

FACULTY OF ARTS & SCIENCE  
NEW PROGRAM FORM for 2010-2011 CALENDAR

1. Department or Program Mathematics

Mathematics (Science program)

Consult the Associate Chair for Undergraduate Studies, Department of Mathematics

Specialist program:

(12 full courses or their equivalent)

The Specialist Program in Mathematics is directed toward students who hope to pursue mathematical research as a career.

First Year:

MAT157Y1, MAT240H1, MAT247H1

Second Year:

MAT257Y1, MAT267H1

Third and Fourth Years:

1. MAT327H1, MAT347Y1, MAT354H1, MAT357H1,
2. One of: APM351Y1, MAT457Y1
3. Three of: APM461H1, MAT309H1, MAT363H1, ANY 400-level APM/MAT.
4. 2.5 APM/MAT including at least 1.5 at the 400-level (these may include options above not already chosen)
5. MAT477Y1

NOTE:

1. The Department recommends that PHY151H1 and PHY152H1 be taken in First Year, and that ~~CSC148H1/CSC150H1/CSC260H1~~ and STA257H1 be taken during the program. If you do not have a year course in programming from high school, the Department strongly recommends that you take CSC107H1/CSC108H1 before attempting and the CSC148H1/CSC150H1. *replace of CSC150H1.*
2. Students who do not include one of PHL275H1 or PHL265H1/PHL268H1/PHL271H1/PHL273H1 as part of their degree are expected to take another Arts and Science course with a significant emphasis on ethics and social responsibility.
3. Students planning to take specific 4<sup>th</sup> year courses should ensure they have the necessary 2<sup>nd</sup> and 3<sup>rd</sup> year prerequisites.

Student are required, as part of their degree, to take a course with a significant emphasis on ethics and social responsibility. Such as PHL275H1 / PHL265H1 / PHL268H1 / PHL271H1 / PHL273H1 or similar courses in other depart ments.

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## 2. Academic Rationale

Mathematics is a central discipline in the liberal arts and sciences and an extremely vibrant area of contemporary scientific research, with profound connections to physics, chemistry, computer science, bioinformatics, statistics, molecular biology, economics, finance, philosophy, among many others.

This program prepares students for further study leading to research careers in mathematics. Historically, this program has been the main training-ground for Canadian mathematicians. A large proportion of our Mathematics Specialist graduates gain admission to the world's best graduate programs in Mathematics. Other students have gone on to top programs in disciplines that use mathematics extensively, such as the ones mentioned in the paragraph above.

## 3. Learning Outcomes

Students in this program acquire fluency in the language of mathematics, with its insistence on precision, and they develop expertise in the basic methodology of mathematics, which demands creative thought expressed in the framework of rigorous proof. Teaching these skills is central to the curriculum, and these goals are emphasized *all of our courses* starting from the first day of the first-year Specialist courses. This distinguishes our program from most other undergraduate mathematics programs in North America, in which students typically spend a year or two learning the techniques and routine applications of calculus and linear algebra, with little attention either to the underlying theory or to the creative aspects of the subject, before gaining much exposure to the logical framework of mathematics.

Students also learn a great deal of mathematics, through about the equivalent of the first year of graduate school at most major North American universities. In particular, they develop a very solid foundation in core areas of mathematics, including Analysis (MAT157Y, 257Y, 354H, 357H, 454H\*, 457Y\*) and Algebra (MAT240H, 247H, 347Y). They also take courses in a wide range of other topics, including possibilities such as Logic (MAT309H), Topology (MAT327H), Geometry (MAT363), Differential Equations (MAT267H, APM351H). Possible advanced topics include analytic number theory, algebraic number theory, differential topology, algebraic geometry, differential geometry, and algebraic topology. The required Seminar in Mathematics (MAT477Y) covers an advanced topic of current research interest, and it also devotes attention to information literacy.

## 4. Degree Objectives

### a. DEPTH OF KNOWLEDGE

Students achieve depth of knowledge in the core areas of Mathematical Analysis (both Real and Complex) and Algebra through the two sequences (MAT157Y, 257Y, 354H, and 357H), and (MAT240H, 247H, 347Y) respectively. These courses develop the foundations of analysis up through the theory of Lebesgue measure and integration, and the foundations of algebra up through Galois Theory and the unsolvability of quintics. Both MAT357 and MAT347, although 300-level courses, contain material that is normally covered only at the graduate level in most North American universities. Students in the program must also complete at least 3.0 FCEs at the 400-level; this includes a seminar covering topics of current research interest (MAT477) and in addition a selection from advanced topics such as representation theory (MAT445H), algebraic topology (MAT427H), analytic number theory (MAT417H), commutative algebra and algebraic geometry (MAT448), advanced real analysis (MAT457Y), among many possibilities.

### b. COMPETENCIES

#### *i. Critical and Creative Thinking*

Every Mathematics course demands and develops the ability to analyze logical arguments, and moreover assigns students from time to time problems unlike any that they have seen before. Solving such problems is a challenge that requires creative thinking.

#### *ii. Communication*

Mathematical communication skills (in particular, the ability to express mathematical insights clearly and correctly, in the form of rigorous proofs) are developed throughout the curriculum and are explicitly emphasized in the core analysis and algebra sequences (MAT157Y, 240H, 247H, 257Y, 347Y, 357H). Oral presentations are an important part of MAT477Y.

Currently, extra TA hours have been assigned in MAT157Y1 and MAT246H1 to help students with their proof-writing skills.

#### *iii. Information Literacy*

References for research in Mathematics, as in other fields, now include not only traditional sources, but also a tremendous range of online resources, including searchable review databases (MathSciNet), preprint servers (arXiv.org), specialized Math Wikis (such as the *Dispersive PDE Wiki*, housed at the university of Toronto Math Department), *wiki*-style online pedagogical resources (eg the *Tricki*, initiated by Fields medallist Tim Gowers) and Math Blogs (eg that of Fields Medalist Terence Tao). Students gain familiarity with these resources in the 300- and 400-level courses of the program, and in particular in MT477Y.

#### *iv. Quantitative Reasoning*

Quantitative reasoning is a central part of all mathematics courses.

v. *Social and Ethical Responsibility*

A fundamental respect for honest argument is omnipresent in mathematics courses.

Students who do not include one of PHL275H1 or PHL265H1/PHL268H1/PHL271H1/PHL273H1 as part of their degree are expected to take another Arts and Science course with a significant emphasis on ethics and social responsibility.

**c. AN INTEGRATIVE, INQUIRY-BASED ACTIVITY**

The required Seminar in Mathematics (MAT477Y) is devoted to a research topic of current interest that changes from year to year. Student presentations, explaining recent or contemporary research papers related to the chosen topic, are the main course requirement. The course also devotes attention to social and ethical issues in mathematics and develops information literacy.

**5. Departmental/College Resource Implications** The Office of the Dean requires a statement of the resource requirements for the proposed program, and an indication of whether you can meet these requirements through your existing resources, or have received additional resources from the Dean. Please give details of the resource areas below.

<b>Estimated Enrolment per Academic Year in this program (please explain)</b>	All years, including 1 <sup>st</sup> and 2 <sup>nd</sup> round = 149  This figure is taken from total POST enrolment supplied by the Faculty of Arts and Science.
<b>New courses necessary to mount for this program</b>	0 New courses
<b>Additional Instructor(s) Requirements</b>	0 additional instructors
<b>Teaching Assistant(s) Requirements</b>	0 additional TAs
<b>Laboratory Equipment Requirements</b>	0 additional requirements
<b>Computing Resources Requirements</b>	0 additional requirements
<b>Other</b>	NA

**DELETE the statement that DOES NOT apply:**

I will provide these resources required for this Program from my existing budget.

**DATE :** October 8, 2009

**Name of Chair/Program Director:** Kumar Murty (Professor)