

8 of 8

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

<b>1. Department or Program</b>	Mathematics
---------------------------------	-------------

**Applied Mathematics (Science program)**

Consult Associate Chair, Department of Mathematics

**Specialist program:**

(13 full courses or their equivalent, including at least ONE 400- level course)

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

First Year:

MAT157Y1, MAT240H1, MAT247H1, CSC148H1/CSC150H1

Second Year:

MAT257Y1, MAT267H1; CSC260H1; STA257H1

*To be cancelled some time later.*

Third and Fourth Years:

1. APM351Y1; MAT327H1, MAT347Y1, MAT354H1, MAT357H1, MAT363H1; STA347H1
2. At least 1.5 full courses chosen from: ~~NEW!~~ MAT332H1, MAT344H1, MAT454H1, MAT457Y1, MAT464H1; STA302H1, STA457H1; CSC350H1, CSC351H1, CSC446H1, CSC456H1
3. Two courses from: APM421H1, 426H1, APM436H1, APM 441H1, APM446H1, 466H1
4. MAT477Y1

**NOTE:**

1. The Department recommends that PHY151H1 and PHY152H1 be taken in First Year. If you do not have a year course in programming from high school, the Department strongly recommends that you take CSC107H1/CSC108H1 before attempting CSC148H1/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.

*Like Math before*

*Like Math*

## 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 applied mathematics. Some students have gone on to programs in disciplines that use mathematics extensively (e.g., theoretical physics, chemistry, economics, finance, engineering)

## 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 in *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.

In Applied Mathematics, just as in pure mathematics, students still learn a great deal of mathematics. In particular, they develop a very solid foundation in core areas of mathematics and applied mathematics, including Analysis (MAT157Y, 257Y, 354H, 357H, 454H\*, 457Y\*) and Algebra (MAT240H, 247H, 347Y), Applied Math (MAT267H, APM351Y, APM421H, APM426H, APM462H, APM466H), Combinatorics (MAT332H or MAT334H, APM461H), Statistics (STA257H, STA302H, STA347H), and Computer Science (CSC148H/150H, CSC260H, CSC350H). They also take courses in other topics, including Topology (MAT327H) and Geometry (MAT363). Possible advanced topics include fluid mechanics, asymptotic and perturbation methods, and applied non-linear equations. The required Seminar in Mathematics (MAT477Y) covers an advanced topic of current research interest, and it also devotes attention to information literacy and to social and ethical issues in mathematics.

## 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. Depth of knowledge in applied mathematics is achieved in the sequences (MAT267H, APM351Y, APM436/441/446H), (STA257H, APM351Y, STA347H, APM466H), (STA257H, STA347H, STA457H), (CSC260, CSC350, CSC456), (CSC260, CSC350, CSC351, APM351Y, CSC446).

Students in the program must complete at least 2.0 FCEs at the 400-level. This includes a seminar covering topics of current research interest (MAT477). In addition a selection from advanced topics such as APM421H (Quantum Mechanics), APM426H (General Relativity), MAT454H (Complex Variable), MAT457Y (Real Variable), MAT464H (Differential Geometry) is also available.

### 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 MAT477Y.

*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 = 42  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>	MAT332H1
<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.

<b>DATE :</b> October 8, 2009	<b>Name of Chair/Program Director:</b> Kumar Murty
-------------------------------	--