Applied Mathematical and Computational Sciences, PhD

The PhD program in applied mathematical and computational sciences is broadly based and interdisciplinary. It is designed to help students achieve a command of applied mathematical techniques and computational tools and obtain basic knowledge in another area (e.g., in physics, engineering, operations research, chemistry, computer science, economics, statistics, geography, or in the biological, medical, or social sciences). The program is flexible; students can concentrate on applied mathematics areas, such as differential equations and numerical analysis, or on other applicable techniques in mathematics. Scientific computing is an important part of applied mathematics, so it is often a part of student training and dissertation research. Prospective students should have a desire to apply mathematical techniques or theory to relevant problems in an outside area.

Learning Outcomes

Students will gain:

- proficiency in core applied mathematics subjects and broad knowledge in mathematics;
- proficiency in computer programming/scientific computing;
- excellent knowledge in at least one application area outside mathematics;
- ability to communicate knowledge and research work to various audiences; and
- ability to carry out research and work independently at a professional level.

Requirements

The Doctor of Philosophy program in applied mathematical and computational sciences (AMCS) requires a minimum of 72 s.h. of graduate credit.

Course of Study

Faculty members can help each student plan a course of study that is consistent with the student's background, interests, and goals. Individual plans are designed to help students develop expertise in methods of applied mathematics and build a strong foundation in related topics. They also provide sufficient knowledge in an outside area to enable students to use mathematical techniques in that area. Students may also arrange their study plan to earn a master's degree from another department after they complete part of their plan. Students find suitable thesis problems and supervisors with the help of the faculty.

Required Courses in Core Areas

Students must successfully complete these three core course sequences in the first two years of graduate study.

Course #	Title	Hours
All of these:		
MATH:5200 & MATH:5210	Introduction to Analysis I-II	6
MATH:5600 & MATH:5700	Nonlinear Dynamics With Numerical Methods - Introduction to Partial Differential Equations	6
MATH:5800 & MATH:5810	Numerical Methods I-II	6

Outside Area Courses

Students must take and pass PhD-level courses in areas in which mathematics is applied: one preparation course in the first two years of study and then two advanced courses outside of mathematics numbered 6000 or above.

Advanced Mathematics Course Requirement

In order to establish a solid foundation in mathematics, students must successfully pass two more mathematics courses (prefix MATH) numbered 5000–5999 and complete at least 12 s.h. of graduate mathematics courses numbered 6000–7999, with the exception of seminar courses. The courses should be chosen to obtain mathematical breadth and must be approved by the AMCS chair.

Comprehensive Examination

Students complete a comprehensive examination that covers their research area within three and a half years after beginning their graduate study. The examination is typically based on outside area courses and/or directed readings.

Admission

Applicants must carefully follow the applied mathematical and computational sciences (AMCS) application procedures and they must meet the Graduate College Admission Requirements on the Graduate Admissions website. Those interested in applying may also view Admissions on the Graduate College website.

To be prepared for graduate-level coursework in applied mathematics, applicants should have a bachelor's or master's degree with a strong mathematics or computational component.

Applications for fall admission are due on Jan. 15. For more information about the academic program, contact the chair of the Applied Mathematical and Computational Sciences Program. The Manual of Rules and Regulations on the Graduate College website can also provide additional information.

Career Advancement

Career opportunities for applied mathematicians include positions in teaching and research institutions, national laboratories, the technology industry, business companies, and consulting firms.

Academic Plans

Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

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Course	Title	Hours
Academic Career		
Any Semester		
72 s.h. must be graduate level coursework; graduate transfer credits allowed upon approval. More information is included in the General Catalog and on department website. [a]		
	Hours	**0**
First Year		
Fall		
MATH:5200	Introduction to Analysis I [b]	3
MATH:5600	Nonlinear Dynamics With Numerical Methods [b]	3
MATH:5800	Numerical Methods I [b]	3
MATH:5900	First-Year Graduate Seminar	1
	Hours	**10**
Spring		
AMCS:5900	Seminar: Applied Mathematical and Computational Sciences	1
MATH:5210	Introduction to Analysis II [b]	3
MATH:5700	Introduction to Partial Differential Equations [b]	3
MATH:5810	Numerical Methods II [b]	3
AMCS Lectures on Programming		
	Hours	**10**
Summer		
MATH:5950	Qualifying Exam Preparation Seminars	0
Exam: PhD Qualifying Exams [c]		
	Hours	**0**
Second Year		
Fall		
MATH:6600	Ordinary Differential Equations I [d]	3
MATH:6850	Advanced Numerical Methods I [d]	3
Outside Area Preparation course [e, f]		3
	Hours	**9**
Spring		
MATH:4820	Optimization Techniques	3
MATH:6610	Ordinary Differential Equations II [d]	3
MATH:6860	Advanced Numerical Methods II [d]	3
AMCS Lectures on Programming		
	Hours	**9**
Third Year		
Fall		
AMCS:7990	Reading and Research	2
MATH:5000 or MATH:5400 or MATH:5750	Abstract Algebra I [d] or Fundamental Groups and Covering Spaces or Mathematical Biology I	3
Outside Area course (numbered 6000 or above) [e, f]		3
	Hours	**8**
Spring		
Exam: PhD Comprehensive Exam		
AMCS:7990	Reading and Research	2
MATH:5410 or MATH:5760 or MATH:5010	Introduction to Smooth Manifolds [d] or Mathematical Biology II or Abstract Algebra II	3
Outside Area course (numbered 6000 or above) [e, f]		3
	Hours	**8**
Fourth Year		
Fall		
MATH:4700	Partial Differential Equations and Applications	3
AMCS:7990	Reading and Research	3
	Hours	**6**
Spring		
MATH:4060	Discrete Mathematical Models	3
AMCS:7990	Reading and Research	3
	Hours	**6**
Fifth Year		
Fall		
MATH:4840	Mathematics of Machine Learning	3
AMCS:7990	Reading and Research	2
	Hours	**5**
Spring		
GRAD:6003	Doctoral Final Registration	1
Exam: PhD Final Exam [g]		
	Hours	**1**
	Total Hours	**72**

a Students must complete specific requirements in the University of Iowa Graduate College after program admission. Refer to the Graduate College website and the Manual of Rules and Regulations for more information.

b Students must pass (grade of B-minus or higher in each course) all three core course sequences (or be exempted) in the first two years of graduate study.

c Taken in August.

d Students must take and successfully pass two MATH courses numbered 5000-5999, and complete at least 12 s.h. of MATH courses numbered 6000-7799 with the exception of the seminars. Work with faculty advisor to determine appropriate graduate coursework and receive departmental approval.

e Students must take and pass PhD level courses in areas in which mathematics is applied: one preparation course in the first two years and then two advanced courses outside of mathematics at the 6000 level or above.

f Work with faculty advisor to determine appropriate graduate coursework and sequence.

g Dissertation defense.