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

1. Department or Program Mathematics

Mathematics and Its Applications (Science program)

Specialist program:

(11.5-12.5 full courses or their equivalent, including one full course at 400-level)

The program requirements are the core courses below, together with the courses in one of the following areas of concentration. If you get a specialist degree in Mathematics and its Applications, your transcript and degree will indicate also your area of concentration. Please be careful to check course prerequisites in choosing your program.

Core Courses:

First Year:

~~CSC108H1/CSC148H1/CSC150H1~~, MAT137Y1/MAT157Y1, MAT223H1/MAT240H1

CSC108H1/CSC150H1

Note:

~~CSC148H1/CSC150H1~~ is required for the Computer Science concentration. 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~~. *and* *replace of CSC150H1.*

Second Year:

MAT224H1/MAT247H1, (MAT235Y1/MAT237Y1/MAT257Y1), MAT246H1(waived for students taking MAT257Y1), MAT244H1/MAT267H1; STA257H1

Note:

MAT237Y1/MAT257Y1 is a direct or indirect prerequisite for many courses in each of the areas of concentration except the Teaching Concentration. Students are advised to take MAT237Y1/MAT157Y1 unless they have planned their program and course selection carefully and are certain that they will not need it.

Higher Years:

MAT301H1, MAT334H1

NOTE:

1. 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.
2. Students planning to take specific 4th year courses should ensure they have the necessary 2nd and 3rd year prerequisites.

AREAS OF CONCENTRATION

Teaching Concentration:

It may be to students' advantage to keep in mind that OISE requires students to have a second teachable subject.

1. MAT329Y1, HPS/MAT390H1, HPS/MAT391H1
2. ~~NEW!~~ Two of: MAT332H1/MAT344H1, MAT335H1, MAT337H1, MAT363H1;
3. Two of: , MAT309H1,MAT315H1; STA302H1/STA347H1
4. MAT401H1/MAT402H1 and one half course at 400 level from MAT475H1, APM, STA

Computer Science Concentration:

1. ~~NEW!~~ CSC148H1/CSC150H1 , CSC165H1, CSC236H1/CSC240H1,CSC209H1
2. CSC207H1, CSC236H1/CSC240H1,CSC209H1
3. MAT332H1/MAT344H1 and three of: MAT309H1; CSC320H1, CSC350H1, CSC351H1, CSC363H1 CSC373H1 (See Note for 363 and 373)
4. Two of : APM461H1, CSC446H1, CSC456H1, CSC465H1, CSC487H1

NOTE:

1. In order to take the Computer Science concentration, you will be required to register also for a Computer Science Major. (The latter is a restricted enrolment program and has certain admission requirements and much higher fees; please see the Computer Science program description.)

Physical Sciences Concentration:

1. PHY151H1, PHY152H1; AST221H1
2. Three of: AST222H1; PHY250H1,PHY252H1, PHY254H1, PHY256H1
3. APM346H1/APM351Y1
4. Three of:; AST320H1, AST325H1; MAT337H1,MAT363H1,PHY350H1, PHY354H1,PHY356H1, PHY357H1, PHY358H1
5. Two of: APM421H1, APM426H1,APM441H1, APM446H1, PHY407H1, PHY408H1, PHY456H1

Probability/Statistics Concentration:

1. STA261H1; APM346H1/351Y1/462H1; MAT337H1; STA302H1, STA347H1, STA352Y1
2. One additional full credit at 300+ level from APM/MAT/STA
3. Two of: STA437H1, STA438H1, STA442H1, STA447H1, STA457H1

Design-Your-Own Concentration:

Eleven half-courses of which at least six must be at the 300+level including at least 2 at the 400 level, to be approved by the Department no later than the beginning of the third year. It is understood that the remaining 5 half-courses may be in the departments pertaining to the area of concentration.

2. Academic Rationale

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.

In Mathematics and its Applications, just as in the other Specialist programs, students still learn a great deal of mathematics.

3. Learning Outcomes

In this program, students use the foundations of mathematics (single and multivariable calculus, linear algebra, ordinary differential equations, group theory, and analysis - real and/or complex) to specialize in their chosen area of concentration. They will learn through a progression of intensive lecture and coursework.

Students acquire a significant foundation in algebra (MAT223H1, MAT224H1, MAT301H1) and analysis (MAT137Y1/MAT157Y, MAT237Y1/MAT257Y1, MAT244H1, MAT334H1, MAT337H1).

In order to make the transition from courses with less emphasis on proof to those with more, students who have not taken MAT257Y1 are required to take MAT246H1.

These foundational courses provide the basis for further development in the various concentrations.

Teaching Concentration:

This concentration addresses an increasing need for highly qualified mathematics teachers. Students get practical teaching experience at a level of their interests. Students successfully completing the Teaching Concentration and having practical experience will be highly competitive for admission to initial teaching programs at OISE/UT.

To develop sufficient mathematical maturity, technical knowledge, historical background and skills in presentation needed for successful teaching, students take the sequence of courses (MAT137Y1/MAT157Y1, MAT223H1/MAT240H1; MAT224H1/MAT247H1, MAT235Y1/MAT237Y1/MAT257Y1), MAT246H1 (waived for students taking MAT257Y1), MAT244H1/MAT267H1; STA257H1; MAT301H1, MAT334H1; HPS/MAT390H1, HPS/MAT391H1, MAT329Y1.

The teaching staff of this program includes an elementary/high-school teacher who supplements the standard material with practical advice about teaching and the teaching profession.

This program is designed so that in addition to the teaching component, students achieve depth of knowledge in algebra/geometry (by taking MAT401H1/MAT402H1) and in at least one other area of applied mathematics or statistics (by taking a 4th year course) or problem-solving (by taking MAT475H1).

Computer Science Concentration:

This concentration addresses the extensive intersection of skill-sets between mathematics and computer science. The program is designed so that students must complete at least one of the following sequences, achieving depth of knowledge in the indicated area:

1. Formal methods of software design
(CSC108H1/CSC148H1/CSC150H1, CSC165H1, CSC236H1/CSC240H1, CSC363H1, MAT309H1, CSC465H1)
2. Computational methods for partial differential equations aka numerical analysis
(CSC108H1/CSC148H1/CSC150H1, CSC207H1, MAT223H1/MAT240H1, MAT237Y1/MAT257Y1, CSC350H1, CSC351H1, MAT244H1/MAT267H1, APM346H1/APM351Y1, CSC446H1)
3. High performance scientific computing
(CSC108H1/CSC148H1/CSC150H1, CSC207H1, MAT223H1/MAT240H1,

MAT237Y1/MAT257Y1,CSC350H1,CSC456H1)

4. Foundations of Computer Vision (CSC108H1/CSC148H1/CSC150H1,CSC207H1, CSC209H1,MAT137Y1,MAT223H1/MAT240H1,CSC320H1,MAT237Y1/MAT257Y1, CSC487H1)
5. Combinatorial Methods (MAT137Y1/MAT157Y1,MAT223H1/MAT240H1,MAT224H1/MAT247H1, MAT332H1/MAT344H1,APM461H1)

Physical Sciences Concentration:

This concentration provides grounding in the mathematical methods of physics and/or astronomy. Building on the foundation of all courses common to the Mathematics and its Applications Program, and adding APM346H1/APM351Y1, a course in partial differential equations, the essential language of physics, students must acquire increasing depth of knowledge in at least two directions, though more are possible. The possibilities culminate in

- APM421H1 Mathematical Foundations of Quantum Mechanics
- APM426H1 General Relativity
- APM441H1 Asymptotic and Perturbation Methods (emphasizing techniques and problems from engineering and physics)
- APM446H1 Applied Non-linear Equations
- PHY407H1 Computational Physics
- PHY408H1 Time Series Analysis
- PHY452H1 Basic Statistical Mechanics
- PHY456H1 Quantum Mechanics
- PHY460H1 Non-linear Physics

Students are required to take at least two of these, in order to do which they must satisfy various series of prerequisites listed in the concentration requirements at the 2nd and 3rd year levels. The 4th year courses have some prerequisites in common, but not all.

Probability/Statistics Concentration:

In this concentration students acquire a strong foundation in that branch of mathematics – statistics and probability -- most used in the analysis of experimental and social data. In analysis, students acquire the necessary background for deeper study of statistics and probability in (MAT334H1, MAT337H1; APM346H1/APM351Y1/APM462H1). In statistics and probability, all students in this concentration acquire depth of knowledge in the required courses (STA257H1, STA261H1, STA302H1, STA347H1, STA352Y1). These courses culminate in choices among

- STA437H1 Methods for Multivariate Data
- STA438H1 Theoretical Multivariate Statistics
- STA442H1 Methods of Applied Statistics (This course requires choosing STA305H1 as one of the additional 300-level courses.)

- STA447H1 Stochastic Processes
- STA457H1 Time Series Analysis

Design-Your-Own Concentration:

Depending on which application students choose to pursue (e.g. biology, chemistry, etc.) a sequence of courses is devised (under the close supervision of the Associate Chair Undergraduate, and with the cooperation of other departments) to acquaint the student with the mathematical methods used in the chosen discipline. The core curriculum is the same as in the other concentrations, but the culminations are individual.

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 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 (MAT137Y1/MAT157Y1, MAT223H1/240H1, MAT224H1/MAT247H1, MAT237Y1, MAT301H1, MAT334H1, MAT401H1/MAT402H1). In addition, for those who have not taken MAT157Y1, rigorous proofs are emphasized in MAT246H1 with additional development in either MAT309H1 or MAT337H1. Oral presentations are an important part of MAT329Y.

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.

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

Please indicate which course(s) or other appropriate activities are eligible means for satisfying this program requirement. The attached Integrative, Inquiry-based Activity description provides both definition and guidelines, with examples of the many types of appropriate courses or other activities.

Each of the chains of courses listed under Learning Outcomes (Heading 3 above) culminate in 4th year courses whose presentation requires the integration of all previous material in the chain.

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 = 98 This figure is taken from total POST enrolment supplied by the Faculty of Arts and Science.
New courses necessary to mount for this program	MAT332H1, MAT475H1
Additional Instructor(s) Requirements	0
Teaching Assistant(s) Requirements	40 hrs.
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 8, 2009	Name of Chair/Program Director: Kumar Murty (Professor)