

MATHEMATICS, PHD

The department offers the doctor of philosophy degree with a major in mathematics and a master of arts degree in mathematics.

The PhD degree requires proficiency in basic and advanced graduate mathematics and the completion of a dissertation containing a significant piece of original research in some area of mathematics. The scope of the research program in mathematics is broad. The PhD specialty and dissertation may be in any area of mathematics, including but not limited to algebra, algebraic geometry, applied mathematics, combinatorics, computational mathematics, complex analysis, differential equations, differential geometry, dynamical systems, harmonic analysis, logic, mathematical biology, number theory, probability, and topology. A complete list of faculty and their areas of expertise is available through the department website (<https://www.math.wisc.edu/graduate/>).

Students in the PhD program also have the option to earn a master of arts degree (<https://guide.wisc.edu/graduate/mathematics/mathematics-ma/>).

ADMISSIONS

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Please consult the table below for key information about this degree program's admissions requirements. The program may have more detailed admissions requirements, which can be found below the table or on the program's website.

Graduate admissions is a two-step process between academic programs and the Graduate School. **Applicants must meet the minimum requirements (<https://grad.wisc.edu/apply/requirements/>) of the Graduate School as well as the program(s).** Once you have researched the graduate program(s) you are interested in, apply online (<https://grad.wisc.edu/apply/>).

Requirements	Detail
Fall Deadline	December 15
Spring Deadline	This program does not admit in the spring.
Summer Deadline	This program does not admit in the summer.
GRE (Graduate Record Examinations)	Not required but may be considered if available.
English Proficiency Test	Refer to the Graduate School: Minimum Requirements for Admission policy: https://policy.wisc.edu/library/UW-1241 (https://policy.wisc.edu/library/UW-1241/).
Other Test(s) (e.g., GMAT, MCAT)	The GRE subject test in Mathematics is optional but may be considered if available.
Letters of Recommendation Required	3

Admission is competitive. Applicants to the PhD program are automatically considered for financial support.

APPLICATION CHECKLIST

A complete application includes the following items:

1. Statement of purpose: Your essay should be a concise description of your reasons for choosing to study this field at the University of Wisconsin-Madison (not to exceed two pages). Please include your research interests and career goals as well as a description of your preparation for graduate study including relevant coursework, related employment, research experience, publications, presentations, awards, and honors. (samples (<https://math.wisc.edu/graduate/prospective-phd/additional-application-information/>))
2. Supplementary application:
 - a. Coursework (different from transcript): In a list or table format, state all advanced mathematics courses you have completed, are currently enrolled in, or intend to take. For each course, give the name of the school where you took it, the course number, the title, description, books used, and the grade you received (for completed courses). If you have more than 20 courses, please include ONLY the most advanced courses. (sample (<https://math.wisc.edu/graduate/prospective-phd/additional-application-information/>))
3. CV/Resume: Your CV/resume should include your educational background as well as teaching and research experience, publications, and accomplishments. (sample (<https://math.wisc.edu/graduate/prospective-phd/additional-application-information/>))
4. Unofficial transcripts: Unofficial transcripts from all previous postsecondary studies are required. International academic records must be submitted in the original language and accompanied by an English translation. If an applicant is recommended for admission, the Graduate School will ask applicants to request official transcripts sent to the Graduate School from the undergraduate institution.
5. Letters of recommendation: Three (3) letters of recommendation that address the question of mathematical promise. These letters should be from mathematics faculty, or other faculty familiar with the demands of graduate work in mathematics.

BACKGROUND EDUCATION

Successful applicants have a bachelor's degree in mathematics/applied mathematics/statistics.

Preparatory Coursework

Code	Title	Credits
Analysis I/II ¹		
Examples of courses (or equivalent):		
MATH 521	Analysis I	3
MATH 522	Analysis II	3
Algebra I/II ¹		
Examples of courses (or equivalent):		
MATH 541	Modern Algebra	3
MATH 542	Modern Algebra	3
Linear Algebra		
Example of course (or equivalent):		
MATH 341	Linear Algebra	3
Electives		

Four electives among advanced undergrad or grad math courses. Incoming students usually, but not always, have some exposure to graduate level mathematics through graduate coursework, independent study, or research experience. This background often exceeds the minimum requirements for a math major.

Faculty Advisors

You do not need an advisor prior to applying. Incoming students are assigned academic advisors at the beginning of their programs. PhD students have until the end of their 6th semester to secure a dissertation advisor.

¹ Candidates with interest in Applied Math may have a different mathematics background, typically including coursework in ordinary and partial differential equations, and computational science with programming experience in Python, Matlab, or similar language. That coursework should be at a commensurately advanced undergraduate level.

FUNDING

FUNDING

GRADUATE SCHOOL RESOURCES

The Bursar's Office provides information about tuition and fees associated with being a graduate student. Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information is available from the Graduate School. Be sure to check with your program for individual policies and restrictions related to funding.

PROGRAM RESOURCES

Prospective students should see the program website for funding information (<https://math.wisc.edu/ta-and-grader/>).

REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

Review the Graduate School minimum degree requirements (<https://guide.wisc.edu/graduate/#requirements-text>) and policies (<https://guide.wisc.edu/graduate/#policies-text>), in addition to the program requirements listed below.

MAJOR REQUIREMENTS

MODE OF INSTRUCTION

Face to Face	Evening/ Weekend	Online	Hybrid	Accelerated
Yes	No	No	No	No

Mode of Instruction Definitions

Accelerated: Accelerated programs are offered at a fast pace that condenses the time to completion. Students typically take enough credits aimed at completing the program in a year or two.

Evening/Weekend: Courses meet on the UW–Madison campus only in evenings and/or on weekends to accommodate typical business

schedules. Students have the advantages of face-to-face courses with the flexibility to keep work and other life commitments.

Face-to-Face: Courses typically meet during weekdays on the UW–Madison Campus.

Hybrid: These programs combine face-to-face and online learning formats. Contact the program for more specific information.

Online: These programs are offered 100% online. Some programs may require an on-campus orientation or residency experience, but the courses will be facilitated in an online format.

CURRICULAR REQUIREMENTS

Requirement Detail	
Minimum Credit Requirement	51 credits
Minimum Residence Credit Requirement	32 credits
Minimum Graduate Coursework Requirement	51 credits must be graduate-level coursework. Refer to the Graduate School: Minimum Graduate Coursework (50%) Requirement policy: https://policy.wisc.edu/library/UW-1244 (https://policy.wisc.edu/library/UW-1244/).
Overall Graduate GPA Requirement	3.00 GPA required. Refer to the Graduate School: Grade Point Average (GPA) Requirement policy: https://policy.wisc.edu/library/UW-1203 (https://policy.wisc.edu/library/UW-1203/).
Other Grade Requirements	No additional grade requirements.
Assessments and Examinations	Students are required to pass at least two qualifying exams. At least one qualifying exam must be passed by the beginning of the fourth semester (the spring semester of the second year). Both qualifying exams must be passed by the beginning of their sixth semester (the spring semester of the third year). Students must pass a preliminary exam (specialty exam) by the end of the eighth semester (end of fourth year). Students must satisfy all the requirements for dissertator status by the end of the eighth semester (end of fourth year).
Language Requirements	No language requirements.
Graduate School Breadth Requirements	All doctoral students are required to complete at least a 12-credit doctoral minor or graduate/professional certificate. Refer to the Graduate School: Breadth Requirement in Doctoral Training policy: https://policy.wisc.edu/library/UW-1200 (https://policy.wisc.edu/library/UW-1200/).

REQUIRED COURSES

Students must take a total of 51 graduate credits, or generally 18 courses. This includes courses in math and in breadth. In the PhD program, math courses numbered above 700 are for graduate credit. Math courses below 700 must be approved by the academic advisor.

Area of Specialization

There are five general and overlapping areas of specialization¹ within the department:

- Algebra, Algebraic Geometry, Combinatorics and Number theory
- Analysis, Differential Equations and Probability
- Applied and Computational Mathematics
- Logic
- Geometry, Topology, and Dynamics

Additional Area of Specialization: Mathematics Education¹

The course requirement is the same as for the other specialties except that the required 51 credits should include 18 credits in courses related to mathematics education, and at least one of the courses must be on research techniques in education. The 18 credits may come (wholly or in part) from courses included in breadth.

There are many different paths that one may take to 51 credits while pursuing a PhD in Mathematics at Wisconsin. Below are a few possible paths in different subject areas. These are just possibilities, and are not meant to prescribe any particular path.

Algebra, Algebraic Geometry, or Number Theory¹

Students may complete the following sequence of courses.

Code	Title	Credits
MATH 741	Abstract Algebra	3
MATH 742	Abstract Algebra	3
MATH 747	Lie Algebras	3
MATH 748	Algebraic Number Theory	3
MATH 750	Homological Algebra	3
MATH 751	Introductory Topology I	3
MATH 752	Introductory Topology II	3
MATH 761	Differentiable Manifolds	3
MATH 763	Introduction to Algebraic Geometry	3
MATH 764	Introduction to Algebraic Geometry	3
MATH 843	Representation Theory	3
MATH 844	Arithmetic Geometry	3
MATH 845	Class Field Theory	3
MATH 848	Advanced Topics in Number Theory	3
MATH 851	Topics in Geometric Topology	3
MATH 900	Graduate Teaching Seminar	1
MATH 941	Seminar-Algebra	1-3
MATH 967	Seminar in Number Theory	1-3
MATH 990	Reading and Research	1-3

Analysis and/or Differential Equations¹

Students may complete the following sequence of courses.

Code	Title	Credits
MATH 719	Partial Differential Equations	3
MATH 720	Partial Differential Equations	3
MATH 721	A First Course in Real Analysis	3
MATH 722	Complex Analysis	3
MATH 725	A Second Course in Real Analysis	3
MATH 751	Introductory Topology I	3
MATH 752	Introductory Topology II	3

MATH 758	Introduction to Ergodic Theory and Dynamics	3
MATH 761	Differentiable Manifolds	3
MATH 821	Advanced Topics in Real Analysis	3
MATH 823	Advanced Topics in Complex Analysis	3
MATH 825	Selected Topics in Functional Analysis	3
MATH 827	Fourier Analysis	3
MATH 828	Advanced Topics in Harmonic Analysis	3
MATH 900	Graduate Teaching Seminar	1
MATH 921	Seminar in Analysis	1-3
MATH 990	Reading and Research	1-3

Probability¹

Students may complete the following sequence of courses.

Code	Title	Credits
MATH 718	Randomized Linear Algebra and Applications	3
MATH/COMP SCI/ ISY E/STAT 726	Nonlinear Optimization I	3
MATH/COMP SCI/ ISY E 730	Nonlinear Optimization II	3
MATH/STAT 733	Theory of Probability I	3
MATH/STAT 734	Theory of Probability II	3
MATH 735	Stochastic Analysis	3
MATH 741	Abstract Algebra	3
MATH 742	Abstract Algebra	3
MATH 751	Introductory Topology I	3
MATH 752	Introductory Topology II	3
MATH 758	Introduction to Ergodic Theory and Dynamics	3
MATH 801	Topics in Applied Mathematics	3
MATH/STAT 833	Topics in the Theory of Probability	3
MATH/E C E/ STAT 888	Topics in Mathematical Data Science	1-3
MATH 900	Graduate Teaching Seminar	1
MATH 921	Seminar in Analysis	1-3
MATH 990	Reading and Research	1-3

Applied or Computational Mathematics¹

Students may complete the following sequence of courses.

Code	Title	Credits
MATH 703	Methods of Applied Mathematics 1	3
MATH 704	Methods of Applied Mathematics-2	3
MATH 705	Mathematical Fluid Dynamics	3
MATH/STAT 709	Mathematical Statistics I	4
MATH/COMP SCI 714	Methods of Computational Mathematics I	3
MATH/COMP SCI 715	Methods of Computational Mathematics II	3
MATH 717	Stochastic Computational Methods	3

MATH 718	Randomized Linear Algebra and Applications	3
MATH 719	Partial Differential Equations	3
MATH 721	A First Course in Real Analysis	3
MATH 722	Complex Analysis	3
MATH 725	A Second Course in Real Analysis	3
MATH 751	Introductory Topology I	3
MATH 752	Introductory Topology II	3
MATH 900	Graduate Teaching Seminar	1
MATH 921	Seminar in Analysis	1-3
MATH 990	Reading and Research	1-3

Logic¹

Students may complete the following sequence of courses.

Code	Title	Credits
MATH 721	A First Course in Real Analysis	3
MATH 725	A Second Course in Real Analysis	3
MATH 740	Enumerative Combinatorics/ Symmetric Functions	3
MATH 741	Abstract Algebra	3
MATH 742	Abstract Algebra	3
MATH 747	Lie Algebras	3
MATH 751	Introductory Topology I	3
MATH 752	Introductory Topology II	3
MATH 763	Introduction to Algebraic Geometry	3
MATH 770	Foundations of Mathematics	3
MATH 771	Set Theory	3
MATH 773	Computability Theory	3
MATH 776	Model Theory	3
MATH 873	Advanced Topics in Foundations	3
MATH 900	Graduate Teaching Seminar	1
MATH 975	Seminar-The Foundations of Mathematics	1-3
MATH 990	Reading and Research	1-3

Geometry, Topology, and Dynamics¹

Students may complete the following sequence of courses.

Code	Title	Credits
MATH 721	A First Course in Real Analysis	3
MATH 722	Complex Analysis	3
MATH 725	A Second Course in Real Analysis	3
MATH 741	Abstract Algebra	3
MATH 742	Abstract Algebra	3
MATH 751	Introductory Topology I	3
MATH 752	Introductory Topology II	3
MATH 758	Introduction to Ergodic Theory and Dynamics	3
MATH 761	Differentiable Manifolds	3
MATH 765	Differential Geometry	3
MATH 843	Representation Theory	3
MATH 851	Topics in Geometric Topology	3
MATH 853	Topics in Algebraic Topology	3
MATH 873	Advanced Topics in Foundations	3

MATH 900	Graduate Teaching Seminar	1
MATH 951	Seminar in Topology	1-3
MATH 990	Reading and Research	1-3

Footnotes

¹ These pathways are internal to the program and represent different curricular paths a student can follow to earn this degree. Pathway names do not appear in the Graduate School admissions application, and they will not appear on the transcript.

POLICIES

GRADUATE SCHOOL POLICIES

The Graduate School's Academic Policies and Procedures (<https://grad.wisc.edu/acadpolicy/>) serve as the official document of record for Graduate School academic and administrative policies and procedures and are updated continuously. Note some policies redirect to entries in the official UW-Madison Policy Library (<https://policy.wisc.edu/>). Programs may set more stringent policies than the Graduate School. Policies set by the academic degree program can be found below.

MAJOR-SPECIFIC POLICIES

PRIOR COURSEWORK

Graduate Credits Earned at Other Institutions

With program approval, students in the PhD program are allowed to transfer no more than 19 credits of graduate coursework from other institutions. Coursework earned ten years or more prior to admission to a doctoral degree is not allowed to satisfy requirements.

Undergraduate Credits Earned at Other Institutions or UW-Madison

No more than 7 credits from an undergraduate degree are allowed to transfer. Coursework must be at a graduate level and must request program approval. Coursework earned ten years or more prior to admission to a doctoral degree is not allowed to satisfy requirements.

Credits Earned as a Professional Student at UW-Madison (Law, Medicine, Pharmacy, and Veterinary careers)

Refer to the Graduate School: Transfer Credits for Prior Coursework (<https://policy.wisc.edu/library/UW-1216/>) policy.

Credits Earned as a University Special Student at UW-Madison

With program approval, refer to the Graduate School: Transfer Credits for Prior Coursework (<https://policy.wisc.edu/library/UW-1216/>) policy.

PROBATION

Refer to the Graduate School: Probation (<https://policy.wisc.edu/library/UW-1217/>) policy.

1. Good standing (progressing according to standards; any funding guarantee remains in place).
2. Probation (not progressing according to standards but permitted to enroll; loss of funding guarantee; specific plan with dates and deadlines in place in regard to removal of probationary status).

- Unsatisfactory progress (not progressing according to standards; not permitted to enroll, dismissal, leave of absence or change of advisor or program).

ADVISOR / COMMITTEE

Students who are not yet working with a dissertation advisor are required to meet semiannually with their academic advisor. All students must have a dissertation advisor by the end of the sixth semester.

CREDITS PER TERM ALLOWED

15 credits. Minimum of 6 per semester, other than dissertators.

TIME LIMITS

Students must complete all program requirements within eight years of beginning the program. Extensions have to be approved by the program.

Refer to the Graduate School: Time Limits (<https://policy.wisc.edu/library/UW-1221/>) policy.

GRIEVANCES AND APPEALS

These resources may be helpful in addressing your concerns:

- Bias or Hate Reporting (<https://doso.students.wisc.edu/bias-or-hate-reporting/>)
- Graduate Assistantship Policies and Procedures (<https://hr.wisc.edu/policies/gapp/#grievance-procedure>)
- Hostile and Intimidating Behavior Policies and Procedures (<https://hr.wisc.edu/hib/>)
 - Office of the Provost for Faculty and Staff Affairs (<https://facstaff.provost.wisc.edu/>)
- Employee Assistance (<http://www.eao.wisc.edu/>) (for personal counseling and workplace consultation around communication and conflict involving graduate assistants and other employees, post-doctoral students, faculty and staff)
- Employee Disability Resource Office (<https://employeeedisabilities.wisc.edu/>) (for qualified employees or applicants with disabilities to have equal employment opportunities)
- Graduate School (<https://grad.wisc.edu/>) (for informal advice at any level of review and for official appeals of program/departmental or school/college grievance decisions)
- Office of Compliance (<https://compliance.wisc.edu/>) (for class harassment and discrimination, including sexual harassment and sexual violence)
- Office Student Assistance and Support (OSAS) (<https://osas.wisc.edu/>) (for all students to seek grievance assistance and support)
- Office of Student Conduct and Community Standards (<https://conduct.students.wisc.edu/>) (for conflicts involving students)
- Ombuds Office for Faculty and Staff (<http://www.ombuds.wisc.edu/>) (for employed graduate students and post-docs, as well as faculty and staff)
- Title IX (<https://compliance.wisc.edu/titleix/>) (for concerns about discrimination)

L&S POLICY FOR GRADUATE STUDENT ACADEMIC APPEALS

Graduate students have the right to appeal an academic decision related to an L&S graduate program if the student believes that the decision is inconsistent with published policy.

Academic decisions that may be appealed include:

- Dismissal from the graduate program
- Failure to pass a qualifying or preliminary examination
- Failure to achieve satisfactory academic progress
- Academic disciplinary action related to failure to meet professional conduct standards

Issues such as the following cannot be appealed using this process:

- A faculty member declining to serve as a graduate student's advisor.
- Decisions regarding the student's disciplinary knowledge, evaluation of the quality of work, or similar judgements. These are the domain of the department faculty.
- Course grades. These can be appealed instead using the L&S Policy for Grade Appeal (<https://kb.wisc.edu/lis/22258/>).
- Incidents of bias or hate, hostile and intimidating behavior (<https://hr.wisc.edu/hib/>), or discrimination (Title IX (<https://compliance.wisc.edu/titleix/>), Office of Compliance (<https://compliance.wisc.edu/eo-complaint/formal-investigations/>)). Direct these to the linked campus offices appropriate for the incident(s).

Appeal Process for Graduate Students

A graduate student wishing to appeal an academic decision must follow the process in the order listed below. Note time limits within each step.

- The student should first seek informal resolution, if possible, by discussing the concern with their academic advisor, the department's Director of Graduate Studies, and/or the department chair.
- If the program has an appeal policy listed in their graduate program handbook, the student should follow the policy as written, including adhering to any indicated deadlines. In the absence of a specific departmental process, the chair or designee will be the reviewer and decision maker, and the student should submit a written appeal to the chair within 15 business days of the academic decision. The chair or designee will notify the student in writing of their decision.
- If the departmental process upholds the original decision, the graduate student may next initiate an appeal to L&S. To do so, the student must submit a written appeal to the L&S Assistant Dean for Graduate Student Academic Affairs within 15 business days of notification of the department's decision.
 - To the fullest extent possible, the written appeal should include, in a single document: a clear and concise statement of the academic decision being appealed, any relevant background on what led to the decision, the specific policies involved, the relief sought, any relevant documentation related to the departmental appeal, and the names and titles of any individuals contributing to or involved in the decision.
 - The Assistant Dean will work with the Academic Associate Dean of the appropriate division to consider the appeal. They may seek additional information and/or meetings related to the case.
 - The Assistant Dean and Academic Associate Dean will provide a written decision within 20 business days.
- If L&S upholds the original decision, the graduate student may appeal to the Graduate School. More information can be found on their website: Grievances and Appeals (<https://grad.wisc.edu/documents/grievances-and-appeals/>) (see: Graduate School Appeal Process).

OTHER

n/a

PROFESSIONAL DEVELOPMENT

PROFESSIONAL DEVELOPMENT GRADUATE SCHOOL RESOURCES

Take advantage of the Graduate School's professional development resources (<https://grad.wisc.edu/pd/>) to build skills, thrive academically, and launch your career.

LEARNING OUTCOMES

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1. Learn a substantial body of mathematics in introductory and research level graduate courses in mathematics.
2. Complete a dissertation under the guidance of an advisor. The dissertation should make an original and substantive contribution to its subject matter.
3. Demonstrate breadth within the learning experiences.
4. Present research in seminar talks, conferences or publications.
5. Communicate complex ideas in a clear and understandable manner.
6. Foster ethical and professional conduct.