

A suggested program of study

Students who are not sure whether they want to pursue a M.S. or Ph.D., are recommended to begin with a Ph.D.-oriented program and then, if desired, switch to a Master's schedule.

For example, if a student pursues the first year of program below, he or she could finish the M.S. course requirements after a total of 3 semesters (plus one summer), upon completion of a thesis or creative component.

Enter fall of odd-numbered year	
F, yr 1	M 607, M 504, M 510
S, yr 1	M 608, M 505, M 511
Su, yr 1	M 501
F, yr 2	M 605, M 515, M 644
S, yr 2	M 606, M 516, M 533*
Enter fall of even-numbered year	
F, yr 1	M 605, M 504, M 510
S, yr 1	M 606, M 505, M 511
Su, yr 1	M 501
F, yr 2	M 607, M 515, M 644
S, yr 2	M 608, M 516, M 533*

*other recommended options:
M 535, C S 311, C S 531 or Stat 543.

This program for the first two years will enable the student to take the [algebra qualifying exam](#) in August of year 1 and the [analysis qualifying exam](#) in either January or August of year 2.

This also includes prerequisites required to take most of the remaining suggested courses or such special topics courses as may be offered.

Students with a strong analysis background are encouraged to take Real Analysis -- M 515 and M 516 -- in year 1.

Courses

Core courses:

- M 504, M 505: Algebra I & II (F,S)
- M 510: Linear Algebra (F)
- M 515, M 516: Real Analysis I & II (F,S)
- M 511: Functions of a Complex Var. (S)

Discrete Mathematics courses:

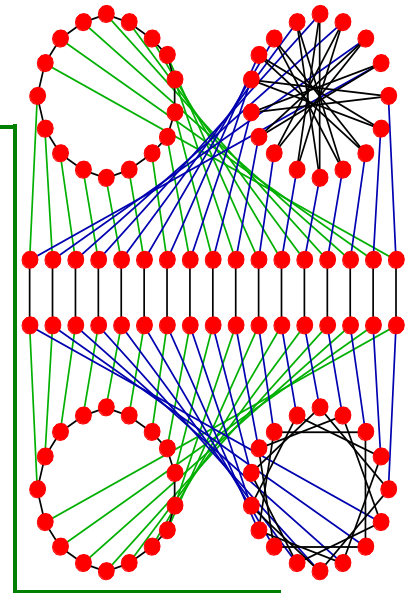
- M 605: Design Th. and Association Schemes (Alt.F)
- M 606: Enum. Combin. and Ordered Sets (Alt.S)
- M 607: Modern (Structural) Graph Theory (Alt.F)
- M 608: Extremal Graph Theory (Alt.S)
- M 690I: Adv. Topics in Combinatorics

Suggested elective courses:

- M 533 [CprE 533]: Cryptography (S)
- M 535 [CprE 535]: Steganography and Watermar. (S)
- E E 621: Coding Theory (Alt.S)
- Stat 542, Stat 543: Th. of Prob. and Stat. I & II (F,S)
- M 554 [Stat 554]: Introduction to Stochastic Proc. (F)
- M 644: Probability Theory (F)
- M 642 [Stat 642]: Advanced Probability Theory (F)
- M 690W: Adv. Topics in Probability
- M 561, M 562: Numerical Analysis I,II (F,S)
- M 601, M 602: Logic I,II (Alt.F,Alt.S)
- M 615, M 616: Th. of Algebraic Struct. (Alt.F,Alt.S)
- M 690E: Adv. Topics in Linear Algebra
- I E 534: Linear Programming (Alt.F)
- M 690V: Adv. Topics in Optimization Theory
- C S 511: Design and Analysis of Algorithms (F)
[or C S 311: Design & Anal. of Alg. (F & S)]
- C S 531: Theory of Computation (S)
[or C S 331: Theory of Computing (F & S)]
- C S 631: Computational Complexity (Alt.F)
- C S 633: Randomness in Computation (Alt.F)

M=Mathematics, C S=Computer Science, Stat=Statistics,
Cpr E=Computer Engineering,
E E=Electrical Engineering, I E=Industrial Engineering

F=Fall Semester S=Spring Semester
Su=Summer Session Alt.=Offered in alternate years



DISCRETE MATHEMATICS

AMES,

IOWA STATE

UNIVERSITY IOWA

Discrete Mathematics

Discrete mathematics is a growing and popular area of study that includes a number of subtopics such as graph theory, combinatorics, design theory, coding theory and cryptography.

Iowa State offers a program in which students can study a variety of discrete mathematical topics with any of a number of active researchers. The mathematics department offers both a Master's degree and a Ph. D. in mathematics. In addition, one can earn an M.S. in the closely-related area of Information Assurance.

Discrete mathematics is applied in a number of areas of science and technology. Our students take courses in Computer Science, Statistics, Electrical and Computer Engineering, Industrial Engineering and other departments. We maintain close connections to interdisciplinary programs such as Bioinformatics and Information Assurance. We also offer and encourage co-major Ph.D.s, which couple mathematics with some other appropriate program of study.

You can find more detailed information on the graduate program at the following web address:

<http://www.math.iastate.edu/grads/>

If you would like to apply, procedures and information can be found here:

<http://www.math.iastate.edu/grads/how-to-apply.html>

This hyperlinked document can be found in MSWord format at:

<http://orion.math.iastate.edu/rymartin/DMatISU.doc>

Or contact one of the following people:

- **Melanie Erickson**, Graduate Secretary,
gradmath@iastate.edu
- **Paul Sacks**, Professor and Graduate Director,
mathdoge@iastate.edu
- **Ryan Martin**, Assistant Professor,
rymartin@iastate.edu

Faculty in Graph Theory and Combinatorics:

- **Maria Axenovich** (Ph.D. Illinois, 1999) Graph theory, combinatorics, coloring problems, Ramsey-type problems
- **Leslie Hogben** (Ph.D. Yale, 1978) Combinatorial matrix theory, matrix completion problems, inverse eigenvalue problem of a graph, spectral graph theory
- **Ryan Martin** (Ph.D. Rutgers, 2000) Extremal graph theory, combinatorics, probabilistic methods
- **Jonathan Smith** (Ph.D. Cambridge, 1975) Quasigroups and loops, non-associative algebra, universal algebra, graph theory, coding theory, group theory, information theory, hierarchical statistical mechanics, mathematical biology, complex systems, demography, convexity, duality, spacetime
- **Sung-Yell Song** (Ph.D. Ohio State, 1987) Combinatorics: algebraic combinatorics, association schemes, algebraic graph theory, combinatorial designs, sampling plans, information theory and cryptography

Seminars:

- **Combinatorics/Algebra Seminar**
- **Discrete Math Seminar**
- **ISU Information Assurance Colloquium**

Program Requirements

Master of Science (M.S.):

- 12 credits from core courses: 6 in abstract/linear algebra, 6 in real/complex analysis
- M 591/592 orientation course
- 30 total credits
- Thesis or creative component

Doctor of Philosophy (Ph.D.):

- 18 credits from core courses
- 6 credits from outside of mathematics (cognates). Can be upper-division undergrad courses in other departments
- 42 credits in 500-600 level mathematics courses
- 48 total classroom credits
- M 591/592 orientation course
- Two written qualifying exams, oral preliminary exam, dissertation
- 72 total credits (including research)

Assistantships

Virtually all of our graduate students are supported by Teaching or Research Assistantships. As a Teaching Assistant you would teach recitations or your own class of algebra, trigonometry, or calculus. As a Research Assistant, you would work closely with a faculty member on a selected research topic.

We expect the stipends to range up to \$16,000 for nine months. Miller scholarships are available on a competitive basis and can supplement this sum. Additional support is usually available for the summer. Tuition scholarships are available to graduate students on assistantships.

About the picture on the cover: The Biggs-Smith graph is a symmetric cubic graph on 102 vertices and 153 edges that is also distance-regular. It is known to be uniquely determined by its graph spectrum (van Dam and Haemers 2002)

For Current Students

Requirements

Master of Science (M.S.):

- 12 credits from core courses: 6 in abstract/linear algebra, 6 in real/complex analysis
- 30 total credits
- M 591/592 orientation course
- Thesis or creative component

Doctor of Philosophy (Ph.D.):

- 18 credits from core courses
- 6 credits from outside of mathematics (cognates). Can be classes cross-listed with another department or upper-division undergraduate courses in other departments
- 42 credits in 500-600 level mathematics courses
- 48 total classroom credits
- M 591/592 orientation course
- [Two qualifying examinations](#), oral preliminary exam, dissertation
- 72 total credits (including research)

Additional requirements (GPA, etc.) are listed in the [Mathematics Graduate Student Handbook \(MGSH\)](#).

A suggested program of study

The following table suggests two programs of study for discrete math students. Program 1 will enable the student to take the [algebra qualifying exam](#) in August of year 1 and the [analysis qualifying exam](#) in either January or August of year 2. Program 2, better for students who are more comfortable with analysis, will enable the student to take the analysis exam first and then the algebra exam.

Some students will wish to take M 502 and M 503 in order to take the numerical analysis qualifying exam instead of analysis.

	Program 1	Program 2
Enter in fall of even-numbered year		
F, yr 1	M 605, M 504, M 510	M 504, M 510, M 515
Sp, yr 1	M 606, M 505, M 511	M 505, M 516, M 511
Su, yr 1	M 501	
F, yr 2	M 607, M 515, M 644	M 607, M 510, M 644
Sp, yr 2	M 608, M 516, M 533*	M 608, M 533*, Elective
Yr 3		M 605(F), M 606(S)
Enter in fall of odd-numbered year		
F, yr 1	M 607, M 504, M 510	M 504, M 510, M 515
Sp, yr 1	M 608, M 505, M 511	M 505, M 516, M 511
Su, yr 1	M 501	
F, yr 2	M 605, M 515, M 644	M 605, M 510, M 644
Sp, yr 2	M 606, M 516, M 533*	M 606, M 533*, M 511
Yr 3		M 607(F), M 608(S)

*other recommended options: M 535, C S 311, C S 531 or Stat 543.

Graduate Minor

Iowa State offers a potential for students to receive a [minor](#) in their Ph.D. Students in mathematics must have permission of the minor department, and their program of study committee.

The program of study committee must contain at least one member from the minor department. Typically, programs require 12 credits to receive a graduate minor, this can be easily accomplished through cognate courses. Some examples:

- A [computer science minor](#) can be achieved by taking C S 311, 331, 631 and one other course at the 300-level or above.
- A [statistics minor](#) can be achieved by taking STAT 401, 542, 543 and one other course at the 300-level or above.

Co-majoring

Iowa State offers a [co-major program](#) for the Ph.D. degree. This enables the student to do a course curriculum that spans two departments. The student typically initiates such a program after admission. This is a program designed for well-qualified students whose interest is not wholly in the department.

Any co-major course of study needs to have a written proposal approved by the respective graduate committees of both departments. There must be a co-major professor from each of the co-major departments. The mathematics department also requires:

- 24 credits in 500--600 level mathematics courses other than M 590, 591, 592 and 699
- Four courses from the mathematics core including at least one one-year sequence (M 504-505 or M 515-516)
- [One qualifying exam](#), oral preliminary exam
- Dissertation with a substantial component of original research spanning each co-major area
- Professional experience (includes teaching)

For example, the [Computer Science dept.](#) also requires:

- C S 511, C S 531
- 21 elective credits including one course from each of four breadth areas
- C S 591, 3 credits of C S 610
- 36 total course credits (except 590, 591, 610, 690, 699)
- 6 credits at 600-level (except 699)



Academic progress

Students in the Ph.D. program are required to maintain good progress in order to continue in the graduate program and to continue to receive funding.

Students who did not enter ISU with a Master of Science (MS) in mathematics from another institution are expected to finish their Ph.D. in 5 years, although a sixth year of funding is often granted, subject to approval by the Graduate Committee. Students who enter with a master's degree are expected to finish a year sooner.

In order to make good progress, a student must maintain a GPA in his or her math courses of at least 3.33. (Only a 3.00 is required for the master's program.)

The progress of a student is dependent on whether the student achieved a master's degree in mathematics before arriving at ISU. **Note:** A student in the ISU master's program who transfers to the Ph.D. program will be considered to have started on the day he or she entered ISU.

The student should check with the Director of Graduate Education (DoGE) in order to determine whether their master's degree from another institution is counted for this distinction.

Students without an MS will have passed 1 qualifying exam in 4 semesters and 2 qualifying exams in 6 semesters to be considered to be making good progress. Students with an MS will be expected to have passed 1 in 4 semesters and 2 in 5 semesters.

English language requirements

Most international students will be required to complete SPEAK/TEACH requirements by May of year 1 and the graduate college English requirement by July of year 1.

Disclaimer: The contents of this brochure should in no way be considered "official" information. For official policies, please consult the [Mathematics Graduate Student Handbook \(MGSH\)](#).



Students entering without an MS degree

For this timetable, the academic year begins Aug. 1 and ends July 31:

- **Year 1 F&S&Su:** Take core courses, be prepared for at least one qualifying exam.
- **Y2, August:** First attempt at first qualifying exam (usually algebra).
- **Y2, Fall:** Finish all fall-semester core courses.
- **Y2, January:** If necessary, second attempt at first qualifying exam.
- **Y2, Spring:** Finish all core courses. Form POS (Program of Study) committee.
- **Y3, August:** First attempt at second qualifying exam (usually analysis or numerical analysis)
- **Y3, Fall:** Begin research program plan.
- **Y3, January:** If necessary, second attempt at second qualifying exam.
- **Y3 or Y4:** Take Oral Preliminary Exam. This is done after passing the second qualifying exam. It is recommended to take the prelim early.
- **Y3 to Y4:** Begin main Thesis research.
- **Year 5:** Thesis writing.

Students entering with an MS degree

For this timetable, the academic year begins on August 1 and ends on July 31:

- **Year 1 F&S&Su:** Take all core courses, be prepared for two qualifying exams.
- **Y2, August:** First attempt at first qualifying exam (usually algebra).
- **Y2, Fall:** Form POS (Program of Study) committee.
- **Y2, January:** If necessary, second attempt at first qualifying exam. Otherwise, first attempt at second qualifying exam.
- **Y2, Spring or Y3:** Take Oral Preliminary Exam. This is done after passing the second qualifying exam. It is recommended to take the prelim early.
- **Year 3, August:** If necessary, second attempt at second qualifying exam.
- **Year 3, Summer:** Begin research program plan.
- **Year 3 to Year 4:** Begin main Thesis research.
- **Year 4:** Thesis writing.