

# Ph.D. in Mathematics - Mathematics Education Emphasis

## Program Overview

The Ph.D. in Mathematics with an emphasis in mathematics education combines study in advanced mathematics, mathematics education, and quantitative and qualitative research methods in education. This pathway is designed for candidates who plan a future of teaching, research, and service relevant to mathematics education in a variety of settings. The program focuses on the teaching and learning of mathematics including curriculum, instruction, assessment, and teacher preparation or professional development in the K-12 education system. Graduates typically go on to faculty positions in mathematics departments that support K-12 teacher preparation and research in mathematics education. Applicants are expected to possess K-12 teaching experience or to gain such experience through internships.

## Admission (preferred qualifications)

- An earned master's degree in mathematics, statistics, or mathematics education, including graduate-level mathematics coursework in topics such as algebra and analysis. Applicants with a strong undergraduate degree in mathematics teaching may start in the M.S. in Mathematics program and earn an M.S. before continuing on to the Ph.D., usually after 2 years.
- One of the following:
  - Teacher licensure in secondary mathematics
  - Two years K-16 teaching experience

## Required Equivalencies (upon completion of coursework)

**Provisional Licensure:** All graduates of this program are expected to acquire a minimum level of competency in secondary mathematics instruction, comparable to satisfying the requirements for Montana's provisional license to teach mathematics. This includes a Bachelor of Science degree in mathematics and at least six credit hours of education coursework. Ph.D. candidates who fall short of the six-credit requirement will select courses from the following:

- Complete a secondary mathematics methods course Methods: 9-12 Mathematics (EDM 405) or Methods: 5-8 Mathematics (EDM 404)
- Complete either Access and Equity in Mathematics Teaching (M 520), Mathematics Learning Theory for Teaching (M 521), or another approved course.

**K-12 Classroom Experience:** Students who lack sufficient exposure to instruction at the elementary or secondary level will be required to complete school-based internships prior to beginning dissertation research. Each internship calls for 135 hours of field experience as well as participation in a spring seminar that may address reviews of research, lesson study, analysis of student work, and reflection on classroom experiences.

- Elementary internship: teach, tutor, and observe students in a K-8 classroom
- Secondary internship: teach one or more courses at the high school level

## Required Course Work (60 credits)

### Mathematics - required (minimum 15 credits at MSU)

M 503 Advanced Linear Algebra

M 505 Principles of Mathematical Analysis

One two-course doctoral sequence from the list below (6 credits)

Additional mathematics courses to be selected (3+ credits)

### Mathematics Education - required (minimum 9 credits)

M 528 Curriculum Design

M 529 Assessment Models and Issues

M 534 Research in Mathematics Education

### Research Methods and Statistics - required (minimum 12 credits)

STAT 511 Methods of Data Analysis I

STAT 512 Methods of Data Analysis II

EDCI 506 Applied Educational Research

EDU 610 Qualitative Educational Research

### Seminars and Internships - see explanation above (0 to 6 credits)

M 576 Internship 2-12

M 594 Seminar 1

### Supporting Coursework - to be approved by committee (3+ credits)

May include specialized research courses or additional mathematics education coursework

### Dissertation - required (21 credits)

M 689 Doctoral Reading & Research

M 690 Doctoral Thesis

### Doctoral Mathematics - choose one two-course sequence from the following:

M 544 Partial Differential Equations I

M 545 Partial Differential Equations II

M 547 Measure Theory

M 551 Complex Analysis

M 560 Methods of Applied Mathematics I

M 561 Methods of Applied Mathematics II

M 581 Numerical Solution of Partial Differential Equations I

M 582 Numerical Solution of Partial Differential Equations II

M 584 Functional Analysis I

M 585 Functional Analysis II

M 586 Probability Theory

M 591 Topics in Applied Math I - Finite Volume Methods for Hyperbolic Problems

M 592 Topics in Applied Math II

M 595 Dynamical Systems I

M 596 Dynamical Systems II

## Comprehensive Examinations

Graduates of the program earn the equivalent of a master's degree in mathematics and must successfully complete a comprehensive examination in mathematics. Two additional examinations address knowledge related to K-12 mathematics teaching and learning and educational research design.

- One comprehensive exam in Mathematics. This exam will be determined by the graduate committee and administered according to the guidelines for mathematics.
- One comprehensive exam in Mathematics Education. This exam is developed and scored by the current (or most recent) instructors

of Curriculum Design (M 528) and Assessment Models and Issues (M 529).

- One comprehensive exam in Educational Statistics and Research Methods. This exam is collaboratively developed by mathematics education faculty and appropriate research methods faculty in Statistics and Education.

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### **Dissertation Research Component**

The dissertation is a study in mathematics education. Scholarship in mathematics education examines teaching and learning, with roots in the disciplines of mathematics and educational theory and practice. It is grounded in mathematics content through the study of curriculum and mathematical practice and is generally carried out through social science research methods, including both qualitative and quantitative analysis. Mathematics education research at Montana State University adopts an applied approach, and research efforts often focus on the development and ongoing support of K-12 mathematics teachers. Doctoral students conduct research in areas relevant to current faculty research interests or funded projects.