

**UVM
Handbook
for Graduate Studies
in Mathematics
2021-2022**

TABLE OF CONTENTS

Department Information	2
Graduate Faculty and Students	4
University Information	5
Information for Applicants	6
Information for New Students	8
Graduate Student Responsibilities	9
Department and University Awards	10
Master and Doctoral Degree Requirements	11
Major Concentration Areas for the M.S. Degree Program	12
Written Examinations	15
Advising and Program Requirements	17
Sample Schedule for the Doctoral Program	19
Accelerated Master's Program	20
Course Descriptions	22

This Handbook contains information about the Graduate Program in Mathematics at the University of Vermont. It is useful for potential students, current students, advisors, and professors. Comments or suggestions may be relayed to Dr. Taylor Dupuy, the Director of the Mathematics Graduate Program, Department of Mathematics and Statistics, University of Vermont, 82 University Place Burlington, VT 05405. Questions about the graduate program can be sent to Dr. Dupuy at Taylor.Dupuy@uvm.edu. The department phone number is (802) 656-2940. Additional information can be found at the dept. website at <http://www.uvm.edu/math> and an online version of this document can be found

Statistics students should contact Professor Jeff Buzas at Jeff.Buzas@uvm.edu. The curriculum for all degrees has two main streams: pure mathematics and applied mathematics, and in addition our PhD offers a stream in statistics. Students are encouraged to take courses common to both areas, enabling them to gain an appreciation of the problems and techniques in each, an understanding of the connections between them, and the common role of scientific computation.

The department is located in Innovation Hall on Central Campus. Professor Jianke Yang is the Department Chair. Senior Lecturer Helen Read is the Vice Department Chair. Professor Jeff Buzas is the Director of Statistics and as well as the Statistics Graduate Program Coordinator. Professor Taylor Dupuy is Mathematics Graduate Program Coordinator.

There is also a standing departmental Mathematics Graduate Committee in charge of overseeing the Mathematics Graduate Program. Any of the people listed above are more than willing to answer your questions about the department. Some relevant e-mail addresses are:

Jianke Yang	Jianke.Yang@uvm.edu
Helen Read	Helen.Read@uvm.edu
Taylor Dupuy	Taylor.Dupuy@uvm.edu

We want to help. Students with a question or a problem are encouraged to ask someone for help. Kiki Reno or Barbara Asiimwe, our department administrators, are always a good person to start with.

Kiki Reno	Kiki.Reno@uvm.edu
Barbara Asiimwe	Barbara.Asiimwe@uvm.edu

New graduate students will need to see Kiki or Barbara for course materials including a textbook if they are teaching a course. They can also point out where the mailboxes and graduate student offices are located. They are available to take phone messages and in general help keep the department running smoothly.

Networked computers are available in the graduate student offices and at many locations around campus. All graduate students have accounts on the UVM network. These accounts are maintained by the University's Information Technology department. They provide access to the Internet and a variety of installed software. Students are encouraged to acquaint themselves with the system and its capabilities. For example, one can access computer algebra systems (Mathematica, MATLAB), packages for mathematical computing (PARI, SAGE, MATLAB), mathematical typesetting software (LaTeX), and various tools for doing mathematical research.

Each graduate student receives both a postal and an electronic mailbox which are used for Department, College, and University Communications.

The University of Vermont (UVM) is located in Burlington, a city of about 50,000 located on the shores of Lake Champlain, with views of Vermont's Green Mountains to the east and New York's Adirondack Mountains to the west. Burlington is 90 miles south of Montreal, 200 miles

climbing, bicycling, in-line skating, mountain-biking, sailing, skateboarding, skiing and snowboarding.

Mathematics Graduate Faculty and Students

The mathematics faculty at UVM has strengths in several areas (see below), and members are actively involved in research in their areas of expertise. The department and university have a friendly, collegial atmosphere in which students have ample opportunity to talk with professors on an informal basis. We strive to offer an education that is comprehensive yet tailored to the individual needs of our students. Students are invited to participate in the ongoing research seminars in number theory, applied mathematics, complex systems and combinatorics. These include participants from St. Michael's College, Middlebury, and other institutions.

A list of all mathematics and statistics faculty member

The *Graduate Catalogue* contains a wealth of essential

Applying to the Ph.D. Program

Graduate Teaching Assistantships are usually awarded (and renewed) for an academic year beginning with the fall semester. *Applicants whose files are complete by January 15 will receive full consideration for a GTA beginning the next fall semester. Applications that become complete after January 15 will be evaluated on a continuing basis for GTA support until all assistantships have been awarded.*

Duties of a Teaching Assistant usually involve teaching one section of an elementary mathematics course per semester (normally 3 teaching hours per week) and conducting help sessions (1 to 2 hours per week). Occasionally, one or more GTA positions will become available at the start of the spring semester. In such a case, all unsupported students currently in Mathematics Graduate Program as well as applicants who have indicated they wish to begin that spring will be considered for the award(s). Master's students serving as GTAs in their first year will normally be renewed for a second year based on good performance as a teacher and a student. Doctoral students may be supported on faculty research grants but are also funded by GTA positions to provide them with important teaching experience. The net amount of support from a research grant is usually comparable to that of a GTA.

GTAs are open to all applicants, domestic and international, with preference given to PhD candidates.

Fees for Graduate Students

Graduate students are responsible for certain fees (some are *not* covered by a GTA stipend). The major ones are combined in a Comprehensive Fee. Complete information about all fees may be obtained from the Graduate College's web pages.

Information for New Students

The college runs an orientation for new students during the week before fall classes begin. Students are strongly encouraged to attend, and new recipients of Graduate Teaching Assistantships are required to attend.

There are also departmental orientation activities during that week. During the orientation, you will learn your way around the department and meet the faculty, staff, and other graduate students. You will be given office assignments, computer accounts, and student identification cards. We will help you register for your courses and give you an introduction to the University computing system, including how to use UVM e-mail.

what material will be covered, the exam schedule, and the criteria for grading. A special rule here at UVM: you may not schedule an exam during the last 5 days of classes, so plan ahead. A very helpful listing of standard teaching practices at UVM is available on the department website.

equipment from offices or other university spaces; graffiti etc.

Students are also subject to the Graduate College code of conduct as well.

Department and University Awards

There are several awards programs in the department and university for graduate students.

Each year at Honors Day, the department gives the John F. Kenney Award to the outstanding graduate student in mathematics. The department also gives the Sang Kil Nam Scholarship Award to an outstanding undergraduate or graduate student in mathematics and statistics.

The department has one free one-year membership in the Mathematical Association of America and several one-

Each April, the Graduate College and other offices on campus host the *UVM Student Research Conference*. Students engaged in research projects are strongly encouraged to participate.

Master's and Doctoral Degree Requirements

The following description of our degree requirements is included for your information. The online Graduate Catalogue contains the formal requirements including rules and regulations, e.g., those concerning residency for in-state tuition.

Doctor of Philosophy in the Mathematical Sciences

The Ph.D. degree requires 75 semester hours in coursework and dissertation research. Students must maintain a 3.0 GPA. Students are required to pass two written qualifying exams and an oral examination based on written proposal; for details see the subsequent section on Doctor of Philosophy Qualifying Exams. Following successful completion of these exams, the student is admitted to candidacy for the degree. The candidate must then write a doctoral dissertation and pass a final oral defense of that dissertation. At least one semester of college teaching experience is required.

Master of Science Degree Requirements

Each student must complete one of the following options:

- a. Twenty-four hours of acceptable graduate credits in advanced mathematics courses; six hours of thesis research culminating in a master's thesis, or
- b. Thirty semester hours of acceptable graduate credits in advanced mathematics courses; six hours of thesis research culminating in a master's thesis, or

Concurrent Credit for M.S. and Ph.D. Programs

Up to 30 credit hours of course work for which graduate credit is earned at UVM in a Master's degree program, whether a Master's degree is received or not, may be applied toward a Ph.D. at UVM, provided they are appropriate for the Ph.D. program. A student may thus potentially complete both the M.S. and Ph.D. degrees with a minimum of 75 credit hours of course and thesis work.

Note that an M.S. in Statistics or Biostatistics can be earned with the Ph.D. in mathematical science. Advising for the M.S. would be arranged through Professor Jeff Buzas in close coordination with the student's Ph.D. advisor.

A third course in the fall of the Second Year could be taken in place of, or in addition to, the Third course in the fall of the First Year.

Core Courses

Graduate students in are (usually) expected to take the “first year sequence”. As such, students preparing to enter the graduate program should take the appropriate courses to prepare for these course. For Pure Mathematics these could include two semesters of real analysis, two semesters of abstract algebra, point set topology, and complex analysis.

Pure mathematics first year sequence.

Fall	Spring
Measure Theory (Math 333)	Complex Analysis (Math 331)
Abstract Algebra III (Math 395)	Abstract Algebra IV (Math 395)
Algebraic Topology (Math 354)	Topics in Combinatorics

Applied Mathematics first year sequence.

Fall	Spring
Differential Equations (Math 330)	Partial Differential Equations (Math 339)
Numerical Analysis (Math 237)	Numerical Analysis (Math 337)
Methods of Applied Mathematics	

Written Examinations

The nature and timing of the written comprehensive examinations depend on your degree objective and whether you've concentrated on pure or applied mathematics.

Master's Comprehensive Examinations

All students in the non-thesis version of the M.S. degree are required to pass 2 written comprehensive examinations. These written exams are given during the week prior to the beginning of the semester in August and January. MS students must

In addition, all students will take a comprehensive exam consisting of a written and oral presentation on a topic chosen in consultation with their research studies committee, whose members will be present for the oral examination. Topics currently offered include

- 3a. Number Theory/Arithmetic Geometry (255 and 351 and 395)
- 3b. Combinatorics (273 and 373)
- 3c. Functional Analysis (335)
- 3d. Methods of Applied Mathematics (395)
- 3e. Complex Systems (266 and 300)
- 3f. Nonlinear PDEs (395)
- 3g. Mathematical Biology and Ecology (268)

Students interested in taking an exam on a topic not found in the above list are encouraged to contact the Graduate Director regarding other possible exam topics.

These exams are offered twice a year in the fall and spring semesters. For more information, contact the Graduate Director at (408) 253-1000.

After successful completion of the qualifying

additional homework assignments and different exams and held to higher grading standards. Please note that credit for Math 230 does not apply towards a degree in Mathematics. Math 230 is considered elementary material which a student should have had as an undergraduate. A student who needs to review this material may sit in on this course without credit or study the material independently. If they do take the course for credit the tuition will be covered under a Graduate Teaching Assistantship, but the credits earned will *not* count towards the degree.

Master's students choosing the thesis option may sign up for Math 391, Master's Thesis Research. Doctoral students may sign up for Math 491, Doctoral Dissertation Research. All students are recommended to take Math 330, Advanced Ordinary Differential Equations, but this course is not required.

Students and advisors should carefully read the section on qualifying and comprehensive examinations in this handbook for information on the scheduling, topics, and structure of these exams.

Advisors should note that GTA students carry a tuition waiver covering up to 9 credits per semester. A minimum of 6 credits per semester is needed to maintain full-time graduate student status. Credits above the 9-credit

Accelerated Master's Program

The Accelerated Master's Program (AMP) in mathematics is designed so that students with strong ability and motivation can complete a bachelor's degree in mathematics, science, or engineering, as well as a master's degree in mathematics at UVM within five years. Interested students should also see the general description of Accelerated Master's Programs on the Graduate College web pages.

The first four years consist of an undergraduate program that includes the core requirements for a minor in mathematics together with other courses that lay a solid mathematical foundation; this portion culminates in a bachelor's degree. During the fifth year, students take courses that complete the requirements for the master's degree in mathematics.

The AMP in mathematics integrates the undergraduate and graduate experiences so that students receive both the breadth and depth they would achieve had they completed the two degrees separately.

Requirements for Admission

The Accelerated Master's Program in mathematics is designed for students who are mathematics majors, or who are majors in science or engineering with a minor in mathematics. A student who is enrolled in this AMP may count 6 credits of Mathematics coursework at or above the 200-level for both the undergraduate and the graduate degrees. If interested in the AMP in Mathematics, a student declares this interest in writing to the Director of the Mathematics Graduate Program before taking any courses that he or she would like to count towards both degrees. The student should also be sure to inform the course instructors that he or she wishes to participate in these courses at the graduate level. fothe

Sample AMP Schedule

First Year, Fall	Math 21 (4hrs) & CS 21 & 3 Electives	16 hours
First Year, Spring	Math 22 (4hrs) & Math 52 & 3 Electives	16 hours
Second Year, Fall	Math 121 (4hrs) & (Math 141,151, or 1XX) & 3 electives	16 hours
Second Year, Spring	Math 124 & (Math 1XX or 2XX) & 3 Electives	15 hours
Third Year, Fall	Math 241 & (Math 230 or 2XX) & 3 Electives	15 hours
Third Year, Spring	Math 242 & Math 2XX & 3 Electives	15 hours
Fourth Year, Fall	Math 333 & 251 & 3 Electives	15 hours
Fourth Year, Spring	(Math 252 or 2XX) & (Math 331 or 3XX) & 3 Electives	15 hours
Fifth Year, Fall	Math 2XX & 2XX & 3XX	9 hours
Fifth Year, Spring	(2XX or 3XX) & Math 3XX & 3XX	9 hours

For more information and a formal list of requirements please contact the Director of the Mathematics

Math 259 *Cryptography*

Math 354 *Algebraic Topology* Homotopy, covering spaces, homology and cohomology theories, fixed point theorems.

Math 373 *Topics in Combinatorics* Topics will vary each semester and may include combinatorial designs, coding theory, topological graph theory, cryptography.

Math 391 *Master's Thesis Research* Provides up to 6 credits for research and preparation of a M.S. Thesis.

Math 395 *Special Topics* Courses which are relatively new or offered infrequently are assigned this number. There can be various sections covering various topics. Recently this has included Algebra III, Algebra IV, Probability Theory, and Topics in Analysis.

Math 491 *Dissertation Research* This course provides credit for the research and preparation of your Ph.D. dissertation.

Stat 233 *Design of Sample Surveys* Design and data analysis for sample surveys. Simple random, stratified, systematic, cluster, multistage sampling. Practical issues in planning and conducting surveys.

Stat 237 *Nonparametric Statistical Methods* Nonparametric and distribution free methods; categorical, ordinal and quantitative data; confidence intervals; rank and Chi-Square hypothesis tests; computer-intensive procedures (Boots, Balsho, ...)

Stat 387 *Data Science II* Advanced data analysis, collection, and filtering. Statistical modeling, monte carlo statistical methods, and in particular Bayesian data analysis, including necessary probabilistic background material. A practical focus on real datasets and developing good habits for rigorous and reproducible computational science.

