

DOCTOR OF PHILOSOPHY IN MATHEMATICS

The Mathematics and Computer Science department's doctoral studies emphasize pure mathematics and theoretical computer science. The close interaction between the computer science faculty and the mathematics faculty—particularly those in logic and discrete mathematics—is a distinctive feature of the department. Students enrolled in the program enjoy small classes and build close connections with faculty and fellow graduate students.

The Doctor of Philosophy in Mathematics degree demands a breadth of knowledge, an intense specialization in one field, a substantial original contribution to the field of specialization, and a high degree of expository skill. Possible fields of specialization for PhD candidates include algebraic geometry, analysis of algorithms, arithmetic geometry, arithmetic theory of quadratic forms, combinatorics, complex analysis, computational logic, dynamical systems, enumerative combinatorics, ergodic theory, geometric group theory, graph theory, higher-order languages, homogeneous dynamics, homotopy type theory, hyperbolic geometry, information security, knot theory, logic programming, mathematical logic, metric geometry, model theory, network and data science, non-Euclidean geometry, number theory, probability theory, proof theory, and topological dynamics.

At least 16 one-semester courses are required for the PhD degree, and graduate students are expected to attend departmental colloquia and the regular seminars. Five years are usually needed to complete all requirements for the PhD, and two years of residence are required. Proficiency sufficient for reading the mathematical literature in French, German, or Russian is required. Every PhD student in satisfactory academic standing is supported by an annual stipend. Most students work as teaching assistants to faculty members for 10 hours a week during the Fall and Spring semesters, but a student who has passed all written preliminary examinations may teach up to one course a year as a lecturer under the guidance of a faculty member. The PhD dissertation is written under the mentorship of a faculty advisor. It must contain a substantial original contribution to the candidate's field of specialization and meet the quality standards of the current research journals in mathematics.

COURSES

At least 16 one-semester courses are required for the PhD degree. Several of the courses are to be in the student's field of specialization, but at least three one-semester courses are to be taken in each of the three areas: algebra, analysis, and topology. First-year students are expected to take the three two-semester sequences in these areas. However, students interested in computer science may replace coursework in one of these areas with coursework in computer science, with the permission of the departmental Graduate Education Committee.

LANGUAGE REQUIREMENT

Students must pass reading examinations in either French, German, or Russian. It is strongly recommended that PhD candidates have or acquire a knowledge sufficient for reading the mathematical literature in all three of these languages. Knowledge of one of these three languages is required.

PROGRESS AND QUALIFYING EXAMS

General preliminary examinations. The general preliminary examinations occur in the summer after the student's first year of graduate study and cover algebra, analysis, and topology (or computer science, in the case of students including this option among their three first-year subjects).

Special preliminary examination. For a graduate student to become an official PhD candidate as recognized by the department, the student has to pass the Special Preliminary Examination, an oral examination that must be passed by the end of the student's third year of graduate work. The student's Examination Committee determines the subject matter content of the Special Preliminary Examination. This committee is chaired by the student's dissertation advisor and must include at least two additional faculty members of the department. The Special Preliminary Examination will be based primarily, but perhaps not exclusively, on the student's field or specialization. Specific details of the form and content of the examination shall be determined by the Examination Committee at the time the subject matter content is discussed.

TEACHING

Most students work as teaching assistants beginning in the first year of study. After passing the general preliminary examinations, most PhD candidates teach one course per year (typically of 20 students, supervised by senior faculty) working as teaching assistants in the remaining semester.

DISSERTATION AND DEFENSE

- **Dissertation.** The dissertation, to be written by the PhD candidate under the counsel and encouragement of the thesis advisor, must contain a substantial original contribution to the field of specialization of the candidate and must meet standards of quality as exemplified by the current research journals in mathematics.
- **Selection of dissertation advisor.** A graduate student should select a dissertation advisor by the end of the student's second year of graduate work.
- **Defense of dissertation.** The final examination is an oral presentation of the dissertation in which the candidate is to exhibit an expert command of the thesis and related topics and a high degree of expository skill.