students who receive temporary Social Security Numbers will need to fill out a second W--4 form when they receive their permanent Social Security Numbers. These students must also change their UD ID cards. All graduate students must use direct deposit, which requires filing a form that you can obtain from the staff. Your pay stub can be viewed online. Your stipend is automatically paid continuously through all nine months of the academic year, including the period between fall and spring semesters. If you are paid through an additional winter session contract, the amount will be added to your other stipend over the winter session period. Summer session payment is handled through separate contracts for additional work duties. Notify the Associate Chair if you are interested in teaching in winter or summer sessions.

Telephone. Any calls from your office phone that incur charges (long distance or international) must be paid for by the caller.

Textbooks. Desk copies may be obtained in the main office for courses in which you are a teaching assistant or instructor. These books must be returned to the department immediately after the course is over.

Copying. Photocopying is available at no charge *only* for work in any course in which you are a teaching assistant or instructor. Students must reimburse the department for the cost of any photocopying for personal or research use. The photocopy machines should not be used for large copy jobs. Please see the office staff for any copy job exceeding 150 total pages.