**APPLIED MATHEMATICS - DOCTOR OF PHILOSOPHY (PHD)**

With internationally recognized faculty and a strong commitment to its graduate program, the Department of Applied Mathematics at CU Boulder strives to provide graduate students a high-quality education and training in applied mathematics while preparing them for careers in industry, laboratories and the academic professions. The department fosters extensive interaction between students and faculty to provide a tailored educational experience in applied mathematics. Currently, the department has both faculty (https://www.colorado.edu/amath/directory/) and affiliated faculty (https://www.colorado.edu/amath/academics/graduate-students/affiliated-faculty/) from other academic departments and colleges. A PhD student can be advised by core faculty or co-advised by an affiliated involved in applied mathematics which creates a uniquely unique learning experience in many areas of physical, biological, computational or engineering sciences. With the breadth of such a diverse faculty, a student can explore their academic and research interests through the investigation of numerous ongoing faculty projects.

Many of our PhD students have had the opportunity to conduct their research at world-class institutes located right here in Boulder such as the National Center for Atmospheric Research, National Institute of Standards and Technology, and the National Oceanic and Atmospheric Administration. Our students have the opportunity to not only work directly with organizations here in Boulder but also the National Renewable Energy Lab and the Laboratory for Atmospheric and Space Physics, along with many other national research laboratories.

The Department of Applied Mathematics offers coursework and research leading to the PhD degree in applied mathematics. The aim of the department is to train graduate students to perform independent research on the methods and applications of applied mathematics. Research areas represented in the department include:

- computational mathematics
- mathematical biology
- mathematical geosciences
- applied nonlinear PDEs and dynamics
- statistics and data science
- stochastic processes and applications

For more information on the department and degree requirements, download the supplement to the catalog (http://www.colorado.edu/amath/prospective-students/graduate/supplement-course-catalog-degree-requirements/) or visit the Applied Mathematics (http://www.colorado.edu/amath/) website.

**PhD with Certificate in Interdisciplinary Quantitative Biology**

Applied mathematicians interested in collaborations with bioscientists will need a breadth of knowledge in quantitative bioscience to be successful. The interdisciplinary quantitative biology (IQ biology) graduate certificate (https://catalog.colorado.edu/graduate/colleges-schools/interdisciplinary-programs/interdisciplinary-quantitative-biology-graduate-certificate/) program emphasizes training at the intersection of biochemistry, biology, computer science, engineering, applied mathematics and physics. The PhD in applied mathematics with a certificate in IQ biology will strengthen this training with additional foundations in numerical and mathematical analysis, probability and statistics, mathematical biology and network analysis.

Candidates interested in this program should apply directly to IQ biology and select applied mathematics as one of their graduate programs of interest. In addition to satisfying the requirements for the PhD in applied mathematics, students in this program must take 12 credit hours in three IQ biology core courses (Quantitative Biology Foundations, Statistics and Computation for Genomes and Meta-Genomes and Forces in Biology), which can serve as the out-of-department sequence for the PhD, as well as three 10-week rotations in labs associated with the IQ biology program.

For more information, visit the BioFrontiers Institute’s IQ Biology PhD Program (http://iqbiology.colorado.edu/) website.

**Requirements**

**Required Courses and Credits**

A minimum of 60 credits is required for the degree, including 30 credits in courses numbered 5000 or above (APPM 5350, APPM 5360, STAT 5000 and APPM 5720 generally do not count toward this requirement) and 30 credits of applied math dissertation credit.

A grade of B- or higher must be attained in each course. PhD students must maintain a grade point average of 3.0 or better each semester.

**Code** | **Title** | **Credit Hours**
--- | --- | ---
APPM 5440 & APPM 5450 | Applied Analysis 1 and Applied Analysis 2 | 6
APPM 5600 & APPM 5610 | Numerical Analysis 1 and Numerical Analysis 2 | 6
APPM 8990 | Doctoral Dissertation | 30

**Electives**

Two sequences in applied mathematics; possibilities include: 12

- or APPM 5460 Methods of Applied Mathematics: Dynamical Systems and Differential Equations
- or APPM 5480 Methods of Applied Mathematics: Approximation Methods

- STAT 5530 & STAT 5540 Mathematical Statistics and Introduction to Time Series

Two semesters of seminars: 2

- APPM 8000 Colloquium in Applied Mathematics
- APPM 8100 Seminar in Dynamical Systems
- APPM 8300 Nonlinear Waves Seminar
- APPM 8400 Mathematical Biology Seminar
- APPM 8500 Statistics, Optimization and Machine Learning Seminar
- APPM 8600 Seminar in Computational Mathematics
A year-long graduate sequence outside of applied mathematics in an area where mathematics has significant application. Approval of the sequence from the graduate committee chair is required.

<table>
<thead>
<tr>
<th>Total Credit Hours</th>
<th>62</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 A student may opt out of either one of these two sequences only if they have demonstrated proficiency in the subject by passing the corresponding preliminary exam.</td>
<td></td>
</tr>
<tr>
<td>2 To be taken no earlier than the second year of graduate study in the department.</td>
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</tr>
</tbody>
</table>

**Exams**

**Preliminary Exams**
- Doctoral students must take and pass two preliminary exams by August at the end of their first year. Exams are graded pass/fail.
- In January, first-year PhD students can choose to take either Partial Differential Equations or Statistics.
- In May, first-year PhD students can choose to take either Applied Analysis or Numerical Analysis.
- Makeup exams are offered in August. Students may only make up exams in areas they have taken before.
- Students may not take any exam more than twice.

**Comprehensive Exams**

The purpose of the comprehensive exam is to ensure that the student has a sufficient grasp of the fundamentals of the chosen thesis area to begin research, the ability to exchange ideas and information with the members of the examining board (thesis committee), and a broad base of knowledge in applied mathematics.

Before the comprehensive exam, the PhD student must submit a 5–10 page thesis proposal, complete with motivation for the topic and references to key papers, to each member of the thesis committee. This proposal should be written in consultation with the chair of the thesis committee.

The exam will consist of a presentation by the student on his/her research proposal, followed by a questioning period of up to one additional hour. The presentation portion is open to all faculty and students in the program.

Students will need to be registered in classes for the semester they are going to complete their examination for it to count towards that semester. This includes the summer semester.

- Select committee members (see rules on Exam form) and inform the Graduate Coordinator.
- Complete Doctoral Exam f (https://www.colorado.edu/GraduateSchool/academics/_docs/docexam-fillable.pdf) or (https://www.colorado.edu/Graduateschool/content/doctoral-final-examination-form/) for committee approval (at least 2 weeks prior to Defense Date).
- Submit thesis to Graduate School electronically (https://www.colorado.edu/Graduateschool/academics/thesis-and-dissertation-submission/) (contact Graduate Coordinator for details).
  - Submit a Thesis Approval Form (https://www.colorado.edu/graduateschool/content/thesis-approval-form/) (TAF) to ensure that the final copy has been accepted by the thesis committee. The TAF must be uploaded as a supplemental file with the thesis in order for the submission to be complete.
- Submit three hard copies of the thesis to the Graduate Coordinator. Same due date as Graduate School submission date. This version will serve as the archival copy kept by the University Library. These three copies will be bound for students by the department free of charge (one for the student, one for the department and one for the student’s advisor).
  - One copy must be printed single-sided, on 8.5” x 11” watermarked paper of at least 25 percent cotton and 20# weight.
  - The other two copies can be printed double-sided, on 8.5” x 11” watermarked paper of at least 25 percent cotton and 20# weight.
- Submit thesis to CU Electronic Scholars Repository (see instructions on the About Institutional Repositories (http://scholar.colorado.edu/about.html) webpage).
- Complete the Survey of Earned Doctorates (contact Graduate Coordinator for details).

**Plan of Study**

The track below is a sample curriculum for students who are interested in focusing on partial differential equations.

<table>
<thead>
<tr>
<th>Year One</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>APMM 5600 Numerical Analysis 1</td>
<td>3</td>
</tr>
<tr>
<td>APMM 5610 Numerical Analysis 2</td>
<td>3</td>
</tr>
<tr>
<td>APMM 5470 Methods of Applied Mathematics: Partial Differential and Integral Equations</td>
<td>3</td>
</tr>
<tr>
<td>APMM 5460 Methods in Applied Mathematics: Dynamical Systems and Differential Equations</td>
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</table>
### Year Two

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>APPM 5440</td>
<td>Applied Analysis 1</td>
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</tr>
<tr>
<td>APPM 5450</td>
<td>Applied Analysis 2</td>
<td>3</td>
</tr>
<tr>
<td>APPM 5480</td>
<td>Methods of Applied Mathematics: Approximation Methods</td>
<td>3</td>
</tr>
<tr>
<td>APPM 5720</td>
<td>Open Topics in Applied Mathematics</td>
<td>1-3</td>
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Part 1 of Out of Department Sequence: 3

**Credit Hours:** 13-15

### Year Three

<table>
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<tr>
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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>APPM 8000</td>
<td>Colloquium in Applied Mathematics</td>
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</tr>
<tr>
<td>APPM 8100</td>
<td>Seminar in Dynamical Systems</td>
<td>1</td>
</tr>
<tr>
<td>APPM 7400</td>
<td>Topics in Applied Mathematics</td>
<td>1-3</td>
</tr>
<tr>
<td>APPM 6470</td>
<td>Advanced Partial Differential Equations</td>
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**Credit Hours:** 9-11

### Year Four

<table>
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<th>Credits</th>
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<td>APPM 8990</td>
<td>Doctoral Dissertation</td>
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**Credit Hours:** 10

### Year Five

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<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>APPM 8990</td>
<td>Doctoral Dissertation</td>
<td>10</td>
</tr>
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</table>

**Credit Hours:** 10

### Year Six

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</thead>
<tbody>
<tr>
<td>APPM 8990</td>
<td>Doctoral Dissertation</td>
<td>10</td>
</tr>
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</table>

**Credit Hours:** 10

**Total Credit Hours:** 64-68