

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

1. Department or Program Mathematics

Mathematics and Physics(Science program)

Consult the Associate Chairs, Department of Mathematics and Department of Physics.

Specialist program:

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

First Year:

MAT157Y1, MAT240H1, MAT247H1, PHY151H1, PHY152H1

Second Year:

MAT257Y1, MAT267H1; PHY224H1, 250H1, PHY252H1, PHY254H1, PHY256H1

Note: PHY252H1 and PHY324H1 may be taken in 2nd or 3rd year.

Third Year:

1. APM351Y1, MAT334H1/MAT354H1, MAT357H1;
2. One of: MAT327H1, MAT347Y1, MAT363H1
3. PHY324H1, PHY350H1, PHY354H1, PHY356H1

Fourth Year:

1. Two of: APM421H1, APM426H1, APM436H1, MAT446H1
2. Two of: PHY450H1, PHY452H1, PHY454H1, PHY456H1, PHY460H1
3. One of: MAT477H1; PHY424H1, PHY478H1, PHY479Y1

Note:

1. Students who are intending to apply to graduate schools in mathematics would be well-advised to take MAT347Y1.
2. Students who do not include JPH441H1 or PHL275H1/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 4th year courses should ensure they have the necessary 2nd and 3rd year prerequisites.

Like
Maths

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 and historical connections to physics.

This program prepares students for further study leading to research careers in mathematics, theoretical physics and applied mathematics. Some students have gone on to programs in disciplines that use mathematics and/or physics extensively (e.g., chemistry, economics, finance, engineering)

3. Learning Outcomes

Students in this program acquire fluency in the language of mathematics, with its insistence on precision, and how it is used in physics. They develop expertise in the basic methodology of mathematical physics, which demands creative thought expressed in the framework of rigorous proof. To keep in touch with physical reality, students also must take some experimental lab courses in physics. 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 specialist programs 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, linear algebra, and physics 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 theoretical physics.

In particular, they develop a solid foundation in core areas of mathematics including Analysis (MAT157Y1, MAT257Y1, MAT267H1, MAT334H1/MAT354H1, APM351Y1, MAT357H1) and Algebra (MAT240H, 247H, 347Y). They can also take courses in other topics, including Topology (MAT327H) and Geometry (MAT363).

After the students all take (PHY151H1, PHY152H1) and all the MAT courses up through the 200 level, they are in a position to develop a solid foundation in the various areas of physics, including Classical Mechanics (PHY254H1, PHY354H1), Electricity and Magnetism (PHY250H1, PHY350H1), Quantum Mechanics (PHY256H1, PHY356H1), and Experimental Physics (PHY224H1, PHY324H1).

This is a very strong program. Students are required to take 2.5 full courses at the 4th year level, thus extending at least two sequences in each of mathematics and physics, by choosing among:

APM421H1 Mathematical Foundations of Quantum Mechanics

APM426H1 General Relativity

APM436H1 Fluid Mechanics

APM446H1 Applied Non-linear Equations

PHY424H1 Advanced Physics Laboratory

PHY450H1 Advanced Electromagnetism

PHY452H1 Statistical Mechanics

PHY454H1 Continuum Mechanics

PHY456H1 Quantum Mechanics II

PHY460H1 Non-linear Physics

Students are exposed to advanced topics of current theoretical or experimental research interest by having to choose one among

MAT477Y1 Seminar in Mathematics

PHY424H1 Advanced Physics Laboratory

PHY478H1/PHY479Y1 Undergraduate Research Project

4. Degree Objectives

a. DEPTH OF KNOWLEDGE

This question has been fully addressed under Learning Outcomes (Heading 3 above).

b. COMPETENCIES

i. Critical and Creative Thinking

Every Mathematics and Physics 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

Communication skills (in particular, the ability to express mathematical and physical insights clearly and correctly, in the form of rigorous proofs, calculations, and detailed lab reports) are developed throughout the curriculum and are explicitly emphasized in the core analysis and algebra sequences, and in the required core physics sequences (listed under Learning Outcomes). Oral presentations are an important part of MAT477Y. Substantial written presentations are essential to the labs in PHY424H1, as well as in the Undergraduate Research Project PHY478H1/PHY479Y1.

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 MATcourses of the program. Similar resources exist in Physics and students become familiar with these in the 300 and 400 level PHYcourses.

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 JPH441H1/ 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

All the 4th year courses in this program have intertwining sequences of prerequisites from both mathematics and physics. Any one of them thus provide an integrative experience for the program.

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.

Estimated Enrolment per Academic Year in this program (please explain)	All years, including 1 st and 2 nd round = 76 This figure is taken from total POST enrolment supplied by the Faculty of Arts and Science.
New courses necessary to mount for this program	0
Additional Instructor(s) Requirements	0
Teaching Assistant(s) Requirements	0
Laboratory Equipment Requirements	0
Computing Resources Requirements	0
Other	0

DELETE the statement that DOES NOT apply:

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

DATE : October 7, 2009

Name of Chair/Program Director: Kumar Murty