MATHEMATICS, PHD

Senior Undergraduate students majoring in mathematics or other sciences with a strong interest in mathematics, and people who already hold undergraduate degrees in mathematics or other sciences, are encouraged to apply for admission to PhD program in Mathematics. Faculty in the Mathematics Department have active research in areas of Algebra, Domain Theory and Theoretical Computer Science, Geometry and Topology, Symbolic Analysis, Applied Mathematics and Partial Differential Equations, Computational Mathematics, Mathematical Biology, Probability and Statistics.

Requirements

Below is a brief outline of the requirements and further explanation of each step.

1. Complete at least 48 hours of coursework-up to two courses may be taken in another department with the approval of the Graduate Studies Committee. For advanced incoming students, limited transfer credit (http://www2.tulane.edu/sse/math/academics/undergraduates/transfer-credit.cfm) is possible.
2. Pass the Placement Exam in linear algebra and advanced calculus. It will be taken at the beginning of the fall semester (the student's first semester). If a student fails to achieve A- in the linear algebra portion, he or she will be required to enroll in MATH 3090 Linear Algebra (4 c.h.)/MATH 6090 Linear Algebra (3 c.h.). If the student fails to achieve A- in the advanced calculus portion, he or she will be required to enroll in MATH 4060 Real Analysis II (3 c.h.)/MATH 6060 Real Analysis II (3 c.h.). Read the *Placement Exam syllabus* for details and previous exams.
3. Pass qualifying written exams Analysis (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/analysis.cfm) and two others chosen from among: Algebra (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/algebra.cfm), Analysis (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/analysis.cfm), Applied Mathematics (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/applied-mathematics.cfm), Differential Geometry (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/differential-geometry.cfm), Probability and Statistics (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/probability-statistics.cfm), PDE (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/pde.cfm), Scientific Computation (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/scientific-computation.cfm), and Topology (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/topology.cfm). Read the exam syllabi for qualifying exams (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/)
4. Pass an oral exam on specific topics of research interest to the student.
5. Write a dissertation.

Credit Hours

The Ph.D. program requires students to complete at least 48 credits. This is equivalent to 16 courses (math courses are 3 credits each). All 7000-level courses may count toward the Ph.D. degree. Students in need of remediation, for example whose undergraduate major was not mathematics, may be advised by the Graduate Coordinator to take some undergraduate courses as 6000-level, but these cannot count toward the Ph.D. degree. Exceptions are 6210 (Differential Geometry) and 6300 (Complex Analysis). These two can be taken for Ph.D. credit if the Graduate Coordinator approves.

It is not enough for a student to complete 48 credits to satisfy this requirement. The credits must be approved by the Graduate Coordinator and must be taken in such a way that they represent breadth and depth.

Owing to these concerns, It is important that the student work closely with the Graduate Coordinator in order to formulate a sequence of courses that will satisfy the coursework requirement. This is done on an individual basis. A student who does not consult with the Graduate Coordinator may find that not all classes taken count toward the degree.

Up to two courses may be taken in other departments when approved by the Graduate Studies Committee. At most two reading courses in total can be counted toward the required 48 credit hours.

In addition, the transfer of up to 9 credits from another graduate program is possible with the approval of the Graduate Studies Committee. Read more about transfer credit »

Placement Exam

This is a 4-hour exam on topics from undergraduate courses on Linear Algebra & Vector Calculus.

This exam is generally offered during the first week of each semester. A sign-up sheet is available in the math office near the end of the preceding semester.

Every first-year PhD student has to take the placement exam prior to his/her first semester at Tulane.

The topics covered in the Preliminary Exam are:

Linear Algebra

- vector spaces
- inner products
- linear transformations
- linear equations
- matrix operations
- determinants
- characteristic equation
- eigenvalues and eigenvectors
- symmetric, skew-symmetric matrices
- hermitian, skew-hermitian matrices
- Jordan canonical form
- spectral theorem

Vector Calculus

- limits in Rn
- partial derivatives
- differentiable functions of several variables
- optimization of functions in Rn (with and without constraints)
- the implicit function theorem
- the inverse function theorem
- Taylor's theorem
- integration in several variables
- line integrals
- the theorems of Green, Gauss and Stokes

References you may want to study:

1. *Linear Algebra, Mathematica Labs* by Terry Lawson
2. *Linear Algebra and Its Applications*, 3rd ed., by Gilbert Strang
3. Almost any textbook with Linear Algebra in its title
4. *Calculus* by Boyce and DiPrima
5. Almost any textbook with Advanced Calculus in its title

Qualifying Exams

These are comprehensive written exams. The student must pass three exams one in Analysis and two others chosen from among:

- Algebra (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/algebra.cfm)
- Analysis (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/analysis.cfm)
- Applied Mathematics (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/applied-mathematics.cfm)
- Differential Geometry (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/differential-geometry.cfm)
- Probability and Statistics (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/probability-statistics.cfm)
- PDE (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/pde.cfm)
- Scientific Computation (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/scientific-computation.cfm)
- Topology (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/topology.cfm)

The topics of each exam are based on the corresponding first-year graduate course sequence. For example, the Analysis exam covers roughly the material in MATH 7210 Analysis I (3 c.h.)-MATH 7220 Analysis II (3 c.h.). Read the Qualifying exam syllabi (http://www2.tulane.edu/sse/math/academics/graduate/qualifying-exams/)

Qualifying exams are offered the first week of each semester. A sign-up sheet is available in the math office near the end of the spring semester for the following semester's exams.

Students do not have to take all three exams at the same time; however, they should complete all three exams by the beginning of the third year in the Ph.D. program.

Oral Exam

After a Ph.D. student has passed the Preliminary exam and three Qualifying exams, the student should:

- decide on the area of mathematics in which he/she would like to write a dissertation (and)
- choose an advisor in this area

The advisor and the student will decide on a reading list and topics for the oral exam.

The exam usually lasts one to two hours and consists of a committee of 5 faculty who ask questions from the list of topics.

The student and the advisor must choose the committee and set the date of the exam. This information must be communicated to the Graduate Coordinator prior to the exam for approval by the Graduate Studies Committee.

It is not necessary that the student complete all coursework before taking the oral exam.

Prospectus

SSE requires a written prospectus. The Mathematics Department requires in addition that the student gives an oral presentation of the prospectus to the committee. Students are encouraged to write a 4-8-page double-spaced prospectus and prepare a 40-minute presentation for the dissertation committee followed by discussion and questions. A suggested format is:
1. Cover sheet: should state the student's name, department/program, the title of the proposed dissertation, and the name of the chair and the other members of the committee.
2. Introduction: a summary of earlier work on the problem, including a substantial number of references.
3. Statement of the dissertation problem: containing the goal of the thesis, possible sub-problems, and their importance in the global view of the field.
4. Investigation plan: containing an orderly description of the major steps of the investigation that will accomplish the goal of the thesis. This is the plan you propose to follow in order to accomplish the goal and the committee should be convinced that the plan is likely to be successful.
5. Expected results: This section should include expected (partial) results of each major step of the investigation plan.
6. References: Major sources of information should be indicated, and a selective bibliography included.

The prospectus should be submitted to the Dean's Graduate Programs office along with a signed copy of the prospectus approval form.

Dissertation

The dissertation must contain original work by the student and demonstrate the student's ability to carry on independent research that results in a genuine contribution to the field. The student must work closely with his/her advisor in order to have a clear vision of what is required of the dissertation.

The student's dissertation committee must sign the dissertation to accept it before it can be submitted to the SSE (http://tulane.edu/sse/).

The student must also give a presentation of the research in the dissertation as an oral defense.

Please contact the Graduate Coordinator if you have additional questions:
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