

APPLIED MATHEMATICS, PHD

Graduate School Policies and Procedures (<http://catalog.ucdenver.edu/cu-denver/graduate/graduate-school-policies-procedures/>) apply to this program.

Please click here to see Mathematical and Statistical Sciences department information.

Introduction

The Department of Mathematical and Statistical Sciences offers a PhD in Applied Mathematics. The degree is designed to give candidates a contemporary, comprehensive education in applied mathematics and to provide research opportunities in the special fields of computational mathematics, discrete mathematics, mathematics of science and engineering, operations research, optimization, probability, and statistics.

These program requirements are subject to periodic revision by the academic department, and the College of Liberal Arts and Sciences reserves the right to make exceptions and substitutions as judged necessary in individual cases. Therefore, the College strongly urges students to consult regularly with their program advisor and CLAS advisor to confirm the best plans of study before finalizing them.

Program Requirements

1. Students must complete a minimum of 72 approved credit hours.
2. Students must complete all credits at the graduate 6000-level and above.
3. Students must earn a minimum grade of B (3.0) or better in all core courses, a B- (2.7) in all other courses taken at CU Denver and must achieve a minimum cumulative program GPA of 3.0. All graded attempts in required and elective courses are calculated in the program GPA. Students cannot complete program or ancillary course requirements as pass/fail.
4. Students must complete 42 credit hours with CU Denver faculty.

Program Restrictions, Allowances and Recommendations

1. There are six phases of the PhD program. A candidate must fulfill course requirements, pass the preliminary examinations, establish a PhD committee, meet the academic residency requirement, pass the comprehensive examination and write and defend a dissertation.
2. The following MATH courses will NOT count toward a graduate degree: MATH 5000-5009, 5010, 5012-5015, 5017, 5198, 5250 and 5830.
3. Students must complete 42 semester hours of non-thesis course work at the graduate level (up to 30 hours of this course work may be transferred in, including courses taken as part of a master's degree). In addition, 30 hours of dissertation credit must be taken. Three readings courses (1 semester hour each) are required as part of the formal course work. Students must also satisfy a **breadth requirement** by completing a total of six graduate math courses from among several areas of mathematics, with no more than three of these courses from any one area.
4. The preliminary examinations are designed to determine that students who intend to pursue the PhD program are qualified to do so. These four-hour written examinations are in the areas of applied

analysis and applied linear algebra. Students must pass these exams by the start of their fourth semester.

5. Six semesters of full-time scholarly work are required, as specified in the rules of the Graduate School (<http://catalog.ucdenver.edu/cu-denver/graduate/graduate-school-policies-procedures/>). All students are strongly advised to spend at least one year doing full-time course work or research with no outside employment.
6. The comprehensive examination is taken after completion of the preliminary exams, completion of at least three semesters of residency, and upon completion of essentially all non-thesis coursework. The exam is designed to determine mastery of graduate-level mathematics and the ability to embark on dissertation research. It consists of a six-hour written examination and an oral follow-up examination. Students must pass the comprehensive exam by the beginning of the 4th year. Within six months after passing the comprehensive examination, the candidate must present a dissertation proposal to their dissertation committee.
7. Each student must write and defend a dissertation containing original contributions and evidence of significant scholarship. The dissertation defense is public and must be given before an examining committee approved by the Graduate School.

For more detailed information about the Applied Mathematics PhD, see department website (<https://clas.ucdenver.edu/mathematical-and-statistical-sciences/phd-applied-mathematics/>).

Required Courses

Code	Title	Hours
<i>Take the following</i>		
MATH 5779	Math Clinic	3

Code	Title	Hours
<i>Take a minimum of three readings courses.</i>		
MATH 7921	Readings in Mathematics	1
MATH 7922	Rdgs:Math Fndts-Cmptr Sc	1
MATH 7923	Readings: Discrete Mathematics	1
MATH 7924	Rdgs:Comp Mathematics	1
MATH 7925	Readings: Optimization	1
MATH 7926	Rdgs:Applied Prob/Stats	1
MATH 7927	Rdgs:Comp/Math Biology	1

Breadth Requirement

Code	Title	Hours
<i>Students must also satisfy a breadth requirement by completing a total of six graduate math courses from among several areas of mathematics, with no more than three of these courses from any one area.</i>		

Computational Mathematics

Code	Title	Hours
MATH 5660	Numerical Analysis I	3
MATH 5661	Numerical Analysis II	3
MATH 5791	Continuous Modeling	3
MATH 6735	Continuum Mechanics	3

Discrete Mathematics

Code	Title	Hours
MATH 5110	Theory of Numbers	3
MATH 5793	Discrete Math Modeling	3
MATH 6023	Topics in Discrete Math	3

Operations Research (including Probability)

Code	Title	Hours
MATH 5310	Probability	3
MATH 5390	Game Theory	3
MATH 5490	Network Flows	3
MATH 5593	Linear Programming	3
MATH 5792	Probabilistic Modeling	3
MATH 5794	Optimization Modeling	3
MATH 6380	Stochastic Processes	3
MATH 7593	Advanced Linear Programming	3
MATH 7594	Integer Programming	3
MATH 7595	Advanced Nonlinear Programming	3

Statistics

Code	Title	Hours
MATH 5320	Statistical Inference	3
MATH 5387	Applied Regression Analysis	3
MATH 5394	Experimental Designs	3
MATH 6330	Workshop in Statistical Consulting	3
MATH 6384	Spatial Data Analysis	3
MATH 6388	Statistical and Machine Learning	3
MATH 7381	Mathematical Statistics I	3
MATH 7382	Mathematical Statistics II	3
MATH 7393	Bayesian Statistics	3
MATH 7397	Nonparametric Statistics	3

General

Code	Title	Hours
MATH 5135	Functions of a Complex Variable	3
MATH 5733	Partial Differential Equations	3
MATH 6131	Real Analysis	3
MATH 7132	Functional Analysis	3

Additional Electives

Code	Title	Hours
<i>Complete an additional 18 credit hours of graduate level coursework, in consultation with the program director.</i>		18
MATH 5027	Topics in Applied Mathematics	3
MATH 5070	Applied Analysis	3
MATH 5110	Theory of Numbers	3
MATH 5135	Functions of a Complex Variable	3
MATH 5310	Probability	3
MATH 5320	Statistical Inference	3
MATH 5337	Intro to Statistical and Machine Learning	3
MATH 5350	Mathematical Theory of Interest	3
MATH 5351	Actuarial Models	3
MATH 5387	Applied Regression Analysis	3

MATH 5388	Machine Learning Methods	3
MATH 5390	Game Theory	3
MATH 5394	Experimental Designs	3
MATH 5410	Modern Cryptology	3
MATH 5432	Computational Graph Theory	3
MATH 5446	Theory of Automata	3
MATH 5490	Network Flows	3
MATH 5576	Mathematical Foundations of Artificial Intelligence I	3
MATH 5593	Linear Programming	3
MATH 5610	Computational Biology	3
MATH 5660	Numerical Analysis I	3
MATH 5661	Numerical Analysis II	3
MATH 5674	Parallel Computing and Architectures	3
MATH 5718	Applied Linear Algebra	3
MATH 5733	Partial Differential Equations	3
MATH 5791	Continuous Modeling	3
MATH 5792	Probabilistic Modeling	3
MATH 5793	Discrete Math Modeling	3
MATH 5794	Optimization Modeling	3
MATH 5840	Independent Study	1-3
MATH 5880	Directed Research	1-6
MATH 5939	Internship	1-6
MATH 5950	Master's Thesis	1-8
MATH 5960	Master's Project	1-8
MATH 6023	Topics in Discrete Math	3
MATH 6101	Uncertainty Quantification	3
MATH 6131	Real Analysis	3
MATH 6330	Workshop in Statistical Consulting	3
MATH 6360	Exploratory Data Analysis	3
MATH 6376	Statistical Computing	3
MATH 6380	Stochastic Processes	3
MATH 6384	Spatial Data Analysis	3
MATH 6388	Statistical and Machine Learning	3
MATH 6395	Multivariate Methods	3
MATH 6398	Calculus of Variations and Optimal Control	3
MATH 6404	Applied Graph Theory	3
MATH 6595	Nonlinear Programming	3
MATH 6653	Introduction to Finite Element Methods	3
MATH 6735	Continuum Mechanics	3
MATH 6840	Independent Study	1-3
MATH 6960	Research Methods in Mathematics and Statistics	3
MATH 7101	Topology	3
MATH 7132	Functional Analysis	3
MATH 7376	Statistical Computing	3
MATH 7381	Mathematical Statistics I	3
MATH 7382	Mathematical Statistics II	3
MATH 7384	Mathematical Probability	3
MATH 7385	Stochastic Differential Equations	3
MATH 7386	Monte Carlo Methods	3
MATH 7393	Bayesian Statistics	3
MATH 7397	Nonparametric Statistics	3

MATH 7405	Advanced Graph Theory	3
MATH 7409	Applied Combinatorics	3
MATH 7410	Combinatorial Structures	3
MATH 7413	Modern Algebra I	3
MATH 7414	Modern Algebra II	3
MATH 7419	Mathematical Coding Theory	3
MATH 7421	Projective Geometry	3
MATH 7593	Advanced Linear Programming	3
MATH 7594	Integer Programming	3
MATH 7595	Advanced Nonlinear Programming	3
MATH 7663	Finite Difference Methods for Partial Differential Equations	3
MATH 7665	Numerical Linear Algebra	3
MATH 7667	Introduction to Approximation Theory	3
MATH 7821	Topics in Projective Geometry	3
MATH 7822	Topics in Linear Algebra	3
MATH 7823	Topics in Discrete Math	3
MATH 7824	Topics in Computational Mathematics	3
MATH 7825	Topics in Optimization	3
MATH 7826	Topics in Probability and Statistics	3
MATH 7827	Topics in Applied Mathematics	3
MATH 7840	Independent Study	1-3
MATH 7921	Readings in Mathematics	1
MATH 7922	Rdgs:Math Fndts-Cmptr Sc	1
MATH 7923	Readings: Discrete Mathematics	1
MATH 7924	Rdgs:Comp Mathematics	1
MATH 7925	Readings: Optimization	1
MATH 7926	Rdgs:Applied Prob/Stats	1
MATH 7927	Rdgs:Comp/Math Biology	1
MATH 8660	Mathematical Foundations of Finite Element Methods	3
MATH 8664	Iterative Methods in Numerical Linear Algebra	3

Dissertation

Code	Title	Hours
	<i>Take the following</i>	30
MATH 8990	Doctoral Dissertation	1-10

To learn more about the Student Learning Outcomes for this program, please visit our website (<https://clas.ucdenver.edu/mathematical-and-statistical-sciences/phd-program-goals-objectives/>).