

GRADUATE HANDBOOK

2011-2012

(Revised 01-17-12)

University of Illinois at Chicago

**DEPARTMENT OF MATHEMATICS, STATISTICS, AND
COMPUTER SCIENCE**

www.math.uic.edu/gradstudies

2011-2012 Graduate Handbook
Department of Mathematics, Statistics, and Computer Science
University of Illinois at Chicago
(revised 01-17-12)

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1. GRADUATE PROGRAM OFFICERS

Department Head	Lawrence Ein
Associate Head for Instruction	Jan Vershelde
Director of Graduate Studies	Brooke Shipley
Assistant Director of Graduate Studies	Kari Dueball

Important Addresses

1. MSCS Graduate Studies offices

Department of Mathematics, Statistics, and Computer Science (MC 249)

Phone: 312/996-3041; Fax: 312/996-1491

Office Location: 339, 341 Science Engineering Office Bldg (SEO), 851 South Morgan Street

E-mail: dgs@math.uic.edu

Web address - <http://www.math.uic.edu/gradstudies>

2. Office of Graduate Admissions (MC 018)

Phone: 312/996-4350; Fax: 312/413-7628

Office Location: 1100 Student Services Bldg (SSB), 1200 West Harrison Street

E-mail: uicadmit@uic.edu

Web address - <http://www.uic.edu/depts/oar>

3. Graduate College (MC 192)

Phone: 312/413-2550; Fax: 312/413-0185

Office Location: 612 University Hall (UH), 601 South Morgan Street

E-mail address: gradcoll@uic.edu

Web address – <http://www.uic.edu/depts/grad>

4. Office of International Service (MC 326)

Phone: 312/ 996-3121; Fax: 312/ 996-9432

Office Location: 1220 Student Services Building (SSB), 1200 West Harrison Street

Email address: ois@uic.edu

Web address – <http://www.ois.uic.edu>

2. DEPARTMENT OF MATHEMATICS, STATISTICS, AND COMPUTER SCIENCE (MSCS)

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 Department of Mathematics, Statistics, and Computer Science belongs to the American Mathematical Society's Group I leading research mathematics departments in the country. MSCS has more than 50 research faculty, including 15 Sloan Foundation Fellows and 11 CAREER Scholars (or Presidential Scholars). Five of the senior faculty have been invited to address the International Congress of Mathematicians.

The Department offers graduate degree programs to 175 graduate students in the areas of Pure Mathematics, Applied Mathematics, Mathematical Computer Science, Probability and Statistics, and Mathematics Education. The MS (Master of Science), PhD (Doctor of Philosophy), MST (Master of Science in Teaching of Mathematics), and the DA (Doctor of Arts) degrees can be earned.

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. The Department averages 12 announced research seminars each week which bring eminent mathematicians, computer scientists, and statisticians to campus. It has held Emphasis Years in Computer Mathematics, Combinatorics and Complexity, Geometry and Topology, Partial Differential Equations, and Logic.

There is a productive interaction with other mathematics departments in the metropolitan Chicago area, in particular with the University of Chicago and Northwestern University. 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 which provides consulting services for academic and administrative units of the University.

The Department has an active program in Mathematics 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.

3. MSCS RESEARCH FACULTY BY AREA

Faculty working in several areas are listed below in each of their research areas.

Algebra

Alina Carmen Cojocaru, PhD, Queen's University, 2002. Number theory, elliptic curves modular forms, sieve methods.

Michael Greenblatt, PhD, Princeton University, 1998. Resolution of singularities in analysis, oscillatory integrals, radon transforms.

Daniel Groves, PhD, University of Oxford, 2000. Group theory and generalizations, manifolds and cell complexes.

Olga Kashcheyeva, PhD, University of Missouri-Columbia, 2003. Algebraic geometry and commutative algebra.

Mark O'Brien, PhD, Tufts University, 2007. Geometric group theory, algebraic topology, group theory.

Ramin Takloo-Bighash, PhD, Johns Hopkins University, 2001. Number theory, dynamical systems and ergodic theory, and algebraic geometry.

Analysis

Alexey Cheskidov, PhD, Indiana University, 2004. Nonlinear PDE, fluid dynamics, and infinite-dimensional dynamical systems.

Laura DeMarco, PhD, Harvard University, 2002. Dynamical systems and ergodic theory, several complex variables and analytic spaces.

Shmuel Friedland, D.Sc, Technion (Israel), 1971. Matrix theory and its applications.

Michael Greenblatt, PhD, Princeton University, 1998. Resolution of singularities in analysis, oscillatory integrals, radon transforms.

Irina Nenciu, PhD, California Institute of Technology, 2005. Integrable systems, random matrices and mathematical physics.

Roman Shvydkoy, PhD, University of Missouri-Columbia, 2001. Fluid mechanics, topology.

Zbigniew Slodkowski, D.Sc, Warsaw, 1981. Several complex variables.

Stefan Wenger, PhD, ETH Zurich, 2004. Differential geometry.

Jie Yang, PhD, University of Chicago, 2006. Financial mathematics, cluster analysis, discriminant analysis, spatial statistics, dimension reduction.

Applied Mathematics

Rafail Abramov, PhD, Rensselaer Polytechnic Institute, 2002. Chaotic dynamical systems with many conserved quantities, information theory-based predictability, numerical methods and computational algorithms.

Jerry Bona, PhD, Harvard University, 1971. Fluid mechanics, partial differential equations, numerical analysis, mathematical economics, oceanography.

Alexey Cheskidov, PhD, Indiana University, 2004. Nonlinear PDE, fluid dynamics, and infinite-dimensional dynamical systems.

Melvin Heard, PhD, Purdue University, 1967. Partial integro-differential equations.

Charles Knessl, PhD, Northwestern University, 1986. Perturbation methods, stochastic models, queuing theory.

Irina Nenciu, PhD, California Institute of Technology, 2005. Integrable systems, random matrices and mathematical physics.

Dave Nicholls, PhD, Brown University, 1998. Fluid mechanics, electromagnetics, acoustics, numerical analysis, partial differential equations, scientific computation.
Christian Rosendal, PhD, University of Paris, 2003. Mathematical logic and foundations.
Roman Shvydkoy, PhD, University of Missouri-Columbia, 2001. Fluid mechanics, topology.
Christof Sparber, PhD, University of Vienna, 2004. Quantum mechanics, nonlinear wave propagation, analysis of multiscaled problems.

Combinatorics

John Lenz, PhD, University of Illinois at Urbana-Champaign, 2011. Combinatorics and graph coloring, all areas of computer science.
Dhruv Mubayi, PhD, University of Illinois at Urbana-Champaign, 1998. Combinatorics.
Gyorgy Turan, PhD, Attila Jozsef (Hungary), 1982. Complexity theory, logic, combinatorics.

Computer Science

John Lenz, PhD, University of Illinois at Urbana-Champaign, 2011. Combinatorics and graph coloring, all areas of computer science.
Gyorgy Turan, PhD, Attila Jozsef (Hungary), 1982. Complexity theory, logic, combinatorics.
Jan Verschelde, PhD, Katholieke (Belgium), 1996. Computational algebraic geometry, combinatorial and polyhedral methods.

Ergodic Theory and Dynamical Systems

Laura DeMarco, PhD, Harvard University, 2002. Dynamical systems and ergodic theory, several complex variables and analytic spaces.
Shmuel Friedland, D.Sc, Technion (Israel), 1971. Matrix theory and its applications.
Alexander Furman, PhD, Hebrew, 1996. Ergodic theories, dynamical systems, Lie groups.
Steven Hurder, PhD, University of Illinois at Urbana-Champaign, 1980. Differential topology, theory of foliations.
ChongGyu (Joey) Lee, PhD, Brown University, 2010. Algebraic number theory, dynamical systems, cryptography.
Iddo Samet, PhD, Hebrew University, 2011. Lie groups, lattices, and group actions.

Geometry and Topology

Marc Culler, PhD, University of California-Berkeley, 1978. Low-dimensional topology, group theory, three manifolds.
David Dumas, PhD, Harvard University, 2004. Teichmuller theory, Kleinian Groups, and hyperbolic geometry.
Daniel Groves, PhD, University of Oxford, 2000. Group theory and generalizations, manifolds and cell complexes.
Steven Hurder, PhD, University of Illinois at Urbana-Champaign, 1980. Differential topology, theory of foliations.
Louis Kauffman, PhD, Princeton University, 1972. Differential topology, knot theory of singularities.
Mark O'Brien, PhD, Tufts University, 2007. Geometric group theory, algebraic topology, group theory.
Peter Shalen, PhD, Harvard University, 1972. Low dimensional topology, group theory.
Brooke Shipley, PhD, Massachusetts Institute of Technology, 1995. Algebraic topology, homological algebra.
Stefan Wenger, PhD, ETH Zurich, 2004. Differential geometry.

Kevin Whyte, PhD, University of Chicago, 1998. Geometry of groups and group actions.

Logic

David Marker, PhD, Yale University, 1983. Model theory and applications to algebra.

Christian Rosendal, PhD, University of Paris, 2003. Mathematical logic and foundations.

Lynn Scow, PhD, University of California-Berkeley, 2010. Model theory.

Mathematics Education

Alison Castro Superfine, PhD, University of Michigan, 2006. Mathematics education, teacher professional development.

Danny Martin, PhD, University of California-Berkeley, 1997. Mathematics education.

Mara Martinez, PhD, Tufts University, 2008. Teaching of algebra and proof, mathematics education.

Dhruv Mubayi, PhD, University of Illinois at Urbana-Champaign, 1998. Combinatorics, extremal problems on graphs and hypergraphs with applications to theoretical computer science.

Philip Wagreich, PhD, Columbia University, 1967. Algebraic geometry, discrete groups, mathematics education.

Kevin Whyte, PhD, University of Chicago, 1998. Geometry of groups and group actions.

Number Theory and Algebraic Geometry

Alina Carmen Cojocaru, PhD, Queen's University, 2002. Number theory, elliptic curves modular forms, sieve methods.

Izzet Coskun, PhD, Harvard University, 2004. Algebraic geometry.

Lawrence Ein, PhD, University of California-Berkeley, 1981. Algebraic geometry.

Henri Gillet, PhD, Harvard University, 1978. Algebraic K-theory, algebraic geometry.

Jing Long Hoelscher, PhD, University of Pennsylvania, 2007. Galois theory, algebraic number theory, arithmetic algebraic geometry.

Olga Kashcheyeva, PhD, University of Missouri-Columbia, 2003. Algebraic geometry and commutative algebra.

ChongGyu (Joey) Lee, PhD, Brown University, 2010. Algebraic number theory, dynamical systems, cryptography.

Mihnea Popa, PhD, University of Michigan, 2001. Algebraic geometry, several complex variables and analytic spaces, commutative rings and algebras.

Arthur Prendergast-Smith, PhD, University of Cambridge, 2009. Algebraic geometry.

Ramin Takloo-Bighash, PhD, Johns Hopkins University, 2001. Number theory, dynamical systems and ergodic theory, and algebraic geometry.

Jan Verschelde, PhD, Katholieke (Belgium), 1996. Computational algebraic geometry, combinatorial and polyhedral methods.

Philip Wagreich, PhD, Columbia University, 1966. Algebraic geometry, discrete groups, mathematics education.

Probability and Statistics

Samad Hedayat, PhD, Cornell University, 1969. Optimal designs, sampling theory, linear models, discrete optimization.

Dibyen Majumdar, PhD, Indian Statistical Institute, 1981. Optimal designs, linear models.

Ryan Martin, PhD, Purdue University, 2009. Nonparametric Bayes and empirical Bayes; foundations of statistics; high-dimensional inference; mixture models; Monte Carlo methods..

Cheng Ouyang, PhD, Northwestern University, 2009. Probability theory; stochastic analysis and its applications to partial differential equations, differential geometry and mathematical finance.
Jing Wang, PhD, Michigan State University, 2006. Non- and semi- parametric inference, polynomial spline and kernel smoothing, nonlinear time series forecasting.
Junhui Wang, PhD, University of Minnesota, 2006. Statistical machine learning and data mining; model assessment and selection, bioinformatics and high dimensional data analysis.
Jie Yang, PhD, University of Chicago, 2006. Financial mathematics, cluster analysis, discriminant analysis, spatial statistics, dimension reduction.

Emeriti

John Baldwin, PhD, Simon Fraser University, 1971. Model theory, universal algebra.
Neil Berger, PhD, Courant Institute of Mathematical Sciences, 1968. Elasticity, fluid mechanics.
Joel Berman, PhD, University of Washington, 1970. Lattice theory, universal algebra.
A. K. Bousfield, PhD, Massachusetts Institute of Technology, 1966. Algebraic topology, homotopy theory.
Calixto Calderon, PhD, University of Buenos Aires, 1969. Harmonic analysis, differentiation theory.
Emad El-Newehi, PhD, Florida State University, 1973. Reliability theory, probability, stochastic processes.
Nasrollah Etemadi, PhD, University of Minnesota, 1974. Probability theory, stochastic processes.
Naomi Fisher, PhD, Northwestern University, 1977. Mathematics education.
Paul Fong, PhD, Harvard University, 1959. Group theory, representation theory of finite groups.
Susan Friedlander, PhD, Princeton University, 1972. Geophysical and fluid dynamics.
Brayton Gray, PhD, University of Chicago, 1965. Homotopy theory, cobordism theory.
Floyd Hanson, PhD, Brown University, 1968. Numerical methods, asymptotic methods, stochastic bioeconomics.
James Heitsch, PhD, University of Chicago, 1971. Differential topology, geometry of foliations, smooth dynamics and ergodic theory, spectral theory of foliated operators.
William Howard, PhD, University of Chicago, 1956. Foundations of mathematics, proof theory.
Steven Jordan, PhD, University of California-Berkeley, 1970. Mathematics education, computer graphics, computational geometry.
Richard Larson, PhD, University of Chicago, 1965. Hopf algebras and application of computers to algebra, algorithms.
Jeffrey Leon, PhD, California Institute of Technology, 1971. Computer methods in group theory and combinatorics, algorithms.
Jeff Lewis, PhD, Rice University, 1966. Partial differential equations, microlocal analysis.
Anatoly Libgober, PhD, Tel-Aviv, 1977. Topology of varieties, theory of singularities.
Charles S. C. Lin, PhD, University of California-Berkeley, 1967. Operator theory, perturbation theory, functional analysis.
Glenn Manacher, PhD, Carnegie Institute of Technology, 1961. Algorithms, complexity, computer language design.
John Masley, PhD, Princeton University, 1972. Mathematics education.
Howard Masur, PhD, University of Minnesota, 1974. Quasiconformal mappings, Teichmüller spaces, topology.
Klaus Miescke, Dr.rer.nat., University of Heidelberg, 1972. Statistics, decision theory, selection procedures.
Vera Pless, PhD, Northwestern University, 1957. Coding theory, combinatorics.

David Radford, PhD, University of North Carolina at Chapel Hill, 1970. Hopf algebras, quantum groups, invariants of knots and links.

T. E. S. Raghavan, PhD, Indian Statistical Institute, 1966. Game theory, optimization methods in matrices, statistics.

G. V. Ramanathan, PhD, Princeton University, 1965. Statistical mechanics, critical phenomena.

Mark Ronan, PhD, University of Oregon, 1978. Buildings, geometries of finite groups.

Yoram Sagher, PhD, University of Chicago, 1967. Harmonic analysis, interpolation theory, mathematics education.

Stephen Smith, D.Phil, University of Oxford, 1973. Finite groups, representation theory.

Bhama Srinivasan, PhD, University of Manchester, 1960. Representation theory of finite and algebraic groups.

Martin Tangora, PhD, Northwestern University, 1966. Algebraic topology, homotopy theory.

David Tartakoff, PhD, University of California-Berkeley, 1969. Partial differential equations, several complex variables.

Charles Tier, PhD, Courant Institute of Mathematical Sciences, 1976. Analysis of stochastic models, queuing theory.

A. I. Weinzweig, PhD, Harvard University, 1957. Teaching and learning of mathematics, microcomputers in education.

John Wood, PhD, University of California-Berkeley, 1968. Differential topology, topology of varieties.

Stephen Yau, PhD, State University of New York at Stony Brook, 1976. Algebraic and complex geometry, singularity theory, and bioinformatics.

4. GRADUATE ADMISSION

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 may do so after meeting the requisite entrance requirements for the program. For questions about program options and admission requirements consult the website or contact the Assistant Director of Graduate Studies.

Admission Application Procedures

A list of required application materials, application deadlines, and links to the graduate application form are accessible from the MSCS Graduate Studies website. The application fee, proof of degree, transcripts, and relevant test scores should be sent to the Graduate Admissions office; required supplemental materials consisting of three letters of recommendation, the Application for Graduate Appointment form, and a personal statement should be sent directly to the MSCS Graduate Studies office. A complete application packet is required *before* the applicant will be considered for admission.

Degree Admission

Admission is selective and competitive. Applicants must have a baccalaureate from an accredited college or university, a grade point average of at least 3.0 (A = 4.00) for the final 60 semester hours of undergraduate study, at least 20 semester hours of undergraduate work in mathematics beyond calculus with a minimum grade point average of 3.0 (A=4.0). Applicants

with an undergraduate degree in an area other than mathematics will be considered for admission *after* prerequisite coursework is completed.

The general GRE (Graduate Record Exam) is *required* of all degree program applicants *except* those applying for the MST program. Applicants are strongly encouraged to take the subject exam (GRE) as well. No other exams may be substituted.

Applicants whose native language is *not* English must take the Test of English as a Foreign Language (TOEFL). Required minimum scores are: 100 (internet-based) with a minimum score of 20 on the Speak portion; 600 (written exam); or 250 (computer-based).

Non-degree Admission

Applicants who do not meet the prerequisites for degree admission may apply for graduate non-degree admission. This will give the applicant access to UIC to take any necessary prerequisites. A baccalaureate degree from an accredited college or university is required for non-degree admission. A few restrictions apply: Non-degree students are not eligible for funding; no more than 12 credit hours of graduate level coursework can be applied to the degree; and only courses in which an A or B is earned can be transferred to the degree.

Prerequisites for Admission to Doctoral Programs

Applicants for the doctoral programs (PhD or DA) must have a BS or BA in Mathematics or related field. Applicants should complete coursework related to their research field of interest as outlined below for the various MS in Mathematics degree programs.

Prerequisites for Admission to Master's Programs

MST program (Elementary School Option): Applicant must hold a valid K-8 Illinois Teaching certificate or the equivalent.

MST program (Secondary School Option): Applicant must have three semesters of engineering calculus plus two of these courses: Advanced Calculus/Analysis (Math 313 or MthT 430), Linear Algebra I (Math 320), and Abstract Algebra (Math 330 or MthT 435), or a course on proofs (Math 215).

MS program with *Pure Mathematics* concentration: Applicant must have one year of work in linear algebra and abstract algebra plus one year of study in analysis or advanced calculus.

MS program with *Applied Mathematics* concentration: Applicant must have proficiency in differential equations (Math 220), applied linear algebra (Math 310), and knowledge of advanced calculus (Math 410).

MS program with *Probability and Statistics* concentration: Applicant must have Applied Linear Algebra (Math 310), Analysis I (Math 313), and Introduction to Probability (Stat 401).

MS program with *Mathematical Computer Science* concentration: Applicant must have Programming Tools and File management (MCS 275), Introduction to Data Structures (MCS 360), Discrete Mathematics (MCS 361), Linear Algebra I (Math 320) or Applied Linear Algebra (Math 310), Introduction to Probability (Stat 401), one upper division mathematics or computer science course, and proficiency in a structured programming language such as C or C++.

Students admitted on limited status must complete all deficiencies prior to the deadline to avoid being dismissed from the Graduate College.

5. POLICIES ON GOOD STANDING, DEGREE DEADLINES, & FUNDING

Students must remain in *good standing* to continue in MSCS toward degree completion and to be considered for funding.

A student is in *good standing* by satisfying the following:

- Students admitted into the MS program must complete the course requirements and pass the MS exam within four semesters.
- Students admitted into the MS program and continuing into the PhD or DA program must pass one written prelim within three years from entry into the MS program; and pass both written prelims and meet the requirements for doctoral candidacy within four years.
- Students admitted directly to the PhD or DA program *without* a previously earned MS degree must earn a high pass on the MS exam by the end of the second year in the program; pass at least one written prelim within three years from entry into the program; and pass both written prelims and meet the requirements for doctoral candidacy within four years
- Students admitted directly to the PhD or DA program *with* a previously earned MS degree must pass at least one written prelim by the end of the second year in the program; and pass both written prelims and meet the requirements for doctoral candidacy within three years.

The extent to which students in *good standing* can be considered for funding is contingent on the time spent completing the degree requirements:

- MS students are expected to complete the program within 4 semesters, and thus are eligible for no more than 4 semesters of support from University sources.
- Students completing the MS at UIC and continuing to the PhD or DA are expected to complete the doctoral program within 6 years from entry into the MS program, and thus are eligible for no more than 6 years of support from University sources.
- PhD and DA students *without* a previously earned MS degree are expected to complete the program within 6 years, and thus are eligible for no more than 6 years of support from University sources.

- PhD and DA students entering the program with a previously earned MS degree are expected to complete the program within 5 years, and thus are eligible for no more than 5 years of support from University sources.

This table illustrates MSCS policies governing *good standing and degree completion*.

End of Year	Admitted to MS	Admitted to UIC MS and continuing to PhD	Admitted to PhD without a MS	Admitted to PhD with MS
1				
2	Complete Degree	High Pass on MS Exam	High Pass on MS Exam	Pass one prelim
3		Pass one prelim	Pass one prelim	Meet requirements for doctoral candidacy
4		Meet requirements for doctoral candidacy	Meet requirements for doctoral candidacy	
5				Complete Degree
6		Complete Degree	Complete Degree	

Students who do not meet the requirements for funding consideration or who have exceeded the limits allowed to complete a degree may petition the Graduate Studies Committee if they have exceptional circumstances. The petition must include a formal research statement and a letter of endorsement by the thesis advisor outlining the plan for completion. *Petitions for funding consideration will only be considered when positions are not filled by current eligible students.*

MSCS Funding Application Procedures

New graduate degree-seeking applicants who submit the *Application for Graduate Appointment* form during the admission process will be considered for any available teaching assistantships, fellowships, or GC waivers. It is important that a Graduate College admission application, fee, and other required materials are submitted along with supplemental materials required by MSCS. All of these materials must arrive by the published Departmental deadline to receive full consideration of available funding. Details are outlined on the MSCS graduate studies website.

Continuing degree-seeking students may apply for funding each term by submitting the *Aid Application for Continuing Students* available from the MSCS website. Deadlines are posted on the website and announcements are typically sent via email.

Teaching Assistantships

MSCS employs graduate students as teaching assistants (TAs) to support the Department's undergraduate courses. Most positions are 50% (full-time) teaching assistantships; 25% awards are occasionally offered. Teaching Assistantships carry a stipend and an assistantship waiver which covers a full waiver of tuition and a partial waiver of fees. Positions are awarded on the basis of academic merit, with teaching abilities, communication skills, and the needs of the Department taken into account. Only MSCS students in *good standing*, both domestic and international F-1 visa holders, are eligible for these positions.

TAs must express an interest in continuing their support for each subsequent year by completing the Aid Application for Continuing MSCS Students. TAs with one semester appointments will need to apply each semester. The continuing aid application and related deadlines are posted on the MSCS website.

Most TA appointments are made for the full academic year, beginning in the Fall semester. As a result, positions for students beginning in January are typically not available. Summer TA positions are appointed based on seniority while addressing the specific needs of the Department.

Graduate College (GC) Tuition and Fee Waivers

The Department receives a limited number of Graduate College (GC) tuition and fee waivers. GC waivers provide the student with a full waiver of tuition and a partial waiver of fees. They are awarded one semester at a time, based on academic merit. GC waivers require 12 credit hours of enrollment if awarded for the fall or spring; and 6 credit hours are required for summer awards. Only MSCS students in *good standing* may be considered for a GC waiver.

University Fellowships and Awards

The Graduate College website posts a complete list of awards and fellowships available through the University. The University Fellowship is one of the most prestigious awards given by the Graduate College. These fellowships enable students to pursue graduate studies and research without a service requirement. University Fellowships carry a stipend along with a fellowship tuition and service fee waiver and require full time enrollment. Most fellowships and awards available through the University require an endorsement from the Department.

Work-Study Program

Students who are U.S. citizens or permanent residents (or have applied for such) and who can demonstrate financial need may be 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. Students can obtain an Application for Federal Student Aid (FAFSA) by contacting the Office of Financial Aid.

6. 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 with the assistance of a **Faculty Mentor**; the faculty mentor serves as the Graduate College mandated academic advisor. The second is following the rules and procedures outlined in the Graduate College catalog and the MSCS Graduate Handbook. In some cases, Departmental policies are stricter than Graduate College policies. **In any case, students are responsible for being aware of all policies and requirements and satisfying them according to university deadlines.**

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

The MSCS Graduate Handbook has more specialized purposes: to provide information about the Department, to inform prospective and current students of Departmental rules and procedures concerning graduate study, and to provide a detailed description of the graduate programs offered by MSCS.

Program Administrators

The *Director of Graduate Studies* (DGS) implements policies and procedures, advises students and faculty on policy and procedural matters, serves as academic advisor to non-degree students and oversees admissions to the program and recommendations for funding.

The *Assistant Director of Graduate Studies* serves in the absence of the Director of Graduate Studies, provides advice regarding University policies and procedures, makes teaching assignments for Departmental teaching assistants, and assists with the admissions process.

The *Faculty Mentors* help students make the best academic decisions by guiding students in the selection of courses to support their academic goals. Faculty approval is required at every stage of a student's program of study. A thesis advisor assumes the role of faculty mentor for students pursuing the thesis option.

The *Graduate Studies Committee* is responsible for formulating policies related to all MSCS graduate study programs. The Committee acts on certain petitions from students concerning Departmental policies or procedures. Questions related to policies and procedures should first be directed to the MSCS Graduate Studies office, not to the Graduate Studies Committee.

7. DEGREE PROGRAMS

The Department offers 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 Master of Science (MS) program is designed to lay the foundation for doctoral work and to prepare students for a career in business, government, or industry. Students can earn 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.

Students can also earn an MS degree in Teaching of Mathematics (MST). In addition to the MS and MST degrees, the Department offers a Doctor of Philosophy (PhD) degree and a Doctor of Arts (DA) degree.

Pure Mathematics is designed to tailor-make a program suitable to the student's interests and needs to the extent possible. Elective courses should be selected from Analysis I and II (Math 313 and 414), Complex Analysis with Applications (Math 417), Linear Algebra II (Math 425), Introduction to Topology I (Math 445), Abstract Algebra I (Math 516), and Real Analysis I (Math 533). Students with strong mathematical backgrounds who intend to continue for a doctoral

degree are encouraged to complete one or more of the basic 500-level course sequences leading to a written prelim exam while they are earning the master's degree.

Applied Mathematics is designed for students who have a bachelor's degree in mathematics, computer science, engineering, or a strong mathematical background along with a degree in the biological or physical sciences. Students are encouraged to take up to 8 semester hours in courses such as electromagnetic theory, continuum mechanics, fluid dynamics, statistical physics, electrical signal processing, or biology and plasma physics.

Mathematical Computer Science is designed primarily for students who have bachelor's degrees in mathematics, computer science, or engineering with a modest background in computer science and mathematics. Students are encouraged to seek additional courses in other departments suitable to their interests.

Probability and Statistics is designed to give students initial coursework in probability, statistical methods, statistical theory, and optimal decision. 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 science, engineering, or the social science for statistical application.

Master of Science in Teaching of Mathematics (MST) students will select either the secondary or elementary education option. This program is a special degree program designed to strengthen the preparation and background of teachers in secondary or elementary 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 prepare student to enter the Department's doctoral programs.** The MS programs and MST program serve very different purposes; coursework in one is not necessarily applicable to the other two.

The Doctor of Philosophy (PhD) degree is designed to provide the highest level of training for independent research. The Department offers programs in Pure Mathematics, Applied Mathematics, Mathematical Computer Science, and Probability and Statistics that lead to the Doctor of Philosophy (PhD) degree.

The Doctor of Arts (DA) degree is designed to train educators for undergraduate instruction in universities, four-year, and two-year colleges. 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.

8. REQUIREMENTS for the MASTER OF SCIENCE (MS) in MATHEMATICS

Requirements for the MS degree in Mathematics *with* a major 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 *excluding* any of the Department's Independent Study courses (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 the TA Workshop (Math 589). For the Mathematical Computer Science concentration, at least two courses must be MCS courses.
 - b. Satisfy core course requirements for the selected area of concentration:

Pure Mathematics: Math 417, 516, 533, and 4 hours from Math 446, 517, 534, 535, 536

Applied Mathematics: Math 417, 480, 481

Mathematical Computer Science: MCS 401, 421, and 471

Probability and Statistics: Stat 401, 411, and 4 hours from Stat 431, 461, 471, 477, 481
 - c. Any remaining hours must be selected with faculty mentor's approval from 400 or 500 level courses. Courses may include Independent Study (596), the TA Workshop (589), or courses outside the Department.
3.
 - a. Pass the Department's (written) Master's Exam in the area of concentration, **OR**
 - b. Achieve a grade point average of at least 3.5 for the core courses, earn 5 credit hours in master's thesis research (Math 598, MCS 598 or Stat 598), write an acceptable thesis, and pass an oral defense.

Students who have completed the core courses at another institution or to satisfy another degree must meet with their faculty mentor to identify suitable courses to substitute for those previously taken. Once the course substitutions have been identified, the student must submit a request to the Director of Graduate Studies, signed by the faculty mentor, listing the recommended course substitutions.

Requirements for the MS degree in Mathematics earned *without* a major area concentration

Earning the MS degree *without* a major area concentration is intended for exceptional students and requires prior approval of the Graduate Studies Committee. Students in this program are warned that they will have to satisfy additional requirements for entry into the doctoral program in some areas.

The requirements for the MS degree in Mathematics earned *without* a major area concentration are:

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

2. Earn a minimum of 32 semester hours of advisor-approved credit in part by completing a program of 24 semester hours from the Department, approved in advance by the Graduate Studies Committee and selected from the following courses:

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

Any Departmental 500-level course *excluding* topics courses (494)

3. Complete 12 hours of Departmental 500 level coursework with an A or B, *excluding* Special Topics courses (494). 8 hours can be selected from outside the Department.
4. Achieve an overall grade point average of 3.25 or better for the program.
5. Earn a high pass on the Department's written Master's Exam in one of four areas of concentration.

Students who choose this option for earning the MS degree and wish to be admitted into the PhD program in Applied Mathematics, Mathematical Computer Science, or Statistics are required to earn a high pass on the comprehensive Master's Exam or receive a qualifying score on a written prelim in that area.

9. MS EXAM AND MS THESIS

The Department's comprehensive written Master's Exam is based on 400-level and 500-level course material and has an option for each of the Department's major areas of concentration. Students are allowed three hours for the exam. The exam must be passed within one year after completion of 32 credit hours applicable to the degree.

Students must pre-register for the exam by downloading a form from the MSCS Graduate Studies website and submitting to the MSCS Graduate Studies office at least three weeks before the exam. Copies of previous exams and solutions are posted on the MSCS Graduate Studies website.

Schedule

The Department's Master's Exam is given twice a year. The fall exam is given during the week preceding the first week of instruction, and the spring exam is given the week following spring break.

Grading and Solutions

The Master's Exam is graded on a scale of 0 to 160 points. Each question is worth 20 points. Each exam consists of multiple questions. Every question the student answers will be graded. The 8 questions with the highest numerical scores are then used to determine the student's Master's Exam score. A minimum passing score on this exam is 90 points; a "**pass**" is one requirement to earn the MS degree. A "**high pass**" requires at least 110 points. A "high pass" is required to advance in the PhD program.

Exam results are given to the students in writing by the Graduate Studies office approximately two weeks after the exam. Students' solutions are retained in the Graduate Studies office for two years. The exam and solutions are posted on the MSCS Graduate Studies website after the exam.

Re-grade Policy

Students who wish to have a portion of their Master's Exam re-graded should understand that this process could result in the raising or *lowering* of the exam score. Requests for a re-grade of any portion of the exam must be made no later than two weeks following the distribution of the exam scores. To make a request, students must obtain a copy of their exam and solutions from the Graduate Studies office and submit a written request and supporting material for each question to be re-graded to the Director of Graduate Studies.

Distribution of MS Exam Questions

The **written master's exam for Pure Mathematics** has 18 questions distributed as follows:

Math 330, 431	Algebra	3 questions
Math 313, 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

The **written master's exam for Applied Mathematics** has 12 questions distributed as follows:

Math 417	Complex Analysis with Applications	3 questions
Math 480	Applied Differential Equations	3 questions
Math 481	Applied Partial Differential Equations	3 questions
MCS 471	Numerical Analysis	3 questions

The **written master's exam for Mathematical Computer Science** has 12 questions distributed as follows:

MCS 401	Computer Algorithms I	2 questions
MCS 421	Combinatorics	2 questions
MSC 423	Graph Theory	2 questions
MCS 425	Codes and Cryptography	2 questions
MCS 441	Theory of Computation I	2 questions
MCS 471	Numerical Analysis	2 questions

The **written master's exam for Probability and Statistics** has 15 questions distributed as follows:

Stat 401	Introduction to Probability	3 questions
Stat 411	Statistical Theory	3 questions
Stat 416	Nonparametric Statistical Methods	1 question
Stat 431	Introduction to Survey Sampling	1 question
Stat 461	Applied Probability Models I	2 questions
Stat 471	Linear and Nonlinear Programming	2 questions
Stat 473	Game Theory	1 question
Stat 481	Applied Statistical Methods II	2 questions

MS Thesis and Defense (optional)

Students opting to earn the master's degree by writing and defending a thesis must achieve a minimum grade point average of 3.5 for the core courses, find a thesis advisor, and notify the Director of Graduate Studies *by the end of their second semester* in the program. Students must complete at least 5 semester hours of master's thesis research (Math 598, MCS 598 or Stat 598) beyond the 32 semester hours of advisor-approved credit required for the degree. A satisfactory thesis must be completed and successfully defended within one year of completion of 32 credit hours applicable to the degree.

All degree requirements must be satisfied before the thesis defense can be scheduled. The defense cannot be scheduled until all members of the Thesis Committee have received a copy of the thesis and had an opportunity to consult with the thesis advisor. Anyone may attend the thesis defense.

MS Thesis Committee

Students opting to write a master's thesis must pass an oral defense of their thesis. A grade of pass or fail is determined by a majority of the committee. Students must submit the Committee Recommendation form (available on the website) to the Graduate Studies office at least 30 days prior to the defense. Committee members are recommended to the Department by the thesis advisor and require Graduate College approval. The 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 (thesis advisor) must be a member of the MSCS Graduate Faculty.

10. REQUIREMENTS for the MS in the TEACHING of MATHEMATICS (MST)

The purpose of the MST program is to strengthen the preparation of mathematics teachers. Students may select one of two options for this degree – Secondary School Option or Elementary School Option.

The MST degree (Secondary School Option) offers courses for certified secondary teachers as well as students seeking certification. The requirements for the **MST degree, Secondary School Option** are:

1. Fulfill the Graduate College requirements pertaining to the master's degree.
2. Earn a minimum of 32 semester hours of faculty mentor-approved graduate credit as follows:
 - a. 12 hours of Departmental 500 level courses earning a grade of A or B, *excluding* Independent Study (596) courses.
 - b. 16 hours of Departmental core courses: MthT 411 (Advanced Euclidean Geometry II), MthT 435 (Abstract Algebra)*, MthT 510 (Introduction to Higher Geometry), MthT 530 (Mathematical Analysis for Teachers II)
*May substitute Math 435 (Number Theory) if a proof-based abstract algebra course has been taken.

3. Advisor-approved electives in mathematics to fulfill the 32 credit hours requirement.
4. If seeking certification, students must fulfill additional requirements to be eligible for state certification in Illinois. *NOTE:* Teaching certification is not automatically awarded upon successful completion of degree and certification requirements.

The MST degree (Elementary School Option) offers courses for elementary teachers holding a current Illinois teaching certificate. The requirements for the **MST degree, Elementary School Option** are:

1. Fulfill the Graduate College requirements pertaining to the master's degree.
2. Core course requirements (22 semester hours):
 - MthT 465 (Teaching Algebra for Understanding)
 - MthT 550 (Concepts in Elementary School Mathematics II)
 - MthT 565 (Teacher Geometry: An Activity Approach)
 - MthT 589 (Practicum in Teaching Elementary School Mathematics)
 - CI 484 (Curriculum and Instruction in the Middle School)
 - EPSY 446 (Characteristics of Early Adolescence)
3. Electives (14 semester hours):
 - MthT 450 (Concepts in Elementary School Mathematics I)
 - MthT 460 (Geometric Measurement and Numerical Methods)
 - MthT 470 (Teaching Mathematics with Science: An Activity Approach I)
 - MthT 480 (Microcomputers in Elementary School Mathematics I)
 - MthT 560 (Introduction to Analytic Geometry and Calculus)
 - MthT 575 (Principles of Probability and Statistics)

11. REQUIREMENTS for the DOCTOR OF PHILOSOPHY (PhD) in MATHEMATICS

The student's major focus in the Doctor of Philosophy (PhD) program is the production of a thesis that is a significant piece of mathematical research acceptable to the Department. PhD students should complete all requirements for doctoral candidacy as soon as possible so they can concentrate on their research and thesis.

The requirements for the PhD in Mathematics are:

1. Fulfill the Graduate College requirements pertaining to the PhD degree.
2. Provide proof of an equivalent MS degree or earn a high pass on the Department's Master's Exam, or write a master's thesis and pass an oral defense.
3. Pass two written prelims and fulfill the minor sequence with qualifying scores:
 - a. Sum of the scores for two written prelims is at most 4.

- b. Sum of the numerical grade for the minor sequence and the sum of the scores for the two written prelims is at most 6.
4. Pass an oral prelim exam (Probability and Statistics students only) *after* completing requirements 2 and 3.
5. Fulfill the language requirement (Pure Mathematics students only).
6. Complete a thesis acceptable to the Department which makes a contribution to original research, and pass an oral defense of the thesis.
7. Earn a total of 96 semester hours of graduate credit* of which at least 40 hours must be from the Department's 500-level courses, and 32 hours must be in thesis research**.

* Students entering the PhD program with a previously earned master's degree in a related field may petition the Director of Graduate Studies to apply 32 credits toward the PhD. Final approval from the Graduate College is required.

**Students cannot enroll in more than four hours of Thesis Research (599) per term until requirements 2-5 are satisfied (MS degree, pass two written prelims and the minor sequence with qualifying scores, pass the oral prelim exam - statistics only, and the language requirement - pure mathematics only).

12. DOCTORAL PRELIM EXAM & DOCTORAL CANDIDACY

The purpose of the prelim examination is to determine the student's readiness to undertake thesis research. The prelim examination is administered in accordance with Graduate College rules as stated in the Graduate College catalog, and requires the student to be enrolled at the time of the exam.

Doctoral Candidacy

Doctoral students who successfully complete their prelim examinations are formally recommended to the Graduate College as *doctoral candidates*. At least one year must lapse between doctoral candidacy and the thesis defense. *Doctoral candidates* must enroll every semester (fall and spring) through the semester they successfully defend the thesis. One way to maintain enrollment is to request permission to enroll for "zero credit hours". Interested students should contact the Graduate Studies office for more details.

To become a doctoral candidate, students in the PhD program specializing in Probability and Statistics must earn a qualifying score for the two written prelims and the minor sequence and earn a "pass" on the oral prelim exam.

To become a doctoral candidate, students in the DA program and the PhD program specializing in Pure Mathematics, Applied Mathematics, or Mathematical Computer must earn a qualifying score for the two written prelims and the minor sequence.

Prelim Exam Committee

The committee for the prelim examination is appointed by the Dean of the Graduate College upon the recommendation of the Department. The committee consists of five members of whom 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.

Minor Sequence

The minor sequence is a breadth requirement and consists of a sequence of two 500-level courses described in the Handbook as leading to a written prelim. The minor sequence *may not* overlap an area in which a written prelim is taken.

Students who complete two written prelims in Mathematical Computer Science must take a minor sequence in another area of the Department.

Consideration for a minor sequence in an area not designated as leading to an approved written prelim must be requested in writing and approved *in advance* by the Director of Graduate Studies. The written request should include:

1. A brief outline of the proposed minor sequence, specifying the two 500-level courses to be taken. The list may contain alternatives.
2. A brief explanation of how the proposed minor sequence 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.

Doctoral students may satisfy the minor sequence in one of two ways:

- a. By taking a sequence of two 500-level courses in a minor subject area. The grades earned in the sequence are converted to a numerical score (see Grading), OR
- b. By passing a written prelim in a minor subject area. The score earned for the written prelim is the numerical score assigned to the minor sequence.

Grading the Minor Sequence

The score assigned for the minor sequence is 1 (best), 2, 3, or 5 (fail). Students who obtain a "5" may repeat one of the courses once, or they may petition the Director of Graduate Studies to approve another minor sequence.

The two course grades earned in the minor sequence are converted into a numerical score as follows:

Two A's	1
One A and One B	2
Two B's	3
All other combinations	5

Oral Prelim Exam (Statistics students only)

PhD students in the Probability and Statistics program must pass an oral prelim exam, and this should be done soon after successfully completing the two written prelims and the minor sequence. To arrange a date of the oral prelim exam, students must submit the Committee Recommendation form, endorsed by the advisor, to the Graduate Studies office at least 30 days prior to the oral prelim exam.

The oral prelim exam is administered in accordance with the Graduate College regulations on prelim exams. The committee for the oral prelim exam is appointed by the Dean of the Graduate College upon the recommendation of the Department. The committee consists of five members; three members must be UIC Graduate Faculty with full membership, and two must be tenured. The committee must include the student's advisor, two examiners in the written prelim areas, and one examiner in the minor sequence. 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.

The committee vote is pass or fail. The student will not pass the oral prelim exam if more than one vote of fail is received. A second oral prelim exam may be recommended by the committee to the Director of Graduate Studies; a third oral prelim exam is *not* permitted.

Language Requirement (Pure Mathematics students only)

PhD students in Pure Mathematics must demonstrate a reading proficiency in French, German, or Russian. To satisfy this requirement students may pass the standard Graduate School Foreign Language Test, pass German 400 or French 401 with a grade of A or B, or pass a language exam 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.

The Department's language exams are arranged between the student and the examiner. The exam is open book, and students may use dictionaries and notes but may not consult others for help or refer to a pre-existing translation of the exam text. The duration of the exam is about one hour, at the discretion of the examiner. Although the length of the text is flexible, 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.

13. WRITTEN PRELIMS

Two written prelims must be selected from the list of approved written prelims below and must be passed with qualifying scores. Each written prelim is based on a sequence of graduate courses identified below. Students are allowed three hours to complete the written prelim. Sample prelims are posted on the MSCS Graduate Studies website. Additional details about the administration of the written prelims are found in "Appendix 1: To the Faculty".

Only DA students may select a prelim from those designated "for DA students only" (written prelims 13-14). Of these prelims, DA students may select at most one.

Statistics students are required to pass the Probability and Statistics prelim (written prelim 10) and select one additional Probability and Statistics prelim (written prelims 11 or 12).

Approved written prelims:

1. Algebra
2. Analysis
3. Geometry and Topology
4. Logic
5. Differential Equations and Asymptotics
6. Applied Mathematics
7. Combinatorics
8. Algorithms and Complexity
9. Computational Science
10. Probability and Statistics
11. Linear Inference, Sampling, and Design
12. Game Theory

Doctor of Arts written prelims (for DA students only; DA students may select at most one prelim from 13-14):

13. Mathematics Education
14. History of Mathematics

Schedule

The written prelims are given once per year, at the end of the spring semester at a specific time arranged between the examiners and the examinees. Students with extenuating circumstances may petition the Director of Graduate Studies for a written prelim to be administered at another time.

Students must submit a registration form to the Graduate Studies office. Registration forms and deadlines are posted on the MSCS Graduate Studies website. Students who have registered to take a written prelim, but no longer wish to sit for the exam *must notify* the examiners at least 10 days before the prelim is given. Failure to do so will result in a failing score for the prelim.

Grading

Written prelim scores are assigned on the basis of 1 (best), 2, 3, and 5 (fail). Students may retake a written prelim repeatedly as long as the time limit is not exceeded. The examiners will report the score to the Graduate Studies office. This office will report the score to the student in writing and maintain a record of the score. Written prelims are to be graded within two weeks of the prelim date. The sum of the scores of the two written prelims may not exceed 4.

Written Prelims in Pure Mathematics

The principal subdivisions of Pure Mathematics are Algebra, Analysis, Geometry and Topology, and Logic. The student's program of study in Pure Mathematics should be planned in close consultation with the Faculty Mentor, based on their research interests. At an early stage, the program of study should include 500-level course sequences that lead to written prelims and the minor sequence as well as advanced topics courses that expose students to possible research areas and potential thesis advisors. The areas need not all be in Pure Mathematics.

Prelim 1:	Algebra	
	Math 516	Second Course in Abstract Algebra I
	Math 517	Second Course in Abstract Algebra II
Prelim 2:	Analysis	
	Math 533	Real Analysis I
	Math 535	Complex Analysis I
Prelim 3:	Geometry and Topology	
	Math 547	Algebraic Topology I
	Math 549	Differentiable Manifolds I
Prelim 4:	Logic	
	Math 502	Mathematical Logic <i>plus</i> one of the following:
	Math 504	Set Theory
	Math 506	Model Theory I
	Math 511	Descriptive Set Theory

Written Prelims in Applied Mathematics

Research in applied mathematics covers a variety of collateral areas:

Mathematical Science

Scattering theory, wave propagation, statistical mechanics, electrodynamics, acoustics, elasticity, fluid mechanics, geophysical fluid dynamics, mathematical biology, oceanography, mathematical economics, financial math, convection-diffusion problems, optimal control, and nonlinear filtering.

Applications-Oriented Mathematics

Asymptotics, perturbation theory, singular perturbations, stability theory, numerical procedures and estimations, stochastic processes, stochastic control theory, partial differential equations, spectral theory, dynamical systems and their statistical description.

Collateral Areas

Scientific supercomputing, parallel computational control, parallel scheduling, stochastic modeling, queuing theory and computer performance evaluation, numerical analysis, symbolic and symbolic-numeric computation, bioinformatics, analysis of algorithms, data mining, computational algebraic geometry, information theory, scientific databases, digital libraries, and high performance computing.

The Department works 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 a Faculty Mentor in Applied Mathematics 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 sequence are taken early.

Prelim 5: **Differential Equations and Asymptotics** (select two)
Math 576 Classical Methods of Partial Differential Equations
Math 577 Advanced Partial Differential Equations
Math 578 Asymptotic Methods
Math 579 Singular Perturbations

Prelim 6: **Applied Mathematics** (select two)
Math 580 Mathematics of Fluid Dynamics
Math 582 Linear and Nonlinear Waves
Math 586 Computational Finance

Written Prelims in 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.

There are three written prelims in Mathematical Computer Science. Students may prepare for the written prelims in Mathematical Computer Science by taking the indicated courses. These prelims typically consist of three questions from each course; the score is comprised of the top five answers. Thus, it is possible to achieve a maximum score on the prelim by completing two of the courses listed for the written prelim. *Students who complete two written prelims in Mathematical Computer Science need to select a minor sequence in another area.*

Prelim 7: **Combinatorics**
MCS 521 Combinatorial Optimization
MCS 531 Error-Correcting Codes
MCS 591 Advanced Topics in Combinatorial Theory

Prelim 8: **Algorithms and Complexity**
MCS 501 Computer Algorithms II
MCS 503 Mathematical Methods of Algorithm Analysis
MCS 541 Computational Complexity

Prelim 9: **Computational Science**
MCS 563 Analytic Symbolic Computation
MCS 571 Numerical Analysis for Partial Differential Equations
MCS 572 Introduction to Supercomputing

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 College of Engineering, Department of Computer Science.

Written Prelims in Probability and Statistics

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

PhD students in Statistics are required to pass the Probability and Statistics prelim (written prelim 10) and select one of the remaining Statistics prelims (written prelim 11 or 12).

Prelim 10: **Probability and Statistics (REQUIRED for all Statistics PhD students)**
Stat 501 Probability Theory I
Stat 511 Advanced Statistical Theory I

Statistics PhD students MUST select one from Written Prelims 11 and 12:

Prelim 11: **Linear Inference, Sampling, and Design**
Stat 521 Linear Statistical Inference *plus* one of the following:

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

Prelim 12: **Game Theory**
Stat 571 Non-cooperative Games *plus* one of the following:

Stat 572 Cooperative Game Theory
Stat 591 Advanced Topics in Statistics, Probability, & Operation
 Research

14. PhD THESIS COMMITTEE and DEFENSE

To obtain a PhD, students must write a thesis acceptable to the Department and pass an oral defense of the thesis. At least one year must lapse between the completion of the prelim examination and the thesis defense.

Thirty days prior to the thesis defense, the student's advisor recommends a thesis committee in consultation with the student. This is done by completing the Committee Recommendation form. The thesis committee is appointed by the Dean of the Graduate College upon the recommendation of the Department. The committee consists of at least five members, including one member selected from outside the university or from another UIC department; at least two members must be tenured graduate faculty at UIC; at least three members must be from the

Department. The thesis advisor serves as Chair of the committee and must be a member of the MSCS graduate faculty.

In exceptional situations a student may choose a thesis advisor outside the Department after obtaining the approval of the Graduate Studies Committee. If approved, the student must find a co-advisor within the Department.

The thesis defense cannot be scheduled until all members of the Thesis Committee have received a copy of the thesis and had an opportunity to consult with the thesis advisor. The committee vote is pass or fail. The student will not pass the thesis defense if more than one vote of fail is received. Anyone may attend the thesis defense.

Faculty should refer to Appendix 1 for further details concerning the administration of the written prelims and defense committees.

15. REQUIREMENTS for the DOCTOR OF ARTS (DA)

Students in the DA program focus on major areas of mathematics and conduct research in the methodology and techniques for successful teaching of mathematics. The course requirements for the DA 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 thesis must be of publishable quality and represent a scholarly and substantive investigation of a topic in mathematics or mathematics education.

The requirements for the **Doctor of Arts degree in Mathematics** are:

1. Fulfill the Graduate College requirements pertaining to the DA degree.
2. Provide proof of an equivalent MS degree or earn a high pass on the Department's written Master's Exam, or write a master's thesis and pass an oral defense. The MST degree is not sufficient equivalency.
3. Earn at least 96 semester hours of graduate credit as follows:
Breadth in Mathematics (48 semester hours) At least 24 hours selected from 500-level courses in at least 3 different prelim areas.

Education and Mathematics Education (12 semester hours) Advisor-approved courses selected from the following list:

- Math 591 (Seminar on Mathematics Curricula)
- Math 592 (Seminar on Mathematics: Philosophy and Methodology)
- LRSC 500 (Introduction to the Learning Sciences)
- LRSC 501 (Research Methods I)
- LRSC 503 (Foundations of Scientific Inquiry)
- LRSC 511 (Analysis of Teaching and Learning Interactions)
- LRSC 512 (Design of Learning Environments)
- CI 547 (Integrating Literacy Instruction)

CI 562 (Design and Conduct of Literacy Research)
CI 570 (Critical Issues in Science Education)
CI 594 (Special Topics in Curriculum and Instruction)
Other advisor-approved education courses

Electives (8 semester hours) Advisor-approved courses selected from mathematics, science, economics, or statistical methods in psychology and education.

Teaching Practicum (8 semester hours of Math 596) on topics concerning the teaching of mathematics (see the Teaching Practicum section). *The one to two page practicum proposal must be approved in advance by the advisor and the DA Committee.*

Thesis Research (20 semester hours) A two-page thesis proposal and proposed thesis committee members must be approved by the DA Committee *before* thesis research can begin.

4. Pass two written prelims and fulfill the minor sequence by achieving qualifying scores as follows:
 - a. Sum of the scores for the two written prelims is at most 4.
 - b. Sum of the numerical score for the minor sequence along with the sum of the scores for the two written prelims is at most 6.
5. Complete a thesis acceptable to the Department and pass the oral thesis defense.

Written Prelims for the DA Program (DA students only)

There are two written prelims designated exclusively for the Doctor of Arts program. DA students are not required to select a prelim from this group; any of the approved prelims may be selected. However, students selecting a prelim from the DA group may take at most one from this group and must first petition the DA Committee for approval. The petition should outline a course of study including a reading list or detailed description of materials involved.

DA written prelims (for DA students only; at most one prelim may be selected from this group)

Prelim 13: **Mathematics Education**

Prelim 14: **History of Mathematics**

Teaching Practicum (DA students only)

DA candidates are expected to demonstrate accomplishment as teachers of undergraduate mathematics by completing a Teaching Practicum*. DA candidates must present a one to two page proposal to the DA committee, describing their teaching practicum and endorsed by the advisor. The course and semesters in which the project is to take place must also be approved *in advance* by the Associate Head for Instruction.

The Teaching Practicum must consist of a program that develops teaching skills under the guidance of University faculty who will supervise the practicum and evaluate the student's performance.

Teaching Practicum examples:

- Teaching two semesters of undergraduate mathematics at the 100-level or above, assuming primary responsibility for the class with the aid of a faculty mentor. There should be demonstrable effort devoted to developing new course materials, such as course worksheets or computer laboratory modules.
- Supervised teaching of an approved class for two semesters, with preparation and use of various instructional materials and a limited education research project. There should be demonstrable effort devoted to developing new course materials, such as course worksheets or computer laboratory modules.
- Team teaching an advanced undergraduate course with a faculty sponsor.

** The Director of Graduate Studies must approve exceptions to the DA Practicum requirement.*

Thesis Proposal (DA students only)

Before thesis work can begin, DA students must pass two written prelims and fulfill the minor sequence with qualifying scores to be accepted as doctoral candidates. As soon as possible and certainly within six months of completing these requirements, the DA candidate must submit a two-page thesis proposal and proposed thesis committee members to the DA committee for approval.

The Thesis Proposal must contain:

1. The main problem area of the thesis, discussion of related research, and outline of research questions, AND
2. For research involving students, the proposal must also include -
 - a list of students and UIC courses affected,
 - class time to be used for the investigation, and
 - a copy of the proposed IRB* submission

* IRB (Institutional Review Board) approval is required for all research involving students. Doctoral candidates need to allow one additional semester *before* beginning research to review the thesis proposal with the thesis committee, obtain approval from the advisor, and secure approval from the IRB.

DA Thesis Committee and Defense

For students writing a thesis in an area of mathematics education, the thesis committee will take an active role and should be chosen as soon as possible. Substitutions to the committee may be made at a later date.

The DA thesis must consist of an original, creative and scholarly contribution to the teaching of college mathematics and can be any one of the following:

- An expository and/or historical treatment of a mathematical topic making a contribution to the teaching of mathematics,
- A two part thesis consisting of: (1) an expository and/or historical treatment of mathematical course material that is created and evaluated; and (2) an instructional part that may be an outgrowth of the Teaching Practicum. The two parts are not required to involve the same mathematical topics, although this is desirable.
- A research study in the area of mathematics education

16. ADVISING SYSTEM

Role of the Faculty Mentor

Students are responsible for planning their programs of study with the assistance of a faculty mentor. The role of the faculty mentor is to assist the student in making the best possible academic decisions. It is essential for students to confer with their faculty mentor each semester to select coursework and obtain approval of their study plan.

Other resources that may be used in program planning in addition to the MSCS Graduate Handbook and the Graduate College catalog include the MSCS list of 500-level courses to be offered during the next academic year. This document is posted on the MSCS graduate studies website. Most 500-level sequences begin fall semester. Courses must be selected with prelim exams in mind.

Students are expected to be *thoroughly prepared* when they meet with their faculty mentor, to be 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 MSCS Graduate Handbook and the Department's list of 500-level courses for the academic year to planning sessions with their faculty mentor.

The Graduate Studies office can access a record of the student's courses and exams taken. As mentioned before, the Director of Graduate Studies serves as the faculty mentor to non-degree students. The Director of Graduate Studies serves as a faculty mentor to others only on a temporary basis under exceptional circumstances.

Faculty Mentors and Thesis Advisors

Each student is assigned a faculty mentor who will guide the student in selecting appropriate courses and answering questions related to the graduate studies program. Students are welcome to consult with any graduate faculty member about selecting courses related to their research goals.

Students who plan to earn a PhD or DA will consult with their assigned faculty mentors until a thesis advisor is selected. Doctoral students who have passed the prelim exam must find a thesis advisor. The thesis advisor has the primary responsibility for directing the student's thesis. In exceptional cases, an advisor may be selected from outside of the MSCS Department. In these cases, the Graduate Studies Committee must approve the outside advisor, and in addition, the student must find a co-advisor among the MSCS Department graduate faculty.

In an effort to identify potential thesis advisors, students are encouraged to attend MSCS colloquia and seminars to learn more about the types of faculty research being conducted in the Department. Taking independent study courses with faculty can be helpful in determining the level of interest a student may have in the professor's research and the compatibility of the work styles.

Students should also maintain close contact with the Graduate Studies office to ensure that they are aware of Graduate College requirements and ongoing Departmental deadlines.

17. COURSE REGISTRATION and GRADUATION

Course Registration

All course registrations and course drops/adds *must* be approved by the faculty mentor and often require the approval of the Director of Graduate Studies.

It is very important for students to advance register for courses they intend to take. Failure to do so may result in courses with low enrollment being cancelled or courses with high demand reaching full capacity, thereby preventing additional enrollment.

The Graduate College will not allow students to add a course "at will" after the tenth day of the Fall and Spring semesters nor after the fifth day of the summer session. Students may not withdraw from courses after the end of the sixth week of instruction during the Fall and Spring semesters without obtaining special approval. Once these deadlines pass, students must petition the Graduate College for permission to add or drop a course. The Department will support such a petition in cases where the student has extenuating circumstances.

Course Load

The Graduate College defines a full-time enrollment as 9 or more credit hours. Graduate students are allowed to enroll in a maximum of 20 credit hours each Fall and Spring term. Most graduate courses are 4 credit hours each. In courses that are offered for either 3 or 4 credits, graduate students select 4 credit hours; three credits are intended for undergraduate students.

Students granted a Graduate College (GC) tuition and fee waiver must complete 12 credit hours during the Fall and Spring term of the award; 6 credit hours is required for a summer award. These rules also apply to fellowship tuition waivers. Students whose enrollment falls below this level may be responsible for the balance of their tuition and fees.

Students holding 50% teaching assistantships register for at least 9 credit hours per Fall and Spring semester and at least 3 credit hours during the summer session. Additional credit hours

may be required for other circumstances, and thus students should consult with the Assistant Director of Graduate Studies to ensure that the minimum enrollment requirements are met for their individual situation.

Graduation

Students who intend to graduate should make an appointment with the Assistant Director of Graduate Studies to verify that all of their degree requirements have been met. Students must electronically file an “intent to graduate” by the deadline posted on the Graduate College website.

Special Courses

Special courses are available for more advanced students. These courses include independent study (reading) courses, graduate student seminar courses, and thesis research.

Independent Study (Reading) Courses

Students may enroll in an Independent Study course (596) with a professor to study a topic not offered as a regular course for the semester. These courses can be taken at the 400 or 500 level and range in credit hours from 1-4 based on the amount of work that is involved. To enroll in an Independent Study course, students must obtain a permission form from the MSCS Graduate Studies website and meet with the professor to discuss the details of the course and complete the form. Instructor, advisor, and Director of Graduate Studies approvals are required. After completing the form along with the signatures, the student will be given permission to add the course.

Graduate Student Seminar Courses

Graduate students may earn one additional credit hour for attending weekly seminars in the Department by enrolling in a Graduate Student Seminar course (593). Seminars frequently host visitors or invite graduate students to present their research.

Thesis Research

Students beginning and continuing research will enroll in a Thesis Research course (599 for doctoral students; 598 for master’s students) for a range of 1-12 credit hours. As noted earlier, doctoral students are limited to 4 credit hours of thesis research per semester until they meet the requirements for PhD candidacy. Once candidacy is reached, this limit is removed.

Zero Hours Registration

Zero Hours registration is for students who have completed all degree requirements except for the master’s thesis, master’s project, or doctoral thesis and need to satisfy a registration requirement until the term of defense or graduation. Students register for their master’s project course (597), master’s thesis (598), or doctoral thesis research (599) for zero (0) hours via Student-Self Service.

SEVIS (federal immigration) regulations do not allow an international student on a visa to register for more than zero hours in a subsequent term if the student was registered for zero hours previously, unless the student is admitted into a different program.

There are two Zero Hour registration options:

Zero Hours – Option A (for MS or Doctoral students)

Students requesting Option A need to petition one time for approval. Students approved for Option A will register for zero hours until the degree is awarded. Range IV tuition and all related fees, including CampusCare student healthcare are assessed.

Zero Hours – Option B (for Doctoral students only)

Students requesting Option B must petition for each renewal and specify Option B. No fees are assessed; only Range IV tuition is assessed. Students who elect Option B are ineligible for access to certain on-campus facilities, such as the gym and CampusCare student healthcare. With each petition, students may elect either one or two terms of Option B and must file a new petition if future terms of Option B are required.

Restricted Courses

Courses with the MthT rubric are intended for the MST program only and do not meet the requirements for the MS, PhD, and DA degrees. Students interested in switching programs or earning a degree in another program, should contact the Director of Graduate Studies for more information.

Incomplete Grades

The grade of “incomplete” (I) should be used only in extenuating circumstances. It may be given only if, for reasons beyond a student's control, required coursework is not completed by the end of the semester. The student and professor must have a clear understanding of how and when the incomplete is to be removed; these agreements should always be in writing.

Students must complete the required work *within one year* subsequent to receiving the “I” grade. The professor will submit the final grade using a Supplemental Grade Report form. If the final grade is not submitted within one year, the “I” will remain permanently on the student’s record. Consult the Graduate College catalog for additional details.

Transfer of Credit

Graduate credits earned in MSCS courses while the student was a degree seeking student in another program may be transferred to the MSCS degree *if* the courses were not used to meet the requirements for another degree and only for courses in which grades of A or B were earned. The transfer of credit is NOT automatic and must be requested by contacting the Graduate Studies office.

Doctoral students who have a previously earned MS degree in mathematics may request 32 credit hours for this degree, thereby reducing the required hours for the PhD or DA from 96 to 64. Interested student must send an official transcript along with proof of the MS degree to the Graduate Studies office.

Non-degree students moving to a degree-seeking program are limited to 12 credit hours of transfer credit in which an A or B was earned. Once admitted to the degree program, the student should contact the Graduate Studies office to request to transfer any qualified courses.

Limited Status Admission

Students admitted to the Graduate College on limited status must meet certain requirements in order to be granted full standing. These conditions will be outlined in the admission letter along

with the deadline to meet the conditions. Failure to satisfy the conditions within the stated deadline can result in the student's dismissal from the Graduate College.

Leave of Absence

Students should refer to the Graduate College Catalog for information regarding a Leave of Absence. Degree seeking students wishing a semester leave must first obtain the approval of the Director of Graduate Studies, followed by the Graduate College. International students and doctoral candidates, whose continued enrollment is required, may not be eligible for a leave of absence.

Mathematics Library

The Mathematics Library, located on the second floor of Daley Library, contains the major portion of the University's mathematics holdings. Its books and journal collections are a valuable research asset.

Mathematics Graduate Student Association (MGSA)

All MSCS graduate students 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. Members belong to a listserv which serves as an avenue for communication among the members of MGSA and also keeps students informed of various dates, deadlines, and general information published by the Graduate Studies office.

Suggestions and Concerns

Suggestions for improving the Department's graduate studies programs should be communicated to the Director or Assistant Director of Graduate Studies. Students are encouraged to voice their ideas and concerns to MGSA. *A complaint concerning a course grade* should first be discussed with the professor before bringing the matter to the attention of the Graduate Studies administration. *Complaints concerning Departmental exams* should be communicated in writing to the Director of Graduate Studies along with all pertinent data and background information.

The Colloquium

The colloquium provides an excellent opportunity for graduate students and faculty to expand their mathematical horizons. Over the course of the academic year, colloquium speakers lecture on many areas 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 following the lectures.

Appendix 1 - To the Faculty

Faculty Mentors/Advising

Faculty mentors and thesis advisors need to be familiar with policies and procedures outlined in this Handbook and the Graduate College catalog. The Graduate College requires all students to be assigned an advisor in the program in which their degree work is done; the *faculty mentor* fills this role until a thesis advisor is selected. Faculty should keep records of their students' registrations and changes.

Each degree has certain course restrictions, as outlined in this Handbook. The Graduate Studies office maintains a record of the requirements met by each student. Issues regarding policy and procedural questions should be referred to the Graduate Studies office. In addition to this Handbook, faculty are encouraged to consult the Graduate College catalog for additional details regarding the rules governing the prelim exam, master's thesis exam, and the thesis defense.

Prelim Exam Administration (Written)

Faculty members appointed as prelim examiners are responsible for:

1. Setting the prelim exam date/time and informing the students
2. Administering and grading the prelims - *Examiners should not make any marks on the students' solutions they grade until the grades are set. At that point they record their grades and comments that they agree are appropriate on the exam papers.*
3. Retaining the students' prelim exam papers
4. Reporting the scores (1, 2, 3, or 5) to the Graduate Studies office
5. Sending a PDF copy of the exam to the Graduate Studies office after the exam, for posting on the website

The Graduate Studies office will:

1. Update the website with the current list of prelims and prelim examiners
2. Announce the prelim registration period to the graduate student listserv and collect the registration forms
3. Send a prelim exam roster electronically to each examiner
4. Report the prelim exam score to the student
3. Maintain a record of the student's exam score

Prelim Exam Administration (Oral – Statistics only)

The oral prelim should be taken *soon* after completing both written prelims and the minor sequence for the PhD degree. It is strongly advised that "soon" be interpreted as meaning "within several weeks" and certainly "within a semester".

The Dean of the Graduate College must approve the oral prelim committee prior to the exam. Recommendations for committee members are made using the Graduate College Committee Recommendation form, first submitted to the Graduate Studies office at least three weeks in advance of the proposed exam date. This provides sufficient time for the Graduate College to approve the committee and return an Exam Report form to the Department prior to the exam.

The Committee Chair is responsible for conducting the oral prelim, obtaining the committee signatures on the Exam Report form, and returning the form to the Graduate Studies office immediately following the exam. The results of this exam must be reported to the Graduate College Dean by the Graduate Studies office within 48 hours of the exam date.

Master's Exam Administration

Each year the Department Head appoints a Master's Exam Chair and a Master's Exam Pure Mathematics Coordinator. The Master's Exam is given twice per year; scores are reported to the students approximately two weeks following the exam. Students take the exam using an assigned exam ID number; no names should appear on the exam paperwork.

Before the exam, the Master's Exam Chair is responsible for:

1. Reserving the exam room.
2. Appointing exam coordinators for AM, MCS, and Stat from tenured and tenure-track faculty who have recently taught the relevant courses. The Pure Math Coordinator is responsible for appointing exam coordinators for the PM exam (see below).
3. Collecting exam questions for each of the exam concentrations, ensuring that the questions match the approved list of exam topics outlined in the current Handbook. It is advisable to request exam questions for the March and August exams at the same time, securing the second set of exam questions until needed.
4. Obtaining the exam roster from the Graduate Studies office two weeks before the exam
5. Preparing exam envelopes for each examinee, containing the exam and displaying the exam ID number on the envelope. Traditionally, ID numbers 100-199 are assigned to Pure Math; 200-299 are Applied Math; 300-399 are Statistics; and 400-499 are Computer Science. A minimum of 2 extra exams for each area should also be prepared.

On exam day, the Master's Exam Chair is responsible for:

1. Setting up the exam room to ensure that students taking like exams are not seated next to each other.
2. Providing stacks of colored paper (all one color) for students to use in working the problems. The use of colored paper is intended to reduce the possibility of students bringing pre-written solutions to the exam.
3. Proctoring the full exam and arranging for Faculty from each exam concentration to be present at the start of the exam to answer student questions.

After the exam, the Master's Exam Chair is responsible for:

1. Checking each exam sheet to make sure the student's ID number appears on each page.
2. Separating each student exam by question, placing the individual questions in envelopes, and distributing the envelopes to the exam coordinator for each of the four areas.
3. Providing exam instructions to the exam coordinators. *Faculty should not make any marks on the students' solutions they grade until the grades are set. At that point they record their grades and comments that they agree are appropriate on the exam papers.*
4. Specifying the date in which the exam scores should be returned and following up with each exam coordinator to ensure that the scores are ready by this date.
5. Completing the MS Exam Score Summary sheet for each area, listing the student's score for each question next to the appropriate exam ID number, indicating the top 8 scores, and listing the sum of the top 8 scores along with an indication of Fail for scores 89 and below; Pass for scores from 90 up to and including 109; High Pass for scores 110 and above.

6. Identifying the top 8 scores for each exam ID number and listing the sum of these 8 scores on the Score Summary Sheet.
7. Obtaining a PDF copy of the exam and solutions for each area and forwarding to the Graduate Studies office.
8. Returning each student's exam to the respective envelope and delivering the envelopes to the Graduate Studies office for filing.

The Master's Exam – Pure Mathematics Coordinator is responsible for:

1. Appointing exam coordinators for each of the pure math fields from tenured and tenure-track faculty who have recently taught the relevant courses.
2. Collecting exam questions for the Pure Mathematics exam and submitting to the MS Exam Chair.
3. Separating each student exam by question, placing the individual questions in envelopes, and distributing the envelopes to the faculty for grading along with instructions. *Faculty should not make any marks on the students' solutions they grade until the grades are set. At that point they record their grades and comments that they agree are appropriate on the exam papers.*
4. Specifying the date in which the exam scores should be returned and following up with faculty to ensure that the scores are ready by this date.
5. Completing the MS Exam Score Summary sheet, listing the student's score for each question next to the appropriate exam ID number, indicating the top 8 scores, and listing the sum of the top 8 scores along with an indication of Fail for scores 89 and below; Pass for scores from 90 up to and including 109; High Pass for scores 110 and above.
6. Identifying the top 8 scores for each exam ID number and listing the sum of these 8 scores on the Score Summary Sheet.
7. Obtaining a PDF copy of the exam and solutions for each area and forwarding to the Graduate Studies office.
8. Returning each student's exam to the respective envelope and delivering the envelopes to the Graduate Studies office for filing.

The Graduate Studies office is responsible for:

1. Announcing the MS exam date and registration period to the graduate student listserv.
2. Collecting MS exam registration forms.
3. Informing the MS exam Chair of the number of registered students by area and their associated exam ID numbers.
4. Sending MS exam instructions and exam ID numbers to students at least one week prior to the exam.
5. Listing the student's name next to their exam ID number on the MS Exam Score Summary sheet once it is received from the MS Exam administrators.
6. Reporting the exam results to the student.
7. Maintaining an individual record of the student's exam score in their academic file and in the student database. The official Score Summary sheet is retained in the DGS office.
8. Posting the exam and solutions on the web following the exam.

Appendix 2 - Current 400 and 500 level Mathematics Courses

Mathematics (Math) Prefix

<u>Math</u>	<u>Title</u>	<u>Hours</u>
410	Advanced Calculus I	4
411	Advanced Calculus II	4
414	Analysis II	4
417	Complex Analysis with Applications	4
419	Models in Applied Mathematics	4
425	Linear Algebra II	4
430	Formal Logic I	4
431	Abstract Algebra II	4
435	Foundations of Number Theory	4
436	Number Theory for Applications	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
494	Special Topics in Mathematics	4
496	Independent Study	1-4
502	Mathematical Logic	4
504	Set Theory	4
506	Model Theory I	4
507	Model Theory II	4
511	Descriptive Set Theory	4
509	Universal Algebra I	4
510	Universal Algebra II	4
512	Advanced Topics in Logic	4
513	Adv 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	Commutative and Homological Algebra	4
531	Advanced Topics in Algebra	4
533	Real Analysis I	4
534	Real Analysis II	4
535	Complex Analysis I	4
536	Complex Analysis II	4
537	Introduction to Harmonic Analysis I	4
539	Functional Analysis I	4

<u>Math</u>	<u>Title</u>	<u>Hours</u>
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	Adv Topics in Geometric and Differential Topology	4
570	Advanced Topics in Differential Geometry	4
571	Advanced Topics in Algebraic Geometry	4
574	Applied Optimal Control	4
575	Integral Equations and Applications	4
576	Classical Methods of Partial Differential Equations	4
577	Advanced Partial Differential Equations	4
578	Asymptotic Methods	4
579	Singular Perturbations	4
580	Mathematics of Fluid Dynamics	4
581	Selected Topics in Fluid Dynamics	4
582	Linear and Nonlinear Waves	4
583	Wave Propagation and Scattering II	4
584	Applied Stochastic Models	4
585	Ordinary Differential Equations	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
594	Internship in Mathematics	0-8
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

<u>MCS</u>	<u>Title</u>	<u>Hours</u>
401	Computer Algorithms I	4
411	Compiler Design	4

<u>MCS</u>	<u>Title</u>	<u>Hours</u>
415	Programming Language Design	4
421	Combinatorics	4
423	Graph Theory	4
425	Codes and Cryptography	4
441	Theory of Computation I	4
451	Object-Oriented Programming in C++	4
471	Numerical Analysis	4
472	Introduction to Industrial Math and Computation	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	Math 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
548	Mathematical Theory of Artificial Intelligence	4
551	Generic Programming and the C++ Standard Template Library	4
563	Analytic Symbolic Computation	4
565	Mathematical Theory of Databases	4
571	Numerical Analysis for Partial Differential Equations	4
572	Introduction to Supercomputing	4
573	Topics in Numerical Analysis of Partial Differential Equations	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
598	Master's Thesis	0-16
599	Thesis Research	0-16

Statistics (Stat) Prefix

<u>Stat</u>	<u>Title</u>	<u>Hours</u>
401	Introduction to Probability	4
411	Statistical Theory	4
416	Nonparametric Statistical Methods	4
431	Introduction to Survey Sampling	4
451	Computational Statistics	4
461	Applied Probability Models I	4
471	Linear and Non-Linear Programming	4
473	Game Theory	4
<u>Stat</u>	<u>Title</u>	<u>Hours</u>

481	Applied Statistical Methods II	4
486	Statistical Consulting	4
494	Special Topics in Statistics, Probability, & 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
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
591	Adv. Topics in Statistics, Probability, & 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

<u>MthT</u>	<u>Title</u>	<u>Hours</u>
400	Methods of Teaching Secondary Mathematics I	4
401	Methods of Teaching Secondary Mathematics II	4
411	Advanced Euclidean Geometry	4
420	Computers in Secondary School Mathematics	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 and Middle 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 Math	1-5

<u>MthT</u>	<u>Title</u>	<u>Hours</u>
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
575	Principles of Probability and Statistics	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 Math	1-5
592	Topics in Advanced Mathematics for Teachers	1-5
596	Independent Study	1-4