**Master of Science in Mathematics**

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**GENERAL INFORMATION**

**Introduction**
The Master of Science in Mathematics program at the Royal University of Phnom Penh provides high-level mathematical training to postgraduate students. The degree takes a broad approach to mathematical training, with students taking courses in both pure and applied mathematics.

The first year of the M.Sc. (Mathematics) provides students with training in subjects including linear algebra, differential geometry, discrete mathematics, probability, real, complex and numerical analysis, statistics and differential equations. The second year of the degree is currently being developed to allow students to specialize in those subjects which will be greatest benefit to the Cambodian context. It is envisioned that this course will focus on applied mathematics, training Cambodian human resources for specialized fields such as financial and economic mathematics, cryptography and mathematics for science, among others.

Whilst the Masters in Mathematics program aims to train students for future careers in mathematics-related fields, it also seeks to build capacity within the Royal University of Phnom Penh. To this end, the M.Sc. (Mathematics) has implemented a unique counterpart system within its teaching program. Under this system, each course is taught by a recognized international mathematician, with the assistance of a Cambodian counterpart from the Department of Mathematics at the Royal University of Phnom Penh. Under this system, each course is taught by a recognized international mathematician, with the assistance of a Cambodian counterpart from the Department of Mathematics at the Royal University of Phnom Penh. Under this system, each course is taught by a recognized international mathematician, with the assistance of a Cambodian counterpart from the Department of Mathematics at the Royal University of Phnom Penh. Under this system, each course is taught by a recognized international mathematician, with the assistance of a Cambodian counterpart from the Department of Mathematics at the Royal University of Phnom Penh. Under this system, each course is taught by a recognized international mathematician, with the assistance of a Cambodian counterpart from the Department of Mathematics at the Royal University of Phnom Penh.

International professors teaching at RUPP come from institutions including the Université Paris VI, Université d’Aix Marseille and Université de Nice Sophia-Antipolis (France), the University of Marrakech (Morocco) and other American and Japanese universities. The International Mathematical Union and the United States National Committee on Mathematics will also support several mathematicians in teaching at RUPP.

In addition to the support of these institutions, the Master of Science in Mathematics at the Royal University of Phnom Penh has been developed thanks to the assistance of several international organizations. Its primary sponsors are the Centre International de Mathématiques Pures et Appliquées (CIMPA), the International Mathematical Union (IMU), the US National Committee on Mathematics, the Agence Universitaire pour la Francophonie (AUF), the French Embassy, Phnom Penh and the Toyota Foundation.

**Course Structure**
The M.Sc. (Mathematics) is taught through a series of intensive, subject-specific modules of 45 hours, each taken over a period of roughly three weeks. Students take eight of these modules in their first year, seven of which are compulsory, and one of which is an elective.

All courses are taught by recognized professors from overseas universities, in association with a member of staff from the Department of Mathematics at the Royal University of Phnom Penh.

**Enrollment**
Students can enroll in one of three ways. Students who have completed the pre-Masters program in Mathematics at RUPP to a high standard can be selected by members of the Department, in association with the vice-rector, for automatic entry into the Master of Science in Mathematics program.

Similarly, outstanding students from the Mathematics and Physics summer program at the Institute of Technology, Cambodia, can be selected for automatic entry into the degree program.
Other applicants must sit an examination set by the organizing committee of the M.Sc. (Mathematics) at RUPP.

Application
All potential applicants must be in possession of a Bachelor’s degree in a related field from a recognized university.

Method of Instruction
All courses are taught in English. However, due to the strong support of French institutions and universities, outstanding students in the M.Sc. (Mathematics) program are encouraged to pursue further study of the French language, which they will find beneficial in future applications for a Ph.D. or further training in France.

CURRICULUM

YEAR ONE

<table>
<thead>
<tr>
<th>Subject</th>
<th>Months</th>
<th>Course Code</th>
<th>Teaching Hours</th>
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<tbody>
<tr>
<td>Linear Algebra</td>
<td>November 2007</td>
<td>MMA101</td>
<td>45</td>
</tr>
<tr>
<td>Differential Geometry</td>
<td>December 2007</td>
<td>MMA102</td>
<td>45</td>
</tr>
<tr>
<td>Discrete Mathematics</td>
<td>January 2008</td>
<td>MMA103</td>
<td>45</td>
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<tr>
<td>Probability</td>
<td>February 2008</td>
<td>MMA104</td>
<td>45</td>
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<tr>
<td>Real Analysis</td>
<td>March 2008</td>
<td>MMA105</td>
<td>45</td>
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<tr>
<td>Complex Analysis</td>
<td>Mid-April – Mid-May 2008</td>
<td>MMA106</td>
<td>45</td>
</tr>
<tr>
<td>Differential Equations</td>
<td>Mid May-June 2008</td>
<td>MMA107</td>
<td>45</td>
</tr>
<tr>
<td>Numerical Analysis (Elective) OR</td>
<td>June-July 2008</td>
<td>MMA108</td>
<td>45</td>
</tr>
<tr>
<td>Statistics (Elective)</td>
<td>March – Mid-April 2008</td>
<td>MMA109</td>
<td>45</td>
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</table>

YEAR TWO

To Be Developed

COURSE DESCRIPTIONS

MMA101 Linear Algebra
Mr. Xavier Bressaud
Year I
Students begin by examining the functions of linear equations, including elementary row operations, row echelon form and reduced row echelon form, solving a system of linear equations, homogenous systems, applications and geometric interpretations. They then go on to study matrices, including systems of linear equations, matrix multiplication, finding inverses by elementary row operations, the criteria for invertibility, applications and more abstract settings; determinants, including definitions, properties, elementary row operations and applications to geometry; vectors, including in 2-space and 3-space, and vector products; vector spaces, including real vector spaces, subspaces, linear combinations, linear independence, basis and dimension, rank of a matrix, solutions of non-homogenous systems and complex vector spaces; linear transformation, including Euclidean linear transformations, elementary properties, change of basis, kernel and range, inverse linear transformations, and change of basis; and finally eigenvalues and eigenvectors, including the diagonalization problem and their applications.

MMA102 Differential Geometry
Mr. Pierre Schapira
Year I
In this course, students explore general topology, including metric, compact and Banach spaces; differentiable maps, plotting from finite dimensional real Banach spaces to other spaces; definitions; compositions; partial derivatives and tge Jacobian matrix. Students also learn about the necessary conditions for local extremum, explore many
applications of these conditions, and study the local
inversion theorem and embedded submanifolds.

MMA103 Discrete Mathematics
Mr. Pierre Arnoux
Year I
Topics covered include the theories of graphs,
including graph theory and problems associated with
graphing; and the theory of codes, including cyclic
groups, and vector spaces. Throughout the course,
students make intensive use of linear algebra, matrix
applications and vectors. Although this course is
taught primarily in English, students will also study
mathematical vocabulary in French, building their
capacity to work with mathematical concepts across
cultures.

MMA104 Probability
TBA
Year I
This course will be taught by a visiting professor
from a Japanese university. Students will explore
advanced concepts in probability, including
probability theory and applied probability.

MMA105 Real Analysis
TBA
Year I
In this course, students examine the system of real
numbers, the concept of a function and the basic
tools and theorems of calculus, and seek to place the
subject on a firm logical basis. The course also
covers additional techniques including power series
and the most important special functions which arise
in great numbers of applications. The course is
designed for students who have a working
knowledge of calculus.

MMA106 Complex Analysis
Michel Waldschmidt
Year I
Students cover the analytic functions of complex
variables, including Holomorphic functions, Cauchy-
Riemann equations and harmonic functions. They
inspect examples including polynomials, the
exponential and trigonometric functions and
complex logarithms. Students also explore power
series, analytic functions, integration on paths,
Cauchy's theory, singularities, residues,
meromorphic functions, series and the products of
analytic or meromorphic functions.

MMA107 Differential Equations
Mr. Hassan Hisid
Year I
In this course, taken by a professor from the
University of Marrakech, students examine
advanced-level differential equations.

MMA108 Numerical Analysis (Elective)
TBA
Year I
In this elective course, students undertake an
examination of the theory, practice and applications
of numerical analysis.

MMA109 Statistics (Elective)
TBA
Year I
This elective course allows students to explore the
applications of advanced mathematical knowledge.
Statistics are used in many fields of study, for
various purposes. Here, students probe the theory
and applications of statistics, and practice
performing advanced statistical analysis.