Applied Mathematical and Computational Sciences, PhD

The PhD program in applied mathematical and computational sciences is autonomous, broadly based, and interdisciplinary. It is designed to help students achieve a command of theoretical and applied mathematics 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, 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.

These individual plans are designed to help students develop expertise in methods of applied mathematics and build a good foundation in related topics of mathematics. The individual plans also provide sufficient knowledge in an outside area to enable students to use mathematical techniques in that area.

Students may arrange their study plans 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.

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH:5200 &amp; MATH:5210</td>
<td>Introduction to Analysis I-II</td>
<td>6</td>
</tr>
<tr>
<td>MATH:5600 &amp; MATH:5700</td>
<td>Nonlinear Dynamics with Numerical Methods - Introduction to Partial Differential Equations</td>
<td>6</td>
</tr>
<tr>
<td>MATH:5800 &amp; MATH:5810</td>
<td>Numerical Methods I-II</td>
<td>6</td>
</tr>
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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 and then two advanced courses outside of mathematics at the 6000-level or above.

Advanced Mathematics Course Requirement

In order to establish a solid foundation in mathematics, students must successfully pass two more courses numbered MATH:5000 to MATH:5999 and complete at least 12 s.h. of graduate mathematics courses numbered MATH:6000 to MATH:7799, 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 outside research area within three and a half years after beginning graduate study. The examination is typically based on the 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 Iowa 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 also can provide additional information.

Financial Support

Financial support in the form of teaching assistantships is provided to every student admitted. Students may apply to various fellowships during their study. Research assistantships for qualified applicants also may be available from certain graduate advisors. Summer support is generally available to students.
Career Advancement

Career opportunities for applied mathematicians include positions in colleges, universities, governmental laboratories, business, industry, 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.

Applied Mathematical and Computational Sciences, PhD

Course | Title | Hours
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**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. \(^a\)

**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

**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 \(^d\) 3
- MATH:5810 Numerical Methods II \(^b\) 3
- AMCS Lectures on Programming

**Summer**
- MATH:5950 Qualifying Exam Preparation Seminars 0
- Exam: PhD Qualifying Exams \(^c\)

**Total Hours** 10

**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

**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

**Third Year**

**Fall**
- AMCS:7990 Reading and Research 2
- MATH:5000 Abstract Algebra I \(^d\) or MATH:5400 or MATH:5750 or Fundamental Groups and Covering Spaces or Mathematical Biology I
- Outside Area course (numbered 6000 or above) \(^e, f\) 3

**Spring**
- Exam: PhD Comprehensive Exam
- AMCS:7990 Reading and Research 3

**Fourth Year**

**Fall**
- MATH:4700 Partial Differential Equations and Applications 3
- AMCS:7990 Reading and Research 3

**Spring**
- MATH:4060 Discrete Mathematical Models 3
- AMCS:7990 Reading and Research 3

**Fifth Year**

**Fall**
- MATH:4840 Mathematics of Machine Learning 3
- AMCS:7990 Reading and Research 3

**Spring**
- GRAD:6003 Doctoral Final Registration 1
- Exam: PhD Final Exam \(^f\)

**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.