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1. GRADUATE PROGRAM OFFICERS FOR 2000-2001

Department Head	Henri Gillet
Associate Head for Instruction	John Wood
Director of Graduate Studies	Jeremy Teitelbaum
Assistant Director of Graduate Studies	Kari Dueball
Graduate Secretary	Darlette Willis

Important Addresses

1. Professor Jeremy Teitelbaum, Director of Graduate Studies
   Department of Mathematics, Statistics, and Computer Science (M/C 249)
   University of Illinois at Chicago
   322 Science and Engineering Offices
   851 South Morgan Street
   Chicago Illinois 60607-7045

   Phone: 312/996-3041; Fax: 312/996-1491
   E-mail: jeremy@uic.edu
   Web address - http://www.math.uic.edu

2. Office of Graduate Admissions (M/C 018)
   University of Illinois at Chicago
   Box 5220
   Chicago, Illinois 60680-5220

   Phone: 312/996-4350; First floor of Student Services Bldg (SSB)
   E-mail: uicadmit@uic.edu
   Web address - http://www.uic.edu/depts/oar/

3. Graduate College (M/C 192)
   601 South Morgan Street
   Chicago, IL 60607-7106

   Phone: 312/413-2550; Fax: 312/413-0185; Sixth floor of University Hall (UH)
   E-mail address: gradcoll@uic.edu
   Web address – http://www.uic.edu/depts/grad/

2. THE DEPARTMENT OF MATHEMATICS, STATISTICS, AND COMPUTER SCIENCE

The department is highly regarded as one with many areas of strength and an outstanding faculty. The diverse interests of nearly 70 regular faculty and nearly 180 graduate students together with the ambiance of major metropolitan area create a stimulating setting for the pursuit of mathematics, statistics or computer science by students and professors alike. The department offers graduate degree programs with specialization in Pure Mathematics, Applied Mathematics, Mathematical Computer Science, Mathematics and Information Sciences for Industry (MISI), Probability and Statistics, and Mathematics Education. The MS (Master of Science) and PhD (Doctor of Philosophy) degrees can be earned as well as the MST (Master of Science in Teaching of Mathematics) and the DA (Doctor of Arts) degrees.

The University of Illinois at Chicago (UIC), one of the three campuses of the University of Illinois, is located within five minutes of downtown Chicago by public transportation. The city offers excellent concerts, opera and theater, a wide variety of museums and galleries and superior restaurants for almost any taste. The parks and lakefront are known for entertainment and recreation also.

The quality of the department's faculty is reflected in the number of grants awarded for research and in terms of national and international recognition. Several faculty members are editors of distinguished journals and some are elected fellows of national or international professional societies. Faculty members have been invited to address the International Congress of Mathematicians. Eight members of the current faculty have been awarded Sloan Fellowships.

The department has a regular Colloquium Series that brings eminent mathematicians, computer scientists and statisticians to campus. It hosts workshops and regional conferences. It has held Emphasis Years in Computer Mathematics, Combinatorics and Complexity, Geometry and Topology, Partial Differential Equations, and Logic. These year-long programs attract many visiting professors and provide graduate students and faculty with additional study and research opportunities.

The faculty work in an atmosphere of professional cooperation with other departments in the University. Some faculty have joint publications in inter-disciplinary areas. There is a productive interaction with other mathematics departments in the metropolitan Chicago area.

The University offers state-of-the-art computing facilities in its Academic Computer Center. Resources include an IBM mainframe, a Convex mini-supercomputer, and an extensive network of UNIX workstations and PCs. The department operates a diverse computing environment with UNIX workstations and PCs available for graduate student use. Many students have become involved with the Advanced Computing Research Facility at the Argonne National Laboratory to which the department has a direct computer connection. Graduate students and faculty also have access to the supercomputers at Urbana and Cornell and the statistical laboratory that provides consulting services for academic and administrative units of the University.

The department has an active and growing program in Mathematics and Computer Science Education. Through this program the department maintains contact with educators and teachers in the Chicago area and is involved in upgrading the mathematical training of primary and secondary teachers.

The MS degree in Mathematics offers these areas of concentration: Pure Mathematics, Applied Mathematics, Mathematical Computer Science, or Probability and Statistics. In addition, the department offers an MS degree in Mathematics and Information Sciences for Industry. It is not unusual for faculty to work in more than one area. The breadth of the department's activity offers graduate students a very rich and extensive variety of study opportunities for the pursuit of their career goals.

3. THE FACULTY

The department's research faculty are listed below along with their major mathematical interests. The names of faculty listed in more than one area are designated by an asterisk (*).

Pure Mathematics

A.O.L. Atkin, Professor (emeritus); Modular forms, number theory.
David Bachman, Research Assistant Professor; Knot theory, three manifold topology, differential topology.
John Baldwin*, Professor; Model theory, universal algebra.
Joel Berman, Professor; Lattice theory, universal algebra.
Daniel Bernstein*, Assistant Professor; Number Theory.
Willem Blok, Professor; Algebraic logic, universal algebra, non-classical logics.
Calixto Calderon, Professor; Harmonic analysis, differentiation theory.
Rick Chartrand, Research Assistant Professor; Functional analysis and operator theory, Hilbert spaces of holomorphic functions.
Marc Culler, Professor; Low-dimensional topology, group theory.
Lawrence Ein, Professor; Algebraic geometry.
Paul Fong, Professor; Group theory, representation theory of finite groups.
Shmuel Friedland, Professor; Matrix theory and its applications.
Alexander Furman, Assistant Professor; Ergodic theory, dynamical systems, Lie groups.
Henri Gillet, Professor; Algebraic K-theory, algebraic geometry.
Brayton Gray, Professor; Homotopy theory, cobordism theory.
Robert Grossman*, Professor; Differential equations.
Melvin Heard, Associate Professor; Integro-differential equations.
James Heitsch, Professor; Differential topology, theory of foliations.
William Howard, Professor; Foundations of mathematics, proof theory.
Steven Hurder, Professor; Differential topology, theory of foliations.
Steven Jordan*, Professor; Differential geometry, mathematics education.
Louis Kauffman, Professor; Differential topology, knot theory of singularities.
Chao Ku, Research Assistant Professor; Representation theory of finite groups, combinatorial topology, group theory.
Richard Larson, Professor; Hopf algebras and quantum groups, control theory, algorithms of algebras.
Jeffrey Leon*, Professor; Group theory and combinatorics.
Olivier Lessman, Research Assistant Professor; Logic.
Jeff E. Lewis, Professor; Partial differential equations, singular integrals, microlocal analysis.
Anatoly Libgober, Professor; Topology of varieties, theory of singularities.
Charles S. C. Lin, Associate Professor; Operator theory, perturbation theory, functional analysis.
David Marker, Professor; Model theory, applications to arithmetic, descriptive set theory.
Howard Masur, Professor; Quasiconformal mappings, low dimensional topology
Uri Peled*, Professor; Combinatorial optimization, graph theory, combinatorics.
Vera Pless*, Professor; Coding theory, combinatorics.
David Radford, Professor; Hopf algebras, quantum groups, invariants of knots and links.
T.E.S. Raghavan*, Professor; Positive operators, measurable selections, convexity.
Mark Ronan, Professor; Group theory, geometry, buildings.
Wei-dong Ruan, Assistant Professor; Symplectic, algebraic, and Kahler geometries, geometry analysis and geometry related to string theory.
Yoram Sagher, Professor; Harmonic analysis, interpolation theory.
Peter Shalen, Professor; Low dimensional topology, group theory.
Zbigniew Slodkowski, Professor; Several complex variables.
Fredrick Smith, Associate Professor; Group theory.
Steven Smith, Professor; Finite groups, representation theory.
Bhama Srinivasan, Professor; Group theory, representation of finite and algebraic groups.
Martin Tangora, Associate Professor; Algebraic topology, homotopy theory.
David Tartakoff, Professor; Partial differential equations, several complex variables.
Jeremy Teitelbaum, Professor; Number theory.
Yuri Tschinkel, Assistant Professor; Number theory, algebraic geometry.

Philip Wagreich*, Professor; Algebraic geometry, discrete groups, mathematics education.
John Wood, Professor; Differential topology, topology of varieties.
Stephen Yau, Professor; Algebraic geometry, singularities of complex algebraic varieties, control and information theory.

Applied Mathematics
Neil Berger*, Associate Professor; Applied elasticity, fluid dynamics, scattering theory.
Susan Friedlander, Professor; Geophysical and fluid dynamics.
Floyd Hanson*, Professor; Numerical Methods, asymptotic methods, stochastic optimal control.
Charles Knessl, Professor; Stochastic models, perturbation methods, queuing theory.
Charles Tier*, Professor; Analysis of stochastic models, queuing theory.

Mathematical Computer Science
John Baldwin*, Professor; Finite model theory.
Neil Berger*, Associate Professor; Numerical analysis, symbolic manipulation.
Daniel Bernstein*, Research Assistant Professor; Algorithms, cryptography.
Martin Grohe, Assistant Professor; Finite model theory, algorithms and complexity theory, database theory.
Robert Grossman*, Professor; Algorithms, symbolic computation, database computing.
Floyd Hanson*, Professor; Numerical analysis, scientific supercomputing, parallel scheduling.
Jeffrey Leon*, Professor; Computer methods in group theory and combinatorics, algorithms.
Glenn Manacher, Associate Professor; Algorithms, complexity, computer language design.
Uri Peled*, Professor; Combinatorial optimization, graph theory, combinatorics.
Vera Pless*, Professor; Coding theory, combinatorics.
Charles Tier*, Professor; Numerical analysis, queuing theory.
Gyorgy Turan, Professor; Complexity theory, logic, combinatorics.
Jan Verschelde, Assistant Professor; Computational algebraic geometry, symbolic numeric computing, combinatorial and polyhedral methods.
Jennifer Wagner, Research Assistant Professor; Algebraic combinatorics, symmetric functions, and permutation statistics.

Probability and Statistics
Emad El-Neweihi, Professor; Reliability theory, probability, stochastic processes.
Nasrollah Etemadi, Associate Professor; Probability theory, stochastic processes.
Samad Hedayat, Professor; Optimal designs, sampling theory, linear models, and discrete optimization.
Dibyen Majumdar, Professor; Optimal designs, linear models.
Klaus Miescke, Professor; Statistics, decision theory, selection procedures.
T. E. S. Raghavan, Professor; Game theory, optimization methods in matrices, statistics.

Mathematics Education
Steven Jordan*, Professor; Mathematics and computer education, computational geometry, computer graphics.
David Page, Professor; Elementary mathematics education.
Philip Wagreich*, Professor; Algebraic geometry, discrete groups, mathematics in education.
A. I. Weinzweig*, Professor; Teaching and learning of mathematics, microcomputers in education.

4. ADMISSION TO A GRADUATE PROGRAM

Application is made to a degree program in a particular area. Students who do not designate a program will be treated as Pure Mathematics applicants. Students who wish to change their program after admission must first fulfill the requisite entrance requirements for the program they wish to pursue.

Completion of a Master's program is required for the department's doctoral program. Students who have earned substantial graduate credit from another institution may be admitted to the department's doctoral program.

Regular Admission
Applicants are considered on an individual basis. Applicants must have a baccalaureate from an accredited college or university, a grade point average of at least 3.75 (A = 5.00) for the final 60 semester hours of undergraduate study, and an average of 4.00 in all mathematics courses beyond calculus. Applicants whose bachelor's degree is not in mathematics but in a related area will be considered for admission.

Each applicant is required to submit three letters of recommendation from persons familiar with the applicant's academic work. These letters must be received before the department will process the application.

The general aptitude and mathematics achievement tests of the GRE (Graduate Record Examination) are *required* of all applicants except applicants for the Elementary School Option of the MST program. However, it is *recommended* that these MST take the GRE.

In addition to the GRE, applicants whose native language is not English must score at least 550 on the TOEFL (Test of English as Foreign Language) to be considered for admission and at least 600 to be eligible for financial aid.

Requisite Entrance Requirements

Applicants for the *Elementary School Option of the MST* program must hold a valid K-8 Illinois Teaching certificate or the equivalent.

Applicants for the *Secondary School Option of the MST* program must have 20 semester hours of undergraduate study in mathematics beyond calculus including at least one course on the problems of teaching secondary school mathematics, these courses or their equivalents: Advanced Calculus II (Math 411), Linear Algebra I (Math 320), and Abstract Algebra (MthT 435).

Applicants for the department's other graduate programs must present 20 semester hours of undergraduate study in mathematics beyond calculus as follows:

Applicants for the MS program in *Pure Mathematics* are expected to have completed a year of work in higher algebra (linear algebra, abstract algebra) plus one year of study in analysis or advanced calculus.

Applicants for the MS program in *Applied Mathematics* are required to have proficiency in ordinary differential equations (Math 220) and linear algebra (Math 310), and some knowledge of advanced calculus (Math 410).

Applicants for the MS program in *Probability and Statistics* are required to have completed the following department's courses or their equivalents: Applied Linear Algebra (Math 310), Analysis I (Math 413), and Introduction to Probability (Stat 401).

Applicants for the MS program in *Mathematical Computer Science* are required to have completed the following departmental courses or their equivalents: Discrete Mathematics (MCS 261), Programming Tools and File management (MCS 275), Introduction to Data Structures (MCS 360), Linear Algebra I (Math 320) or Applied Linear Algebra (Math 310), Introduction to Probability (Stat 401), and one other upper division mathematics or computer science course. In addition, applicants are required to be proficient in a structured programming language such as C or C++.

Applicants for the MS program in *Mathematics and Information Sciences for Industry (MISI)* are required to have completed the following departmental courses or their equivalents: Differential Equations (Math

220), Linear Algebra (Math 320), Introduction to Data Structures (MCS 360), and Applied Statistical Methods (Stat 381) or Introduction to Probability (Stat 401).

At the discretion of the department's Admissions, Fellowships, and Assistantships Committee distributions of the 20 semester hours other than the ones described above may be considered. Students who are deficient in meeting the entrance requirements may be admitted on limited status. Students in this category must remove these deficiencies within time limits set by the department and Graduate College to avoid being dismissed from the Graduate College.

Non-degree Admission
Applicants for non-degree admission are considered on an individual basis. Applicants must have a baccalaureate from an accredited college or university and normally must have completed a calculus sequence and two or more mathematics courses at a more advanced level.

Admission Application Procedures and Deadlines
Application forms for admission may be obtained from the MSCS Graduate Studies office, the Office of Graduate Admissions at UIC, or the website at http://www.math.uic.edu. Applicants must submit transcripts and completed application forms to the Office of Graduate Admissions. The letters of recommendation should be sent directly to the Director of Graduate Studies. Graduate study may begin any term.

Domestic applicants should submit application forms and credentials about two months before the term of intended enrollment. *International applicants* must apply about six months in advance to allow the University sufficient time for review of documentation and to allow the applicant sufficient time to obtain a visa. In any case the department suggests applying well before deadlines to give the University ample time to process application materials.

5. FINANCIAL AID

The typical forms of financial aid offered by the University to support graduate study are described in this section. Contact the Director of Graduate Studies of the department or the Office of Graduate Admissions at UIC for further information.

Fellowships
The University awards a limited number of University Fellowships. These carry a tuition and service fee waiver. The 2000-2001 stipend for a twelve month period is $15,000. The department recommends students for a University Fellowship on the basis of academic merit. Students who hold a University Fellowship must maintain a full time course load. The department allows them to hold a 25% Teaching or Research Assistantship in addition to the fellowship. Most students recommended for a University Fellowship are entering students (prematriculants) or continuing PhD candidates within a year or so of finishing the degree. These two groups are considered separately.

Teaching Assistantships
The department maintains a large staff of teaching assistants (currently over 70 positions). Normally the department awards 50% Teaching Assistantships although some 25% awards are also offered. The 2000-2001 stipend for the 50% time Teaching Assistantship is $12380 for the academic year. International students on F-1 visa status are eligible for 25% or 50% time awards.

Teaching Assistantships carry a tuition and service fee waiver and are awarded on the basis of academic merit, with teaching capabilities and communication skills taken into account. Continued support is contingent on satisfactory academic progress and performance of assistantship duties. Students may be supported up to two years in the Master's program. Late in the spring semester the Admissions, Fellowships, and Assistantships Committee will evaluate students holding Teaching Assistantships and make recommendations to the Graduate Studies Committee regarding continued support.

Tuition and Fee Waivers
The department is given a limited number of Board of Trustees Tuition and Fee Waivers to award. These are granted on a semester by semester basis. Awards are based on academic merit and are independent of financial need. Students granted Tuition and Fee Waivers must complete 12 credit hours each semester of their award and 6 hours during the summer.

Work-Study Program
Students who are U.S. citizens or permanent residents (or have applied for such) and who can demonstrate financial need are eligible for the Work-Study Program. Awards are based on financial need and academic progress. Students who are eligible for this program are strongly encouraged to apply. In many cases, academically promising students in the Work-Study program are given opportunities to make additional money during the summer months.

Financial Aid Application Procedures and Deadlines
There is a single application form for prematriculants, *the Application for Graduate Appointment*, covering the types of financial aid described above. This form is included in the admission application packet. For prematriculants, the application deadline for financial aid commencing fall semester is January 15. Continuing students may apply for financial aid during any term of the academic year by completing and submitting a departmental form to the Director of Graduate Studies. Application deadlines are posted, but normally occur 3 months after the start of the semester for subsequent semesters.

Financial aid for students matriculating spring semester is quite limited. Summer Teaching Assistantships are very limited in number. Priority for summer support is given to students with outstanding teaching ability and to students very close to finishing their dissertations.

6. RULES, PROCEDURES AND PROGRAM ADMINISTRATION

Graduate students in the department have two important responsibilities during the pursuit of their academic goals. The first is planning a program of study. This is to be done with the assistance of an advisor. The second is understanding and following the rules and procedures of the Graduate College and the department. In particular, students are expected to be familiar with the details of course registration, change of program, and course load found in Section 9. **We emphasize that the Graduate College holds students responsible for being aware of all regulations and requirements and satisfying them as soon as possible.**

Together, the catalog of the Graduate College and the Graduate Handbook of the department contain the rules and procedures referred to in the preceding paragraph. Since neither document is self-contained, both must be used in program planning. Students are expected to be familiar with each of them. In some cases departmental rules are stricter than Graduate College rules.

The catalog of the Graduate College has three primary purposes: to provide information about UIC, to inform potential and enrolled students of the general rules and procedures governing graduate study, and to describe the programs offered through the Graduate College.

The Graduate Handbook of the department has more specialized purposes: to provide information about the department, to inform potential and enrolled students of departmental rules and procedures concerning graduate study, and to provide a detailed description of the many programs the department offers graduate students.

Under unusual circumstances, a student may wish to *request a waiver of rules* by completing a Graduate College Petition form. If the rule is a Graduate College rule, then the student's advisor must endorse the petition followed by the Director of Graduate Studies; the petition is then directed to the Dean of the Graduate College. If the rule is a departmental rule, the Director of Graduate Studies is consulted first, followed by the Graduate Studies Committee.

Many people are involved in the administration of the department's graduate program. See Section 1 for a list of the program officers. Several individuals play key roles.

The *Director of Graduate Studies* (DGS) manages the day to day operations of the department's graduate program. The DGS implements policies and procedures, advises students and faculty in policy and procedural matters, serves as academic advisor to non-degree students and is responsible for admissions to the program and recommendations for financial aid.

The *Assistant Director of Graduate Studies* assists in the absence of the Director of Graduate Studies, provides advice regarding university policies and procedures, makes teaching assignments for departmental Teaching Assistants, and oversees the admissions process.

The *Graduate Secretary* is responsible for keeping records and copies of materials relevant to the program. Students and faculty should contact the Graduate Secretary to make requests for most forms. Copies of comprehensive Master's exams and syllabi for these exams are available in the Mathematics Library on the fourth floor of SEO.

The bulletin board near the Graduate Secretary's office should be checked frequently for notices pertinent to the graduate program. Current job openings are posted on the department's website as well as the bulletin board located near SEO 320.

The *Advisor*'s role is to help students make the best academic decisions. Advisor approval is required at every stage of a student's program of study. The advising system is described in detail in Section 8.

The *Graduate Studies Committee* is responsible for overseeing the department's graduate program. Its two most important functions are formulating policy and acting on petitions from students concerning departmental rules or procedures. Students should seek policy or procedural advice from the Director of Graduate Studies, not from the chair of the Graduate Studies Committee.

7. THE DEGREE PROGRAMS

The department offers students a wide variety of programs of study at the Master's and doctoral levels. The scope of the department's activities is reflected in the richness of opportunities available to graduate students.

The Programs - Purpose and Relationship

The Master of Science (MS) program is designed to lay the foundations for doctoral work and also to prepare students for a career in business, government, or industry. Students can earn the MS degree in Mathematics and Information Sciences for Industry or the MS degree in Mathematics with a concentration in one of these major areas: Pure Mathematics, Applied Mathematics, Mathematical Computer Science, or Probability and Statistics. Superior students who want more breadth in their course work have the option of earning the MS degree without an area of concentration.

Passing a comprehensive written examination, or writing and successfully defending an acceptable Master's thesis is required for the MS degree.

The department offers Doctor of Philosophy (PhD) and Doctor of Arts (DA) programs. The PhD program is designed to provide the highest level of training for independent research. Each of the department's major areas has a program leading to the PhD degree.

The goal of the DA program is to produce graduates who have demonstrated breadth in their understanding of mathematics, demonstrated mastery of the ability to learn new mathematics independently and are prepared to teach a wide range of topics in two-year and four-year colleges.

The department's doctoral program has a Master's requirement. Students from other institutions who have a Master's degree, or have done substantial work toward the PhD degree, may be admitted to the doctoral program. The Master's requirement for the doctoral program is satisfied by earning the department's MS degree with a concentration in one of the major areas along with either a high pass on the written Master's Examination or the grade of high pass on a Master's thesis and oral defense. For a complete explanation, see the section on the written Master's Examination, the Master's thesis and defense, and on the requirements for the MS degree earned *without* an area concentration.

The department's MST program is a special degree program designed to strengthen the preparation and background of teachers in secondary or primary schools. The *secondary school option* includes courses for high school mathematics teachers as well as a program of study that leads to State of Illinois teacher certification for those who are not already certified. The *elementary school option* is designed to broaden the student's understanding of learning and teaching mathematics in grades K-8. **The MST program does not lead into the department's doctoral program.**

The MS program and the two options of the MST program serve very different purposes. Coursework in one is not necessarily applicable to the other two.

We note here that each degree has certain course restrictions. For details, see the restricted courses in Section 9.

Requirements for the Master of Science Degree

Requirements for the MS degree with an area concentration
The requirements for the MS degree in Mathematics, Statistics, and Computer Science earned with an area concentration are:

1. Fulfill the Graduate College requirements pertaining to the Master's degree, including the completion of 9 hours of 500 level coursework NOT including independent study (596).

2. Earn a minimum of 32 semester hours of advisor-approved graduate credit (excluding thesis research) as follows:

   a. 12 hours of Departmental 500 level courses earning a grade of A or B. Courses selected may include independent study (596) but may NOT include TA Workshop (589). For the Mathematical Computer Science concentration, at least 2 courses must be MCS courses.

   b. Satisfy core course requirements* as follows:

      Pure Mathematics: Math 417, 516, 533, and 4 hours from Math 446, 517, 534, 535, 536.
      Applied Mathematics: Math 417, 480, 481 and 8 hours from Math 574, 578, 579, 580, 581, and 586 (Computational Finance).
      Mathematical Computer Science: MCS 401, 421, and 471.
      Mathematics and Information Sciences for Industry: MCS 401, 471, 504, 507, 598, and Math 589.
      Probability and Statistics: Stat 401, 411, and one of Stat 431, 461, 471, 477, 481.

   c. Any remaining hours must be selected from 400 or 500 level courses. Courses may include independent study (596), TA Workshop (589), or courses outside the department.

3. a. Pass the department's (written) Master's Examination in the area of concentration (except MISI students – see item 4), **OR**

   b. Achieve a grade point average of at least 4.5 for the core courses, write an acceptable thesis and pass an oral defense.

4. MISI students must achieve an overall grade point average of at least 4.5 for the program and successfully complete a Master's project or write and successfully defend a major thesis.

*Students may not have to take a core course in their area of concentration if they have satisfactorily completed an equivalent elsewhere. For such an exemption to be considered, students must submit a documented petition to the Director of Graduate Studies. The Graduate Secretary has the form necessary for this request.

Master's Examination

Examination questions are based on both 400-level and 500-level course material. The examination has four options, one for each of the department's major areas of concentration. Details are found in the section below on programs of study leading to the MS degree with an area concentration.

Syllabi and copies of previous exams as well as solutions to the Master's Examination questions can be obtained from the Mathematics Library, fourth floor of SEO.

Schedule

The department's Master's Examination is given twice a year. In the fall the exam is given during the week preceding the first week of instruction and graded by the end of the second week of instruction. In the spring, the exam is given around the ninth week of the semester and graded within two weeks. Students are allowed three hours for the examination.

Grading

The Master's Examination is graded on a scale of 0 to 160 points. Each question is worth 20 points and the 8 questions with the highest numerical scores are used to determine the student's grade. The passing grade for the examination is 90 points; a **high pass** is 110 points or more.

Examiners are not to make any marks on the papers they grade until they set the grades. At that point they record their grades and comments which they agree are appropriate on the examination papers. Examination papers are to be photocopied and returned to examinees after they are graded. The Master's examination is to be graded within two weeks of the date it is given.

Time Limits and Attempts

All students earning the MS degree with an area concentration by taking the Master's examination in the area of concentration must pass the examination within one year after earning 32 hours of credit applicable to the degree, regardless of whether they are seeking a terminal Master's degree or seeking to qualify for doctoral work. Full-time students who have not passed the Master's Examination must take it at least once each academic year; part-time students must take the exam after completing 24 semester hours and at least once a year thereafter, until they pass the exam.

Students who exceed the time limit will normally be dropped from the graduate program. However, students may petition the Graduate Studies Committee for an extension of the time limit. In exceptional circumstances, this petition may be granted.

Students are encouraged to take the examination early and often until it is passed. Students intending to take the written Master's Examination must register in advance with the Graduate Studies office. All questions concerning the written Master's Examination, including questions about the grading of solutions, should be addressed to the Director of Graduate Studies. The Director of Graduate Studies reports the grade to the student.

Pure Mathematics

The department offers students opportunities for study in many areas of Pure Mathematics. Students who wish to earn the **MS degree with a concentration in Pure Mathematics** will have their program tailored

to suit their interests and needs to the extent possible. They should select courses listed below whose equivalent they did not take as undergraduates:

Math 413, 414	Analysis I, II
Math 417	Complex Analysis with Applications
Math 425	Linear Algebra II
Math 445	Introduction to Topology I
Math 516	Second course in Abstract Algebra I
Math 533	Real Analysis I

The Pure Mathematics core courses are:

Math 417	Complex Analysis with Applications
Math 516	Second Course in Abstract Algebra I
Math 533	Real Analysis I

plus 4 hours from:

Math 446	Introduction to Topology II
Math 517	Second Course in Abstract Algebra II
Math 534	Real Analysis II
Math 535	Complex Analysis I
Math 536	Complex Analysis II

The **written Master's Examination (Pure Mathematics option)** covers a broad range of topics. There are 18 questions which are distributed in the following manner:

Math 516	Algebra	3 questions
Math 413, 414	Analysis	3 questions
Math 417	Complex Analysis	3 questions
Math 430	Logic	3 questions
Math 435	Number Theory	3 questions
Math 445	Point-set Topology	3 questions

Students with a strong mathematical background who intend to continue for a doctoral degree are encouraged to complete one or more of the basic 500-level course sequences which lead to a written prelim while they are earning the MS degree. (See the section on the doctoral degree programs.)

Applied Mathematics

The **MS degree with a concentration in Applied Mathematics** is designed for students who have a bachelor's degree in mathematics, computer science, engineering, or in the physical or biological sciences and have a good background in undergraduate mathematics. It is recommended that students satisfy the 32 hours of graduate credit requirement from the following distribution of courses:

The Applied Mathematics core courses are:

Math 417	Complex Analysis with Applications
Math 480	Applied Differential Equations
Math 481	Applied Partial Differential Equations

plus 8 hours from:

Math 574	Applied Optimal Control
Math 578	Asymptotic Methods
Math 579	Singular Perturbations
Math 580	Introduction to the Mathematics of Fluid Dynamics
Math 581	Selected Topics in Fluid Dynamics

The remaining 12 hours can be selected from courses on the above list or from the following groups:

I. Applications-oriented Mathematics:

Math 574	Applied Optimal Control
Math 575	Integral Equations and Applications
Math 576	Boundary Value Problems
Math 577	Advanced Applied Partial Differential Equations
Math 584	Applied Stochastic Models

II. Mathematical Science:

Math 582	Wave Propagation and Scattering I
Math 583	Wave Propagation and Scattering II

III. Math 590 - Advanced Topics in Applied Mathematics:

Geophysical Fluid Dynamics
Magnetohydrodynamics
Stability Theory
Nonlinear Problems
Asymptotic and Exact Methods for Discrete Math
Applied Stochastic Optimal Control

IV. Collateral courses:

MCS 472	Advanced Numerical Analysis
MCS 563	Analytic Symbolic Computation
MCS 572	Introduction to Supercomputing
MCS 575	Computer Performance Evaluation

V. Advanced undergraduate courses:

Math 419	Models in Applied Mathematics
Math 484	Tensor Analysis
MCS 471	Numerical Analysis
Stat 401	Introduction to Probability

VI. 500-level courses in real or complex analysis or differential equations may be substituted after consultation with an Applied Mathematics advisor.

Students may take up to 8 semester hours in outside departments in courses such as electromagnetic theory, continuum mechanics, fluid dynamics, statistical physics, electrical signal processing, biology and plasma physics.

The **written Master's Examination (Applied Mathematics option)** has 12 questions and is based on the following courses:

Math 310 or 320	Applied Linear Algebra or Linear Algebra I	2 questions
Math 410, 411	Advanced Calculus I, II	2 questions
Math 417	Complex Analysis with Applications	2 questions
Math 480	Applied Differential Equations	3 questions
Math 481	Applied Partial Differential Equations	3 questions

Mathematical Computer Science

The **MS degree with a concentration in Mathematical Computer Science** is designed primarily for students who have bachelor's degrees in mathematics or engineering, with a modest background in computer science and mathematics, and for students who have an undergraduate degree in computer science.

The Mathematical Computer Science core courses are:

MCS 401	Computer Algorithms I
MCS 421	Combinatorics
MCS 471	Numerical Analysis

Students must choose at least three courses from the department's MCS graduate level courses and Stat 471 (Linear and Non-linear Programming), of which two courses must be at the 500-level (satisfying part of the required 12 semester hours of advisor-approved 500-level courses in the department). Students are encouraged to seek out additional courses that fit their needs in the department, or in other departments, and to use these courses to satisfy the remainder of their course requirements.

The **written Master's Examination (Mathematical Computer Science option)** has 14 questions and is based on advanced computer science courses. The questions are drawn from the following areas:

MCS 401	Computer Algorithms I	2 questions
MCS 415	Programming Language Design	1 question
MCS 421	Combinatorics	2 questions
MSC 423	Graph Theory	1 question
MCS 425	Codes and Cryptography	2 questions
MCS 441	Theory of Computation I	2 questions
MSC 460	Introduction to Symbolic Computation	1 question
MCS 471	Numerical Analysis	2 questions
MCS 481	Computational Geometry	1 question

Probability and Statistics

Students who wish to earn the **MS degree with a concentration in Probability and Statistics** take an initial program of courses in probability, statistical methods, statistical theory, and optimal decisions. After completing this program, students have two directions of study available: applied statistics or theoretical statistics. Students are encouraged to become familiar with some areas of the natural sciences, engineering, or the social sciences for statistical applications.

The Probability and Statistics core courses are:

Stat 401	Introduction to Probability and Statistics
Stat 411	Statistical Theory

plus one of the following:

Stat 431	Introduction to Survey Sampling
Stat 461	Applied Probability Models I
Stat 471	Linear and Nonlinear Programming
Stat 477	Introduction to Reliability Theory
Stat 481	Applied Statistical Methods II

The **written Master's Examination (Probability and Statistics options)** has two options:

Option I:

The exam for this option has 10 problems and is based on the following courses:

Math 310	Applied Linear Algebra	1 question

Math 413	Analysis I	1 question
Stat 401	Introduction to Probability	1 question
Stat 411	Statistical Theory	2 questions
Stat 416	Nonparametric Statistical Methods	1 questions
Stat 431	Introduction to Survey Sampling	1 question
Stat 461	Applied Probability Models I	1 question
Stat 481	Applied Statistical Methods II	2 question

Option II:
The exam for this option has 10 problems and are based on the following courses:

Math 310	Applied Linear Algebra	1 question
Math 413	Analysis I	1 question
Stat 401	Introduction to Probability	1 question
Stat 411	Statistical Theory	1 question
Stat 461	Applied Probability Models I	1 question
Stat 462	Applied Probability Models II	2 questions
Stat 471	Linear and Nonlinear Programming	1 question
Stat 473	Game Theory	1 question
Stat 477	Introduction to Reliability Theory	1 question

Master's Thesis and Defense
Students who wish to earn the Master's degree with an area concentration by writing and defending a thesis must find a thesis advisor and notify the Director of Graduate Studies by the end of their second semester in the program. A satisfactory thesis must be completed and successfully defended no later than one year after the completion of 32 credit hours applicable to the degree. All Master's thesis students must take at least 5 semester hours of Master's thesis research (Math 598, MCS 598 or Stat 598). Thesis research hours cannot be used to fulfill the requirement of 32 semester hours of advisor approved credit.

After each member of the committee receives a copy of the thesis, the advisor, in consultation with the committee, sets a date for the defense. Anyone may attend the thesis defense. Announcement of the thesis defense must be posted on the bulletin board, and the thesis must be available in the Mathematics Library, at least ten days before the thesis defense. The thesis defense takes place before a committee appointed by the Dean of the Graduate College on recommendation by the department. Before the defense can take place, all other degree requirements must be satisfied. The grade (pass, high pass, fail) is decided by a majority of committee members.

Thesis Committee
The thesis committee consists of at least three members, one of whom must be tenured and a full member of the graduate faculty. The chair of the committee must be a member of the graduate faculty. The student's advisor recommends a committee to the department on consultation with the student.

Requirements for the MS degree earned without an area concentration
This option is intended for exceptional students and requires prior approval of the Graduate Studies Committee. Students who earn the MS degree in this manner are warned that they will have to satisfy additional requirements for entry into the PhD program in some areas.

The requirements for the MS degree in Mathematics, Statistics, and Computer Science earned without an area concentration are:

1. Fulfill the Graduate College requirements pertaining to the Master's degree.

2. Pass one of the four options of the department's written Master's Examination with a score of at least 110 of 160 points.

3. Earn (a minimum of) 32 semester hours of advisor-approved graduate credit, 12 of which must be in the department's 500-level courses. Of the remaining 20 hours, at least 12 must be in the department's courses.

4. Fulfill the 32 semester hour requirement of advisor-approved credit in part by completing a program of 24 semester hours of graduate study (12 hours at the 500-level), approved in advance by the Graduate Studies Committee, earning the grade of A or B in each course, and achieving the overall average of 4.25 or better for this program.

Any program of 24 hours of course work (12 hours at the 500-level) chosen from the following department's courses will receive advance approval from the Graduate Studies Committee:

Math 417, 427, 430, 435, 436, 440, 442, 445, 446, 480, 481,
MCS 401, 411, 418, 421, 423, 441, 471, 472,
Stat 411, 416, 431, 461, 462, 471, 473, 481, and
any 500-level course except topics courses (these courses may be approved by petition).

The time limit and regulations regarding the number of attempts for the department's written Master's Examination apply to the written examination for this option. Students who choose this option for earning the MS degree and who wish to be admitted into the PhD program in Applied Mathematics, Mathematical Computer Science, or Probability and Statistics are required to pass the written Master's examination option, or a written prelim, for that area.

Requirements for the MST degree

The purpose of this program is to strengthen the preparation of mathematics teachers in elementary and secondary schools. There are two options offered in the program. One is designed for secondary school teachers and includes courses for current high school mathematics teachers as well as a program of study to prepare candidates not certified for Illinois state teacher certification. The second option is for elementary teachers holding a current Illinois teaching certificate who wish to broaden their understanding of learning and teaching mathematics in grades K through 8.

The requirements for the MST degree in Mathematics, Statistics, and Computer Science **(Option for Secondary School Teachers)** are:

1. Fulfill the Graduate College requirements pertaining to Master's degree.

2. Earn 32 semester hours of advisor-approved graduate credit as follows:
   a. MthT 410, 411 (Advanced Euclidean Geometry I, II).

   b. Math 425 (Linear Algebra II) or MthT 435 (Abstract Algebra).

   c. MthT 510 (Introduction to Higher Geometry).

   d. MthT 530 (Mathematical Analysis for Teachers II).

   e. Breadth requirement. At least 12 semester hours of graduate credit in advisor-approved mathematics courses representing at least three areas listed in groups A and B below:

   Group A (at least two courses must be selected): Combinatorics and discrete mathematics, computer science, probability and statistics.

   Group B: Complex variables, number theory, topology.

f. Electives in mathematics, which are advisor-approved.

3. Be eligible for a certificate to teach mathematics at the secondary level in Illinois.

At least one of the courses used to fulfill the breadth or elective requirement must be at the 500-level. The electives complete the student's 32 hour requirement. In exceptional cases, the student's advisor may approve elective courses in other fields beyond mathematics. Courses taken as admission requirements or courses that are comparable to admission requirements cannot be counted towards the degree.

The requirements for the MST degree in Mathematics, Statistics, and Computer Science (**Option for Elementary School Teachers**) are:

1. Fulfill the Graduate College requirements pertaining to the Master's degree.

2. Earn 36 semester hours of advisor-approved graduate credit, 24 of which are from the required core courses and 12 of which are from electives described below.

The MST – Elementary School Option core courses are:

MthT 450 (Concepts in Elementary School Mathematics I)
MthT 460 (Geometric Measurement and Numerical Methods)
MthT 465 (Teaching Algebra for Understanding)
MthT 470 (Teaching Mathematics with Science: An Activity Approach, I)
MthT 480 (Microcomputers in Elementary School Mathematics I)
MthT 589 (Practicum in Teaching Elementary School Mathematics).

The elective courses (from which 12 hours are selected) are:

MthT 550 (Concepts in Elementary School Mathematics II)
MthT 560 (Introduction to Analytic Geometry and Calculus)
MthT 565 (Teacher Geometry: An Activity Approach)
MthT 570 (Teaching Mathematics with Science: An Activity Approach, II)
MthT 575 (Principles of Probability and Statistics)
MthT 580 (Microcomputers in Elementary School Mathematics II)
MthT 585 (Problem solving with LOGO)
Math 494 or MthT 591 (Topics in Teaching Elementary/Junior High School Mathematics).

A maximum of 8 semester hours of related graduate level courses may be accepted toward the degree with departmental approval. For further details concerning the MST Program or secondary teacher certification in mathematics, call the Office of Mathematics and Computer Education at (312) 996-2439.

Doctoral Degree Programs

The department offers programs in Pure Mathematics, Applied Mathematics, Mathematical Computer Science, and Probability and Statistics that lead to the PhD degree.

Students must be formally admitted to the department's doctoral program. Students who wish to continue into the doctoral program must notify the Director of Graduate Studies of their intention. Their records will be reviewed by the department's Admissions, Fellowships and Assistantships Committee; additional credentials may be required. Students must be recommended by the department for further work.

A doctoral student who has completed 64 semester hours of graduate course work and has passed the doctoral preliminary examination (described below) is formally designated by the department as a Doctoral Candidate. Except in special cases, participation in college instruction is required of all doctoral students as part of their professional training and growth.

Requirements for the PhD degree

The student's major focus in this program is the production of a thesis that is a significant piece of mathematical research acceptable to the department. PhD students should complete all other requirements as soon as possible so they can concentrate efforts in this direction.

The requirements for the PhD degree in Mathematics, Statistics, and Computer Science are:

1. Fulfill the Graduate College requirements pertaining to the PhD degree.

2. Earn the Master's of Science degree from the department with a high pass on the department's written Master's Examination, or with a high pass on a Master's thesis and oral defense; or, if from another program, satisfy the equivalent.

3. Pass the doctoral written examination and fulfill the doctoral minor requirement in the following manner:
   a. the sum of the two grades for the written examination is at most 4.
   b. the sum of the numerical grade for the minor requirement and the two grades for the written examination is at most 6.

4. Pass a doctoral oral examination, if the program is the PhD program in Probability and Statistics.

5. Fulfill the PhD language requirement.

6. Complete a thesis acceptable to the department which makes a contribution to original research, and pass the doctoral thesis examination (defense).

7. Have 96 semester hours of graduate credit, at least 40 of which are in the department's 500-level courses excluding thesis research.

To enter the PhD program in Computer Science, students are required to have achieved a high pass on the department's written Master's Examination (Computer Science option) or have earned a high pass on a Master's thesis and defense or, if from another program, have satisfied the equivalent. To enter the PhD program in Probability and Statistics, students must have achieved a high pass on the department's written Master's Examination (Probability and Statistics option I or II) or, if from another program, have satisfied the equivalent.

All students must satisfy requirements 2-5 before taking more than four hours of thesis research (Math 599, MCS 599 or Stat 599) per semester. Thesis research usually constitutes 32 of the 96 hours required for the degree. Students required to take the doctoral oral examination must satisfy requirements 2 and 3 before taking the examination.

Students entering the PhD program who have done substantial work towards the degree at another institution may petition the Graduate College to have this work transferred to fulfill degree requirements at UIC. Master's degrees in mathematics and related fields will be evaluated for suitability and content by the Director of Graduate Studies and the related area committee.

In some cases a student with deficiencies will be allowed to enter the program conditionally. The conditions must be satisfied before credit is granted for the Master's degree and related course work. The conditions may be passing the department's Master's Examination, or taking additional course work, and/or passing written prelims, by a specified time. Students who feel they are eligible to be admitted with deficiencies are encouraged to contact the Director of Graduate Studies.

Doctoral Preliminary Examination
The purpose of the preliminary examination is to determine the student's readiness to undertake dissertation

research. The examination is administered in accordance with Graduate College rules as stated in the Graduate College catalog. In particular these rules require that the preliminary examination occur at least one year in advance of the dissertation defense.

For students in the PhD program in Probability and Statistics, the doctoral preliminary examination consists of the doctoral written examination, the doctoral minor sequence and the doctoral oral examination. For all other PhD and DA students the doctoral preliminary examination is the doctoral written examination and the doctoral minor sequence. The doctoral preliminary examination is passed when PhD requirements 2, 3, and 4 are satisfied.

Time Limits
All PhD students must pass the doctoral preliminary examination within one year after completion of 64 semester hours of coursework (which includes credit hours for the MS program). All DA students must pass the doctoral preliminary examination within one year after completing the teaching practicum and 60 hours of coursework.

The committee for the preliminary examination is appointed by the Dean of the Graduate College upon the recommendation of the department. The committee consists of at least five members, of whom at least three are UIC Graduate Faculty with full membership and two of whom must be tenured. The chair of the committee must be a full member of the UIC Graduate Faculty.

Doctoral Written Examination
The written examination consists of two written prelims, each of which is in a major subject area. These subject areas must be in different clusters (subject areas are grouped in clusters). The grades for the doctoral written examination are the grades for these two written prelims. There are twelve written prelim clusters:

1. Algebra
2. Analysis
3. Algebraic Topology
4. Logic and Universal Algebra
5. Applications-Oriented Mathematics
6. Mathematical Science
7. Combinatorics
8. Algorithms and Complexity
9. Computational Science
10. General Topics
11. Special Topics
12. Doctor of Arts (for DA candidates only)

The clusters are described in a subsequent section on the programs of study leading to the PhD degree. Only written prelims described in this handbook can be given.

After completing a written prelim course sequence students can, and should, take the exam even if they have not passed the Master's examination. Copies of previous written prelims and syllabi are available in the Graduate Studies office, 339 SEO.

To remain in good standing, a student who has completed the Master's degree and wishes to earn the PhD degree must take at least one written prelim each year.

Schedule
The written prelims are given at the end of the spring semester and the beginning of the fall semester (no later than the end of the third week of instruction). Students may petition the Graduate Studies Committee for a written prelim at any time during the academic year provided there are two faculty members who are willing to serve as examiners. Each written prelim exam lasts three hours and is based on a sequence of graduate courses.

Students who wish to take a spring exam must notify the Prelim Coordinator by the end of the third week of that semester. Those wishing to take a fall exam must notify the Prelim Coordinator no later than July 10.

Grading
Grades for a written prelim are 1(best), 2, 3, and 5(fail). Students may retake a written prelim repeatedly as long as the time limit is not exceeded. They may retain, without re-examination, a grade of 1 or 2. When a student's written prelim has been graded, the Prelim Coordinator will report the grade to the student and advisor. Written prelims are to be graded within two weeks of the exam date.

Doctoral Oral Examination
PhD students in the Probability and Statistics program must take a doctoral oral examination, and this should be done soon after completion of requirement 3 for the PhD degree.

The doctoral oral examination is administered in accordance with the Graduate College regulations on preliminary examinations. The head of the department appoints a committee, four members of which belong to the graduate faculty, to conduct the examination.

For PhD students, the committee must include the student's advisor, two examiners in the major areas of the written part of the preliminary examination, and one examiner in the minor area. If the student takes a minor course sequence in one or more other departments, then a member of one of them normally serves on the committee (see the doctoral minor requirement below).

The committee vote is pass or fail. The student being examined is not passed if there is more than one vote of fail. In this case the committee may recommend to the head of the department that a second exam be given. A third exam is not permitted.

Faculty are directed to Appendix 1 for further details concerning the doctoral preliminary examination.

Doctoral Minor Requirement
DA students must take an approved sequence of two 500-level courses in a minor subject area. PhD students must take such a sequence or a written prelim in a minor subject area. In any case, the minor area must not overlap an area in a cluster in which a major area lies.

If the area requirement is satisfied, students can use a 500-level two course sequence described in this Handbook as leading to a written prelim as a minor sequence (see Section 7). Students wishing to do this must inform the Director of Graduate Studies (*before*) taking it. Any other minor course sequence must be approved by the Director of Graduate Studies. The three area requirement is a breadth requirement.

A minor course sequence may be taken in one or more other departments. This is justifiable when the sequence is important to the student's (prospective) research area. However, students who take two written prelims in the Computer Science clusters (Combinatorics, Algorithms and Complexity, Computational Science) for the written part of the preliminary examination must take their minor in the department and not in the third Computer Science cluster.

Students who need approval of their minor course sequence are expected to submit a petition to the Director of Graduate Studies (*before*) taking it. Students may obtain a form from the Graduate Secretary outlining what is required for the petition:

1. A brief outline of the proposed minor program, including the proposed minor course sequence. The list may contain alternatives. A minor course sequence must consist of two 500-level courses.
2. A brief explanation of how the minor program is relevant to the student's major mathematical area.
3. Confirmation that the minor proposal is acceptable to the other department(s), if any.
4. Written approval of the student's advisor.

The two course grades earned in a minor course sequence are translated into the numerical grade for the minor requirement as follows:

two A's	1
one A and one B	2
two B's	3
all other combinations	5

Students who obtain an unsatisfactory numerical grade may repeat (once) one of these courses, or they may petition the Director of Graduate Studies to approve another minor course sequence.

For PhD students electing to take a written prelim to fulfill the minor requirement, the prelim grade is the numerical grade for the minor requirement.

Doctoral Thesis Examination

To obtain a doctoral degree, students must write a thesis acceptable to the department and pass an oral examination (defense) of their thesis. The student's thesis advisor, who must be a member of the graduate faculty, serves as chair of the thesis committee. The committee must have at least five members, at least three of whom are in the department and at least one of whom is not in the department. The committee must include three full members of the graduate faculty. The student's advisor recommends a thesis committee in consultation with the student.

After each member of the thesis committee receives a copy of the thesis, the advisor, in consultation with the committee, sets a date for the defense. Anyone may attend the thesis defense. Announcement of the thesis defense must be posted on the bulletin board, and the thesis must be available in the Mathematics Library, at least ten class days before the thesis defense.

The committee vote is pass or fail. The student being examined is not passed if there is more than one vote of fail.

Faculty are directed to Appendix 1 for further details concerning the examination and the thesis committee.

Language Requirement

PhD students in Pure Mathematics must demonstrate a reading proficiency in one of French, German, or Russian. To satisfy this requirement students may pass the standard Graduate School Foreign Language Test, pass German 400 with a grade of A or B, or pass a language examination given by the department. Students are encouraged to fulfill the language requirement as soon as possible so they can read foreign literature in their research area.

PhD students in programs other than Pure Mathematics have no language requirement.

The department's language examinations are arranged between the student and the examiner. Normally students will be asked to translate mathematical text in their area of interest. The examination is open book. Students may bring dictionaries, grammars, and notes of any kind to use. They may not consult others for help or refer to a pre-existing translation of the examination text (even if it is their own work). The duration of the examination is about one hour, at the discretion of the examiner. The length of the text to be translated is flexible. However, the shorter the text, the higher the standard of precision required. Performance is evaluated on comprehension of the subject matter. A translation may be linguistically free as long as it is mathematically precise. Grammatical mistakes will be weighted according to their impact on comprehension of the material.

Programs of Study Leading to the PhD Degree

Pure Mathematics

The principal subdivisions of Pure Mathematics represented in the department are Analysis, Algebra,

Number Theory, Geometry, Topology, and Logic and Universal Algebra. Students' program of doctoral study in Pure Mathematics should be planned in close consultation with their advisor and will depend on the students' mathematical interests and prospective research areas. At an early stage, the program should include 500-level course sequences leading to the two written prelims and to the fulfillment of the minor requirement. The areas need not all be in Pure Mathematics. Students may prepare for written prelims in the Pure Mathematics clusters by taking the indicated 500-level courses.

1. Algebra Cluster
   Math 516 Second Course in Abstract Algebra I
   Math 517 Second Course in Abstract Algebra II

2. Analysis Cluster

   Real Analysis:
   Math 533 Real Analysis I
   Math 534 Real Analysis II

   Complex Analysis:
   Math 535 Complex Analysis I
   Math 536 Complex Analysis II

3. Algebraic Topology Cluster
   Math 547 Algebraic Topology I
   Math 548 Algebraic Topology II

4. Logic and Universal Algebra Cluster

   Logic:
   Math 502 Metamathematics I

   and at least one of the following:

   Math 500 Recursion Theory I
   Math 504 Set Theory I
   Math 506 Model Theory I

   Universal Algebra:
   Math 509 Universal Algebra I
   Math 510 Universal Algebra II

The exam syllabi provide further information on the scope of the written prelims and on alternate preparatory courses.

Students' programs should not only lead to completion of the preliminary examination, minor, and language requirement, but should also progressively include advanced sequences and topics courses. The purpose of the latter is to expose them to possible research areas and to introduce them to potential thesis advisors.

Applied Mathematics
There are two related programs in Applied Mathematics leading to the PhD degree - Mathematical Science and Applications-Oriented Mathematics. These two programs provide frameworks for the study of mathematics and its interactions with science and engineering. In addition, the members of the applied mathematics group have interests in certain collateral areas. Current topics in these programs include:

Mathematical Science
Scattering theory, wave propagation, statistical mechanics, electrodynamics, acoustics, plasmas, magnetohydrodynamics, elasticity, critical phenomena, fluid mechanics, geophysical fluid dynamics, and

mathematical biology.

Applications-Oriented Mathematics
Asymptotics, perturbation theory, singular perturbations, stability theory, numerical procedures and estimations, stochastic processes, and stochastic control theory.

Collateral Areas
Scientific supercomputing, control theory, parallel computational control, parallel scheduling, stochastic modeling, queuing theory and computer performance evaluation, numerical analysis, and symbolic computation.

The department will also work with other departments on combined study programs and joint degrees to meet individual needs and special interests of students. The department's broad spectrum of activities includes group theory, classical and functional analysis, differential geometry and topology, statistics and probability, and computational science. Joint programs of any of these and Applied Mathematics may be arranged.

Students' programs of doctoral study in Applied Mathematics should be made in close consultation with an Applied Mathematics advisor and will depend upon their interests and research area. Programs should be arranged so that 500-level courses leading to the two written prelims and to the fulfillment of the minor requirement are taken early.

There are two Applied Mathematics clusters. Students may prepare for the written prelims in Applied Mathematics by taking the indicated courses.

5. Applications-Oriented Mathematics Cluster

Math 578	Asymptotic Methods
Math 579	Singular Perturbations

6. Mathematical Science Cluster (take two of the following three courses)

Math 574	Applied Optimal Control
Math 580	Introduction to the Mathematics of Fluid Dynamics
Math 586	Computational Finance

The doctoral minor requirement should be designed in consultation with an Applied Mathematics advisor and in accordance with the department regulations. The minor typically consists of a sequence of two 500 level courses either in the department or in an outside department. If the minor courses are in the department, the two courses may be chosen from the list issued by the Graduate Studies Committee. Typically these courses are required for one of the preliminary examinations in clusters outside of applied mathematics, such as Combinatorics, Algorithms and Complexity, Computational Science, Analysis, etc. Any other sequence of the department's courses or courses in an outside department must be approved in advance by the Director of Graduate Studies. A minor in an outside department is recommended for students interested in a specific application area such as plasma physics, fluid dynamics, elasticity, scattering, or neuroscience

Mathematical Computer Science
The department offers advanced graduate level work in a number of areas within mathematical computer science and computer-related mathematics. A special strength of the department is the application of computers in various areas of mathematics. Students interested in both computer science and mathematics should find the program especially attractive.

There are three Computer Science clusters. Students may prepare for the written prelims in Computer Science by taking the indicated courses.

7. Combinatorics Cluster

MCS 521	Combinatorial Optimization
MCS 531	Error-Correcting Codes
MCS 591	Advanced Topics in Combinatorial Theory

8. Algorithms and Complexity Cluster

MCS 501	Computer Algorithms II

and one of the following:

MCS 541	Computational Complexity
MCS 542	Theory of Computation II.

9. Computational Science Cluster

Symbolic and Numerical Computing

MCS 571	Numerical Methods for Partial Differential Equations
MCS 590	Advanced Topics in Computer Science (Database Computing)

and one of the following:

MCS 561	Algebraic Symbolic Computation
MCS 563	Analytic Symbolic Computation.

High Performance Computing

MCS 571	Numerical Methods for Partial Differential Equations
MCS 572	Introduction to Supercomputing
MCS 575	Computer Performance Evaluation.

Advanced work is offered in areas other than those listed above. These include automatic theorem proving, compiler design, cryptography, computational number theory, database computing, database theory, parallel computational control, parallel programming tools, and programming language design.

Students may also take courses offered by the department of Electrical Engineering and Computer Science (EECS).

Probability and Statistics.
Students with concentration in Probability, Statistics, and Operations Research take an initial program of courses in probability, statistics, and optimization techniques. After completing this program students have three broad directions of research open to them: applied statistics, operations research, and theoretical statistics. Students are encouraged to become familiar with some areas of the natural sciences, engineering, or the social sciences for statistical applications.

A variety of both applied and theoretical research topics is offered to meet current interests of graduate students. This is reflected in the list of written prelim options (a) - (c) listed below.

10. General Topics Cluster

a. Probability, Statistics, and Operations Research

Stat 501	Probability Theory I

and one of the following:

Stat 511	Advanced Statistical Theory I
Stat 571	Non-cooperative Games

11. Special Topics Cluster

b. Linear Inference, Sampling, and Design

Stat 521	Linear Statistical Inference

and one of the following:

Stat 522	Multivariate Statistical Analysis
Stat 531	Sampling Theory I
Stat 535	Optimal Design Theory I

c. Operations Research

Stat 577	Reliability Theory
Stat 591	Advanced Topics in Statistics, Probability, and Operation Research

Requirements for the Doctor of Arts degree

Students in the department's DA program study major areas of mathematics, and study and do research in the methodology and techniques that make for successful teaching in mathematics. The program is still evolving. The DA Committee will give serious consideration to alternative ways of fulfilling requirements. The course requirements for the Doctor of Arts degree reflect a broad selection of the courses offered by the department to expose the DA student to the full variety of topics taught at the undergraduate level. The DA dissertation must be a scholarly and substantive investigation of a topic in mathematics or mathematics education. The DA dissertation should be of publishable quality.

The requirements for the **DA degree in Mathematics, Statistics, and Computer Science** are:

1. Fulfill the Graduate College requirements pertaining to the DA degree

2. Earn the Master of Science degree from the department with a high pass on the department's written Master's Examination, or with a high pass on a Master's thesis and oral defense; or, if from another program, satisfy the equivalent.

3. Earn at least 96 semester hours of credit beyond the baccalaureate distributed as follows:

   a. Breadth in Mathematics. 40 semester hours, at least 24 of which are regular 500-level courses, which include complex analysis with applications, introduction to topology, abstract algebra, and real analysis. Five semester courses must be chosen so that the areas of computer science, differential equations, geometry, logic, and probability and statistics are all represented.

   b. Related Science/Minor. 8 semester hours in an area of mathematics or a related science, such as physics, philosophy, history of science, chemistry, or another science approved by the department (this is to be the doctoral minor sequence).

   c. Education and Mathematics Education. 12 semester hours comprised of the department's DA sequence 591, 592 and one of the following (advisor approved) courses: DA 502, 504, 505 and 506 (which are EPsy 554, 555, 556 and 557 respectively).

   d. Electives. 16 semester hours of coursework normally restricted to mathematics and/or

science.

e. Thesis. 20 semester hours of thesis research (Math 599, MCS 599 or Stat 599).

4. Pass the doctoral written examination, and fulfill the doctoral minor requirement in the following manner:

   a) the sum of the grades for the written examination must be at most 4, **and**

   b) the sum of the numerical grade for the minor requirement and the sum of the grades for the written examination must be at most 6.

5. Practicum. The DA candidate is expected to demonstrate accomplishment as a teacher of undergraduate mathematics. The teaching practicum is required of each candidate and will consist of a program that develops these skills under the guidance of University faculty. Suggested possibilities for satisfying the practicum are: teach one semester of "reform curriculum" undergraduate courses (for example reform calculus) aided by a faculty mentor; team teach an advanced undergraduate course with a faculty sponsor; teach a standard undergraduate course with effort devoted to developing new course materials for it (for example course worksheets or computer laboratory modules).

6. Complete a thesis acceptable to the department and pass the thesis examination (defense).

The doctoral preliminary examination, written prelims, minor requirement, and thesis examination are discussed in Section 7. Note that the preliminary examination must be passed within one year of completion of 60 semester hours and the practicum.

To arrange the practicum, students submit to the DA Committee, after consultation with their advisor, a practicum proposal and nominations of three faculty members (with designated chairman) to supervise the practicum and evaluate the student's performance. Students who have teaching experience may request a proficiency examination to satisfy the practicum requirement.

Courses in economics and statistical methods in psychology and education may, under certain conditions, be used in fulfilling requirement 3e).

DA students cannot formally begin thesis work until they have passed the doctoral preliminary examination and fulfilled the doctoral minor requirement. The DA thesis must make an original, creative and scholarly contribution to the teaching of college mathematics and can be any one of the following:

a. an expository and/or historical treatment of a mathematical topic, making a contribution to the teaching of mathematics.

b. a two part thesis consisting of an expository and/or historical part as in a) but on a smaller scope, and an instructional part in which mathematical course material is created and evaluated. (The instructional part may be an outgrowth of the practicum. The two parts are not required to involve the same mathematical topics, although this is desirable.)

c. a research study in the area of mathematics education.

Before starting to work on a dissertation, a DA student must submit a formal thesis proposal to the Doctor of Arts Committee for approval. The student must submit the proposal within six months after passing the doctoral preliminary examination.

DA students are initially advised by the chair of the DA Committee. DA students have the responsibility of finding a thesis advisor from the department. DA students should prepare a thesis proposal (of perhaps two pages) and nominations for a thesis committee.

Students are to pass the department's written Master's Examination within one year of completion of 24 semester hours of credit. The MST degree or an equivalent is not sufficient for requirement 2.

The Doctor of Arts Cluster can be used for the written part of a doctoral preliminary examination by DA students only. Permission is required.

12. Doctor of Arts Cluster

    Mathematics Education
    History of Mathematics

To use an area in the Doctor of Arts cluster as a major subject area, students must petition the Doctor of Arts Committee. Their petitions should outline a course of study - in particular contain reading list or a detailed description of materials involved.

8. THE ADVISING SYSTEM

Role of the Advisor
Students are ultimately responsible for planning their program of study and for meeting all requirements. All students will have an advisor whose role is to assist them in making the best possible academic decisions. Each semester it is essential for students to confer with their advisor in selecting coursework and to receive their advisor's approval of their study plan.

There are other resources that need to be used in program planning in addition to this Handbook and the Graduate College catalog. Each year the department issues a description of its 500-level courses to be offered during the next academic year. This document is distributed in the middle of the spring semester in time for fall pre-registration. Most 500-level sequences begin fall semester. Programs must be planned with departmental examinations in mind.

Students are expected to be *thoroughly prepared* when they meet with their advisor, to be completely familiar with the requirements of their program, and also to have thought out their course of study as completely and carefully as possible. In particular, students should be prepared to answer any questions about their academic record. Students should take the Graduate College catalog, the department's Graduate Handbook, the department's list of 500-level courses for the academic year, and the Timetable for the next term to planning sessions with their advisor.

The Director of Graduate Studies keeps a form in each student's file that lists courses taken and examinations passed. Students update their form each year. The Director of Graduate Studies must know at all times who the students' advisors are. Students have the responsibility of keeping the Director of Graduate Studies so informed.

As mentioned before, the Director of Graduate Studies is the initial academic advisor to non-degree students and new students who are admitted into the PhD program without a Master’s degree. The Director of Graduate Studies serves as an academic advisor to others only on a temporary basis under exceptional circumstances.

Master's Program Advisors
Each of the department's four major areas usually has a single faculty advisor for all Master's students in that area. There are special faculty advisors for MST students.

Doctoral Program Advisors
Students who are entering the department's doctoral program must find a faculty member who will serve as their initial advisor (not necessarily as their thesis advisor). This must be done as soon as possible, and in any case by the end of the first semester in the program. If necessary the Director of Graduate Studies will

assist them in finding an initial advisor. The role of the initial advisor is to guide students through the formal non-thesis portion of the program including the written preliminary examination, the language requirement (applies to Pure Mathematics students only), the minor course sequence, etc. These advisors should play an important role in the selection of thesis advisors.

Doctoral students who have passed the preliminary examination must find a thesis advisor. In exceptional situations a student may choose a thesis advisor outside the department. The Graduate Studies Committee must approve the arrangement in this case, and in addition, the student must find a co-advisor within the department. All candidates for the PhD degree must have a thesis advisor who is a member of the graduate faculty.

The thesis advisor has the primary responsibility for directing the student's thesis. After students have begun their thesis research, they should find one or two faculty members who will serve as associate advisors, and give their names to the Director of Graduate Studies. Students should discuss their research periodically with their associate advisors whose role is to give helpful suggestions. Thesis students should feel free to consult any faculty member in connection with thesis work.

9. DETAILS OF COURSE REGISTRATION AND OTHER INFORMATION

Course Registration and Changes
All course registrations and subsequent changes (adds and drops) *must* be approved by the student's advisor.

It is very important for students to pre-register for the graduate courses they intend to take. The department usually cancels its 500-level courses with low pre-registration. Students may not be able to enroll in oversubscribed computer science courses if they do not pre-register for them.

It is a Graduate College rule that a course may not be added after the tenth day of instruction of a sixteen-week semester (after the sixth day of instruction of the eight-week summer session). It is a LAS College rule that LAS courses cannot be dropped or sections changed after the tenth day of instruction of the sixteen-week semester (the Graduate College rule is that no course can be dropped after the end of the sixth week). After the Graduate College deadlines students must petition the Graduate College to add or drop a course. The department will support such a petition only if there is a very good reason for these changes in registration.

Course Load
A full-time course load is 12 or 16 semester hours (3 or 4 courses). Students granted a Tuition and (Service) Fee Waiver must complete a certain number of hours of coursework during the term of their award: 12 hours for semester awards and 6 hours for awards for the summer session. There are no exceptions to this rule. Students holding a Teaching Assistantship must register for a minimum number of hours each term of their award: 12 per semester and 4 for the summer session. Exceptions to this rule are considered by the Director of Graduate Studies. Students holding fellowships must complete 12 hours of course work each semester of their award and complete 6 hours during the summer session if they hold the fellowship during the summer.

It is Graduate College policy that graduate students are not permitted to register for more than 20 hours of coursework a term. They may register for more than a full-time course load *only* with the permission of their advisor and the Director of Graduate Studies.

Application for Graduation
Students are expected to notify the Director of Graduate Studies well in advance of the time they anticipate receiving a degree. There is an Application for Graduation form that must be signed by the Director of Graduate Studies and turned in to the Graduate College Office by the specified deadline. Students who intend to graduate are to make an appointment to obtain the signature of the Director of Graduate Studies and to verify that all of their requirements should be met in time for graduation. Master’s degree students

must complete the requirements within 5 years; doctoral students with prior master's degree must complete the requirements within 7 years; a period of 9 years is allowed for doctoral students without a previous master's degree. Students who do not graduate by these deadlines will be dismissed from the Graduate College for failure to progress.

Special Courses
There are special courses for more advanced students.

Reading and Research/seminar courses. These are used as reading courses or as a means of giving course credit for seminar participation. Students make arrangements for faculty supervision and report this to their advisor. Advanced graduate students are expected to take a reading and research/seminar course every semester.

It is departmental policy that a reading and research/seminar course not to be used as a reading course if a regular section of the course is given the same semester. Research/seminar courses are meant to encourage active participation in seminars. The degree of participation required is left to the discretion of the supervising faculty member.

Thesis research (Math 599, MCS 599 and Stat 599). As noted earlier, before completing requirements 2-5 for the PhD degree, doctoral students in the PhD program cannot take more than four hours of thesis research per semester. After candidates complete these requirements, they must register for at least 12 semester hours of thesis research each semester, except for the summer session, until their thesis has been accepted. However, candidates who do not hold a Fellowship, Assistantship, or a Tuition and Fee Waiver may petition the Graduate College (see the catalog of the Graduate College for details) for permission to:

1. Register for zero credit in Math 599, MCS 599 or Stat 599 each semester, except for the summer session, until the degree is awarded; **OR**

2. Pay a single dissertation fee in lieu of further registration.

Restricted Courses
Some courses are applicable only to the Elementary Option of the MST degree or the Secondary Teacher Option of the MST degree. Courses with the MthT rubric may not be applied to the MS, PhD, and DA degrees. Students interested in switching programs, or doing work in more than one, should consult the Director of Graduate Studies and the Office of Mathematics Education.

The list of restricted courses is subject to revision. Consult the Director of Graduate Studies for its current status.

Incomplete Grades (IN)
The grade of incomplete is for genuine emergencies. It may be given only if, for reasons beyond a student's control, required work has not been completed by the end of the semester. Generally a grade of incomplete must be removed by the end of the subsequent term. See the Graduate College catalog for details. Students and their advisors are responsible for seeing that grades of incomplete are removed promptly. When the grade of incomplete is given, students and their teacher must have a clear understanding of how and when the incomplete is to be removed.

Transfer of Credit
Graduate work completed at other accredited institutions, or completed by UIC undergraduates during the senior year, may be transferred to apply to a graduate degree at UIC. No transfer is automatic, and the work to be transferred must not have been used for a degree. A special petition must be made to the Graduate College for transfer of credit. The Director of Graduate Studies signs this petition on approval of the student's advisor.

Removal of Limited Status
Sometimes students are admitted to the Graduate College on limited status because of a low grade point average or other entrance requirement deficiencies. When students are admitted on limited status, the Director of Graduate Studies sends them a letter outlining the conditions that must be met in order to be granted full standing. When students on limited status meet the conditions, they are to notify the Director of Graduate Studies who in turn will request that the Graduate College change their status to full standing. If the conditions are not met by the specified deadlines, the students' advisor will recommend to the Director of Graduate Studies that they be dropped or extended deadlines be granted.

Leave of Absence and Off-semester Vacation
Students should refer to the catalog of the Graduate College for information regarding a leave of absence or vacations. If a student wishes a semester leave which requires Graduate College approval, the leave must be recommended by the department. In any event the Director of Graduate Studies must be aware of students' plans for semester leaves in advance. Application for readmission is usually not necessary after returning from approved leaves.

Mathematics Library
The Mathematics Library, conveniently located on the fourth floor of SEO, contains the major portion of the University's mathematics holdings. Its books and journal collection are a valuable research asset. Materials reserved for the department's 500-level courses are held there as well as sample examinations. The Mathematics Library is a branch of the Main Library.

Mathematics Graduate Student Association (MGSA)
All graduate students admitted to the department on a regular basis are automatically members of the Mathematics Graduate Student Association (MGSA). The purpose of the association is to promote the interests of the graduate students in the department.

The Association has a program to orient and assist graduate students new to the department; provides a forum for exchanging ideas and information; encourages fellowship among graduate students and faculty through a series of on and off campus social events; and provides appropriate communication channels between itself and departmental structures for handling student grievances.

An officer of the Association attends Graduate Studies Committee meetings to represent the Association and keep graduate students informed of relevant proceedings.

Suggestions and Concerns
Suggestions for improving the department's graduate programs, or complaints about them, should be communicated to the Director of Graduate Studies. Students are also encouraged to voice their ideas and concerns to MGSA.

A complaint concerning a course grade should first be discussed with the professor. Students who are still dissatisfied can then take the matter to the department's Student Grievance Committee.

Complaints concerning departmental examinations should be communicated to the Director of Graduate Studies.

The Colloquium
The colloquium provides an excellent and an easy opportunity for graduate students and faculty to expand their mathematical horizons. Over the course of the academic year colloquium speakers lecture on many different aspects of mathematics, statistics, and computer science. For these reasons graduate students are encouraged to attend as many colloquia as possible, as well as the Colloquium tea preceding the lecture.

Appendix 1 - To the Faculty

Faculty who advise graduate students need to be as familiar with this Handbook and the Graduate College catalog as graduate students are expected to be. It is a Graduate College rule that **students must have an advisor** in the program in which their degree work is done. The department's advising system is described in Section 8, its degree programs are described in great detail in Section 7, and Section 9 in part deals with the mundane but important matters of course registration, course load, and program changes. It would be helpful if advisors kept records of their advisees' registrations and changes.

Each degree has certain course restrictions. See the Restricted Courses paragraph of Section 9 for details. The Director of Graduate Studies keeps a form in each student's file listing courses taken and examinations passed. This form could be very useful for advising. The Director of Graduate Studies can be consulted on policy and procedural matters.

Faculty members appointed as written prelim examiners are responsible for setting, administering and grading the exams and are normally responsible for both the spring exam and the fall exams.

PhD students who are required to take the doctoral oral preliminary examination are expected to do so soon after completing requirement 3 for the PhD degree. It is strongly advised that "soon" be interpreted as meaning “within several weeks” and certainly “within a semester”.

The doctoral oral preliminary examination committees are appointed by the head of the department. An examination cannot be given before the head formally appoints the committee. The head expects committee recommendations to be routed through Director of Graduate Studies at least three weeks in advance of the proposed examination date. The committee chair is responsible for conducting the examination and preparing the official form for reporting the results of the examination to the Graduate College.

The Doctor of Arts Committee will report its decision on a student petition to the Graduate Studies Committee within two weeks of when the decision is made.

Committees which conduct Master's thesis examinations or the doctoral thesis examinations are appointed by the Dean of the Graduate College after receiving departmental recommendation. An examination can not be given before the Dean formally appoints the committee. Currently the Graduate College expects committee recommendations to be made at least three weeks in advance of the proposed examination date. Committee proposals are to be routed through the Director of Graduate Studies. The committee chair is responsible for conducting the examination and preparing the official form for reporting the results of the examination to the Graduate College.

The thesis committee is proposed by the student's advisor, after consultation with the student. The department recommends the thesis committee to the Dean on approval of the Director of Graduate Studies and the head. The chair of the thesis committee (the student's advisor) is responsible for seeing that the thesis is available in the Mathematics Library, and that announcement of the thesis defense is posted on the bulletin board, at least ten class days in advance of the thesis examination. Anyone may attend the thesis defense.

Faculty are also referred to the sections of the catalog of the Graduate College which deal with the preliminary examination, Master's thesis examination and the dissertation defense.

Appendix 2 - Current 400 and 500 level Mathematics Courses

Mathematics (Math) Prefix

Math	Title	Hours
410	Advanced Calculus I	4
411	Advanced Calculus II	4
413	Analysis I	4
414	Analysis II	4
417	Complex Analysis With Applications	4
419	Models in Applied Mathematics	4
421	Modern Partial Differential Equations	4
425	Linear Algebra II	4
427	Analysis in Several Variables	4
430	Formal Logic I	4
435	Foundations of Number Theory	4
436	Number Theory for Applications	4
440	Introduction to Higher Geometry	4
442	Differential Geometry of Curves and Surfaces	4
445	Introduction to Topology I	4
446	Introduction to Topology II	4
480	Applied Differential Equations	4
481	Applied Partial Differential Equations	4
484	Tensor Analysis	4
494	Special Topics in Mathematics	4
496	Independent Study	1-4
500	Recursion Theory I	4
502	Metamathematics I	4
503	Metamathematics II	4
504	Set Theory I	4
506	Model Theory I	4
507	Model Theory II	4
508	Lattice Theory	4
509	Universal Algebra I	4
510	Universal Algebra II	4
512	Advanced Topics in Logic	4
513	Advanced Topics in Universal Algebra and Lattice Theory	4
514	Number Theory I	4
515	Number Theory II	4
516	Second Course in Abstract Algebra I	4
517	Second Course in Abstract Algebra II	4
518	Representation Theory	4
519	Algebraic Groups	4
520	Homological Algebra	4
530	Advanced Topics in Number Theory	4
531	Advanced Topics in Algebra	4
532	Advanced Topics in Finite Groups	4
533	Real Analysis I	4
534	Real Analsysis II	4
536	Complex Analysis II	4
537	Introduction to Harmonic Analysis I	4
538	Introduction to Harmonic Analysis II	4

Math	Title	Hours
539	Functional Analysis I	4
540	Functional Analysis II	4
541	Partial Differential Equations I	4
542	Partial Differential Equations II	4
546	Advanced Topics in Analysis	4
547	Algebraic Topology I	4
548	Algebraic Topology II	4
549	Differentiable Manifolds I	4
550	Differentiable Manifolds II	4
551	Riemannian Geometry	4
552	Algebraic Geometry I	4
553	Algebraic Geometry II	4
554	Complex Manifolds I	4
555	Complex Manifolds II	4
568	Topics in Algebraic Topology	4
569	Advanced Topics in Geometric and Differential Topology	4
570	Advanced Topics in Differential Geometry	4
571	Advanced Topics in Algebraic Geometry	4
572	Advanced Topics in Geometric Analysis	4
573	Methods of Applied Mathematics	4
574	Applied Optimal Control	4
575	Integral Equations and Applications	4
576	Boundary Value Problems	4
577	Advanced Applied Partial Differential Equations	4
578	Asymptotic Methods	4
579	Singular Perturbations	4
580	Introduction to the Mathematics of Fluid Dynamics	4
581	Selected Topics in Fluid Dynamics	4
582	Wave Propagation and Scattering I	4
583	Wave Propagation and Scattering II	4
584	Applied Stochastic Models	4
585	Applied Deterministic Models	4
586	Computational Finance	4
589	Teaching and Presentation of Mathematics	2
590	Advanced Topics in Applied Mathematics	4
591	Seminar on Mathematics Curricula	4
592	Seminar on Mathematics: Philosophy and Methodology	4
593	Graduate Student Seminar	1
595	Research Seminar	1
596	Independent Study	1-4
598	Master's Thesis	0-16
599	Thesis Research	0-16

Mathematics and Computer Science (MCS) Prefix

MCS	Title	Hours
401	Computer Algorithms I	4
411	Compiler Design	4
415	Programming Language Design	4
421	Combinatorics	4
423	Graph Theory	4
425	Codes and Cryptography	4
441	Theory of Computation I	4

MCS	Title	Hours
471	Numerical Analysis	4
481	Computational Geometry	4
494	Special Topics in Computer Science	4
496	Independent Study	1-4
501	Computer Algorithms II	4
503	Mathematical Methods for Algorithm Analysis	4
504	Mathematics and Information Science for Industry Workshop	4
507	Mathematical, Statistical and Scientific Software	4
521	Combinatorial Optimization	4
531	Error-Correcting Codes	4
541	Computational Complexity	4
542	Theory of Computation II	4
545	Advanced Complexity Theory	4
547	Theory of Parallel Computation	4
548	Mathematical Theory of Artificial Intelligence	4
563	Analytic Symbolic Computation	4
565	Mathematical Theory of Databases	4
571	Numerical Methods for Partial Differential Equations	4
572	Introduction to Supercomputing	4
575	Computer Performance Evaluation	4
590	Advanced Topics in Computer Science	4
591	Advanced Topics in Combinatorial Theory	4
592	Advanced Topics in Error-Correcting Codes	4
593	Graduate Student Seminar	1
595	Graduate Seminar	1
596	Independent Study	1-4
597	MISI Master's Project	2-4
598	Master's Thesis	0-16
599	Thesis Research	0-16

Statistics (Stat) Prefix

Stat	Title	Hours
401	Introduction to Probability	4
411	Statistical Theory	4
416	Nonparametric Statistical Methods	4
431	Introduction to Survey Sampling	4
461	Applied Probability Models I	4
462	Applied Probability Models II	4
471	Linear and Non-Linear Programming	4
473	Game Theory	4
477	Introduction to Reliability Theory	4
481	Applied Statistical Methods II	4
486	Statistical Consulting	4
494	Special Topics in Statistics, Probability, and Operations Research	4
496	Independent Study	1-4
501	Probability Theory I	4
502	Probability Theory II	4
511	Advanced Statistical Theory I	4
512	Advanced Statistical Theory II	4
521	Linear Statistical Inference	4
522	Multivariate Statistical Analysis	4
531	Sampling Theory I	4

Stat	Title	Hours
532	Sampling Theory II	4
535	Optimal Design Theory I	4
536	Optimal Design Theory II	4
571	Non-Cooperative Games	4
572	Cooperative Game Theory	4
575	Optimization Methods in Matrices	4
577	Reliability Theory I	4
591	Advanced Topics in Statistics, Probability, and Operations Research	4
593	Graduate Student Seminar	1
595	Research Seminar	1
596	Independent Study	1-4
598	Master's Thesis	0-16
599	Thesis Research	0-16

Mathematics Teaching (MthT) Prefix

MthT	Title	Hours
400	Methods of Teaching Secondary Mathematics I	4
401	Methods of Teaching Secondary Mathematics II	4
410	Advanced Euclidean Geometry I	4
411	Advanced Euclidean Geometry II	4
420	Methods of Structured Programming I	4
425	Computers in Secondary Education	4
430	Mathematical Analysis for Teachers I	4
435	Abstract Algebra	4
438	Educational Practice with Seminar I	6
439	Educational Practice with Seminar II	6
450	Concepts in Elementary School Mathematics	4
460	Geometric Measurement and Numerical Methods	4
465	Teaching Algebra for Understanding	4
466	Introduction to Calculus and Graphing Calculator	4
467	Introduction to Number Theory with Application	4
468	Geometry with Applications for Middle Grade Teachers	4
470	Teaching Mathematics with Science: An Activity Approach I	4
480	Microcomputers in Elementary School Mathematics I	4
490	Topics in Teaching Secondary Mathematics	1-5
491	Topics in Teaching Elementary/Junior High School Mathematics	1-5
496	Independent Study	1-4
510	Introduction to Higher Geometry	4
530	Mathematical Analysis for Teachers II	4
550	Concepts in Elementary School Mathematics II	4
560	Introduction to Analytic Geometry and Calculus	4
565	Teaching Geometry: An Activity Approach	4
570	Teaching Mathematics with Science: An Activity Approach II	4
575	Principles of Probability and Statistics	4
580	Microcomputers in Elementary School Mathematics II	4
589	Practicum in Teaching Elementary School Mathematics	4
590	Topics in Teaching Secondary Mathematics	1-5
591	Topics in Teaching Elementary/Junior High School Mathematics	1-5
592	Topics in Advanced Mathematics for Teachers	1-5
596	Independent Study	1-4