The University of British Columbia

# Institute of Applied Mathematics

# Graduate Student Handbook

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# INTRODUCTION

This handbook provides a brief guide to graduate studies in the Institute of Applied Mathematics. It outlines administrative procedures, Masters and Ph.D. program requirements, and the Institute's policies regarding the use of its resources.

# ADMINISTRATIVE PROCEDURES

The Institute of Applied Mathematics (IAM) provides an administrative structure to arrange graduate program of an interdisciplinary nature for students with an interest in both mathematics and another field. Examples of IAM program are graduate studies in Mathematical Finance, Mathematical Biology, or Fluid Mechanics.

**IAM students must register through a department they have chosen and must clearly state their intention of joining the Institute of Applied Mathematics.**

The availability of financial support and the location of a potential supervisor usually determine the student's department. The majority of IAM students are registered in the Department of Mathematics, although some of them may have a supervisor in a different department. An IAM student may also choose to be registered in Computer Science, Electrical Engineering, Mechanical Engineering, Earth and Ocean Sciences, Physics, Chemistry, Zoology, etc.

Every graduate student, upon arrival, is assigned a faculty member as his/her advisor. These assignments are made keeping in mind the research interests of the student and the workload of the faculty member. The advisor will oversee the student's program, including recommending and approving courses. After eight months, the student will normally have chosen a thesis topic and thesis supervisor, and consequently, responsibility for the student will shift from the advisor to the thesis supervisor. It is not necessarily intended that the initial advisor be the future thesis supervisor. The thesis supervisor should be a member of the IAM, or is expected to join the Institute.

The Director, handles administrative matters concerning all graduate students, including the selection of new students and the yearly monitoring of the academic progress of all students. Although the academic program of each student is typically decided upon in consultation with the advisor or thesis supervisor, graduate students are invited at any time to call on the Director for advice on their programs. However, the final responsibility of meeting deadlines of the Faculty of Graduate Studies or other requirements of the graduate program rests with each individual student.

Students should consult the UBC Calendar and the IAM web site for the descriptions of available graduate and undergraduate courses that might be of interest to them. The graduate courses for the upcoming academic term are normally announced a few weeks before the beginning of the term, but the previous year's course list may also serve as a rough guideline and help in the course selection. Students are encouraged to take courses from several departments and should consult their advisors for recommendations. Information on suitable courses can be found on the IAM web site http://www.iam.ubc.ca/courses/.

All students are expected to attend the weekly IAM seminar, and participation at the annual IAM retreat is strongly encouraged. In addition, each student is expected to give at least one presentation during his or her graduate career in the IAM student-seminar to be held each week during the fall and winter terms.

# MASTERS PROGRAM

All graduate students must follow regulations from the Faculty of Graduate Studies. Refer to the UBC Calendar for details. There are three options available to a Masters student:

1. 18 credits of course work plus a 12-credit Masters thesis.
2. 24 credits of course work plus a 6-credit Masters thesis.
3. 30 credits of course work plus a Masters essay and an oral examination.

Generally, a 68% mark is required by the Faculty of Graduate Studies in order to obtain graduate credit in any specific course.

Students choosing options 1 or 2 will normally be expected to complete the program within two years. Under option 1 a student supported by a scholarship may be able to complete the program in a shorter time.

During the first year, the student must formulate an appropriate thesis topic and find a thesis supervisor. It is essential that students begin their thesis or essay work in the summer following their first two terms of course work. While the student is normally responsible for defining a suitable thesis topic on his/her own, the supervisor must approve the thesis programme and topic.

After one year in the Masters program, students with sufficiently high standing can petition their home department for transfer directly into the Ph.D. program. The possibility of such a transfer must be discussed with the thesis supervisor before petitioning the home department.

Part-time study is also available: A student may be enrolled part-time in the Faculty of Graduate Studies and take 6-12 credits per year, as well as work on a thesis. The program must be completed in five years.

The following sections outline the details of the three Masters options:

**1. 12-Credit Masters Thesis**

This is roughly equivalent in effort to four graduate courses. A thesis supervisor is required in addition to two additional readers. The 12-credit Masters thesis must satisfy the following criteria:

a. It involves some original and publishable research results, or else it deals with a novel exploratory technique, the results of which will be of interest to some portion of the Applied Mathematics community.
b. Of the 18 credits of course work required under this option, a maximum of 6 credits can be 300 or 400 level undergraduate courses. At least 6 credits of 500 level mathematics are required. At most 15 of the 18 credits can be from any single department. The student's advisor or thesis supervisor must approve all courses.

### 2. 6-Credit Masters Thesis

This is roughly equivalent in effort to two graduate courses. A thesis supervisor is required plus one additional reader. The 6-credit Masters thesis must satisfy the following criteria:

a. It is a comprehensive critical survey of the literature in some area of Applied Mathematics, and must go well beyond the material covered in any of the student's courses. Typically, it involves an analysis or implementation of lesser scope than that required for the 12-credit thesis.

b. Of the 24 credits of course work required under this option, a maximum of 6 credits can be 300 or 400 level undergraduate courses. At least 6 credits of 500 level mathematics is required. At most 18 of the 24 credits can be from any one department. The student's advisor or thesis supervisor must approve all courses.

### 3. Masters Essay

An essay supervisor is required. The basic distinction between an essay and a thesis (6 or 12 credits), aside from the lesser scope of the former, is that the supervisor, in consultation with the student, normally assigns the essay topic.

The Masters essay must satisfy at least one of the following criteria:

a. The supervisor will specify one or more papers and/or books in the literature. The student will write an essay that reports on the assigned reading and which demonstrates appropriate comprehension of the material. The assigned reading will be an extension of, but not identical with, material covered in the student's course work.
b. The supervisor will specify a technique to be implemented by the student. The essay will report on the implementation. The project will be an extension of, or adjunct to, some course project already completed by the student.

Of the 30 credits of course work required under this option, a maximum of 6 credits can be 300 or 400 level undergraduate courses. At least 12 credits of 500 level mathematics is required. At most 21 of the 30 credits can be from any one department. The student's advisor or thesis supervisor must approve all courses.

In addition to the essay, the student will be required to pass an oral comprehensive examination to be administered by his/her essay supervisor together with two other faculty members chosen by the essay supervisor. The examination will deal with the material covered by the student's Masters course selection as well as with the findings of his/her Masters essay. A candidate failing the exam may, with the permission of the Director, attempt it once more within eight months.

## Ph.D. PROGRAM

Immediately upon transferring into the program a student will choose, or be assigned, a Ph.D. supervisor. Students entering the Ph.D. program from outside UBC will normally choose a thesis topic and a thesis supervisor within eight months of arrival. The supervisor will be responsible, in consultation with the student, for assembling four additional members of the student's Ph.D. committee, not all from the same department. This Ph.D. committee must be in place by the time the student presents his/her thesis proposal. The three main requirements that must be satisfied are the following:

## 1. Breadth Requirement

*a. Preliminary Breadth Report*

Shortly after the student enters the Ph.D. program, the supervisor, in consultation with the student, will decide on three of the eight core areas listed below which will define the student's Ph.D. breadth requirements. The supervisor and student will prepare a brief report indicating:

(i) The student's choice of three core areas from the following eight:
1. Applied Analysis. 2. Numerical Analysis. 3. Optimization & Control. 4. Combinatorial Optimization. 5. Probability & Statistics. 6. Discrete Math 7. Mathematical Analysis (such as rigorous theory of Partial Differential Equations) 8. An area of application, for example: Fluid Dynamics, Mathematical Biology, Atmospheric Science, Finance, Economics, Mechanical Vibrations, Semiconductors, etc. One area should be specified as the student's major field.

(ii) Courses taken, and their grades, which already fulfill part of the breadth requirements. In addition, previously written theses and papers as well as previous work experience, which can be viewed as contributing to the fulfillment of the breadth requirements, may be included in the report. Courses taken at the M.Sc level at UBC for students transferring into the Ph.D program can be counted towards the breadth requirement.

(iii) Proposed program of studies. This includes courses, readings, etc., which the student intends to complete in order to fill any gaps in his/her breadth requirements.

Although not mandatory, it is strongly recommended that this preliminary report be submitted to the Director. Based on this report, the Director may offer suggestions for improving the academic preparation of the student. Once the preliminary breadth report has been formulated by the student and thesis supervisor the student will proceed with his or her program of study. The final breadth report is normally is to be completed **within sixteen months** from the date of registration

*b. Satisfying the Breadth Requirements*

The student's major area requires the equivalent of at least 9 credits of related course work, with at least 6 credits at the graduate level. The other core areas require at least 6 credits of related course work, with at least 3 credits at the graduate level. In order to satisfy the Ph.D. breadth requirements, a student must obtain a minimum grade of 70% in each of these courses taken at UBC contributing to the requirement, and an overall average in these courses across all three core areas of at least 75%. In those cases where previous work experience, previously written theses or papers, or courses taken elsewhere, contributes to the breadth requirements, the Director will be the final arbiter.

*c. Breadth Report*

When the student feels that he or she has satisfied the breadth requirements, the student will submit a written report documenting the courses taken and their grades, theses, papers, previous work experience, etc., which, taken together, are intended to fulfill the breadth requirement. On the basis of this report, the Director will decide whether the student has fulfilled the breadth requirements. There are three possible outcomes of this decision:

(i) Approval to proceed with a thesis proposal and eventual defense of this proposal.
(ii) Adjourned, with exactly one more opportunity to fulfill the breadth requirement within 12 months.

(iii) Failure. Withdrawal from the Ph.D. program in the IAM is required.

## 2. Thesis Proposal

Having satisfied the breadth requirements the student will continue his/her research and will write a Ph.D. thesis proposal. The thesis proposal must be presented in written form to the thesis committee at least two weeks prior to the oral comprehensive examination. The purpose of this exam is the defense of the student's thesis proposal and the examination of the candidate on related material in the major core area. The format of this examination may vary in different departments. Typically, the thesis proposal is 20-30 pages long. The comprehensive examination will normally be taken within two years of entering the Ph.D. program; in exceptional circumstances this may be extended to three years. A committee member other than the thesis supervisor will chair this examination. There are three possible outcomes of this examination:

a. Approval to proceed with the thesis.
b. Adjourned, with exactly one more opportunity to retake the qualifying exam within six months.
c. Failure. A withdrawal from the Ph.D. program in the IAM is required.

## 3. Ph.D. Thesis and Final Oral Examination

Once the comprehensive examination is passed, the student must carry out a research program in accordance with his/her research proposal under the supervisor's guidance, with periodic reviews by the student's committee. A thesis describing his/her research findings must be written by the student, approved by the committee and an external examiner, and defended at a final oral examination set up by the Faculty of Graduate Studies. The Faculty of Graduate Studies provides a guide to the preparation of Ph.D. theses. The student has the final responsibility for meeting the requirements and deadlines of the Faculty of Graduate Studies. In particular, the student must complete all requirements within six years of becoming a Ph.D. student. Extensions beyond six years are given only in exceptional circumstances.