Department of Mathematics
2019-2020 Graduate Student Handbook
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Graduate Student Advisory Committee

TBA

Table of Contents

Mission Statement

The Department of Mathematics at Brigham Young University serves the university community and furthers the university's mission through the pursuit of excellence in teaching, scholarship and service.

We offer a first-rate education to students, preparing them for career success in both academia and industry. Such an education inspires students, intellectually enabling them to employ critical analysis, logical deduction, thoughtful synthesis and insightful problem solving skills in any career path.

We extend the frontiers of mathematical knowledge in ways that involve students and colleagues, support the undergraduate major and graduate programs of the department, contribute to our understanding of the universe and the nature of truth, and bring positive recognition to the university.

Graduate Programs

The Department of Mathematics has approximately 35 graduate students, and supports most of them via teaching assistantships. These students receive help with tuition as well as a stipend for the teaching support they provide in college algebra and calculus.

Two degrees are offered through the Department of Mathematics: mathematics—MS; and mathematics—PhD.

MS students study mathematics courses in preparation for careers in business, industry, government, or education. Some students use a master's degree in mathematics in preparation for a doctoral degree in mathematics or a closely related discipline or a discipline where technical competence is appreciated. Master's students graduate in an average of two years.

The department supports from 10-15 PhD students. Designed for gifted and dedicated students, the program requires about four years beyond a master's degree. The department has research interests in the areas of applied mathematics, algebraic geometry, geometric analysis, dynamical systems, number theory, geometric and low-dimensional topology, mathematical biology, and group theory. PhD students graduate in, on average, four years.

Mathematics Department

With an enrollment of nearly 30,000 full-time students, Brigham Young University, founded in 1875 as Brigham Young Academy, is one of the nation's largest private universities and ranks 7th in the nation among all undergraduate institutions for the number of alumni who successfully complete a PhD in mathematics or statistics.

The faculty of the Brigham Young University Department of Mathematics includes some of the most renowned instructors, researchers, and mentors in the nation. They are recognized for their research and creative endeavors, innovations and discoveries, excellence as teachers and advisors, and for their outstanding service in department and university appointments.

Our faculty members have received university, college or national teaching and research awards. The math department regularly places in the top 20 of the Putnam Mathematical Competition, an annual competition for the brightest mathematical student minds in the country.

Each fall, the BYU mathematics department offers a career and internship talk series for students. We invite five-eight guest speakers who talk about internships and careers opportunities for mathematics majors. Past speakers have included a lawyer, a doctor, an actuary, an operations researcher at communications firm, a senior scientist at a pharmaceutical company, a mathematician at Lawrence Livermore National Lab, the president of a computer company, and a financial planner at Goldman Sachs. These presentations have been very popular with an average attendance of about 200 people.

Mathematics is central to life in a technological society. The rigor and discipline required to excel in mathematics develop skills that are in constant demand. Therefore, graduates are equipped to obtain positions in a wide variety of business, governmental, and industrial enterprises. Mathematics majors are also sought after by professional schools of law, medicine, and management. Mathematical experience beyond basic calculus enhances the life and capabilities of every intellectually curious student.

BYU Location

Brigham Young University is located in Provo, Utah. Provo is 45 miles south of Salt Lake City, a major metropolitan area. Salt Lake City is home of the Mormon Tabernacle Choir, the Utah Jazz, the Utah Symphony, and a large number of other attractions.

Religious Environment

The Church of Jesus Christ of Latter-day Saints sponsors BYU to provide a university education in an atmosphere that nurtures spiritual growth and a strong conviction of the divinity of Jesus Christ. Church programs are closely correlated at all levels with the activities of the university, and students will find many opportunities to grow spiritually.

There are about twenty-five other religious denominations represented in the BYU student body. These students are encouraged to attend a congregation of their faith in the surrounding area.

University Devotionals

University devotionals are held throughout the year on Tuesdays at 11:05 a.m. They provide an inspirational and integrative part of the university experience. Devotional speakers, selected from the General Authorities and other leaders of the Church and university personnel, come to teach the gospel and affirm the spiritual dimension of the university experience for students, faculty, and staff.

University Forums

University forums are held on selected Tuesdays at 11:05 a.m. and are designed to enrich the general education experience. Speakers are noted authorities in the arts, sciences, humanities, media, and government, chosen for their contributions to their field and their ability to inspire and communicate. Participation in these assemblies and the associated question-and-answer sessions prompts inquiry into significant intellectual, cultural, and social issues and helps lay the foundation for lifelong learning.

Harold B. Lee Library

The Harold B. Lee Library collection numbers over eight million volumes, including books, periodicals, government documents, microfilm, and other non-print items. The library's Web-based catalog contains numerous full-text databases and many electronic indexes to other sources.

The library is a depository for United State government documents and regularly receives publications of state and local governments. The Religion and Family History Library supports family history and genealogical research through an extensive collection of microfilm, microfiche, and online resources. L. Tom Perry Special Collections houses non-circulating books and manuscripts related to Mormonism, western Americana, incunabula, Victorian and Edwardian literature, historical manuscripts and photographs, motion pictures, and many other preserved items for research and use.

Cultural Environment

Students can immerse themselves in culture at BYU through the Performing Arts Series, Museum of Art, and Museum of Peoples and Cultures.

Athletic Facilities

BYU's athletic facilities are among the best in the nation. The Richards Building has facilities for racquetball, volleyball, basketball, aerobics, dance, and swimming. The Smith Fieldhouse houses ball courts, weight rooms, an indoor track, and a west annex big enough for spring batting practice.

The Great Outdoors

The Wasatch Mountains overlook BYU on the east, and Utah Lake lies to the west. Within an hour's drive are several canyons and ski resorts; six national parks are only a half day away. Outdoor gear may be rented on campus for everything from skiing to windsurfing.

Applications and Admissions

University Application Requirements

Admission to graduate study is highly selective and is granted to a specific program for a specific semester or term (Deadlines: January 15 (spring, summer, fall), September 15 (winter). As a minimum, applicants who wish to be considered for admission must do the following:

U.S. Applicants
1. Submit a complete application before the application deadline. An application is not considered complete until the application fee has been paid and all transcripts, letters of recommendation, the statement of intent, and the confidential report are in, as well as parts A and D of the admissions application.
2. Agree to maintain university standards of personal conduct.
3. Have received or be about to receive a baccalaureate degree from an accredited U.S. or Canadian university. The Office of Graduate Studies must receive an unofficial transcript showing that the degree has been conferred. Without such verification, registration will not be permitted beyond the first semester. U.S. students with a degree from a foreign university equivalent to an American baccalaureate must submit unofficial transcripts from all institutions attended and an accompanying certified translation.
4. Have earned at least a 3.0 GPA in the last 60 semester hours of course work.
5. All applicants for whom English is not the native language: Submit evidence of proficiency in English.
6. Have a score of at least 600 on the GRE Math Subject Test.
7. Satisfy departmental requirements for consideration. See all the sections under Mathematics Department Application and Admission Requirements.

International Applicants (all non-U.S.)
1. Submit a complete application before the application deadline. An application is not considered complete until the application fee has been paid and all transcripts, evidence of degrees earned, letters of recommendation (Part C), the statement of intent, official TOEFL score, financial certification, and the Code of Honor commitment and confidential report (Part B) are in, as well as Parts A and D of the admissions application.
2. Agree to maintain university standards of personal conduct.
3. Submit transcripts from each institution attended, with accompanying certified English translation.
4. Submit a copy of a diploma (preparation completed at least equivalent to a U.S. bachelor's degree), with accompanying official English translation.
5. Have earned at least a 3.0 GPA (on a 4.0 scale) for all previous undergraduate work.
6. Submit a TOEFL score of at least 580. To be competitive for financial support, a TOEFL score of at LEAST 600 or a computer equivalent score of at least 237 is preferred. This is required of all applicants for whom English is not the native language. Students with a bachelor's degree from a U.S. or Canadian university are usually exempt from this requirement.
7. Have a score of at least 600 on the GRE Math Subject Test.
8. Submit a completed Financial Certification and Visa Information form with supporting documents. Applicants must provide proof of sufficient funds for the total length of their program of study.

9. Satisfy departmental requirements for consideration. See all the sections under Mathematics Department Application and Admission Requirements.

Note: Brigham Young University will not process applications from applicants entering the United States with a B visa. An admitted student will receive an I-20 or IAP-66 form (Certificate of Eligibility) with the official letter of acceptance; the I-20 and IAP-66 are used to obtain a student visa (F-1 or J-1).

Financial Support and Employment

Financial Aid

Most of the graduate students in mathematics are supported by teaching assistantships. The usual load for a teaching assistant is twenty hours a week. Teaching assistants currently receive a stipend of $16,200 for MS and $18,600 for PhD per calendar year. Some research or travel funding is available for those students who are making good progress toward a degree, and who have submitted a program of study and have an advisor's endorsement.

To be considered for financial support, applications should be submitted by January 15 for fall semester and September 15 for winter semester.

Guidelines for the Continuation of Financial Support

Continued financial support is recommended for graduate teaching assistants who are making satisfactory progress in an approved program of study and who are judged satisfactory in their teaching duties. Quality teaching performance is essential for continuation. Unsatisfactory teaching may lead to loss of support, and cases of conspicuous irresponsibility or neglect will be cause for immediate termination.

Employment Outside the Mathematics Department

The combined obligations of teaching and studying are full-time undertakings. The Department of Mathematics does not permit teaching assistants to assume any additional form of employment.

Teaching Loads and Tuition Waivers

The normal teaching load for a teaching assistant is twenty hours per week. Duties include teaching, grading, holding office hours, recitations, and working in the Math Lab.

In addition, full tuition for mathematics courses will generally be provided for teaching and research assistants during fall and winter semesters, provided they make adequate progress in their programs of study and regularly attend an appropriate seminar and the TA training (if applicable). Tuition may also be paid in spring and summer, depending on department budget constraints.

The department will not pay additional tuition for courses that are not on the student's program of study. For example, a student enrolled in six hours of mathematics courses and three hours of physical education courses will have tuition paid only for the six hours of mathematics courses. However, a student who is enrolled full-time (9 hours) in mathematics courses will have full-time tuition paid by the mathematics department. Thus that student may take additional non-mathematics courses that do not interfere with performing other responsibilities without charge. Students may petition the graduate committee to take courses outside the math department, provided the courses are relevant to their program of study and have been approved by their advisors.

Living Expenses and Tuition

Graduate Tuition

A significant portion of the cost of operating the university is paid from the tithes of The Church of Jesus Christ of Latter-day Saints (LDS). Therefore, students and families of students who are tithe-paying members of the Church have already made a contribution to the operation of the university. Because others have not contributed

in this way, they are charged a higher rate of tuition, as shown below. This practice is similar in principle to that of state universities that generally charge nonresidents at a higher rate than residents.

Costs and Financial Aid
https://enrollment.byu.edu/financialaid/cost-of-attendance

Tuition for fall and winter semesters:

Full-Time (8.5+ hours) LDS: $3,645   Non-LDS: $7,290
Part-Time (per credit hour) LDS: $430   Non-LDS: $860

Tuition for spring and summer terms:

Full-Time (4.5+ hours) LDS: $1,823   Non-LDS: $3,645
Part-Time (per credit hour) LDS: $430   Non-LDS: $860

Teaching and research assistants receive a tuition scholarship for mathematics courses fall and winter semesters if they are making good progress toward completion of their program.

Cost of Living Expenses (Fall 2019 through Summer 2020)

Item	Single
Books & Supplies	$872
Room and Board	$13,080
Misc. Personal Expenses*	$3,784
Transportation	$2,944
Total Living Expenses	$28,154

*personal expenses include the cost of BYU health insurance premiums for a single student. Married students may have to pay a higher health insurance premium. BYU health insurance is required if you are not covered by another annual policy. Students are billed each semester and term for the entire academic year including future periods of non-attendance.

Program Purpose and Objectives

The general objective of the Department of Mathematics at Brigham Young University, as related to the degrees offered by the department, is to teach mathematics and mathematical thinking at the level appropriate to each student. This enables students to employ critical analysis, thoughtful synthesis, logical deduction, and insightful problem solving, not only within mathematics itself but also in a wide variety of natural and man-made situations.

MS Objectives

The Master of Science program is specifically designed to help students as they progress towards becoming independent mathematical thinkers, and participate in advancing the frontiers of mathematical knowledge. The program also prepares students for positions in business and industry that require advanced mathematics skills, critical analysis, thoughtful synthesis, and insightful and independent problem solving.

PhD Objectives

The specific purpose of the Doctor of Philosophy program in mathematics is to prepare students for a career in research and teaching at the university level. It also prepares them for professions that require independent mathematical research, advanced mathematical knowledge, critical analysis, thoughtful synthesis, and insightful and independent problem solving. It gives students an opportunity to become full contributors to the important and exciting process of extending the frontiers of mathematical knowledge.

The underlying philosophy of the program is that graduate-level mathematics is both enabling and ennobling. Mathematical knowledge, logical reasoning, and the ability to solve problems and discover mathematical truths

are powerful and important skills that promote student success in a wide range of academic, professional, or business-related careers.

But more importantly, deep and careful mathematical thought expands both the mind and the soul. It increases understanding of many things, both physical and spiritual. Our purpose in this program is to enrich the spiritual and temporal lives of our students by sharing the beauty and power of mathematics with them.

The accomplishment of these objectives requires the students to gain a deep understanding of and appreciation for mathematics, its versatility, depth, and power. They must also understand important ideas of the main mathematical subdisciplines and the relationship of mathematics to other subjects.

Finally, students should be able to work independently, without the direct supervision and guidance of a senior mathematician. The development of this independence is certainly begun at the undergraduate and masters levels, but for most students it can only be fully achieved at the doctoral level. Although coursework plays some role in the requirements for the PhD in mathematics, the most important element is the dissertation, a significant and substantial work of original mathematical research.

Specific goals of the programs

MS: The specific goals of the MS in mathematics are to help each individual student
- Achieve an understanding of graduate-level mathematics, including several areas such as analysis, algebra, topology, and applied mathematics.
- Achieve depth and application in a specialized area.
- Develop mathematical research skills.
- Develop problem-solving skills applicable to a wide variety of settings.
- Learn to communicate complex ideas effectively and demonstrate sound reasoning in both quantitative and qualitative settings.
- Acquire the mathematical foundation necessary to enter a variety of opportunities in occupations and further schooling.
- Relate knowledge of mathematics and mathematical processes to physical, natural, and social sciences, humanities, and other human endeavors.
- Develop a reasoned relationship between secular knowledge and spiritual insight that fosters faith and commitment to the gospel of Jesus Christ and leads to lifelong learning and service.

PhD: The specific goals of the PhD in mathematics are to help each individual student
- Achieve a broad understanding of graduate-level mathematics, including several areas such as analysis, algebra, topology, and applied mathematics.
- Achieve depth and a thorough knowledge of current developments in a specialized area.
- Develop mathematical research skills at the doctoral level, discovering significant new results in mathematics or solving outstanding problems.
- Develop expository skills that will allow communication of future research results with the academic world.
- Learn to communicate complex ideas effectively and to reason soundly in both quantitative and qualitative settings.
- Acquire the expertise necessary to continue to contribute to the frontiers of mathematical knowledge
- Relate knowledge of mathematics and mathematical processes to physical, natural, and social sciences, humanities, and other human endeavors.
- Develop a reasoned relationship between secular knowledge and spiritual insight that fosters faith and commitment to the gospel of Jesus Christ and leads to lifelong learning and service.

Program Requirements and Offerings

The Department of Mathematics offers a master's and a doctoral program. The Master of Science (M.S.) Program prepares students for positions in business and industry, and also provides preparation for further graduate study leading to a doctoral degree at Brigham Young University or elsewhere.

The Doctor of Philosophy (PhD) Program prepares students for a career in research and teaching at the university level. The PhD program in mathematics was approved in 1986 when the department received a program improvement grant to fund teaching assistantships in mathematics. The current research areas of the faculty include: algebraic geometry, applied mathematics, dynamical systems, combinatorics, geometric and low-dimensional topology, geometric and combinatorial group theory, number theory, numerical methods, mathematical biology, and partial differential equations.

With small classes and individual attention, the department supports high quality research programs in the selected areas.

Forms

All forms needed for graduate studies may be downloaded from the following website: https://gradstudies.byu.edu/page/form-list.

Mathematics M.S. Degree

Approved Courses (Both Thesis and Non-Thesis Programs)

Approved graduate mathematics courses include all classes numbered 500 and above, with the exception of Math 500. All courses must be passed with a grade of C+ or better. No credit is given for prerequisite courses such as Math 342 or Math 372.

Students are required to submit a program of study before the end of the third week of their second semester. The study list form may be found at https://gradstudies.byu.edu/file/adv-form-3

Note: The minimum registration requirement is six credit hours per year. Students not meeting this requirement will be dropped from the program.

Thesis Program Requirements
- **Credit hours (30):** Minimum 24 course work hours in approved graduate mathematics with a grade of C+ or better in each and six thesis hours (Math 699R). Twelve of the course hours must be from Math 540, Math 541, Math 571, and Math 572 or any 600-level course.
- **Examination:** The examination requirement in the thesis program may be met by way of coursework, or by way of written examination as explained below, in two of three broadly defined areas of applied mathematics, analysis, and algebra, by the end of year two. Failure by a master's student to meet the examination requirement by the end of year two will result in the discontinuation of financial support for that master's student at the end of year two.

  Continuing master's students have the option of meeting the examination requirement under the current or new system.

  Coursework: To meet the examination requirement by way of coursework, a master's student will need to earn an A- or better in two courses, or their equivalents at another institution, with one course in one of the three areas and another course in one of the remaining two areas. Courses in the area of applied mathematics include, but are not limited to, Math 510, Math 511, Math 521, Math 522, Math 611, and Math 636. Courses in the area of analysis included but are not limited to Math 532, Math 540, Math 541, Math 565, Math 641, and Math 655. Courses in the area of algebra include but are not limited to Math 561, Math 571, Math 572, Math 586, Math 656, and Math 676. A graduate course, or its equivalent at another institution, can only be used to count towards one of the three areas. For example, Math 636 (Probability 1) is both applied mathematics and analysis, but it can only be counted for one of these two areas. The Graduate Committee will maintain a list of associations of graduate courses with the three areas.

  A master's student may meet the examination requirement by way of graduate coursework completed as an undergraduate.

Written Examination. To meet the examination requirement by way of written examination, a master's student will need to pass written examinations in two of the three areas. The written examinations will be based on published syllabi associated to the basic courses listed below. If a Master's student has earned an A- or better in one course associated to one of the three areas, but not in another course in another area, the master's student need only pass one written examination in an area not met by coursework. Written examinations will be offered in August/September, January, and May.

1. Applied Mathematics: Math 521 and Math 522
2. Analysis: Math 540 and Math 541
3. Algebra: Math 571 and Math 572

The Graduate Committee may change the basic courses associated to any of the three areas, but there will always be two basic courses associated to each of the three areas. No written examinations are available for other courses.

- **Graduate Program of Study.** Students are required to submit a program of study before the end of the third week of their second semester. The study list form may be found at https://gradstudies.byu.edu/file/adv-form-3

- **Thesis.** Each student in the program is required to write a thesis (or project) on a mathematical topic at a level well beyond what they encounter in the classroom. The master's thesis (or project) usually includes an introductory chapter that is a comprehensive survey of the literature on the student's research topic. Upon completion of the thesis (or project) and before graduation, the student is required to give an oral presentation of his work. The department tracks student publications in professional journals and student presentations in professional meetings.

- **Oral defense of thesis.** Defenses must be scheduled AT LEAST two weeks before the date of the defense. Students will not be permitted to defend their theses until their faculty advisors have approved their work. To schedule the final oral exam, bring the completed ADV Form 8c (https://gradstudies.byu.edu/file/adv-form-8c) to the graduate secretary.

Non-Thesis Program Requirements

- **Credit hours (32):** Minimum 30 course work hours in approved graduate mathematics with a grade of C+ or better in each and two hours for the project (698R). Eighteen course hours must be taken from Math 540, 541, 571, and Math 572 or courses numbered 600 or above. No credit is given for prerequisite courses such as Math 342 or Math 372.
- **Examination:** The examination requirement in the thesis program may be met by way of coursework, or by way of written examination as explained below, in two of three broadly defined areas of applied mathematics, analysis, and algebra, by the end of year two. Failure by a master's student to meet the examination requirement by the end of year two will result in the discontinuation of financial support for that master's student at the end of year two.

Continuing master's students have the option of meeting the examination requirement under the current or new system.

Coursework: To meet the examination requirement by way of coursework, a master's student will need to earn an A- or better in two courses, or their equivalents at another institution, with one course in one of the three areas and another course in one of the remaining two areas. Courses in the area of applied mathematics include, but are not limited to, Math 510, Math 511, Math 521, Math 522, Math 611, and Math 636. Courses in the area of analysis included but are not limited to Math 532, Math 540, Math 541, Math 565, Math 641, and Math 655. Courses in the area of algebra include but are not limited to Math 561, Math 571, Math 572, Math 586, Math 656, and Math 676. A graduate course, or its equivalent at another institution, can only be used to count towards one of the three areas. For example, Math 636 (Probability 1) is both applied mathematics and analysis, but it can only be counted for one of these two areas. The Graduate Committee will maintain a list of associations of graduate courses with the three areas.

A master's student may meet the examination requirement by way of graduate coursework completed as an undergraduate.

Written Examination. To meet the examination requirement by way of written examination, a master's student will need to pass written examinations in two of the three areas. The written examinations will be based on published syllabi associated to the basic courses listed below. If a master's student has earned an A- or better in one course associated to one of the three areas, but not in another course in another area, the master's student need only pass one written examination in an area not met by coursework. Written examinations will be offered in August/September, January, and May.

1. Applied Mathematics: Math 521 and Math 522
2. Analysis: Math 540 and Math 541
3. Algebra: Math 571 and Math 572

The Graduate Committee may change the basic courses associated to any of the three areas, but there will always be two basic courses associated to each of the three areas. No written examinations are available for other courses. Previous exams (https://math.byu.edu/graduate/exams/) may be used as study guides.

- **Graduate Program of Study.** Students are required to submit a program of study before the end of the third week of their second semester. The study list form may be found at https://gradstudies.byu.edu/file/adv-form-3

- **Project, Paper and Presentation:** Complete a project (Math 698R) focused on an area of advanced mathematics, write a paper about the project, and present a 45-minute talk based on the paper.

M.S. Degree Recommended Schedule of Study

Below is a recommended schedule of courses for students in the master's program. Students should consult with their advisor to determine whether some deviation from this plan is better suited to their individual needs. The standard load for a student with a teaching or research assistantship is 9 credit hours of graduate-level mathematics courses per semester. Students who enroll in fewer mathematics courses may have trouble completing their program requirements in a timely manner. Students not enrolled in at least six hours of mathematics courses per semester are generally not making satisfactory progress toward completion of their degree and may have their funding reduced or their degree candidacy terminated.

Semester 1 (Fall)
- Take Math 541, Math 553, and Math 571 or Math 510, or other courses as directed by your (perhaps temporary) advisor.
- Attend the weekly graduate seminar and department colloquia.
- Choose an advisory committee and prepare a study list.
- Take the master's algebra and analysis exams in August.

Semester 2 (Winter)
- Take Math 540, Math 554, and Math 572, or other courses as directed by your advisor.
- Attend the weekly graduate seminar.
- Pass the master's exams (in January and February if necessary).

Spring/Summer
- Begin the thesis or project.
- Take reading courses relevant to the thesis or project, as directed by your advisory committee.

Semester 3 (Fall)
- Take at least three hours of 600-level courses.
- Take six more hours of courses according to your study list (some may be thesis or project hours).
- Attend a weekly research seminar as directed by your advisor, and attend department colloquia.
- Continue work on your thesis or project.

Semester 4 (Winter)
- Take at least three hours of 600-level courses.
- Take six more hours of courses according to your study list (some may be thesis or project hours).
- Attend a weekly research seminar as directed by your advisor.
- Finish and defend the thesis or project.

Guidelines for M.S. Degree Projects and Theses

Content

A mathematics MS project should entail learning mathematics not normally taught in graduate or undergraduate classes. It may be of an expository nature or may involve the investigation of mathematical structures in some depth. It does not need to include original research, but it should include some proofs.

A mathematics MS thesis should be a substantial mathematical work. This does not only refer to length, but rather to content. Students should pursue original work sufficient for publication in a college mathematics journal. The thesis should be the work of the student and should not be written primarily by the advisor. Other than original work the thesis might be an account of work at the frontier of research in a particular area, perhaps including new examples worked out in detail.

Computational/algorithmic projects or theses are also possible; however, the mathematical content needs to be the core of the writing.

Students should be stretched and will be called to account for the logical content of their written work. They should contribute in some way to mathematics and not just reiterate what they have already learned.

Students should be aware of the limitations of their methodology (e.g. statistical significance) yet also be aware of the possibilities for amplification of their results. They should have a broad view of the subject matter and how what they have done fits into the general subject.

Presentation or Defense

The student should give a presentation in which the essential ideas of the written work are exposed and put into context. The student should be able to answer straightforward questions on the basic parts of their work, indicating a thorough understanding. The talk should include at least one proof. You **MUST** schedule your defense **NO LATER THAN** two weeks before the date you want to present. Bring the completed ADV Form 8c (https://gradstudies.byu.edu/file/adv-form-8c) to the graduate secretary to schedule the exam.

Mathematics PhD Degree

Requirements for Doctoral Degree
1. **Credit Hours** (54): Minimum 36 coursework hours in mathematics courses numbered 600 or above (Math 521, 522, 540, 541, 571, 572 may be substituted) with a grade of B or better in each, plus 18 dissertation hours (Math 799R). More than nine credit hours of Math 695R being counted towards the coursework hours requires approval of the graduate coordinator. Graduate level courses in other departments can be counted toward the coursework hours with the approval of the graduate coordinator.
2. **Required Courses:** Complete six credit hours in one of the three areas applied mathematics, analysis, and algebra, and complete six credit hours in one of the remaining two areas.
3. **Examination Requirement:** The examination requirement ensures that PhD students have acquired a sufficient level of mathematical mastery to undertake high-level research. The examination requirement can be met by way of coursework or by way of written examination, as explained below, in two of three broadly defined areas of applied mathematics, analysis, and algebra, by the end of year two. Failure of a PhD student to meet the examination requirement by the end of year two will result in the discontinuation of funding at the end of year two.

    Continuing PhD students have the option to meet the examination requirement under the current or new

system.

Coursework. To meet the examination requirement by way of coursework, a PhD student will need to earn an A- or better in four courses, or their equivalents at another institution, with two of the four courses in one of the three areas and two courses in one of the remaining two areas. Courses in the area of applied mathematics include but are not limited to Math 510, Math 511, Math 521, Math 522, Math 611, and Math 636. Courses in the area of analysis included but are not limited to Math 532, Math 540, Math 541, Math 565, Math 641, and Math 655. Courses in the area of algebra include but are not limited to Math 561, Math 571, Math 572, Math 586, Math 656, and Math 676. A graduate course or its equivalent at another institution can only be used to count towards one of the three areas. For example, Math 636 (Probability 1) is both applied mathematics and analysis, but it can only be counted for one of these two areas. The Graduate Committee will maintain a list of associations of graduate courses with the three areas.

Written Examinations. To meet the examination requirement by way of written examination, a PhD student will need to pass written examinations in two of the three areas. The written examinations will be based on published syllabi associated to the basic courses listed below. If a PhD. student has earned an A- or better in two courses associated to one of the three areas, but not in two courses in another area, the PhD student need only pass one written examination in an area not met by coursework. Written examinations will be offered in August/September, January, and May.

The Graduate Committee may change the basic courses associated to any of the three areas, but there will always be two basic courses associated to each of the three areas. No written examinations are available for other courses.

1. Applied Mathematics: Math 521 and Math 522
2. Analysis: Math 540 and Math 541
3. Algebra: Math 571 and Math 572

4. **Dissertation:** A PhD student must register for and complete a minimum of 18 hours of dissertation credit Math 799R. No more than 18 hours may count toward the 54 hours required, and all 18 hours may not be taken in one term or semester. Registration for dissertation credit and work on the dissertation must be concurrent. A PhD student may not register for Math 799R until that student has completed the examination requirement and completed 27 credit hours of the required 36 credit hours of coursework.

Defense of Dissertation: A final oral defense of the dissertation is conducted by a faculty committee consisting of the student's research advisor and four other members of the faculty (one of whom must be an outside examiner). Defenses must be scheduled **NO LATER THAN** two weeks before the date of the defense. Students will not be permitted to defend their dissertations until their faculty advisors have approved their work. To schedule the final oral exam, bring the completed ADV Form 8c https://gradstudies.byu.edu/file/adv-form-8c) to the graduate secretary.

PhD Degree Recommended Schedule of Study

The following schedule is recommended for teaching assistants in the PhD program. Except where there are extenuating circumstances, teaching assistants who fall more than one year behind this schedule should not expect their teaching assistantships to be renewed. Students who have strong potential but lack adequate preparation may petition to have a year zero added in which they complete their preparation for the PhD program. During this year, their teaching duties and pay will be similar to master's students. Students who have passed fewer than two of the three required qualifying examinations by February of their second year will not be allowed to continue. Students who have passed only two of the three examinations by February of the second year may request special permission to continue for an additional year by submitting a written request to the student's graduate committee. The student's committee reviews the request and submits a written recommendation to the departmental graduate

committee. In addition, students who have completed an M.S. degree at BYU are required to pass at least one examination by February of their first year of study in the PhD program in order to continue beyond the first year.

Year 1
- Take three 600-level yearlong mathematics sequences.
- Attend the weekly graduate seminar (or a research seminar, as directed by your advisor).
- Select an area of specialty, an advisor, and advisory committee.
- Attend department colloquia.
- Prepare a study list in consultation with your advisor (due during the first year, and no later than the first week of second year).
- Pass at least one qualifying exam.

Year 2
- Take nine credit hours of advanced graduate courses each semester, ideally in yearlong sequences (Dissertation hours may suffice for some of these credit hours).
- Attend a weekly research seminar, as directed by your advisor.
- Attend department colloquia.
- Pass three written qualifying examinations by the end of the year.

Year 3
- Continue taking advanced graduate courses.
- Actively participate in research seminars.
- Attend department colloquia.
- Begin work toward a dissertation.

Year 4
- Devote primary attention to finishing the dissertation.
- Continue participating in advanced courses and seminars.
- Consider publishing dissertation results in a journal and present them at a professional conference.
- Find research topics to pursue beyond a dissertation and begin to develop a long-term research plan.
- Complete the requirements for the doctoral degree.

Note: It is expected that students attend a seminar of their choice as well as colloquia throughout their programs.

Advisement

Temporary Advisor

Once accepted into the graduate program, students are assigned a temporary advisor who guides their first registration and individual study until the student selects an advisory committee, which is appointed in the first semester. Students should contact their temporary advisor well before their first semester of graduate study so that they can be sure to enroll in courses best suited to their individual case.

Advisor and Advisory Committee

The advisor plays a significant role in guiding the student through the program and helping the student become an independent mathematician. The advisor helps the student choose a project, thesis, or dissertation topic, and gives guidance and supervision throughout the task.

Choosing an Advisor

The main component in choosing a professor to be an advisor should be to match the student's research interests with the type and quality of research done by the professor. In order to determine the type of research currently being done by faculty members, students should attend the various seminars offered. Once a student has determined that someone has similar interests, the student should then consult with the professor and ensure that

he or she is willing to act as an advisor.

Advisory Committee

During the first semester, students should work with the selected advisor to arrange for the appointment of an advisory committee. Master's (thesis and project) committees consist of a chair and at least two other members; doctoral committees have a chair and at least four other members. The department may require additional members.

Program of Study List

The goal of the graduate program in mathematics is for the student to become an independent mathematician. This is not accomplished by taking a random selection of courses but by carefully working with an advisory committee to create a program that has a solid mathematical foundation and meets the student's interests.

A program of study list must be submitted and approved by the student's advisory committee. (https://gradstudies.byu.edu/file/adv-form-3).

Master's students should complete the program of study list under the direction of their graduate committee during the student's first semester, and in no case later than the third week of the second semester. A master's committee must consist of a chair and at least two members.

Doctoral students should receive approval and submit their program of study during the first year, and in no case later than the third week of the beginning of the second year of study. A doctoral committee must consist of a chair and at least four members.

Financial support will be reduced and may be withdrawn if a study list is not submitted on time. The Graduate Study List gives the approved courses of study for the graduate degree. It is possible at any time to amend the study list for courses not yet taken. A program of change form may be accessed at the following website: https://gradstudies.byu.edu/file/adv-form-3b. After the list has been filled out and the appropriate signatures have been obtained, the list should be returned to the department graduate secretary.

In addition to the official study list, by the end of October of each year, students should submit a tentative schedule of when they plan to take each remaining course on their study list. This allows the graduate committee to ensure that graduate course offerings for the coming year will meet students' needs.

Graduation and Evaluation of Student Progress

Graduation Deadlines (University requirements are in red.)

Dec 2018	Apr 2019	Jun 2019	Aug 2019	
Oct 19	Jan 25	Mar 15*	Mar 15*	Last day for graduate students to apply for graduation online in AIM. Go to **byu.edu → myBYU → School → Apply for Graduation**. *This date applies to those students who want to walk in April Graduation Ceremonies.
		May 3**	Jun 28**	**Last day for students to receive a diploma but <u>NOT</u> walk in the April Graduation Ceremonies
Nov 2	Feb 8	Mar 22	Mar 22	Last day for departments to accept a student's graduation application in AIM (GRADQ, GRADAPP, and ADV01).
		May 17***	Jul 12***	***Last day for departments to accept a student's graduation application in AIM for a diploma.
Nov 16	Mar 8	May 17	July 5	Last day to **SCHEDULE** a final oral examination (defense of thesis or dissertation) with department using the Department Scheduling of Final Oral Examination form (ADV Form 8c: https://gradstudies.byu.edu/file/adv-form-8c), and submit copies of your document to your graduate committee. No matter which day you

				choose to present, you must schedule the final oral exam **NO LATER THAN TWO WEEKS PRIOR TO THE DATE YOU CHOOSE TO PRESENT**. Final examinations may not be held during the "interim period" between semesters or terms.
Nov 30	Mar 22	May 31	July 19	Last day to **HAVE** a final oral examination. Note: Ample time should be allowed to make corrections in dissertations, theses, or selected projects after the final oral examination and before the deadline for submitting the ETD.
Dec 7	Apr 5	June 13	Aug 2	Last day to submit dissertation, thesis, or selected project with the Approval for Submission of Dissertation, Thesis, or Selected Project form (ADV Form 8d: https://gradstudies.byu.edu/file/adv-form-8d) to Associate Dean Gus Hart for his signature. Upon receipt of the signed ADV Form 8d, the ETD must be submitted for electronic format approvals through the ETD submission website (http://etd.byu.edu/). After the department has approved the ETD, the dean's office will review and approve the ETD.
Dec 14	Apr 12	June 20	Aug 9	This is the **last day to take final paperwork (ADV Form 8d) to Graduate Studies** (105 FPH) once the ETD status shows 'Grad Office Review.' Last day to complete any remaining requirements for a degree including payment of fees, submitting grade changes (for I's, T's, etc.), prerequisite independent study courses, and for departments to enter examination results (oral or written) in AIM (ADV08).
None§	Apr 25	None§	None§	Graduation — University Commencement
None§	Apr 26	None§	None§	Graduation — College Convocations

§December, June, and August graduates are invited to participate in April graduation exercises.

Items that must be completed by the final paperwork deadline:
- Submit ETD and receive approvals from department and college
- College signatures on ADV Form 8d
- Submit form ADV Form 8d to Graduate Studies
- Order bound copy of thesis and send reorder number to department

The math department requires a bound copy of your work for the department as well as your advisor (unless he or she is content with the PDF version). You are responsible for paying for these copies.

If you are submitting a project, you need to send a final PDF copy to Lonette (276 TMCB), no page numbers.

Graduation

The math department encourages students to complete their degree programs in a timely fashion. An MS degree is expected to take two years to complete while a PhD should take four years. We understand that unavoidable delays may occur, plans may change, and personal challenges may arise. However, taking too much time to graduate reflects poorly on the student, advisors, and department. Students should not extend the time it takes to graduate.

For instructions to apply for graduation, visit the following website: https://gradstudies.byu.edu/page/graduation

Evaluation Process

I. The math department will monitor graduate student progress twice a year (fall semester and spring term).
   A. The graduate committee will review the progress of each student.
   B. Students will be rated as making satisfactory, marginal, or unsatisfactory progress.

1. If marginal or unsatisfactory progress is noted, students will be notified in writing what they need to do, when it needs to be accomplished, and who to contact for help to demonstrate satisfactory progress.
        2. Students who receive an unsatisfactory evaluation will not be eligible to obtain financial support.
    C. Students will be notified in writing of their progress.
    D. Students making marginal or unsatisfactory progress will be informed by certified letter with return receipt regarding the following:
        1. What they need to do to make satisfactory progress.
        2. When each task needs to be accomplished.
        3. Which faculty member(s) they should contact for more information or support.
        4. What will happen if these tasks are not accomplished (e.g., an unsatisfactory rating for the next semester, termination from the program, etc.).

II. Definitions of ratings:
    A. Satisfactory progress includes the following:
        1. On track in all things to successfully graduate within the proper time frame.
        2. No concerns with departmental responsibility.
    B. Marginal progress includes the following:
        1. Failure to submit program of study form within the first two semesters.
        2. Failure to establish a graduate committee within the first two semesters.
        3. Registering for thesis hours but doing little or no work.
        4. Minimal contact with chair or advisory committee members.
        5. Failure to maintain a 3.0 GPA.
        6. Earning an unacceptable grade in a study list course (C+ grade for master's students, and a B grade for doctoral students).
        7. Unsatisfactory performance of departmental responsibilities.
    C. Unsatisfactory progress includes the following:
        1. Failing a course.
        2. Not progressing at a rate necessary to finish all courses in a timely manner.
        3. Not meeting the requirements set forth in a previous marginal evaluation.
        4. Poor performance in research.
        5. Lack of ethics.

III. If a student receives a marginal and an unsatisfactory or two unsatisfactory ratings in succession the department will:
    A. Terminate the student's support at the conclusion of the semester OR
    B. Submit a petition to the Office of Graduate Studies making a convincing case that the student be given another semester to demonstrate satisfactory progress. A copy of a contract listing student and faculty responsibilities and a time line should be attached.

IV. If a student receives a marginal rating in one semester and is not making satisfactory progress in the next semester, the student will be rated as making unsatisfactory progress. A student will not be rated as making marginal progress in two sequential semesters. Failing to correct marginal progress is unsatisfactory

Graduate Student Advisory Committee

The Graduate Student Advisory Committee exists to improve the graduate program by:

1. Advising graduate students concerning classes, requirements for degrees, and other aspects of the graduate program.
2. Making recommendations concerning the graduate program to the Department of Mathematics.
3. Assisting the department in making its policies and requirements fully understood by the graduate students.
4. Organizing the weekly graduate seminar.

This committee consists of three graduate students, elected in the fall of each year by the mathematics graduate students. If there are not sufficient nominations, the Graduate Committee may nominate or select members of this committee.

Courses and Seminars

Seminars

Part of becoming an independent mathematician is becoming exposed to a broad range of mathematical research as well as studying some specific areas in greater depth. It is expected that students attend colloquia and a seminar of their choice. Students receiving tuition awards are expected to attend the graduate seminar or, with the approval of their advisor, a research seminar at least 11 weeks per semester. Students are expected to attend at least five department colloquia a semester.

The graduate seminar is a weekly seminar organized by the Graduate Student Advisory Committee. Its purpose is to acquaint students with the faculty and their research, prepare students for the department colloquia, and to permit students an opportunity to share their research with other students. As students advance in the program, it is generally expected that they will attend a regular research seminar instead of or in addition to the graduate seminars.

The research seminars usually include the following:

- Algebra
- Algebraic Geometry
- Dynamical Systems
- Mathematical Biology
- Mathematical Physics
- Number theory
- Partial Differential Equations
- Stochastic Differential Equations
- Topology

Other seminars also run from time to time. Please see the Seminar Page for more information.
http://math.byu.edu/upcoming-seminars-colloquia/

Courses

We have 20 core courses that are regularly scheduled and that are mainly for first year students. The remaining courses (about 10) are determined according to the needs of the current graduate students.

Core Courses
Twenty courses will be taught every year:
Math 510, 511 Numerical Analysis
Math 532 Complex Analysis
Math 540, 541 Real Analysis
Math 543,544 Probability
Math 553, 554 Topology
Math 570 Matrix Analysis
Math 571, 572 Algebra

Non-core courses
Math 586, 587 Number Theory
Math 634, 635 ODEs/Dynamical Systems
Math 640, 641 Analysis
Math 655, 656 Algebraic/Differential Topology
Math 673 Algebra 3

Other courses are offered less regularly. Consult the course schedule to check availability.

All students should submit their program of study by the end of November of their first year. Students must also submit an additional list to the secretary, giving a schedule of when they plan to take the courses in their programs of study. Students should consult with their advisors to select the most beneficial courses, and to decide when they should take them. The graduate committee uses these lists to determine which classes will be taught the next year, and to ensure that students' coursework needs are met.

Descriptions of Approved Courses

510. Numerical Methods for Linear Algebra. (3)
Prerequisite(s): Math 410 or equivalent.
Numerical matrix algebra, orthogonalization and least squares methods, unsymmetric and symmetric eigenvalue problems, iterative methods, advanced solvers for partial differential equations.

511. Numerical Methods for Partial Differential Equations. (3)
Prerequisite(s): Math 303 or 447; 410; or equivalents.
Finite difference and finite volume methods for partial differential equations. Stability, consistency, and convergence theory.

513R. Advanced Topics in Applied Mathematics. (3)
Prerequisite(s): Instructor's consent.

521. Methods of Applied Mathematics 1. (3)
Prerequisite(s): Math 334 or equivalent.
Possible topics include variational, integral, and partial differential equations; spectral and transform methods; nonlinear waves; Green's functions; scaling and asymptotic analysis; perturbation theory; continuum mechanics.

522. Methods of Applied Mathematics 2. (3)
Prerequisite(s): Math 521 or equivalent.
Possible topics include variational, integral, and partial differential equations; spectral and transform methods; nonlinear waves; Green's functions; scaling and asymptotic analysis; perturbation theory; continuum mechanics.

532. Complex Analysis. (3)
Prerequisite(s): Math 352 or instructor's consent.
Introduction to theory of complex analysis at beginning graduate level. Topics: Cauchy integral equations, Riemann surfaces, Picard's theorem, etc.

534. Introduction to Dynamical Systems 1. (3)
Prerequisite(s): Math 334, 341; or equivalents.
Discrete dynamical systems; iterations of maps on the line and the plane; bifurcation theory; chaos, Julia sets, and fractals. Computational experimentation.

540. Linear Analysis. (3)
Normed vector spaces and linear maps between them.

541. Real Analysis. (3)
Prerequisite(s): Math 341; 314 or 342; or equivalents.
Rigorous treatment of differentiation and integration theory; Lebesque measure; Banach spaces.

543. Advanced Probability 1. (3)
Prerequisite(s): Math 314 or equivalent.
Foundations of the modern theory of probability with applications.
Probability spaces, random variables, independence, conditioning, expectation, generating functions, and Markov chains.

544. Advanced Probability 2. (3)
Prerequisite(s): Math 543.
Advanced concepts in modern probability. Convergence theorems and laws of large numbers. Stationary processes and ergodic theorems. Martingales. Diffusion processes and stochastic integration.

547. Partial Differential Equations 1. (3)
Prerequisite(s): Math 334, 342; or equivalents.
Methods of analysis for hyperbolic, elliptic, and parabolic equations, including characteristic manifolds, distributions, Green's functions, maximum principles and Fourier analysis.

548. Partial Differential Equations 2. (3)
Prerequisite(s): Math 547.
Tools for PDEs and special topics: spherical means, method of descent, subharmonic functions, Hamilton-Jacobi equations, Riemann invariants, conservation laws for linear and nonlinear waves.

553. Foundations of Topology 1. (3)
Prerequisite(s): Math 451 or instructor's consent.
Naive set theory, topological spaces, product spaces, subspaces, continuous functions, connectedness, compactness, countability, separation axioms, metrization, complete metric spaces, function spaces, and Baire spaces.

554. Foundations of Topology 2. (3)
Prerequisite(s): Math 553 or instructor's consent.
Fundamental group, retractions and fixed points, homotopy types, separation theorems, classification of surfaces, Seifert-van Kampen Theorem, classification of covering spaces, and applications to group theory.

561. Introduction to Algebraic Geometry 1. (3)
Prerequisite(s): Math 571 or concurrent enrollment.
Basic definitions and theorems on affine, projective, and quasi-projective varieties.

562. Introduction to Algebraic Geometry 2. (3)
Prerequisite(s): Math 561.
Local properties of quasi-projective varieties. Divisors and differential forms.

565. Differential Geometry. (3)
Prerequisite(s): Math 342 or equivalent.
A rigorous treatment of the theory of differential geometry.

570. Matrix Analysis. (3)
Prerequisite(s): Math 302 or 313 or equivalent.
Special classes of matrices, canonical forms, matrix and vector norms, localization of eigenvalues, matrix functions, applications.

571. Algebra 1. (3)
Prerequisite(s): Math 372 or equivalent.

572. Algebra 2. (3)
Prerequisite(s): Math 571.

586. Introduction to Algebraic Number Theory. (3)
Prerequisite(s): Math 372 or equivalent.
Algebraic integers; different and discriminant; decomposition of primes; class group; Dirichlet unit theorem; Dedekind zeta function; cyclotomic fields; valuations; completions.

587. Introduction to Analytic Number Theory. (3)
Prerequisite(s): Math 352 or equivalent.
Arithmetical functions; distribution of primes; Dirichlet characters; Dirichlet's theorem; Gauss sums; primitive roots; Dirichlet L-functions; Riemann zeta-function; prime number theorem; partitions.

621. Matrix Theory 1. (3)
Prerequisite(s): Math 570.
Symmetric matrices, spectral graph theory, interlacing, the Laplacian matrix of a graph.

622. Matrix Theory 2. (3)
Prerequisite(s): Math 621.
Research topics in combinatorial matrix theory.

634. Theory of Ordinary Differential Equations. (3)
Prerequisite(s): Math 334, 341; or equivalents.

635. Dynamical Systems. (3)
Prerequisite(s): Math 634.

640. Nonlinear Analysis. (3)
Differential calculus in normed spaces, fixed point theory, and abstract critical point theory.

641. Functions of a Real Variable. (3)
Prerequisite(s): Math 541 or instructor's consent.
Abstract measure and integration theory; $L(p)$ spaces; measures on topological and Euclidean spaces.

643R. Special Topics in Analysis. (3)
Prerequisite(s): Math 641 or instructor's consent.
Advanced topics in analysis drawn from pure and applied mathematics.

644. Harmonic Analysis. (3)
Prerequisite(s): Math 532, 541.
Harmonic analysis on the torus and in Euclidean space; pointwise and norm convergence of Fourier series and functional-analytic aspects of Fourier transforms emphasized.

647. Theory of Partial Differential Equations 1. (3)
Prerequisite(s): Math 541, 547.

648. Theory of Partial Differential Equations 2. (3)
Prerequisite(s): Math 647.

651. Topology 1. (3)
Prerequisite(s): Math 553, 554.
Advanced topics in topology. Topics may include, but are not limited to, piecewise linear topology, 3-manifold theory, homotopy theory, differential topology, Riemannian geometry, and geometric group theory.

652. Topology 2. (3)
Prerequisite(s): Math 651.
Advanced topics in topology. Topics may include, but are not limited to, piecewise linear topology, 3-manifold theory, homotopy theory, differential topology, Riemannian geometry, and geometric group theory.

655. Differential Topology. (3)
Prerequisite(s): Math 342 or equivalent; Math 554 or equivalent.
Topological and smooth manifolds, tangent vectors, vector bundles, cotangent bundles, submersions, immersion, and embeddings of submanifolds, transversality, embedding and approximation theorems, differential forms, wedge products, exterior derivative, orientation, Stokes' theorem and integration on manifolds.

656. Algebraic Topology. (3)
Prerequisite(s): Math 655.
Fundamental group and homotopy, Von Kampen theorem, covering spaces, group actions, higher homotopy; simplicial, singular, and cellular homology, homology with coefficients, exact sequences, excision, Mayer-Vietoria; cohomology, universal coefficients, cup product, Poincare duality.

663. Algebraic Geometry 1. (3)
Prerequisite(s): Math 676 or concurrent enrollment.
Basic definitions and theorems on varieties, sheaves, and schemes.

664. Algebraic Geometry 2. (3)
Prerequisite(s): Math 663.
Cohomology of schemes. Classification problems. Applications.

673. Algebra 3. (3)
Prerequisite(s): Math 572 or equivalent.

675R. Special Topics in Algebra. (3)
Prerequisite(s): Math 572.

676. Commutative Algebra. (3)
Prerequisite(s): Math 572.
Commutative rings, modules, tensor products, localization, primary decomposition, Noetherian and Artinian rings, application to algebraic geometry and algebraic number theory.

677. Homological Algebra. (3)
Prerequisite(s): Math 572.
Chain complexes, derived functors, cohomology of groups, ext and tor, spectral sequences, etc. Application to algebraic geometry and algebraic number theory.

686R. Topics in Algebraic Number Theory. (3)
Prerequisite(s): Math 372, 487 and instructor's consent.
Current topics of research interest.

687R. Topics in Analytic Number Theory. (3)
Prerequisite(s): Math 352, 487; or equivalents.
Current topics of research interest.

691R. Graduate Mathematics Colloquium. (1)
Prerequisite(s): Math 371 or equivalent.
A diverse set of talks at the graduate level. Students will broaden their knowledge of recent and current research in mathematics. Speakers will be faculty, visitors, and students reporting on thesis work.

695R. Readings in Mathematics. (1-2)

698R. Master's Project. (2)

699R. Master's Thesis. (1-9)

751R. Advanced Special Topics in Topology. (3)
Prerequisite(s): Math 652.
Current topics in topology of research interest

799R. Doctoral Dissertation. (1-9)

Graduate Faculty and Areas of Interest

Algebra and Algebraic Geometry
- Stephen Humphries: Group Theory, Low-dimensional Topology
- Tyler Jarvis: Algebraic Curves, Moduli Spaces
- Pace Nielsen: Ring Theory, Module Theory, and Number Theory
- Nathan Priddis: Algebraic Geometry

Combinatorics
- Rodney W. Forcade: Combinatorics, Number Theory, and Graph Theory
- Mark Kempton: Spectral Graph Theory and Combinatorial Matrix Theory

Differential Equations and Dynamical Systems
- Mark Allen: Partial Differential Equations
- Lennard Bakker: Dynamical Systems and Celestial Mechanics
- Todd Fisher: Dynamical Systems
- Christopher P. Grant: Nonlinear Partial Differential Equations, Dynamical Systems
- Kening Lu: Nonlinear Partial Differential Equations, Dynamical Systems, and Applied Mathematics
- Benjamin Webb: Dynamical Systems and Applied Mathematics

Minimal Surfaces
- Michael Dorff: Minimal Surfaces, Geometric Function Theory
- Gary Lawlor: Minimal Surfaces

Number Theory
- Roger Baker: Number Theory
- David A. Cardon: Analytic Number Theory, Algebraic Number Theory, Automorphic Forms
- Jasbir S. Chahal: Number Theory
- Darrin Doud: Number Theory
- Michael Griffin: Number Theory
- Paul Jenkins: Number Theory, Modular Forms, Partitions
- Xian-Jin Li: Analytic Number Theory

Numerical Analysis and Applied Mathematics
- Blake Barker: Applied Mathematics, Partial Differential Equations
- Shue-Sum Chow: Numerical Analysis
- John Dallon: Mathematical Biology
- Emily Evans: Applied Mathematics
- Scott Glasgow: Optics both Classical and Quantum
- Robin Roundy: Operations Research
- Vianey Villamizar: Numerical Solution of Partial Differential Equations, Wave Scattering, and Asymptotic Methods
- Jared Whitehead: Applied Mathematics, Fluid Dynamics

Topology and Geometric Group Theory
- Gregory Conner: Geometric Group Theory, Topology, and Combinatorial Group Theory
- Denise Halverson: Geometric Topology
- Mark Hughes: Geometric Topology and Low-dimensional Topology
- Curtis Kent: Geometric Group Theory
- Eric Swenson: Geometric Group Theory, Topology