

**HANDBOOK FOR GRADUATE
STUDIES IN MATHEMATICS
WEST VIRGINIA UNIVERSITY
2020-2021**

WVU Department of Mathematics
<https://mathematics.wvu.edu/>

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I. Introduction

The Department of Mathematics offers the following degrees: Master of Science (M.S.) and Doctor of Philosophy (Ph.D.). Currently, there are options in Pure Mathematics and Applied Mathematics for the M.S. program. Students in the Ph.D. program are expected to pursue a core of fundamental mathematics courses followed by specialized studies culminating in an original research dissertation directed by a faculty advisor.

This handbook provides information on both the M.S. program and the Ph.D. program in Mathematics. The policies below, their interpretation and their execution, are the responsibility of the Graduate Programs Committee. In general, any questions about policy, or appeals of policy decisions, should be brought to the Graduate Programs Committee, either directly, or after consultation with the student's advisor. This Handbook is intended for the use of faculty as well as prospective and current graduate students. Other information and regulations concerning program requirements are contained in the University's [Graduate Catalog](#). The handbook is subject to annual updates as approved by the Graduate Programs Committee and Graduate Program Director.

The handbook will be updated at least annually, and while students are encouraged to download and save the handbook, they must also stay up to date with changes.

Deadline: Applications to WVU Mathematics programs are due February 15th for Fall enrollment and evaluated on a case-by-case basis for Spring enrollment only.

II. General Information

The Department of Mathematics is committed to excellence in undergraduate and graduate preparation in instruction and research in Pure and Applied Mathematics and Mathematics Education. The Department has approximately 25 faculty members, 6 visiting faculty/postdoctoral researchers, 16 instructors, and 30 supported graduate students. Department faculty members have won College and University awards for teaching, research, and service.

Our faculty conduct research in a broad range of areas, including combinatorics, topology, mathematical biology, differential equations, numerical analysis, collegiate mathematics education, and scientific computing. The Department of Mathematics offers the B.S. and B.A. in Mathematics. At the graduate level it is possible to earn an M.S. or a Ph. D.

III. Program Requirements – M.S.

Admissions

For regular admission, a baccalaureate degree in mathematics or its equivalent is required, including an introductory course in real analysis and courses in linear algebra and modern algebra. Students who have deficiencies in their background may be granted provisional admission to the M.S. program. Deficiencies must be completed within the first year. GRE Scores are not required. International students must submit TOEFL or IELTS scores to determine English language proficiency. The WVU Graduate Catalog has more information about admissions requirements [here](#).

Placement – Basic Exam

The Basic Exam in Advanced Calculus and Linear Algebra is given as a placement exam at the beginning of graduate study for M.S. students, as part of the Real Analysis and Linear Algebra Requirement in order to assess their background in introductory real analysis and linear algebra.

Each exam consists of a 2-hour written exam, a take-home exam, and an oral discussion on the take-home part. The exam will be given during the week before the start of the Fall semester. The Graduate Program Director will administer the exam and will provide deadlines to students for the take-home portions. After grading the Basic Exam, the examination committees will send the Graduate Program Director their course recommendations in time for students to enroll in the appropriate level of Real Analysis and Linear Algebra courses. The recommendation will be based on the student's background, and performance on the exam.

Topics to be covered in Advanced Calculus: Elementary properties of Open/closed/compact/connected sets in \mathbb{R}^n . Numerical sequences and series. Limits, Cauchy sequences, convergence. Continuity. Continuity and compactness/connectedness. Uniform continuity. Sequences and series of functions; uniform convergence. Calculus of real-valued functions: Differentiation, mean value theorems, Taylor's theorem. Definition and existence of the Riemann integral. Fundamental Theorem of Calculus. Integration and differentiation of series/sequences of functions.

Topics to be covered in Linear Algebra: Vector spaces, linear independence, basis, dimension, linear transformation, and matrix representations, rank, range space, null space, eigenvalues and eigenvectors, diagonalizations, canonical forms, inner product spaces, orthogonal basis, symmetric and Hermitian matrices and properties.

Degree Requirements - Courses

Please see the [catalog](#) for degree requirements for the M.S. in Mathematics.

Real Analysis: The M.S. degree requires the completion of Real Analysis with at least a B in Math 452 or in Math 551. Students without two semesters of undergraduate real analysis, will normally be required to take the full Math 451-452 sequence, unless they show on the Basic Exam that they have sufficient background to take Math 551.

Linear Algebra: The M.S. degree requires the completion of Math 543 with at least a B, unless that requirement is waived in writing as a result of performance on the Basic Exam.

Seminar in Professional Tools: Math 694, a one credit seminar course, covers software and technology useful for professionals in mathematics and is required for the M.S. degree. The goals of this seminar are to provide all graduate students with a working knowledge of professional tools for research, technical typesetting, presentation, and computation. (For example, using Math Reviews & Science Citation Index, internet resources, TeX-based typesetting/word processing, presentation software, Web publishing, MATLAB for computation and graphics, guidelines for mathematical/technical writing). Students who have already developed expertise in using one or more of the tools involved may, at the option of the instructor, arrange for an appropriate demonstration of that expertise in lieu of attendance at the corresponding lectures.

Area of Emphasis: Students must graduate under one of two listed Areas of Emphasis (AoEs), either Pure Mathematics or Applied Mathematics.

Pure Mathematics Area of Emphasis

Students who pursue the Pure Mathematics AoE, must satisfy required coursework, elective coursework and exam requirements. The core requirements of this AoE include the following, in addition to the Linear Algebra, Real Analysis and Professional Tools requirements described above:

Course Requirements

- a. One sequence from the following:

Sequence	Course Numbers
Real Variables	551 & 651
Algebra	541 & 641
Topology	581 & 681

- b. One additional course from the following, outside of the sequence chosen to meet the requirement above:

Course	Course Number
Real Variables	551
Algebra	541
Topology	581

- c. One additional course from the following:

Course	Course Number
Modern Algebra	541
Number Theory 1	545
Real Variables 1	551
Complex Variables 1	555
Intermediate Differential Equations	564
Combinatorial Analysis 1	571
Graph Theory	573
Topology 1	581

- d. Twelve additional credit hours of electives, from courses listed in the Graduate Program catalog, on the Department website, and in consultation with your advisor and the Graduate Program Director.

Exam Requirements

Students in the Pure Mathematics Area of Emphasis must pass the M.S. Advanced Examination by the end of the third year of their study. This consists of obtaining M.S. level passes (or better) in two subject areas chosen from Real Analysis, Algebra, Topology, and Differential Equations. The Advanced Exam also serves as the Ph.D. Entrance Examination.

The M.S. Advanced Exam

Two times each year, in the late spring and early fall, the Department administers four subject area exams over a one-week period. The four subjects are Real Analysis, Algebra, Topology and Differential Equations. Each exam is a three-hour written exam. These subject area exams together constitute the M.S. Advanced Exam. Each subject area exam taken by the student is graded, in terms of decreasing performance, as either Ph.D. level pass, M.S. level pass, or fail. For a student in the M.S. program, the M.S. Advanced Exam is passed by achieving at least an M.S. level pass in two subject areas.

Policies and Time Limits for the M.S. Advanced Exam

A student may attempt any set of subject area exams each time they are administered (i.e. one subject area exam or up to four). A student may attempt a given subject area exam no more than three times. This is a cumulative overall limit that applies while the student is in any degree program. Thus, for instance, if a student attempts a subject area exam twice while in the M.S. program, they may attempt that subject area exam at most once more if they subsequently enter the Ph.D. program. Students remain in good standing in the program until they have exhausted all attempts. Passing the M.S. Advanced exam is a graduation requirement in the Pure Mathematics Area of Emphasis. Students have up to three academic years in which to pass from when they first enroll in the M.S. program. Graduate Assistants have additional expectations regarding the exams. Failure to meet these expectations may result in the withdrawal of their assistantship. Please see the section on Graduate Assistantships. Part-time students are expected to comply with the deadlines above. Extensions of the time in which to pass can be considered by the Graduate Programs Committee based on the particular circumstances involved, including the overall number of credits taken by the student. Students unable to pass the exams successfully will need to consult with the Graduate Program Director to determine their options and explore alternative means of graduation (e.g. via the applied mathematics AoE and a project presentation, etc.)

Exam Schedule of M.S. Advanced Exam

The M.S. Advanced Exam is given in the second week of classes in Fall and again two weeks before the final exam week of the Spring term. Students must notify the Graduate Program Director of their intention in writing to take the exams a month before the exams are given, specifying the subject area(s) to be taken. The Graduate Program Director will request this information via email each term. The one-month advanced notification stated above may be waived by the Graduate Program Director.

Examining Committees

Each subject area exam has an examining committee consisting of two designated faculty members and the Graduate Program Director as a member ex-officio. Members will serve on the committee for a two-year period, with renewal possible. Members (including replacements for absent members) of each committee will be appointed by the Graduate Program Director in consultation with the Graduate Programs Committee. Each examining committee acts independently from each other examining committee in preparing and grading its exam. Grades are assigned to exam papers based on the judgment of the examiners and not on particular percentages. Instructors who regularly teach the related subject should be expected to serve on an examining committee in the field, if asked. Each examining committee is to report to the Graduate Program Director the outcome of each exam for each student within five working days upon the completion of the exams. Written notification from the Graduate Program Director concerning the decision of the examination committee is to be sent to the student within ten working days upon the completion of all the exams.

Content of Exams

Lists of topics for each subject area exam posted online on the department website. The lists are reviewed and updated approximately every five years. Faculty teaching the related courses are expected to cover a reasonable amount of the material listed. However, the exams are topic oriented, not course oriented and students should not assume that a given course sequence will cover exam content in its entirety. Therefore, samples of previous exams will be made available to students through the Department website and via email. Students are allowed to take the exams without taking the related courses at WVU.

Appeals and Exceptions

Students may speak with examiners, as available and agreeable, concerning their performance on a given subject area exam, and may review their answers. The exams themselves remain in the custody of the Department and are not returned to the students. Since the grade on an exam is a collective decision of the examiners, students will normally not see scores assigned by individual examiners. A student may appeal their grade to the Graduate Programs Committee. However, if the examiners concur in the assigned grade, the Graduate Programs Committee will usually defer to the examination committee's judgment unless there is strong evidence that the grade given is inconsistent with usual practice or is based on a mistake or a misreading of the solutions. Students have 10 business days from the date they receive notice of their performance on an exam, to file an appeal via email to the Graduate Director.

Exceptions to these policies may be considered by the Graduate Programs Committee on rare occasions, when warranted. Personal circumstances, including medical problems, accidents, hardships, etc. may play a role. However, the general outlook of the Graduate Programs Committee is that the allowed three attempts and the time period in which to pass the respective exams already build in substantial opportunity to overcome most individual difficulties. In considering exceptions, the Graduate Programs Committee will review not just the reasons for the exception, but also the student's academic and exam performance and their potential for success.

Applied Mathematics Area of Emphasis

The basic components of the Applied Mathematics AoE include computation, modeling, differential equations, and complex variables. Electives may be chosen to complement this background, such as statistics, discrete mathematics, algorithms; to deepen the background, with courses such as partial differential equations, dynamical systems, numerical partial differential equations; or to broaden the student’s background in traditional areas of mathematics with a view toward subsequent doctoral studies.

The core requirements of this AoE include the following, in addition to the Linear Algebra, Real Analysis and Professional Tools requirements described above.

Students must complete a project, internship, or thesis related to the area of emphasis. This should be approved in advance by the student’s advisor and the Graduate Program Director.

Course Requirements

- a. Core Courses:

Course	Course Number
Numerical Analysis	521
Mathematics Modeling	563
Intermediate Differential Equations	564

- b. One additional course from the following as a Complex Variables Elective:

Course	Course Number
Complex Variables	456
Complex Variables 1	555
Advanced Calculus	568

- c. Twelve additional credit hours of electives, from courses listed in the Graduate Program catalog, on the Department website, and in consultation with your advisor and the Graduate Program Director.

Grade Point Average

Students in any of the degree programs are expected to remain in good standing and to meet standards of degree progress. To remain in good standing, and as a condition of satisfactory progress, students must earn a minimum overall GPA of 2.75, a minimum grade of B- in all courses applied to the degree with the exception of elective courses, and a minimum GPA of 3.0 in all coursework applied to the degree. Students making satisfactory progress are expected to complete their M.S. program within two years of full-time study of full-time study, and decisions on the award and/or continuation of financial support include such expectations. Students are also expected to receive at least a B in any course taken to remedy deficiencies in their background, usually in connection with their admission as a provisional student. Courses may be repeated if the required grade is not met but all courses are counted in the overall GPA.

Independent Study and Doctoral level course work

Independent Study courses are rarely used in the M.S. program. They are to be avoided in the first year and will be approved after that by the Graduate Program Director if judged essential for the student's program. An independent study course requires supervision by a faculty member, along with a description of the course content, planned meetings with the supervisor, and assessments. Independent Study may not be used as a substitute for a required course, only as an elective. At most two 700-level courses will be approved for M.S. students while in the program.

IV. Program Requirements – Ph.D.

Admissions

An M.S. degree in Mathematics or the equivalent is normally required for admission to the Ph.D. program. GRE Scores are not required. International students must submit TOEFL or IELTS scores to determine English language proficiency. The WVU Graduate Catalog has more information about admissions requirements [here](#). However, [provisional admission](#) can be granted in some circumstances including the following (*note: WVU no longer grants provisional admission to international students*):

- Students lacking appropriate preparation for Ph.D. level coursework may be admitted provisionally but will be required to pass the Basic Exam and their program of study must include 12-18 credit hours of approved coursework, at the M.S. level or above, beyond the basic Ph.D. coursework requirements. Students who fall into this category will have their status reevaluated by the Graduate Program Director, in consultation with the Graduate Programs Committee, during their annual evaluation and may request a change in the student's status at that time. Students must meet WVU guidelines which state that only 18 hours of graduate work may be completed in provisional status, so at that point students must demonstrate ability to pursue doctoral work or may be dismissed from the program.
- Well-prepared students enrolled in the M.S. program can be advanced to the Ph.D. program with permission of the Graduate Programs Committee after their first year of study. These students must pass the Ph.D. Entrance Exam and complete 18 hours of regular M.S. coursework in their first year. Students potentially interested in this provision should ideally consult with their advisor or the Graduate Program Director prior to their initial enrollment. The Graduate Programs Committee will consider the student's background and performance in deciding whether to grant permission to transfer to the Ph.D. program.

Ph.D. Entrance Exam

Two times each year, in the late spring and early fall, the Department administers four subject area exams over a one-week period. The four subjects are Real Analysis, Algebra, Topology and Differential Equations. Each exam is a three-hour written exam. These subject area exams together constitute the Ph.D. Entrance Exam (these are the same exams described in the M.S. Advanced Exam section). Each subject area exam taken by the student is graded, in terms of decreasing performance, as either Ph.D. level pass, M.S. level pass, or fail. For a student in the Ph.D. program, the Ph.D. Entrance Exam is passed by achieving a Ph.D. level pass in two subject areas.

Students entering the Ph.D. program must pass the Ph.D. Entrance Exam within two full academic years from when they first enroll. Specifically, a student first enrolling in the Ph.D. program in Year N must pass the Ph.D. Entrance Exam by the end of the Spring semester in Year N+2. Normally, to consider an extension of time to pass the Ph.D. Entrance Exam, the student will be expected to have obtained at least a Ph.D. pass in one subject area and an M.S. pass in another; to have taken advantage of prior opportunities to attempt the exams; to have strong academic record; and to have made reasonable progress in identifying a research area and thesis supervisor.

Ph.D. students that do not pass the Ph.D. Entrance Exam within the allowed period may be dismissed from the Ph.D. program. In this event they may be eligible for an M.S. degree based on their course work and exam outcomes or continue work toward an M.S. degree.

Policies and Time Limits for the Ph.D. Entrance Exam

A student may attempt any set of subject area exams each time they are administered (i.e. one subject area exam or up to four). A student may attempt a given subject area exam no more than three times. This is a cumulative overall limit that applies while the student is in any degree program. Thus, for instance, if a student attempts a subject area exam twice while in the M.S. program, they may attempt that subject area exam at most once more if they subsequently enter the Ph.D. program. Students remain in good standing in the program until they have exhausted all attempts. Graduate Assistants have additional expectations regarding the exams. Failure to meet these expectations may result in the withdrawal of their assistantship. Please see the section on Graduate Assistantships. Part-time students are expected to comply with the deadlines above. Extensions of the time in which to pass can be considered by the Graduate Programs Committee based on the particular circumstances involved, including the overall number of credits taken by the student.

Exam Schedule of Ph.D. Entrance Exam

The Ph.D. Entrance Exam is given in the second week of classes in Fall and again two weeks before the final exam week of the Spring term. Students must notify the Graduate Program Director of their intention in writing to take the exams a month before the exams are given, specifying the subject area(s) to be taken. The Graduate Program Director will request this information via email each term. The one-month advanced notification stated above may be waived by the Graduate Program Director.

Examining Committees

Each subject area exam has an examining committee consisting of two designated faculty members and the Graduate Program Director as a member ex-officio. Members will serve on the committee for a two-year period, with renewal possible. Members (including replacements for absent members) of each committee will be appointed by the Graduate Program Director in consultation with the Graduate Programs Committee. Each examining committee acts independently from each other examining committee in preparing and grading its exam. Grades are assigned to exam papers based on the judgment of the examiners and not on particular percentages. Instructors who regularly teach the related subject should be expected to serve on an examining committee in the field, if asked. Each examining committee is to report to the Graduate Program Director the outcome of each exam for each student within five working days upon the completion of the exams. Written notification from the Graduate Program Director concerning the decision of the examination committee is to be sent to the student within ten working days upon the completion of all the exams.

Content of Exams

Lists of topics for each subject area exam are to be made up by appropriate faculty (committees) and posted online. The lists are reviewed and updated approximately every five years. Faculty teaching the related courses are expected to cover a reasonable amount of the material listed. However, the exams are topic oriented, not course oriented and students should not assume that a given course sequence will cover exam content in its entirety. Therefore, samples of previous exams will be made available to students through the Department website and via email. Students are allowed to take the exams without taking the related courses at WVU.

Appeals and Exceptions

Students may speak with examiners, as available and agreeable, concerning their performance on a given subject area exam, and may review their answers. The exams themselves remain in the custody of the Department and are not returned to the students. Since the grade on an exam is a collective decision of the examiners, students will normally not see scores assigned by individual examiners. A student may appeal their grade to the Graduate Programs Committee. However, if the examiners concur in the assigned grade, the Graduate Programs Committee will usually defer to the examination committee's judgment unless there is strong evidence that the grade given is inconsistent with usual practice or is based on a mistake or a misreading of the solutions.

Exceptions to these policies may be considered by the Graduate Programs Committee on rare occasions, when warranted. Personal circumstances, including medical problems, accidents, hardships, etc. may play a role. However, the general outlook of the Graduate Programs Committee is that the allowed three attempts and the time period in which to pass the respective exams already build in substantial opportunity to overcome most individual difficulties. In considering exceptions, the Graduate Programs Committee will review not just the reasons for the exception, but also the student's academic and exam performance and their potential for success.

Degree Requirements – Courses (24 hours)

Please see [the catalog](#) for degree requirements for the Ph.D. in Mathematics.

Regular Ph.D. students are required to complete a minimum number of 54 graduate credit hours in Mathematics at the 500 level or above, with a minimum of 18 credits at the 700 level (excluding seminar and Math 797), with at least 12 from discrete mathematics, algebra, foundations, applied mathematics, and topology as described below. Students must complete a program that includes a minimum of eight graduate courses (exclusive of seminar and research requirements), subject to the catalog requirements.

Additional course requirements generally apply to Ph.D. students admitted provisionally. A student's program should be chosen in agreement with the Graduate Program Director and the student's dissertation advisor so as to meet the educational objectives of the program and the needs of the student's research area.

Students will choose a dissertation area from the options below, and coursework options will be based on this choice.

Group	Research Area
A	Discrete Mathematics, Algebra & Foundations
B	Analysis, Applied Mathematics & Topology
C	Research in Undergraduate Mathematics Education

For students whose dissertation area is represented by one of the subject areas in group *A*, four courses in this area must be taken at the 700-level. For students whose dissertation area is represented by one of the subject areas in group *B*, four courses in this area must be taken at the 700-level. For students whose dissertation area is Research in Undergraduate Mathematics Education (RUME, group *C*), they must take the four RUME courses: Math 631, Math 732, Math 733 and Math 734.

Besides the listed regular courses, relevant advanced courses offered under numbers Math 791 Advanced Topics or Math 793 Special Topics can usually be used for satisfying course requirements with the agreement of the Graduate Program Director and (if appointed) the dissertation advisor. On occasion, if sufficiently relevant courses are not offered in the student's research area concentration, Math 795 Independent Study can be approved by the Graduate Program Director with the agreement of the student's advisor.

In addition, for all students, two courses must be taken at the 700-level in each of groups A and B, as a way of ensuring a measure of breadth in mathematical background. The two courses should constitute a course sequence or be related so as to be two courses studying the same topic. These courses should not be from the same area as the dissertation research but may be chosen to support that work.

Course options in group A:

Course Topic	Course Numbers
Graph Theory	573 & 773
Set Theory and Applications	683 & 783
Number Theory	745 & 746
Modern Algebra	747 & 747*
Matroid Theory	771 & 772

* Math 747 may be repeated multiple times for credit

Course options in group B:

Course Topic	Course Numbers
Functional Analysis	751 & 752
Theory of Partial Differential Equations	757 & 758
Seminar in Topology	780*
Continuum Theory	781 & 782

* Math 780 may be repeated multiple times for credit

Courses in group C - RUME:

Course	Course Numbers
Introduction to RUME	631
Learning Theories	732
Advanced Learning Theories	733
Advanced Topics in RUME	734

Degree Requirements – Seminars and Research Hours (30 hours)

- a. Math 694, a one credit seminar course, covers software and technology useful for professionals in mathematics and is required for the Ph.D. degree. Each Ph.D. student must satisfactorily complete

this seminar, though students who completed it as part of their M.S. requirements will not be required to retake the seminar. The seminar is offered once per year. The goals of this seminar are to provide all graduate students with a working knowledge of professional tools for research, technical typesetting, presentation, and computation. (For example, using Math Reviews & Science Citation Index, internet resources, TeX-based typesetting/word processing, presentation software, Web publishing, MATLAB for computation and graphics, guidelines for mathematical/technical writing). Students who have already developed expertise in using one or more of the tools involved may, at the option of the instructor, arrange for an appropriate demonstration of that expertise in lieu of attendance at the corresponding lectures.

- b. Each Ph.D. student must take Math 696 Graduate Seminar for five semesters of one credit enrollment each. The goals of this seminar are to develop the ability in doctoral students to read mathematical literature in journal and books and provide supervised experience in assembling research background on a topic or subject and developing and delivering a presentation, and to expose graduate students to a broad range of subject areas within mathematics as reflected by the interests of their colleagues and faculty members.

Under the supervision of their dissertation supervisor (or another faculty member if the dissertation advisor has not yet been appointed) each doctoral student will be responsible for delivering *three one-period talks* during their program of study, as part of their enrollment in Math 696.

- i. One talk will be an expository talk in an area outside their main research interest (which could, for instance be based on material in a chapter of a book, or an article in a general interest journal such as the Monthly or the Intelligencer).
- ii. One talk will be a general expository talk on basic results within their research area. (Survey papers may provide a good base for assembling the information for this talk.)
- iii. One talk will be an advanced research talk in the area of their dissertation, which may contain their own work. (This talk may serve as the research prospectus presentation portion of the Ph.D. qualifying examination.)

If any talk is not considered satisfactory by the supervisor, an additional presentation must be made. These talks may, if appropriate, be part of an ongoing seminar within the department. A student may substitute a presentation (of at least 20 minutes) at a conference for one of the required talks. The required talks will be completed no later than the end of the 4th full academic year enrolled in the program.

Doctoral students will be expected to attend 5 mathematical presentations each semester they are enrolled in Math 696. These may include visiting colloquia, faculty presentations, and seminar talks, but at least half should be presentations by other doctoral students. A record of attendance should be maintained by the student and submitted to the Graduate Program Director at the end of the semester, for this purpose.

Special cases that require exceptions to the above, or questions of interpretation or procedure, will be resolved by the Graduate Program Director, consulting with the Graduate Programs Committee as suitable. Any such decisions may be appealed to the Graduate Programs Committee for final adjudication.

- c. Research hours. Ph.D. students must complete at least 24 hours of Math 797. These are research hours to be directed by a member of the graduate faculty, usually as part of a student's dissertation work.

Grade Point Average

Students in any of the degree programs are expected to remain in good standing and to meet standards of degree progress. To remain in good standing, and as a condition of satisfactory progress, students must earn a minimum overall GPA of 2.75, and of 3.00 in coursework applied to the Ph.D. program. Students making satisfactory progress are expected to complete their Ph.D. program within five years of full-time study, and decisions on the award and/or continuation of financial support include such expectations.

Committees

An initial advisory committee of three faculty is appointed to advise students in their program prior to the appointment of a dissertation advisor. Once a dissertation advisor has been identified, and the Ph.D. Entrance Exam has been passed, the Ph.D. committee can be appointed in place of the advisory committee. The committee will consist of five faculty members, of whom four, including the supervisor, must be Regular Members of the graduate faculty. One member must be external to the Department of Mathematics.

Ph.D. Qualifying/Comprehensive Examination

The purpose of the qualifying examination is to demonstrate that the student has acquired the background necessary to proceed on to research for the dissertation. The comprehensive examination consists of two parts for all students. The qualifying/comprehensive exam is considered to have been passed when both parts have been successfully completed. In some cases, a minor area examination may also be required. A student is officially advanced to doctoral candidacy upon successful completion of the Qualifying Exam.

- For students with research areas in discrete mathematics, algebra, foundations, analysis, applied mathematics, or topology, a 3-hour written exam is given in the student's research area, based on the corresponding course work and other specialized knowledge needed for the dissertation. For all students, the written examination should be primarily prepared by the dissertation supervisor, preferably in close collaboration with at least one other member of the committee. The written examination should be distributed to the committee members for review no later than one week before it is administered, with the student's answers distributed to the committee as soon as available.

Paired with the written exam is an oral exam, to be given within one week of the written exam and covering similar material. Each member of the committee will be invited to question the student. Questions may concern general topics from the major area or involve examination problems. Members of the graduate faculty, but not students, may attend the oral examination in an observing capacity. These exams are led by the dissertation supervisor in consultation with the student's committee.

Students whose research area is in RUME are assigned a written research project whose results are examined at an oral presentation. The oral defense is the same as for students with research areas in Group A or B.

- The second part of the comprehensive examination is the public presentation of the *dissertation prospectus*, followed by questioning by the student's committee. The purpose of this is to demonstrate that the student has mastered the relevant literature in his or her field, and has developed a clear, realizable and program-suitable research topic, along with a research plan to achieve the desired results. This presentation may be held in conjunction with the oral defense of the written exam (above). The student will provide the committee, no later than one week before the presentation, with a copy of the written prospectus. The prospectus should describe the proposed subject of the thesis with background information, along with preliminary results and proposed approaches, as available. The presentation should last approximately 30 minutes but may longer at the discretion of the committee. The presentation will be open to the department, and the audience may ask questions. Subsequent to the presentation, the committee will question the student, with only members of the graduate faculty allowed to be present in an observing capacity. Acceptance of the prospectus by the committee as part of the qualifying examination represents the judgment of the committee members.

After any part of the qualifying examination (including the written and oral examinations on the major area) the committee may meet and decide not to proceed further if the student's performance has not been satisfactory to that point. In such a case, the vote will be recorded on the signature page of the qualifying examination form and the decision outlined in the space provided, along with the committee's decision on the time and content of appropriate reexamination, if applicable.

Given that the qualifying examination proceeds to the prospectus presentation, the committee will meet alone after the questioning following the prospectus presentation to determine whether the student has passed the qualifying exam. Each member will vote *pass* or *fail* and the vote will be recorded on the signature page of the qualifying examination form. The student will be deemed to have passed the qualifying examination if all members, or all members but one, vote pass. If the overall vote is to pass the student, the committee may add minor conditions to be fulfilled by the student, as written on the signature page. In this case, the passing vote is not considered final, and the student is not considered to have passed the qualifying examination, until the conditions have been met and accepted via a signed memo from the committee. Students who are unable to meet these conditions set out by their committee will have one future attempt to pass their qualifying exam. After two unsuccessful attempts, students may be dismissed from the program.

Minor area examination:

In case a student fails to achieve a 3.5 GPA overall in one or both of their elective sequences (one in group A, one in group B), a written examination will be prepared in the corresponding elective courses, which the student must pass in the judgement of the committee.

V. Advising and Evaluation

All first-year students attend orientation meetings during the week before classes begin in the fall. The graduate curriculum and assistantship assignments are discussed and explained by the Graduate Program Director, Department Chair, Graduate Teaching Assistant Coordinator, course coordinators and lead instructors, and administrative staff. Therefore, new students must arrive in Morgantown in time to attend this orientation. Graduate assistants will receive their office space, mailbox keys, and learn the location of necessary supplies to do their jobs. New M.S. students will also take the M.S. Basic Exam during this time. Students register for courses and complete a number of online training modules prior to arriving in Morgantown.

Students will remain in contact with the Graduate Program Director and their faculty advisors throughout the duration of their time in the graduate program. Each year, the Graduate Program Director will provide a letter of evaluation detailing progress in their program. Students are encouraged to request additional evaluations throughout the year if they are unsure of their progress in their degree program. Students who earn probationary status (not maintaining satisfactory GPA, not earning required grades, etc.) will be evaluated at the end of each semester to ensure they are aware of the conditions needed to rectify the situation. Students unable to rectify their situation may be dismissed from the program.

All graduate students at the university are required to adhere to time limits as set by the university.

Information can be found in the WVU catalog here

http://catalog.wvu.edu/graduate/advisingcoursesdegrees/degree_regulations/#timelimitstext

VI. Professional Standards and Behavior

Graduate students in the Department of Mathematics are expected to adhere to the following standards of behavior throughout their time in the program. This code governs student behavior in classrooms, research endeavors, academic and professional gatherings and travel, and in their daily conduct outside of the University. In addition to the code outlined below, all students will uphold the WVU Student Conduct and Discipline Policy. This code can be found at: <https://studentconduct.wvu.edu/campus-student-code>

a. Academic Integrity

Students will:

- Not plagiarize the work of others
- Not cheat on any examinations, on academic assignments and activities, and will not provide unauthorized help to others during an examination or graded academic assignment
- Adhere to University policies on academic integrity
<http://catalog.wvu.edu/graduate/enrollmentandregistration/#academicdishonestytext>

b. Scientific and Departmental Citizenship

Students will:

- Strive to provide timely, efficient and high-quality work
- Check email communications daily and respond to those from their faculty advisors, department administrators and any other supervisors with whom they work. For those with paid research and teaching responsibilities, it is crucial that you are in frequent contact with your supervisors to ensure that our research and teaching efforts are well executed.
- Attend and actively participate in departmental seminars, colloquia and presentations
- Treat all individuals in a caring, respectful, professional, and empathetic manner
- Function as an effective and respectful team member in the performance of collaborative research
- Strive to always acknowledge the contributions of their co-workers
- Be attentive in presentations by their colleagues and Departmental visitors
- Assist faculty and Department personnel in hosting local events to showcase the work of the Department of Mathematics
- Adhere to the guidelines above when traveling on behalf of the Department to conferences and meetings

VII. Considerations for Graduate Assistants

The awarding of a graduate assistantship, as well as other forms of departmental financial aid, is based upon a meritorious record, as reflected in the student's application and/or performance as a graduate student in the Mathematics Department as well as on availability of resources. Renewal of such rewards carries an expectation of continued meritorious academic performance in the program that exceeds the minimum or standard requirements. Besides meeting the requirements of good standing and satisfactory progress as described above and elsewhere in this document, reappointment as a Graduate Assistant includes the following expectations:

- Graduate assistants must maintain full-time enrollment
- Graduate assistants will receive at least a B in any courses designated as required prerequisites or taken to remedy a deficiency.
- Graduate assistants in the M.S. program and Ph.D. students in their first two years are generally expected to enroll for three courses each semester, exclusive of one-credit seminar requirements. During this period Ph.D. students with designated advisors may enroll for three credits of research with permission of their advisor and the Graduate Program Director.
- Graduate assistants must meet the criteria for good standing and satisfactory degree progress.
- Graduate assistants proceeding to the Ph.D. program from the M.S. program are expected to have completed their M.S. program requirements prior to starting the Ph.D. program and to pass the Ph.D. Entrance Examination no later than the second time the exams are given after their initial enrollment as Ph.D. students.
- While subject area exams maybe attempted up to three times, graduate assistants are expected to require no more than two attempts at any one subject area exam.
- Departmental support as a graduate assistant will be provided to M.S. students for a maximum of two years, and for Ph.D. students, a maximum of five years. This assumes that the student maintains associated expectations, remains in good standing, and is making and has made, satisfactory progress. Any extension must be approved by the Graduate Programs Committee.
- Graduate Teaching assistants enroll each semester for one-credit of Math 590, Teaching Practicum. Unsatisfactory performance in the course, which reflects assigned duties and participation as expected in the Teaching Seminar, may result in withdrawal of the assistantship.

Note: Graduate Service Assistantships are available for advanced Ph.D. students unable to receive funding as GTAs due to English Language proficiency requirements on a semester-by-semester basis, to be reevaluated each semester.

Note: Graduate Research Assistantships are in most cases based on external funding provided to a faculty member through a grant. In such cases the research assistantship supervisor will set standards for continuation, but not less than those for good standing and satisfactory progress.

VIII. Miscellaneous Issues

Leaves of Absence

Students requesting a leave of absence must meet with the Graduate Program Director to discuss this, and then work with the Eberly College staff and appropriate University offices (e.g. Registrar's office, the Office of International Students and Scholars, etc.) to ensure all appropriate procedures are followed to best ensure the success of the student and continuation of their status in the program. Please direct any questions about Leaves to the Graduate Program Director.

Professional Development Opportunities

Students are encouraged to pursue professional development opportunities both on and off campus. Within the Department, there are many seminars, colloquia and presentations provided by visitors, faculty and fellow graduate students. In addition, there are active student organizations (Association of Women in Mathematics Student Chapter, Actuarial Science Club, Math Club) whose information can be found on the Departmental website. Occasionally there are also various activities led by faculty members on the academic job search, mathematics study sessions, proposal writing workshops, etc. On campus, the WVU Office of Graduate Education and Life often provides opportunities specifically for graduate students (<https://graduateeducation.wvu.edu/>), the WVU Teaching & Learning Commons offers many opportunities for teaching development (<https://tlcommons.wvu.edu/>), etc. Students should participate in these activities throughout the duration of their time in the program. Some of these opportunities may be highlighted in the graduate student's CV.

In addition to occasional opportunities, for students who plan to pursue teaching as some part of their future, they may also enroll in the WVU Certificate in University Teaching (<https://tlcommons.wvu.edu/programs-services/certificate-in-university-teaching>)

University Support Services

The University provides a variety of services for students. The most comprehensive resource for learning about these services (as well as a great deal of other useful information) is the WVU A-Z Site Index link at <http://www.wvu.edu/>. The webpage of the Office of Graduate Education and Life (<http://grad.wvu.edu>) includes a brief description of some of these services; a sample of just a few of the university services available to students is described below.

Living in Morgantown

There are many strategies students can use to find housing. Perhaps the most useful strategy is to contact current graduate students for advice and information. Current students often know of apartments that will be available due to graduation of other students within the program. Other resources for finding housing include the classified ads for houses or apartments for rent. These are listed on the web sites for the University newspaper, the Daily Athenaeum <http://www.thedaonline.com/> and the Morgantown newspaper, the Dominion Post <http://dominionpost.com/>. The WVU Off-Campus Housing Office also maintains current listings of housing available in Morgantown. Visit them at the front desk of Elizabeth

Moore Hall or at their web site: <http://www.wvu.edu/~studlife/>. Students with pets will find locating housing more difficult.

Students looking for a roommate to help keep costs down might contact people on the list of incoming graduate students and make arrangements to have one or both of you come to Morgantown early to find housing. In any case, it is advisable to begin looking for an apartment not later than two months before orientation. Many incoming students visit Morgantown to find a place to live as early as the spring before classes start, for example, while they are on spring break at their undergraduate institution.

Parking: Parking on or near campus is very difficult. Some private parking spaces are listed for rental every so often in the newspaper. Most students do not drive their cars to class. Rather, they walk, ride bikes, use the PRT, or use buses. Morgantown buses are free for students. Remember this problem when looking for an apartment. The Mountainlair has a parking garage but early arrival (usually before 8:00 a.m.) is needed to get a space, and parking in these places is moderately expensive. More information on parking can be found at: <http://transportation.wvu.edu/parking>.