

Graduate Programs in the Department of Mathematical Sciences

Draft version of October 28, 2008.

Changes to academic requirements and courses are in red.

Changes in blue are non-academic and for bringing this policy statement
more in line with University recommended form for policy statements.

October 28, 2008

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1 The Academic Program

1.1 History

The Department of Mathematics is said to have its origins in the 1830s. The initial graduate degrees offered were at the Master's level. The PhD program in the Department of Mathematics was created in 1965; the first Ph.D. was awarded in 1969. The name and focus of the department evolved to the Department of Mathematical Sciences. Currently, the Department offers MS and PhD degrees in Mathematics and in Applied Mathematics.

The first chaired professorship in Mathematical Sciences Department was established in 1975. The Department currently has five chaired professors and this number is expected to grow.

Graduates from our program hold or have held positions in academia in the US, Canada, Turkey, the United Kingdom, Germany, and many other countries. Our graduates have also landed positions in industry, commerce and government which includes positions at DuPont, Merck, National Security Agency, Fred Hutchinson Cancer Research Center, Schonfeld Securities LLC and many others.

1.2 Introduction

The Department of Mathematical Sciences offers programs of study leading to [Master of Science \(MS\)](#) and [Doctor of Philosophy \(PhD\)](#) degrees in [Applied Mathematics](#) and [in Mathematics](#). Requirements for the degrees in the various programs are spelled out in detail in the [Program Descriptions](#) chapter of this document. Our program is sufficiently small that we will be able to give individualized attention to your graduate studies.

Many 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](#), [inverse problems](#), [partial differential equations](#), [integral equations](#), [numerical analysis](#), [complex function theory](#), [probability](#), [discrete mathematics](#), and [topology](#).

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 of interest to the Department and there is steady additional stimulus from professional visits by scientists from the U.S. and abroad.

1.3 Getting Started

The authority for administering the program rests with the ~~Committee on~~ Graduate Studies [Committee](#). The Director of Graduate Studies will serve as adviser to all students until such time as a supervisor for the thesis or dissertation is appointed. Director of Graduate Studies will help you formulate your plan of study through formal meetings with individual graduate students. These meetings occur twice yearly before the beginning of the preregistration period.

New students, as part of the usual orientation program, will meet with the Departmental Director of Graduate Studies to plan their first year of study in the program. It is recommended that incoming students with an MS take the Preliminary Exam prior to beginning courses. Success in this exam will allow students to place out of some introductory courses. Well prepared students with a BS may also take Preliminary Exam prior to beginning course work (sample exams will be mailed on request). Exams are usually given the week before classes begin. Check the website for details.

During advisement, help will be given concerning course selection based on student's interests, student's undergraduate background, and the results of the preliminary exam if you choose to take it. Each student will have a [progress sheet](#) on which the courses taken, grades, and progress toward the degree is noted. Before each semester, students must obtain their advisor's permission to register. Continuing students are required to enroll for courses during the preregistration period, and are required to meet with the Director of Graduate Studies. You should feel free to discuss with a faculty member any difficulties you are having. It is important that you get sound advice and correct information.

1.4 General Plan of Study

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, or need to, change your plan as your experience in the Department grows. Nevertheless, such tentative plans will serve to insure progress toward your degree.

Here are some things to keep in mind in drawing your plan.

- Students holding Graduate Assistantships (**GA**), Research Assistantships (**RA**), or Graduate Teaching Assistantships (**TA**) must register for 9 hours of course work.

- It is expected that the requirements for a Master’s degree be completed by the end of the fourth semester.
- A student must pass the Preliminary Exam by the beginning of the fourth semester in order to continue his/her studies beyond the Master’s degree (see chapter on Preliminary Examinations).

For a student to remain in the Graduate Program a minimum cumulative GPA of 3.0 (B) is required. Students who do not perform to this standard are subject to review and/or ~~dismissed~~ [dismissal](#) as determined by the Graduate Student Probation Policy.

Permission to continue study toward a Ph.D. degree is given on the basis of a complete review of your academic performance. The Graduate [Studies](#) Committee permits students to enter the Ph.D. program on the basis of (1) Prelim Exam score, (2) course grades, (3) instructor assessments.

By the time you are admitted to the Ph.D. program, it is desirable to have identified a general area in which you wish to work. The Department may waive course requirements and certify that hour requirements have been met after a review of your record.

Waiver of course requirements are made if either (i) you pass a Prelim Exam based on material covered by the course (details in §3.3 below); (ii) you earn at least a grade of “B” in a higher level course in the subject; or (iii) you discuss your course work with a designated staff member who will certify that you have mastered the course material. ~~The Committee on~~ Graduate Studies [Committee](#) will give final approval to course waivers.

Waiver of hour requirements will be made on the basis of transcripts and information supplied by you. You should make an appointment with a member of the Graduate [Studies](#) Committee as early as possible to insure that all the information the Committee will need is available. It is important that your course waivers be approved as early as possible so that you know what requirements you will have to satisfy for your degree.

2 Regulations Relative to the Master’s and Ph.D. Programs

1. In order to be graduated with a Master’s Degree in Mathematics, a student must satisfy the general academic requirements of the Office of Graduate Studies and must have a “B” or better average in all courses.
2. Under normal circumstances a student with a “C” or lower grade in 3 courses will be advised to leave the graduate program.

3. A student who has not passed the Candidacy Exam for the Ph.D. degree is not allowed to register for Ph.D. dissertation or noncontractual research.
4. Two semesters experience in the teaching of undergraduates is required of all candidates for a Master's Degree and four semesters of undergraduate teaching experience is required for Ph.D. candidates. This is a Departmental requirement, exceptions are rarely permitted.
5. The Graduate Office requires that those graduate students holding ~~Graduate Assistantships, Research Assistantships and Graduate Teaching Assistantships~~ [GAs, RAs and TAs](#) register for a *minimum* of 6 hours. It is the policy of the Department that all students register for 9 hours each semester. Under special circumstances, and when approved by the Graduate [Studies](#) Committee, 3 hours may be taken as a listener. The Graduate [Studies](#) Committee *strongly* discourages students in their first three years of study from registering as a listener. Students may carry more than the 9 credits which are covered by the tuition. A student wishing to carry 13 credits or more must first get permission from the Department Director of Graduate Studies and the Office of Graduate Studies.
6. Students who expect to continue beyond the Master's level toward a Ph.D. degree must file the request for permission to continue studies toward the Ph.D. no later than the second year of admission (Change of Classification Form).

3 Program Descriptions

3.1 [Introduction](#)

[\(The material that was in this subsection has been moved to the introduction and history sections in the beginning of this document and rewritten there.\)](#)

~~The Department of Mathematical Sciences offers programs of study leading to the degrees of Master of Science and Doctor of Philosophy in Applied Mathematics and Mathematics.~~

~~Many 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, inverse problems, partial differential equations, integral equations, numerical analysis, complex function theory, discrete mathematics, and topology.~~

~~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

~~Recent recipients of advanced degrees from the department are research topics and there is steady additional stimulus from professional visits by scientists from the U.S. and abroad. successfully employed in academic, government and industrial positions.~~

3.2 Admission Requirements

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. ~~The advanced test in mathematics is highly recommended.~~ **The applicant is required to take a GRE subject test; the advanced test in mathematics is not required but is highly recommended.** For foreign students the TOEFL exam is also required with a grade of 600 for the written exam or 250 for the electronic exam. Admission to the graduate program is selective and competitive based on the number of well-qualified applicants and the limits of available faculty and facilities. Those who meet stated minimum academic requirements are not guaranteed admission, nor are those who fail to meet those requirements necessarily precluded from admission if they offer other appropriate strengths.

3.3 Master's Degree Requirements for Mathematics and Applied Mathematics

To be eligible for the degree an MS candidate must complete 30 hours of course work beyond the Bachelor's degree. This is a non-thesis degree. Students must maintain a GPA of 3.0 or better.

- Students must pass M600, M602, and M611, M616, M672 with a **C grade of C or better**. Students may test out of M600, M602, ~~and~~ M672 ~~and M611~~ by taking the Preliminary Exam and replace these courses with electives. **Currently, the Preliminary Examinations in a particular subject are graded by two graders and each grader grades each examinees work as Unacceptable, Acceptable, or Outstanding. In order to test out of one of the above courses, the student's work in the**

corresponding Preliminary Examination must be graded Outstanding by at least one grader and Unacceptable by none of the graders.

- Complete one of the following: M617 or M650.
- Complete an additional 12 hours of course work at or above the 600 level. At most 3 credit hours may be taken outside the department with approval of the Graduate Studies Committee.
- ~~Pass M668 (1 credit) (graduate student seminar, 1st and 2nd Years). The seminar is in addition to the 30 hours of course work.~~
- 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 Studies Committee.
- Choose a course adviser before the end of the second semester.
- **Thesis Option:** 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 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.

Summary

The 30-hour course ~~and seminar~~ requirement for the MS in both Applied Mathematics and Mathematics is summarized below.

Core requirements	18	credit hours
Additional MS requirements	12	credit hours
Seminars-colloquia	4	credit hours

The 30-hour course requirement for the MS with the Thesis Option in both Applied Mathematics and Mathematics is summarized below.

Core requirements	18	credit hours
Research (M868)	3	credit hours
Thesis (M869)	3	credit hours
Additional MS requirements	6	credit hours

3.4 Ph.D. Requirements

Students with no prior graduate course work must complete 48 credit hours of courses ~~and 4 credit hours of seminar requirement~~. In addition, a student must complete 9 credit hours of MATH 969 (Doctoral Dissertation). A maximum of 6 credit hours of research (MATH 868) is allowed to count towards the 48 credit hour requirement. A GPA of 3.0 or better must be maintained. Of the 48 hours, a maximum of 27 credit hours of 600-level courses in the mathematics department is allowed. ~~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.~~ Students entering with a Bachelor's degree must pass the Preliminary Exam in order to continue beyond their second year (beyond the first year for those entering with a Master's degree). An oral Candidacy Exam must be passed in order for a student to be admitted to the Ph.D. candidacy. ~~If a student completes his or her course requirements before admission to candidacy, the student is expected to enroll for MATH 964 according to the rules governing Degree Requirements for the Doctor of Philosophy in the University's Graduate Catalog. Once a student has been admitted to candidacy, he or she must take 9 credits of MATH 969 (Doctoral Thesis) and thereafter must maintain matriculation in the graduate program via MATH 999 (Doctoral Sustaining) according to the rules in the University's Graduate Catalog regarding the Degree Requirements for the Doctor of Philosophy.~~

Summary

The ~~64~~ 57 credit Ph.D. requirement is summarized below.

	APPLIED	MATH
Core requirements same as the MS degree	18 credit hours	18 credit hours
Additional PhD requirements	12 credit hours	12 credit hours
Electives	18 credit hours	18 credit hours
Seminars-Colloquia	4 credit hours	4 credit hours
Doctoral dissertation	9 credit hours	9 credit hours

Requirements for PhD:

- Complete the requirements for MS and pass the Preliminary Exam based on M600, M602 and M672 or M611.
- Complete 48 credit hours of scheduled courses at the 6xx or higher level, of which a maximum of 27 hours can be 6xx level courses in the Math Department. More than 6 credit hours outside the department requires Graduate [Studies](#) Committee approval.
- Pass the oral candidacy examination by a committee of at least 3 faculty members. The syllabus will be designed by the student in collaboration with his/her committee and subject to approval by the Graduate [Studies](#) Committee. The exam should contain material from at least one 8xx level course.
- Dissertation

3.5 Course Offerings

The following schedule of classes is to help plan a student's program of study.

Schedule of Courses

We [typically](#) ~~can only~~ offer 3 M8xx level courses per semester. Because of the areas of interest of the faculty members, the following schedule of courses is proposed.

Fall	Spring
M600 (Analysis I)	M602 (Analysis II)
M611 (Numerical Analysis I)	M612 (Numerical Analysis II)
M616 (Applied Math I)	M617 (Applied Math II)
M672 (Linear Algebra)	M650 (Algebra)
M689 (Combinatorics II)	M688 (Combinatorics I)
M630 (Probability)	M631 (Stochastic)
	M694 (Optimization)
M810 (Asymptotics)	M835 (PDEs)
M850: Probability (Topics)	M806 (Functional) M807 (Complex)
M845 (Groups) M827 (Topology)	(Topics) M838 (Numerical PDE)
M806 (Functional)	M810 (Asymptotics)
M835 (PDE I) M824 (Applied Topics)	M836 (PDE II) M838 (Numerical Topics)
M850 (Probability) M845 (Groups)	M827 (Topology) M826 (Pure Topics)

- The courses grouped together will be offered in alternate years. It is expected that the upper courses in those grouped together will run in academic years with the fall semester in an even-numbered year.
- The Graduate Studies Committee will invite proposals for these topics courses and will advise the chair Director of Graduate Studies which proposals to accept. The course(s) to be taught will be recommended to the Associate Chair.

3.5.1 Typical Course Choices During the PhD

Here we outline a typical choice of courses for students in the applied mathematics or mathematics PhD programs. The tables assume that the student starts in the fall of academic year one with an undergraduate degree in mathematics.

The actual sequence of courses taken by any given student is likely to differ from this sequence based on individual needs, interests and when the student enters the program.

Sample Courses of Study for PhD

A student interested in Applied Mathematics may choose

Year	Fall	Spring
1	M600, M616, M611/M672	M602, M617, M612/M694
2	M672/M611, M835/M630, M806	M810, M836/M631, M694/M612
3	M835/M630, Topics	M836/M631, Topics
4	Topics/Research	Topics/Research

If M806 is offered in the second year for Applied Mathematics, a student may take Functional Analysis in the fourth year after they have had M672. A student interested in Combinatorics may choose

Year	Fall	Spring
1	M600, M672, M616	M602, M650, M688
2	M689, M630, M845/M850	M827/Topics, M631, M694
3	M850/M845, Topics	M827/Topics, Research
4	Topics/Research	Topics/Research

A student interested in Analysis may take

Year	Fall	Spring
1	M600, M672, M616	M602, M810, M617
2	M806, M611/M630, M835/Topics	M836/M838, M694, Application
3	M611/M630, M835/Topics	M836/M838, M612/M631, Topics
4	Topics/ Research	Topics/Research

3.6 Examinations

(The preliminary and candidacy examinations are discussed in detail in §4 and 5.)

3.6.1 Preliminary Exams

(merged with section below.)

3.6.2 Candidacy Exams

(moved to another section below.)

3.7 Seminar Attendance

Students are expected from the beginning of their studies to attend the graduate student seminars, departmental colloquia and some of the regularly scheduled research seminars.

3.8 Dissertation

A student must successfully defend his/her dissertation in front of a committee consisting of the thesis adviser and no less than 3 additional members, one of whom must be from outside the department. The dissertation must contain original publishable results.

3.9 Sustaining Status

Once a student has completed all the course requirements, passed the Preliminary and the Candidacy Examinations, and registered for 9 credits of dissertation (MATH 969), the student is required to maintain his/her matriculation in the degree program by registering for Doctoral Sustaining (UNIV 999). A student must be registered in the semester in which the degree is awarded.

4 Preliminary Examinations

Those students who wish to continue work toward a Ph.D. degree must take a written examination called the Preliminary Examination. The Preliminary Examination contains two subject areas: ~~Advanced Calculus~~ [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 611. Note that material beyond that taught in MATH 600, 602 and 672 may be on the syllabus for the exams given below. ~~This Exam~~ The Preliminary Exam will be given twice each year, once before the start of the Fall Semester, and once before the start of the Spring Semester. For students entering with a Bachelor's degree, it is required that the Prelim Exam be passed by the beginning of the fourth semester of study. Providing it is before the beginning of the 4th semester, a student may take ~~this exam several times~~ [each part of this exam up to two times](#). Only the part not passed needs to be repeated. Students who failed to pass both subject areas of the Preliminary Exam by the beginning of the fourth semester will be asked to leave the graduate

program. Notification of the results of the Preliminary Exams will be sent to the Office of Graduate and Professional Studies.

The syllabus to be covered by each examination is included in the following subsections. Please obtain copies of past examinations and a more detailed the syllabus from the Graduate Program Secretary in 301 Ewing Hall. Note also that the references cited on the following pages are intended to indicate the material to be covered. It is not necessarily intended that the student study all the references.

4.1 Real and Complex Analysis

Topics covered on the exam include the following. Many of these topics have been discussed in Math 600 and Math 602, some of you students have had as an undergraduate and others you may not have seen. References are given for each topic.

1. Metric Spaces: open and closed sets, compactness, connected sets, complete sets, continuous functions on metric spaces ([1], Chapters 3 and 4).
2. Continuity and Differentiation: mean value theorem, Rolle's theorem, Taylor's formula, derivatives of vector valued functions, uniform continuity, monotonic functions, functions of bounded variation ([1], Chapters 5 and 6).
3. Integration: ~~The Riemann-Stieltjes integral, fundamental theorem of calculus, sufficient conditions for existence of Riemann-Stieltjes integral, differentiation under the integral sign, interchange of order of integration, mean value theorems ([1], Chapter 7).~~ Sets of measure zero. Lebesgue's criterion for the existence of Riemann integrals. The Lebesgue integral in R^1 . Convergence theorems. Measurable functions. Fubini's theorem. Measurable sets. The space $L^2(I)$. The Riesz-Fischer theorem. ([1], Chapter 10)
4. Infinite Sequences and Series: Limit superior and limit inferior, monotonic sequences, alternating series, absolute and conditional convergence, power series, tests for convergence of series, rearrangement of series ([1], Chapter 8).
5. Sequences of Functions: Pointwise convergence, uniform convergence, uniform convergence and continuity, differentiability and integration ([1], Chapter 9).

6. Functions of Several Variables: Directional derivatives, the total derivative, Jacobians, inverse function theorem, implicit function theorem, extrema problems ([1], Chapters 12 and 13).
7. Vector Calculus: Line integrals, Green's theorem, surface integrals, Stokes theorem, the divergence theorem ([2], Chapters 10, 11 and 12).
8. Analytic Function Theory: Analytic functions, Cauchy's theorem, Cauchy's integral theorem, the maximum principle, the identity theorem, Taylor and Laurent series, the residue theorem, elementary conformal mappings ([1], Chapter 16).

References:

1. Tom Apostol, *Mathematical Analysis*, 2nd edition, Addison Wesley, 1974.
2. Tom Apostol, *Calculus, Vol. 2*, 2nd edition, John Wiley, 1969.

4.2 Linear Algebra

Topics covered on the exam include the following. Most of these topics should have been discussed in Math 672, but some of them you may not have seen all of them. References are given for each topic.

1. Subspaces, bases and dimension (Chapters 1 - 2, [SA]).
2. Linear transformations and matrix representations (Chapter 2, [SA]; Chapters III - IV, [SL]).
3. Determinants and rank (Chapter VI, Section V.3, [SL]).
4. Inner products and inner product spaces (Chapter 6, [SA]).
5. Linear functionals, adjoints, and dual spaces (Chapter 6, [SA]).
6. Bilinear forms, Hermitian forms, and quadratic forms (Chapter V, [SL]; Sections IV.A - IV.C, [MLC]).
7. Eigenvalues, eigenvectors, and characteristic polynomials (Sections VIII.1 - VIII.2, [SL]).
8. Cayley-Hamilton Theorem (Sections X.1 - X.2, [SL]; Sections III.A - III.C, [MLC]).

9. Operators on inner product spaces and Spectral Theorems (Chapter 7, [SA]; Section VIII.3 - VIII.6, [SL]; Section III.D, [MLC]).
10. Jordan Canonical Form (Chapter XI, [SL]; Section III.E, [MLC]; Chapter 8, [SA]).

References:

- SA** Sheldon Axler, *Linear Algebra Done Right, Second Edition*, Springer-Verlag, 1997.
- MLC** Morton L. Curtis, *Abstract Linear Algebra*, Springer-Verlag, 1990.
- SL** Serge Lang, *Linear Algebra, Third Edition*, Springer-Verlag, 1987.

4.3 Numerical Linear Algebra

Direct and iterative methods for the solution of linear systems, LU factorization, row pivoting, stable QR factorization, solution of linear least squares problems by normal equations and QR, stability and conditioning issues, power and inverse iterations, QR iteration, singular value decomposition, simple iterations for sparse matrices, conjugate gradients and other Krylov subspace iterations.

Suggested References:

1. L.N. Trefethen and D. Bau, III, *Numerical Linear Algebra*, SIAM (see e.g., I, II, III).
2. J.W. Demmel, *Applied Numerical Linear Algebra*, SIAM (Sections 2.1-2.4, 3.1-3.3, 4.4, 6.5, 6.6.)
3. A. Quarteroni, R. Sacco and F. Saleri, *Numerical Mathematics*, Springer-Verlag (Sections 3.1, 3.3, 4.1-4.3, 5.2-5.5, 5.8.)

5 Candidacy Examination

This oral examination can take place at any time mutually agreed upon by the Examining Committee and student. Students entering with a Bachelor's degree must pass the Candidacy Exam by the beginning of their 6th semester of study (by the beginning of the 4th semester of study for those entering with a Master's degree). A second and final attempt is permitted following a failed attempt. Dismissal will be recommended for a student who does not pass the Candidacy Exam on the second try. [Students who fail the Candidacy Exam are eligible for the MS degree.](#)

The student should take the following steps to organize their oral examination and are advised to allow ample time for the process:

1. Contact four faculty to act as an Examining Committee. Since the student must be examined on two topics, normally two faculty will be expert in each area (one examiner should be the adviser if the student has already chosen an adviser).
2. After the faculty agree to serve as examiners the student should contact the Director of Graduate Studies at least six weeks in advance of the proposed examination date and supply the following information:
 - (a) Date of the exam.
 - (b) Names of the examiners making up the Examining Committee.
 - (c) Choice of topics.
3. Final approval of the Examining Committee and topics rests with the Graduate [Studies](#) Committee. Only after the Graduate [Studies](#) Committee has approved the Examining Committee and topics may the exam take place.

The scheduling, topics and composition of the Examining Committee will be announced to the faculty.

It is the responsibility of the examining committee to decide the duration of the exam (typically 2-3 hours). They should report the results of the exam and a recommendation of Pass or Fail with written justification to the Director of Graduate Studies within two days of the exam. A final decision on the outcome of the exam is the responsibility of the Graduate [Studies](#) Committee.

In this examination a student must choose 2 topics from the following table:

Topic	Graduate Courses Pertaining to this Topic
Algebra	MATH 650 and MATH 845
Analysis	MATH 805 and MATH 807
Applied Mathematics	MATH 616 , MATH 617 and MATH- 810/M835
Discrete Mathematics	MATH 688 and MATH 689
Numerical and Functional Analysis	MATH 611 , MATH 612 and MATH 806
Probability	MATH 630 , MATH 631 and MATH 850
Functional Analysis and PDE	M806 and M836

Another subject area may be substituted for one in the table above by petition to the Graduate [Studies](#) Committee based on two graduate level courses and [if it is](#) supported by a faculty member.

Should a candidate fail a part of the Candidacy Exam, the candidate need only retake the failed topic. In no case will a candidate be allowed to take the candidacy exam more than twice.

6 Financial Aid

This section was moved from subsection 1.4 and merged with the previous subsection 4.9 on financial aid. The label for subsection 6.1 was added.

6.1 Forms of Aid

Financial aid for study at Delaware takes several forms including Research Assistantships, or Departmental Fellowships, Teaching Assistantships and Tuition Scholarships. These forms of financial aid are awarded by the Department on a year-by-year basis. There is also a University Fellowship which is awarded by the University on a competitive basis. Continuation of support is dependent upon your academic progress and your performance of any duties assigned to you. All students receiving support of any kind are expected to discharge assigned tasks including certain jobs such as proctoring of departmental examinations and assisting with undergraduate registration (“drop-add”).

The Department encourages students to compete in nationally advertised graduate fellowships. Information on what [fellowships](#) are currently available can be obtained from the graduate studies secretary.

The stipend for Teaching and Research Assistants for the [2009-2010](#) academic year is determined by the following schedule. Check the Departmental websites for updates.

1. Initial appointments of first year graduate students [will be made at no lower than the University minimum level; this is level 1. \\$14,600.](#)
2. TA qualified second year graduate students or initial appointment of TA qualified graduate students who have passed the Preliminary Exam [will be paid at least \\$250 more than level 1; this is level 2. \\$14,850.](#)
3. Graduate students who have passed their Candidacy Exam [will be paid at least \\$250 more than level 2; this is level 3. \\$15,120.](#)

Students will remain at level 2 until the requirements for level 3 are met.

As most students are supported as Teaching Assistants, at least for some period of their studies, it is expected that all graduate students prepare themselves for classroom teaching. All new students are required to participate in the Department's orientation and TA training program which takes place in the days before the beginning of classes. The program includes both departmental and University presentations. In addition, new teaching assistants are required to attend teaching workshops scheduled by the department.

For foreign students, preparation for classroom duties includes work with the English Language Institute (ELI) both in the month preceding the Fall or Spring term as appropriate. Students also must attend departmental training sessions. ELI must certify that a foreign student has a sufficient command of English 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. Foreign students are expected to meet the following schedule with respect to test scores reported by ELI:

- (1) achieve a score of at least 600 on the TOEFL examination (or an equivalent score on another examination approved by ELI) before the beginning of the first semester of study;
- (2) attend the workshop for foreign Teaching Assistants given by ELI and CTE before the *beginning of the Fall or Spring term* of residence;
- (3) must meet the minimum requirements set forth by the University's policy for SPEAK and UDIA scores for ITA instructional assignments (level II).

6.2 Support for Student Travel

The department would like to encourage graduate students to attend national meetings to present papers and to help in job searches. Therefore the department will support student travel as follows:

1. Supported graduate students who pass both the preliminary and candidacy exams will be awarded an amount of travel money (at the current rate determined by the department) for use during the remainder of their studies at Delaware. This money can be spent on a combination of approved travel at the choice of the student.
2. The student can apply to use this [travel](#) money to pay the costs of attending scientific meetings or other educational/academic events. To

make an application for travel funds the student must fill out a travel approval form available from the Graduate Administrative Assistant. The form must be completed and approved before travel commences (it needs to be signed by the students adviser, and if grant funds are to be used, the PI of the grant also needs to approve the use of the grant funds). In no cases will students be reimbursed for travel without prior approval of this form.

3. Except as noted below, in no case will any funds beyond the amount approved for the student at the time of passing the candidacy exams. We recommend that students reserve some travel money to attend a national meeting for recruitment purposes late in your time at Delaware. Exceptions to the funding cap are as follows:
 - (a) Students who wish to return to their undergraduate school to help recruit new graduate students may petition the department for extra support.
 - (b) Students may also petition the Graduate [Studies](#) Committee to receive partial funding to attend special training programs/workshops or clinics. Such requests must be clearly documented.

6.3 Support during the Summer

Graduate student contracts are usually for nine months. Opportunities for further employment during the summer months include Research Assistantships and Teaching positions. In addition the department offers summer support as follows:

- Continuing students, with financial support, who are in their first summer at Delaware are eligible for summer support at the rate specified in their offer letter.
 - Students are expected to be at Delaware during this time and available for classes and workshops as determined by the Graduate [Studies](#) Committee.
 - At the request of the student this support may be carried over to the second summer.
- Students who have passed the candidacy exam are eligible for ~~a further one~~ [an additional](#) summer of support at the current rate for summer support determined by the department.

- The duration of support is for the first summer session.
- By university policy, all students supported during the summer must register as full-time students (minimum 3 credit hours) for M868, M964, or M969.
- Students who are being supported may not teach, or receive other University of Delaware support in the first summer session.

6.4 Continuation of 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 guarantee financial aid for 10 semesters for students entering with a Bachelor's degree; those entering with a Master's degree can expect to receive financial aid for 8 semesters. The department, however, will make every attempt to provide some form of funding for qualified students during their tenure.~~

~~Due to the size of our program, the~~ The Department has a limit on its support of graduate students. The total number of semesters a student can be funded under a TA , GA, or Fellowship/~~RA~~ is 10 semesters; 8 semesters for a student entering with a Master's degree. The department, however, will make every attempt to provide some form of funding for qualified students during their tenure. If a student has had RA support, an additional year of TA, GA or Fellowship may be possible after approval by the Graduate Studies Committee; such an extra year is not guaranteed.

For continued support beyond the 3rd year, a student entering with a Bachelor's degree must pass the Candidacy Exam by the beginning of his/her 6th semester. 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 guaranteed 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.

7 Guidelines for the Teaching Assistant

(moved here from section 3 of previous book.)

1. Teaching Assistants are expected to attend lectures in the course in which they are assisting if so asked by the instructor. They are expected to know the content of the course, methods of teaching used by the professor, and the relative importance of the subject matter.
2. Teaching Assistants are responsible for assisting the professor in charge of the course in the formulation, administration and grading of quizzes and examinations given in the course. Specific responsibilities will be discussed with the professor in charge.
3. Quiz sections should be conducted along guidelines specified by the professor in charge of the course. The quiz sections are an integral part of each course and are expected to meet for the full 50 minutes in the assigned classroom. Teaching Assistants may not dismiss class early unless directed to do so by the professor in charge of the course.
4. The Teaching Assistant will be informed what part he or she will play in the final exam process regarding grading and averaging and recording grades. The assignment of final course grades is the responsibility of the professor in charge of the course. No Teaching Assistant may leave campus until final exam grades for their course have been turned in to registration.
5. At the beginning of the semester, professors and Teaching Assistants together should plan office hours and then announce office hours to their classes.
6. Teaching Assistants are expected to spend an average of 20 hours per week working in the course in which they are assisting. This average includes time in class, in preparation for class, and in grading of quizzes and exams.
7. The TA cannot give out information on student performance (including grades) over the telephone. The TA cannot give out final exams. If students wish to see them, the TA will need to make an appointment to meet them after classes have ended, or leave the exams with a secretary in 501 Ewing and have students check with the secretaries. Final exams must remain in the department for one year after students take them.
8. Renewal of assistantships is not automatic. Continued support is contingent upon appropriate progress toward a degree and satisfactory performance of assigned duties as a graduate assistant.
9. Teaching Assistants may not be absent during any semester without permission of the Associate Chair.

8 Miscellaneous Information

(This section moved from 2 to the end.)

Change of Address or Telephone Number Please notify the Math Office (301 Ewing) of your current address and telephone number and notify us immediately of any changes.

Class Enrollment Limits Limits for all classes are established by the Department.

Class Supplies TA classroom supplies (as opposed to personal supplies) may be secured from the workroom supply cabinet (obtain key from 501 Ewing). Available supplies: grade books, chalk, pencils, pens, writing pads. *These supplies are for the classes you are teaching, not the classes you are taking.*

Computer Accounts As students you are automatically given accounts for e-mail on the university's Unix machines. Please go to Smith Hall, Room 2A, to obtain your user number and password. For your mathematical sciences workstation account all students need to fill out a "System Security and Access" form available from the staff office in Ewing. This form must be completed and handed in to the Graduate [Secretary Assistant](#). For additional computing resources, please see the Assistant to the Chair.

Typing of Tests The policy is that the office staff does not type tests for graduate student TAs. The two exceptions to the rule are:

1. If you are the instructor in charge of a course during the *regular semester*, the office staff will do your ~~hourlies~~ [hourly exams](#) and final the same way they do a regular faculty member's work. You are expected to adhere to the same policy for turning [in](#) these exams as the faculty members do; i.e., at least 3 days before the hourly is due and at the time given you by the staff for finals. Also, you are expected to turn in the exams in good order – the office staff does not have time to redo exams several times because of their inability to decipher your notes.
2. During special sessions the office staff does not normally type exams but exceptions may be made for single exams given to several different sections of a course. The same policy holds for ~~turning them in~~ [submitting them](#) in a timely manner – at least 3 days before.

As a courtesy to the typist, you are expected to be available to proof-read all exams when they are typed so that corrections and duplication can be done in good time.

All requests for typing services must be made to Mrs. Burns and she will assign the work to the staff.

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

Proctoring of Exams As part of their obligation to the department, all students are required to assist in the proctoring of the hour exams and finals in courses with common exams (e.g. M010, M115, M221, etc.). Failure to do your share will affect your winter/summer teaching assignments and may jeopardize future support from the Department.

Pay Checks 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 for tax purposes. All graduate students must use direct deposit.

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, or their paychecks will be halted. These students must also change their UD ID cards.

Checks are automatically deposited after a form (obtained in 501 Ewing) is sent to Payroll. Your check stub can be seen on line. Your stipend continues straight through all nine months of the academic year and, therefore, you can expect your paycheck as usual between semesters.

Winter session is a separate contract, and this stipend is added into your paycheck over the Winter session period. Your stipend does not include summer session, but there is a possibility of teaching. For winter and summer sessions, if you don't have 10 people in your class after the first day of class, contact someone in the Math Office, 501 Ewing Hall. Your pay could be substantially reduced if this happens.

Telephone Any call beyond the Newark local calling area is to be paid by the student making the call.

Textbooks Desk copies may be obtained in 501 Ewing by TA's for courses in which they are assisting.

Copying Free copying for the course in which you are assisting. Ten (10) cents per copy for personal use. Please note the key count number and the number of copies made. The photocopy machine is not to be used for multiple copies for class use (see office staff for >100 copies). Any exceptions must be approved by the office staff.