SPECIAL REPORT

OF THE

GRADUATE COUNCIL

concerning a

REVISION OF THE MATHEMATICS Ph.D. PROGRAM (#4949)

Presented at the
785th Regular Meeting of the Faculty Senate
March 7, 2019

COUNCIL MEMBERSHIP

GRADUATE COUNCIL

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GRADUATE COUNCIL RECOMMENDATION

The Graduate Council recommends approval of this proposal.

Please describe your proposal

This proposal is a significant reworking of the Mathematics Ph.D. program's exam and course requirements. The primary goal is to have a system which better reflects the department's priorities and which better prepares the students for the transition to research.

Please describe the existing program requirements, listing all required courses and available electives, as well as any additional requirements, and continuation or admissions policies.

36 credits of graduate coursework in mathematics and related areas, including three of the following five course sequences (Math 611-612, 623-624, 645-731, 671-703, Stat 607-608) and the first semester of the remaining two, as well as Math 621.

The student must pass three written basic exams (Advanced Calculus/Linear Algebra plus any two of Complex Analysis, Numerics, Probability, Topology) by the beginning of their fourth semester and two written advanced exams (from Algebra, Analysis, Differential Equations, Geometry) by the beginning of their sixth semester. Exams are offered twice a year in August and January.

Math 611-612: Algebra
Math 623-624: Analysis
Math 645: Ordinary differential equations
Math 731: Partial differential equations
Math 671: Topology
Math 703: Differential geometry
Stat 607-608: Statistics
Math 621: Complex Analysis

The student must write a satisfactory dissertation and pass a final oral examination (primarily a defense of the dissertation), and must satisfy all other requirements of his or her dissertation committee. The student is required to register for a minimum of 18 dissertation credits.

Please describe the requirements that you are proposing, listing course requirements, elective options, as well as any additional requirements, and continuation or admissions policies.

36 credits of graduate coursework in mathematics and related areas, including three of the six course sequences (Math 605-606, 611-612, 623-624, 645-646, 671-672, Stat 607-608) and Math 621. The student must also take at least one course in pure mathematics (Math 611, 623, 671), one course in applied mathematics (Math 645, 646, 651) and one course in probability and statistics (Math 605, 606, Stat 607).

The student must pass three written qualifying exams (Advanced Calculus/Linear Algebra and any two taken from the six course sequences above: Probability, Algebra, Analysis, Applied Mathematics, Topology, Statistics) by the beginning of their fourth semester. Exams will be given twice a year in August and January, with Advanced Calculus/Linear Algebra offered a third time in May.

Students must pass an oral exam by the mid-semester date of their sixth semester. The oral exam will be governed by the following rules:

(1) By the end of a student's fourth semester, they must name a three person exam committee of faculty in the department. One member will be designated as the chair.
(2) The student and the committee will draw up a list of topics for the exam.
(a) The list should be roughly equivalent to 6 credits worth of material selected from 9 credits worth of courses.
(i) Typically the 9 credits will break down as 3 credits from a second year course, 3 from a reading course with a member of the committee and 3 from either source.

(ii) The topic list will then be further refined to reflect approximately 2/3 of the material from each course.
(b) The committee member(s) responsible for second year course material need not be the actual instructor of the course which the student took, although they should be qualified to teach it.
(c) The topic list must be approved by the GPD.
(3) The exam may be scheduled by the student at any time after the relevant courses have been completed and at least one month after approval of the topic list by the GPD.
(4) The exam may be a combination of a presentation by the student and questions from the committee, with the presentation portion not to exceed half of the time of the exam; or it may consist entirely of questions.
(5) The exam length will be between one to two hours depending on the judgment of the committee.
(6) The committee will decide after the exam on a recommendation to the GAC. A passing recommendation must be a unanimous decision of the committee.
(a) The chair of the committee should promptly submit a short (approximately one page) review of the exam to the GAC explaining the recommendation.
(b) The GAC will determine whether or not to accept the recommendation of the committee. The GAC retains the ultimate authority to determine the results of the exam but expects to override the committee's recommendation only in unusual circumstances.
(c) The GPD will notify the student of the final decision.
(7) The exam must be passed by the mid-semester date in the student's sixth semester. It may be taken at most twice.

Math 605-606: Probability
Math 611-612: Algebra
Math 623-624: Analysis
Math 645-646: Ordinary differential equations and Introduction to Applied Mathematics
Math 671-672: Topology and Algebraic Topology
Stat 607-608: Statistics
Math 621: Complex Analysis

The student must write a satisfactory dissertation and pass a final oral examination (primarily a defense of the dissertation), and must satisfy all other requirements of his or her dissertation committee. The student is required to register for a minimum of 18 dissertation credits.

Please provide the rationale for these revisions.

The new system is primarily designed to provide a more natural progression for the students, leading from coursework to reading courses and specialization to research, while also better reflecting the department's research groups. In the new system, a typical student will progress as follows:

First year: Focused on course work (primarily the course sequences listed above which are closest to their interests), plus the Advanced Calculus/Linear Algebra exam. The primary goal of this year is a solid grounding in the fundamental material in areas related to the student's interests.

Second year: Advanced coursework together with reading courses. During this year the student begins to specialize and works more closely with faculty. The student must also pass their two qualifying exams this year based on the courses taken the previous year.
By the late spring the student should be forming an oral exam committee.

Third year: Remaining coursework and more specialized reading courses. The student will be spending a significant amount of time preparing for the oral exam, which should be taken for the first time no later than January.

In the current system, there can be more than a year separation between completion of courses and having to take the corresponding exam. In addition, the distinction between the basic and advanced exams has become minimal over time, resulting in a very long time spent passing exams. The two discontinued advanced exams (Differential Equations and Geometry) were taken by only a handful of students are being replaced with more natural topics (Applied Mathematics and Topology) that better reflect the modern priorities of the department.

Although the oral exam does indeed serve as a final requirement for candidacy, pedagogically the primary purpose is to give the student a chance to work with multiple faculty in their area of interest and figure out which is best suited to serve as their advisor. In most cases we expect that immediately following the oral exam the student will select the chair of the committee as their advisor, but there is no requirement to that effect.

Note that the old course requirement of taking the first course in each sequence was a breadth requirement and has been replaced by the requirement to take one course in each of the department's three broad areas.

If this proposal requires no additional resources, say so and briefly explain why. If this proposal requires additional resources, explain how they will be paid for. For proposals involving instruction, indicate how many new enrollments are expected and whether the courses have room to accommodate them.

This proposal involves only changing requirements to existing courses and thus requires no new resources. Note that several of the courses in the new requirements are still in the approval process and are being offered on a temporary basis until they are approved.

MOTION: 19-19 **That the Faculty Senate approve the Revision of the Mathematics Ph.D. Program, as presented in Sen. Doc. No. 19-052.**