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. For more information, call the Faculty Senate Office at 831-2921.

Submitted by: ____John A. Pelesko_____phone number___x 1467____

Department: ___Mathematical Sciences_____email address_pelesko@math.udel.edu_

Action: Revise M.S. Degree in Applied Mathematics
(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_____10F_____
(use format 04F, 05W)

Current degree_____M.S. Applied Mathematics_____
(Example: BA, BACH, BACJ, HBA, EDD, MA, MBA, etc.)

Proposed change leads to the degree of: _____M.S. Applied Mathematics_____
(Example: BA, BACH, BACJ, HBA, EDD, MA, MBA, etc.)

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

Revising or Deleting:

Undergraduate major / Concentration:_____N/A_____
(Example: Applied Music – Instrumental degree BMAS)

Undergraduate minor:_____N/A_____
(Example: African Studies, Business Administration, English, Leadership, etc.)

Graduate Program Policy statement change:____Yes, attached_____
(**Must attach** your Graduate Program Policy Statement)

Graduate Program of Study:____M.S. App;ied Mathematics_____
(Example: Animal Science: MS Animal Science: PHD Economics: MA Economics: PHD)

Graduate minor / concentration:____N/A_____

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

The changed document is attached. The old text is struck out and the new text is in blue or red. The final form of the new document is also attached.

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")

None. Please note however, that the content of several of our existing courses is being revised and reorganized as part of this proposal. This is explained in an attached document.

Explain, when appropriate, how this new/revised curriculum supports the 10 goals of undergraduate education: http://www.ugs.udel.edu/gened/

N/A

Identify other units affected by the proposed changes:
(Attach permission from the affected units. If no other unit is affected, enter "None")

None

Describe the rationale for the proposed program change(s):
(Explain your reasons for creating, revising, or deleting the curriculum or program.)

See attached.

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 attached.

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

Department Chairperson _____ _Velo_ _UU_____ Date_ _10/30/05_ _____

Dean of College_____ Date_____

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_____

Provost _____ Date_____

Board of Trustee Notification_____ Date_____

Revised 10/23/2007 /khs

This document summarizes the changes proposed for our graduate program. We also address the question of the rationale for changes and note implications for courses. While no new courses are part of this proposal, course revision has taken place. Please also note that our Program Policy Statement has been extensively revised for readability and to bring it in line with the template provided by the Graduate Studies Office.   Our policy statement now also includes an assessment plan; this plan is being filed with the university's assessment office.

Rationale for the proposed program changes

Our proposed changes are the outcome of a year-long series of discussions with our faculty organized by our Graduate Studies Committee. As a result of these discussions, our faculty decided to revise our program so that first, it was more flexible, and second, so that it was more in line with the current research strengths of our department. By offering a more flexible program, we aim to recruit higher quality students, retain our best students, and reduce the time to degree by introducing students to research opportunities early in their career. Bringing the program in line with the research strengths of our department is a natural outcome of the fact that our faculty is continually evolving.

The heart of the proposal is a change in the course requirements for the degree. Our current program requires a set of core courses that all students must take. The new program keeps the credit requirement but removes the core requirement. A smaller, de-facto core is now required only through the existence of preliminary examinations based on a small set of courses. In tandem with the program changes outlined here, our courses have also undergone revision. While no new courses are part of this plan, the material in current courses has been updated and reorganized to better align with the goals of this revision. These changes are detailed below.

Summary of academic changes

1. The requirement that students must complete Math 600, 602, 611, 616, 672, and either Math 617 or 650 has been deleted. Students must still complete the same number of credit hours. For a student seeking a Ph.D., the preliminary exam is still required. A student must take the preliminary examination based on Math 600 and Math 602. They must take a second preliminary exam based on either Math 672 or Math 614. Note that Math 614 is a revised course.
2. The required number of semesters of teaching for the Ph.D. degree has been reduced from four to two. This allows our program to better accommodate students with fellowships.
3. One possible choice of topics for our candidacy examination has been changed from "Numerical and Functional Analysis" to "Numerical Analysis." Courses on which topics for the candidacy exam are based have been updated to reflect changes to our courses.

Course implications

As noted above, revision of our courses is part of this plan. In short, while the total number of courses remains the same and no new courses are created, the content of our courses has been reorganized and revised. This reorganization creates five basic course sequences that are aligned with research interests of our department. These sequences are in analysis, applied mathematics, computational mathematics, probability, and discrete mathematics. The table below details these changes in each sequence.

Current Course Sequence	Revised Course Sequence
Analysis – Math 600, 602, 806, 836	This sequence was recently revised. The only change at this time is to the title of Math 836 to better reflect content.
Applied Mathematics – Math 616, 617, 835, 810	This sequence remains largely unchanged. Some material from Math 616 is being moved to Math 810. Math 835 is being renamed to better reflect course content.
Computational Mathematics – Math 611, 612, 694, 838	This sequence will now become Math 613, 614, 813, 814. The material from Math 611, 612, and 694 has been reorganized in the new sequence. Math 838 is moving from a special topics course in computational mathematics to Math 814, a regular course in computational mathematics.
Probability – Math 630, 631, 850	This sequence remains largely unchanged. Course descriptions have been revised to better reflect current content.
Discrete Mathematics – Math 688, 689, 650, 845	This sequence will now become Math 688, 650, 888, 846. Material in these courses is slightly reorganized. Math 689 will become Math 888 to reflect the higher level of mathematics in this course.

Table 1 - Side-by-side course catalog comparison

Current Course Catalog Description	Proposed Course Catalog Description
Mathematical Sciences Telephone: (302) 831-2346 http://www.math.udel.edu Faculty Listing: http://www.math.udel.edu/people/ **Program Overview** The Department of Mathematical Sciences offers programs of study leading to the degrees of Master of Science and Doctor of Philosophy in Applied Mathematics or Mathematics. Most of the major areas of mathematics are included among the research interests of the faculty of the department, but the areas most heavily represented are applied mathematics, partial differential equations, integral equations, inverse problems, discrete mathematics, topology, and probability. Each of the graduate programs in the department is relatively small allowing for close contact between graduate students and faculty. Individual attention is common. There are several active seminars on research topics and there is steady additional stimulus from professional visits by scientists from the U.S. and abroad. **Requirements for 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 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	**Mathematical Sciences** Telephone: (302) 831-2346 http://www.math.udel.edu Faculty Listing: http://www.math.udel.edu/people/ **Program Overview** The Department of Mathematical Sciences offers programs of study leading to the degrees of Master of Science and Doctor of Philosophy in Applied Mathematics or Mathematics. Many of the major areas of mathematics are included among the research interests of the faculty of the department. There are numerous active seminars on these and other mathematical topics, as well as a steady stream of visiting scientists from all over the world. The department is committed to providing individualized attention and guidance to every student in the program. **Requirements for 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 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 Aptitude Test.

completed an advanced degree must have done so with a GPA of at least 3.0. In addition, applicants must take the GRE Aptitude Test.

Financial Aid

Students holding assistantships are expected to perform satisfactorily in their assigned duties and to make good progress in their academic work. Renewal of financial aid is not automatic. Due to the size of our program, we can only offer financial aid for up to 10 semesters for students entering with a Bachelor's degree; those entering with a Master's degree for up to 8 semesters. The department, however, will make every attempt to provide some form of funding for qualified students. First year teaching assistants are required to attend teaching workshops scheduled by the department.

For continued support beyond the 3rd year, a student entering with a Master's degree must pass the Candidacy Exam by the beginning of his/her 4th semester in order to be offered continued support beyond the 2nd year. For a student who does not pass the Candidacy Examination on the first try, there is no guarantee for support for the following academic year. However, a student may make a second and final attempt to pass the Candidacy Examination, and if the attempt is successful, the department will make every effort to secure funding for such a student.

Requirements for the Master's Degree

Master's degree students must complete 30 hours of course work beyond the Bachelor's degree. Students must maintain a GPA of 3.0 or better.

Core requirements (18 credit hours): MATH 600, MATH 602, MATH 611, MATH 616, MATH 672, and either MATH 617 or MATH 650.

Financial Aid

Students holding assistantships are expected to perform satisfactorily in their assigned duties and to make good progress in their academic work. Renewal of financial aid is not automatic. Due to the size of our program, we can only offer financial aid for up to 10 semesters for students entering with a Bachelor's degree; those entering with a Master's degree for up to 8 semesters. The department, however, will make every attempt to provide some form of funding for qualified students. First year teaching assistants are required to attend teaching workshops scheduled by the department.

For continued support beyond the 3rd year, a student entering with a Master's degree must pass the Candidacy Exam by the beginning of his/her 4th semester in order to be offered continued support beyond the 2nd year. For a student who does not pass the Candidacy Examination on the first try, there is no guarantee for support for the following academic year. However, a student may make a second and final attempt to pass the Candidacy Examination, and if the attempt is successful, the department will make every effort to secure funding for such a student.

Requirements for the Master's Degree

To be eligible for the degree an M.S. candidate must complete 30 hours of course work beyond the Bachelor's degree. Students must maintain a GPA of 3.0 or better. These thirty hours of course work must be at or above the 600 level excluding Math 607. Students may take 3 credit hours worth of coursework outside of the department. Any additional course work taken for credit outside of the department requires approval of the Graduate Studies Committee.

Of the 30 credit hours required for an MS, at most 3 credits can be from a reading course unless an exception is granted by the Graduate

Complete an additional 12 hours of course work at or above the 600 level.

The **thesis option** consists of 24 credit hours of course work plus 3 credit hours of research via Math 868 and 3 credit hours of thesis via Math 869 leading to a Master's Thesis. 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; it is not required that a member of the committee be from outside mathematics. After the topic(s) and the project format have been determined, the student will have a maximum of one year to complete the written thesis (typically 50 to 60 pages). An oral defense will be scheduled following the Advisory Committee's evaluation of the thesis.

Requirements For The PhD Degree

Students with no prior graduate course work must complete 48 credit hours of courses, plus an additional 9 credits of MATH 969 (Doctoral Dissertation). A maximum of 6 credit hours of research (MATH 868) is allowed to count as an elective in the 48 credit hour requirement. Of the 48 hours, a maximum of 27 credit hours of 600-level courses in the mathematics department is allowed. All electives must be approved by the graduate committee. After completing their course requirements, students are expected to enroll for at least one course each semester (which may be as a listener) in addition to MATH 964 or MATH 969. A GPA of 3.0 or better must be maintained.
1. All Applied Mathematics and Mathematics students must complete the requirements for MS and pass the **Preliminary Examination** based on MATH 600, MATH 602, (Advanced

Studies Committee.

The thesis option for the M.S. degree consists of 24 credit hours of course work plus 3 credit hours of research via Math 868 and 3 credit hours of thesis via Math 869, leading to a Master's Thesis. 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; it is not required that a member of the committee be from outside mathematics. 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). An oral defense will be scheduled following the Thesis Committee's evaluation of the thesis.

Requirements For The PhD Degree

Students with no prior graduate course work must complete 48 credit hours of courses including:

– At least 27 credits of MATH courses at the 600 level or above, excluding MATH 607.

– A maximum of 27 credits of MATH courses at the 600 level.

– A maximum of 6 credits of MATH 868 (Research).

– 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.

Calculus) and MATH 672 (Linear Algebra) or MATH 611 (Numerical Linear Algebra). Students entering with Bachelor's degrees are required to pass the Preliminary Examination by the beginning of their 4th semester (by the beginning of their 2nd semester for students entering with Master's degrees). Students who do not meet this requirement are recommended for dismissal.

2. Complete 48 hours of scheduled courses at the 6xx or higher level, of which a maximum of 27 credit hours may be 6xx level courses in the Mathematics Department.
3. Pass the oral Candidacy Examination by a committee of at least 3 faculty members.
4. Doctoral Dissertation (9 credits): MATH 969.

Candidacy Exam: A student entering with a Bachelor's degree must pass the oral Candidacy Exam by the beginning of his/her 6th semester of study (by the 4th semester of study for those entering with a Master's degree). A second and final attempt is permitted. Dismissal will be recommended for a student who does not pass the Candidacy Exam on the second try.

In this examination a student must choose 2 topics from Algebra, Analysis, Applied Mathematics, Discrete Mathematics, Probability, and Numerical and Functional Analysis. The exams are based on MATH 650 and MATH 845 (Algebra), MATH 616, MATH 617 and MATH 810/MATH 835 (Applied Mathematics), MATH 688 and MATH 689 (Discrete Mathematics), MATH 611, MATH 612 and MATH 806 (Numerical and Functional Analysis), MATH 806 and MATH 836 (Functional Analysis and PDE) and MATH 630, MATH 631 and MATH 850 (Probability). Another subject area may be substituted for one of the above by petition to the graduate committee based on two graduate level courses and supported by a faculty member.

Dissertation: A student must successfully defend his/her dissertation

Candidates for the Ph.D. degree must also:

• Maintain a GPA of 3.0 or better.

• All Applied Mathematics and Mathematics students must complete the requirements for MS and pass the **Preliminary Examination** based on MATH 600, MATH 602, (Advanced Calculus) and MATH 672 (Linear Algebra) or MATH 614 (Numerical Linear Algebra). Students entering with Bachelor's degrees are required to pass the Preliminary Examination by the beginning of their 4th semester. Students entering with a Master's degree must complete this requirement by the end of the second semester of study. Students who do not meet this requirement are recommended for dismissal.

• Pass the oral Candidacy Examination.

• Select a Dissertation Committee, subject to the approval of the Graduate Committee.

• Complete two semesters of experience in teaching undergraduate students, or obtain a waiver from the Graduate Committee.

• Complete 9 credits of MATH 969 (Doctoral Dissertation) after admission to candidacy.

• Complete and successfully defend a dissertation.

Candidacy Exam: A student entering with a Bachelor's degree must pass the oral Candidacy Exam by the beginning of their sixth semester of study. Students entering with a Master's degree must pass the Candidacy Examination by the beginning of their fourth semester of study. A second and final attempt is permitted. Dismissal will be recommended for a student who does not pass the Candidacy Exam on the second try.

in front of a committee consisting of the dissertation advisor and no less than three additional members, one of whom must be from outside the department. The dissertation must contain original publishable results.	In this examination a student must choose 2 topics from Algebra, Analysis, Applied Mathematics, Discrete Mathematics, Probability, and Numerical Analysis. The exams are based on MATH 650 and MATH 8456 (Algebra), MATH 616, MATH 617 and MATH 810/MATH 835 (Applied Mathematics), MATH 688 and MATH 888 (Discrete Mathematics), MATH 613, MATH 614 and MATH 813/814 (Numerical Analysis), MATH 806 and MATH 836 (Functional Analysis and PDE) and MATH 630, MATH 631 and MATH 850 (Probability). Another subject area may be substituted for one of the above by petition to the graduate committee based on two graduate level courses and supported by a faculty member. **Dissertation:** A student must successfully defend his/her dissertation in front of a committee consisting of the dissertation advisor and no less than three additional members, one of whom must be from outside the department. The dissertation must contain original publishable results.