Requirements and Guidelines
for the Ph.D. in Mathematics
Boston College

The requirements for the Ph.D. fall into five categories:

1. Residency,
2. Coursework,
3. Exams,
4. Teaching,
5. Dissertation.

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1. RESIDENCY

A student must be in residence in the Mathematics Department at Boston College for at least two consecutive semesters of one academic year with full-time registration. Full-time is at least 2 courses per semester. This is a Boston College GSA&S regulation.

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2. COURSEWORK

Students must complete at least 50 credit hours at the graduate level, including all courses in Year 1 in the table below, and receive a grade of B- or higher in at least 44 of these. Typically, students will take 6,4,4 three-credit courses in years 1,2,3, respectively. Additionally, students must take a one-credit teaching seminar in the fall of years 1 and 2 and a one-credit research seminar in the spring of year 1.

Students with prior graduate-level course experience may be exempted from up to 18 credit hours of coursework, including one or more of the first-year graduate courses, upon approval of the Graduate Vice Chair.

A typical course schedule:

Year	Fall	Spring
1	Math 8810 Real Analysis Math 8806 Algebra I Math 8808 Geometry/Topology I Math 8890 Teaching Seminar (1 credit)	Math 8811 Complex Analysis Math 8807 Algebra II Math 8809 Geometry/Topology II Math 8892 Research Seminar (1 credit)
2	2 courses in the range Math 8820-8865 Math 8891 Teaching Seminar (1 credit)	2 courses in the range Math 8820-8865
3	2 courses in the range Math 8820-8865	2 courses in the range Math 8820-8865

4	1 course in the range Math 8820-8899	1 course in the range Math 8820-8899
5	1 course in the range Math 8820-8899	1 course in the range Math 8820-8899

Course descriptions

Core graduate courses:

- **Math 8806-8807 Algebra I, II:** Group theory, ring theory, modules and vector spaces, algebraic number theory, commutative algebra, algebraic geometry and homological algebra.
- **Math 8808-8809 Geometry-Topology I, II:** Point-set topology, fundamental group and covering spaces, smooth manifolds, smooth maps, partitions of unity, tangent and general vector bundles, (co)homology, tensors, differential forms, integration and Stokes' theorem, de Rham cohomology.
- **Math 8810 Real Analysis:** Measure theory, functional analysis and possibly topics from Fourier analysis or probability.
- **Math 8811 Complex Analysis:** Local and global theory of analytic functions of one variable.

Advanced graduate courses:

- **Math 8820 Introduction to Representation Theory:** Representation theory of finite groups, Lie groups and Lie algebras, root systems, the Peter-Weyl theorem, highest weight theory.
- **Math 8821-22 Number Theory I, II:** Sample topics: class field theory, elliptic curves and abelian varieties, arithmetic geometry, modular forms and their applications, L-functions and automorphic forms, representations of p-adic groups, Shimura varieties, analytic number theory.
- **Math 8831-8832 Geometry-Topology III, IV:** Possible topics include: differential geometry, hyperbolic geometry, three dimensional manifolds, knot theory.
- **Math 8845 Topics in Algebra and Number Theory**
- **Math 8855 Topics in Geometry and Topology**
- **Math 8865 Topics in Algebraic Geometry**

Additional courses offered on an occasional basis:

- **Advanced graduate topics courses in dynamical systems, machine learning**

Professional formation courses:

- **Math 8892 Graduate Research Seminar:** The research seminar introduces first year graduate students to active areas of research represented in the department.
- **Math 8890 Graduate Teaching Seminar I:**

The first year teaching seminar is for teaching assistants, covering their responsibilities both to their students and their supervisors, and providing guidance on leading a classroom for the first time.

- **Math 8891 Graduate Teaching Seminar II:** The second year teaching seminar is for teaching fellows, providing guidance on teaching one's own class.

Notes:

1. Math 8820, 8821, 8822, 8831, and 8832 are courses suitable for graduate students who have a solid grasp of the material covered in the relevant core graduate courses (Math 8806-8811); courses numbered 8845 and above may require more advanced background knowledge.
2. Since topics in the courses 8820-8865 vary from year to year, these courses may be repeated for credit with the permission of the Graduate Vice Chair.

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3. EXAMS

The PhD program includes three types of exams, which are discussed below.

1. Preliminary Exams,
2. Doctoral Comprehensive Exam, and
3. Doctoral Dissertation Defense.

1. Preliminary Exams: All students must pass preliminary exams in two of the three following subjects: i) Analysis, ii) Algebra, and iii) Geometry and Topology.

Exam Contents and Schedule: These exams cover the material in the core first year graduate courses. They are offered twice a year, early in the fall semester (late September) and at the end of the spring semester (mid-late May).

Note: The preliminary exam in Analysis consists of both a Real Analysis part and a Complex Analysis part. Both parts must be taken at the same time and a single grade will be assigned to the entire exam.

Program Requirements: Preliminary exams are graded as follows: Ph.D. pass, M.A. pass, Fail. Students are strongly encouraged to complete two preliminary examinations at the Ph.D. pass level by the start of their second year, and must pass two preliminary examinations at the Ph.D. level by the end of their second year in order to continue in the program. Students may re-take each preliminary exam once.

Entering students: Entering students may take one or more of the preliminary examinations in the fall of their first semester without counting this as one of their two attempts. Entering students who wish to take a preliminary examination in the fall of their first year must notify the Graduate Vice Chair in writing by mid-July.

2. Doctoral Comprehensive Exam:

Schedule: Prior to taking the comprehensive exam, a student must i) pass two preliminary exams at the Ph.D. level, ii) secure the agreement of a faculty member to serve as their PhD advisor, and iii) formally constitute a Comprehensive Examination Committee.

The doctoral comprehensive exam should be completed no later than the end of the student's third year.

Comprehensive Exam Committee: A comprehensive exam committee consists of the PhD advisor and two other members. It is expected that the faculty advisor and dissertation committee are BC Math Department ladder-rank faculty; any exceptions to this require the approval of the Chair and Graduate Vice Chair. Committee composition is subject to the approval of the Graduate Vice Chair.

Exam Contents: The purpose of the comprehensive exam is to demonstrate mastery in one or more areas of specialization in mathematics, in which the student will ultimately do original research. The topics of the doctoral comprehensive exam will be selected by the student's PhD advisor, in consultation with the student's Comprehensive Exam Committee; typically these are based on topics or independent study courses completed by the student in the second and third years. The comprehensive exam is an oral exam and may, at the discretion of the PhD advisor and exam committee, also include a written component.

Program Requirements: The Comprehensive Exam Committee grades the entire comprehensive exam as Pass with Distinction, Pass, or Fail. A student who fails the comprehensive exam may take it one additional time, but not sooner than the following semester.

3. Doctoral Dissertation Defense:
The doctoral dissertation defense is an oral exam, held publicly and evaluated by the student's Dissertation Committee, at which the student presents their dissertation. See the Dissertation section for more information.

Exceptions to exam policies: Any exceptions to the requirements above pertaining to the preliminary exams, comprehensive exam, or doctoral dissertation defense require the approval of the Chair, who will consult the Graduate Vice Chair and the student's instructors before arriving at a decision. Exceptions may be granted when there is clear evidence of potential to complete a degree in a timely way, or for special circumstances such as extended illness.

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4. TEACHING

Graduate Students typically earn stipends by working as a Teaching Assistant (TA) or Teaching Fellow (TF). Teaching assignments for graduate students are decided by the Chair, the Vice

Chair for Graduate Studies, and the Vice Chair for Undergraduate studies, with input from other faculty members. A TA is an assistant to the primary instructor of a course. TAs perform a range of duties that vary from course to course; these duties often include leading recitation sections, holding office hours, and grading student work. A TF is the primary instructor of a course.

Math 8890, Graduate Teaching Seminar I, is for first year graduate students. It covers the responsibilities of TAs to their students and supervisors, and provides guidance on leading a classroom for the first time. Math 8891, Graduate Teaching Seminar II, is for second year graduate students and provides guidance for TFs on how to teach one's own class.

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5. DISSERTATION

Upon passing the Doctoral Comprehensive Examination, the student is eligible to be admitted to candidacy for the Ph.D. To be admitted, the student formally constitutes a Dissertation Committee, which is then approved by the Graduate Vice Chair. Typically, the Comprehensive Examination Committee will become the student's Dissertation Committee. Any changes to the membership of the Dissertation Committee require the department's approval. At this point the student begins research for the doctoral dissertation.

The dissertation must consist of original scholarly work. The Dissertation Committee will read and evaluate the completed dissertation and conduct an oral examination, at which the dissertation is defended in a public meeting. The dissertation is accepted when endorsed on the official title page by the Dissertation Committee after the oral examination. After ensuring that the format of the accepted dissertation conforms to Boston College requirements, the student submits the dissertation to the University.

M.A. Degree

Students enrolled in the Ph.D. program who receive at least an M.A. pass in two of the three preliminary exams and pass at least 30 credits of math graduate courses, including at least five semesters of the first-year graduate courses in Real and Complex Analysis, Algebra and Topology, can apply to receive an M.A. degree. Advanced undergraduate courses may count towards the 30 credits in meeting the M.A. requirement with the permission of the Graduate Vice Chair. Students who skip a first-year course because of advanced preparation may substitute more advanced courses in any area, with the permission of the Graduate Vice Chair. A student may receive an M.A. and continue on to a Ph.D. provided the student meets the Ph.D. requirements above.