UNIVERSITY of TECHNOLOGY, MAURITIUS

School of Innovative Technologies and Engineering

Department of Applied Mathematical Sciences

BSc (Hons) Mathematics

PROGRAMME DOCUMENT

VERSION 3.1
BMv3.1
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University of Technology, Mauritius
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A. Programme Information

As well as being a discipline in its own right, mathematics forms the basis of modern commercial, industrial and technological activities. Mathematical models underpin engineering, sciences, computing and many aspects of management today.

The BSc (Hons) Mathematics programme lays focus on the attributes of pure and applied mathematics. The modules are designed with a blend of mathematical, statistical and computer modelling so as to imbibe students undertaking the programme of study with appropriate skills to deal with the multidisciplinary involvement of mathematics. Moreover, the students enrolled on the programme on full time basis will be required to undergo a work placement at the second level of the programme of study.

B. Programme Aims

The BSc (Hons) Mathematics has been designed to provide the students with the skills and aptitudes needed to develop analytical, computational and statistical knowledge. Students are expected to be versatile in the application of mathematics and mathematical reasoning in different fields, including science, finance, transportation, engineering and education, amongst others. The programme will give the students experience of mathematical activity and investigation, and develop them to be resourceful in solving problems for which ready-made methods are not available. The programme will also provide the students with broad concepts of the principal branches of mathematics.

C. Programme Objectives

After successful completion of the programme, the graduates should

- display a mastery of the principal skills required for work in mathematics;
- have achieved a broad understanding and knowledge, and have an interest in and appreciation of mathematics;
- be conversant with information technology, communication and scientific presentation;
- have acquired problem-solving attributes;
- be skilled in the application of mathematics in a variety of fields, including science, engineering and business.

D. General Entry Requirements

As per UTM'S Admissions Regulations, and 'Admission to Programmes of Study at Degree Level' or APL / APEL requirements.

E. Programme Entry Requirements

'A' Level in Mathematics.

F. Programme Mode and Duration

Full Time:	Minimum 3 Years, Maximum 6 Years	(Minimum 6 Semesters, Maximum 12 Semesters)
Part Time:	Minimum 4 Years, Maximum 7 Years	(Minimum 8 Semesters, Maximum 14 Semesters)

G. Teaching and Learning Strategies

- Lectures, Tutorials and Practical Laboratory Sessions;
- Class Tests, Assignments and Dissertation;
- Structured Discussions and Self-Directed Study;
- Workshops and Seminars;
- Case Study of real world problems;
- Work Placement (full time mode only);
- Mini Project (part time mode only).

H. Student Support and Guidance

Each cohort of the programme is allocated a Programme Coordinator who acts as a liaison between the students and school management and provides support for academic management of the programme.

I. Attendance Requirements

As per UTM's Regulations and Policy.

J. Credit System

For the award of

- a Certificate, a minimum of 36 credits are required;
- a Diploma, a minimum of 69 credits are required;
- an Ordinary Degree, a minimum of 96 credits are required;
- an Honours Degree, a minimum of 105 credits are required.

K. Student Progress and Assessment

The programme is delivered mainly through lectures, tutorials, and practical laboratory sessions. Students are expected to be as autonomous as possible and activities may include reading research articles, delivering presentations, taking part in quizzes, case-studying amongst others. Each module carries 100 marks and unless otherwise specified will be assessed as follows:

- written and/or practical examination, and continuous assessment carrying up to 40% of total marks;
- continuous assessment can be based on a combination of assignments, field study, workshops, practical and class tests;
- modules 'Computer Programming I', 'Linear Programming', 'Numerical Computing', 'Matrix Computations', 'Numerical Methods for ODEs', 'Numerical Solution of PDEs', 'Stochastic Calculus and Applications', 'Financial Option Valuation', 'Practical Applied Mathematics' and 'Applied Multivariate Statistics' will be assessed by 100% coursework. The coursework must consist of at least one class test and one assignment.
- Module 'Communication Skills Seminar' will be assessed by 100% coursework. The coursework must consist of at least two assessments.
- For the Mini Project in the part time version of the programme structure, the students are required to work on a project with significant mathematical/statistical content. Upon completion of the Mini Project, the student must submit a report. Moreover, each student must his/her work in an oral presentation, with opportunity for questions from the examiner(s).

Module grading structure:

Grade	**Marks *x* (%)**
A	$70 \leq x \leq 100$
B	$60 \leq x < 70$
C	$50 \leq x < 60$
D	$40 \leq x < 50$
F	$x < 40$
A-D	Pass
F	Fail

L. Evaluation of Performance

1. The % mark at Level 1 contributes a 20% weighting towards the degree classification.
2. The % mark at Level 2 contributes a 30% weighting towards the degree classification.
3. The % mark at Level 3 contributes a 50% weighting towards the degree classification.

M. Award Classification

Overall weighted mark *y* (%)	**Classification**
$70 \leq y \leq 100$	1st Class Honours
$60 \leq y < 70$	2nd Class 1st Division Honours
$50 \leq y < 60$	2nd Class 2nd Division Honours
$45 \leq y < 50$	3rd Class Honours
$40 \leq y < 45$	Pass Degree
$y < 40$	No Award

N. Programme Organisation and Management

Programme Director: Dr Mohammad Sameer SUNHALOO

Contact Details:

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PART II - Programme Structure

O. BSc (Hons) MATHEMATICS – Full Time (Version 3.1)

YEAR 1 (Level 1)

Semester 1				Semester 2			
Code	**Modules**	**Hrs/Wk** L+T/P	**Credits**	**Code**	**Modules**	**Hrs/Wk** L+T/P	**Credits**
MATH 1332C	Calculus and Matrix Algebra I	2+1	3	MATH 1333C	Calculus and Matrix Algebra II	2+1	3
MATH 1210C	Real Analysis I	2+1	3	MATH 1211C	Real Analysis II	2+1	3
STAT 1217C	Probability and Mathematical Statistics I	2+1	3	STAT 1218C	Probability and Mathematical Statistics II	2+1	3
MATH 1201C	Algebra	2+1	3	MATH 1212C	Linear Algebra	2+1	3
COMP 1101C	Computer Programming I	2+2	4	MATH 1315C	Mechanics	2+1	3
COMM 1116C	Communication Skills Seminar	1+1	2	MATH 1334C	Linear Programming	2+1	3

YEAR 2 (Level 2)

Semester 1				Semester 2			
Code	**Modules**	**Hrs/Wk** L+T/P	**Credits**	**Code**	**Modules**	**Hrs/Wk** L+T/P	**Credits**
MATH 2208C	Complex Analysis	2+1	3	MATH 2213C	Metric Spaces	2+1	3
MATH 2316C	Numerical Computing	2+2	4	MATH 2319C	Numerical Methods for ODEs	2+2	4
MATH 2318C	Matrix Computations	2+2	4	PROJ 2119C	Work Placement		4
MATH 2302C	Differential Equations	2+1	3				
STAT 2212C	Linear Statistical Models	2+2	4				
UTM 2101	Life Skills and Good Practices	2+2	4				

YEAR 3 (Level 3)

Semester 1				Semester 2			
Code	**Modules**	**Hrs/Wk** L+T/P	**Credits**	**Code**	**Modules**	**Hrs/Wk** L+T/P	**Credits**
MATH 3322C	Numerical Solution of PDEs	2+2	4	MATH 3321C	Fluid Dynamics	2+1	3
MATH 3320C	Optimisation	2+1	3	STAT 3301C	Probability Models	2+1	3
MATH 3214C	Functional Analysis	2+1	3	QFIN 3201C	Financial Option Valuation	2+2	4
MATH 3335C	Stochastic Calculus and Applications	2+2	4	MATH 3336C / STAT 3336C	Practical Applied Mathematics or Applied Multivariate Statistics	2+2	4
PROJ 3112C	Dissertation						8

P. BSc (Hons) MATHEMATICS – Part Time (Version 3.1)

YEAR 1							
→ Start of Level 1							
Semester 1				**Semester 2**			
Code	**Modules**	**Hrs/Wk** L+T/P	**Credits**	**Code**	**Modules**	**Hrs/Wk** L+T/P	**Credits**
MATH 1332C	Calculus and Matrix Algebra I	2+1	3	MATH 1333C	Calculus and Matrix Algebra II	2+1	3
STAT 1217C	Probability and Mathematical Statistics I	2+1	3	STAT 1218C	Probability and Mathematical Statistics II	2+1	3
COMP 1101C	Computer Programming I	2+2	4	MATH 1210C	Real Analysis I	2+1	3
COMM 1116C	Communication Skills Seminar	1+1	2	MATH 1201C	Algebra	2+1	3

YEAR 2							
				→ Start of Level 2			
Semester 1				**Semester 2**			
Code	**Modules**	**Hrs/Wk** L+T/P	**Credits**	**Code**	**Modules**	**Hrs/Wk** L+T/P	**Credits**
MATH 1211C	Real Analysis II	2+1	3	MATH 2208C	Complex Analysis	2+1	3
MATH 1212C	Linear Algebra	2+1	3	MATH 2316C	Numerical Computing	2+2	4
MATH 1315C	Mechanics	2+1	3	MATH 2302C	Differential Equations	2+1	3
MATH 1334C	Linear Programming	2+1	3	STAT 2212C	Linear Statistical Models	2+2	4
				PROJ 2118C	Mini Project	-	-
End of Level 1 →							

YEAR 3							
				→ Start of Level 3			
Semester 1				**Semester 2**			
Code	**Modules**	**Hrs/Wk** L+T/P	**Credits**	**Code**	**Modules**	**Hrs/Wk** L+T/P	**Credits**
MATH 2318C	Matrix Computations	2+2	4	MATH 3322C	Numerical Solution of PDEs	2+2	4
MATH 2213C	Metric Spaces	2+1	3	MATH 3320C	Optimisation	2+1	3
MATH 2319C	Numerical Methods for ODEs	2+2	4	MATH 3214C	Functional Analysis	2+1	3
UTM 2101	Life Skills and Good Practices	2+2	4	MATH 3335C	Stochastic Calculus and Applications	2+2	4
PROJ 2118C	Mini Project	-	4				
End of Level 2 →							

YEAR 4							
Semester 1				**Semester 2**			
Code	**Modules**	**Hrs/Wk** L+T/P	**Credits**	**Code**	**Modules**	**Hrs/Wk** L+T/P	**Credits**
MATH 3321C	Fluid Dynamics	2+1	3	MATH 3336C / STAT 3336C	Practical Applied Mathematics or Applied Multivariate Statistics	2+2	4
STAT 3301C	Probability Models	2+1	3				
QFIN 3201	Financial Option Valuation	2+2	4				
PROJ 3112C	Dissertation						8
End of Level 3 →							

Q. Module Outline

MATH 1332C: CALCULUS AND MATRIX ALGEBRA I

Functions, limits, derivatives and Mean Value Theorem. Differentiation formulas, chain rule, implicit differentiation, higher derivatives. Taylor's Theorem. Indeterminate forms. Hyperbolic functions. Techniques of integration: substitution, integration by parts, trigonometric substitutions, partial fractions. First order differential equations: separable equations, homogeneous equations, integrating factors. Linear ordinary differential equations of second and higher order. Complex numbers. Polar coordinates.

MATH 1210C: REAL ANALYSIS I

Real numbers: supremum, infimum and completeness axiom. Sequences: limit theorems, monotone convergence theorem, Bolzano-Weierstrass theorem, Cauchy sequence, subsequence, Cauchy's criterion for convergence. Series: infinite series, Cauchy's criteria, absolute and conditional convergence, tests for convergence. Limit of functions and limit theorems. Functions: Continuous functions, continuous functions on intervals, uniform continuity.

STAT 1217C: PROBABILITY AND MATHEMATICAL STATISTICS I

Data representation. Combinatorial analysis. Axioms of probability. Conditional probability and independence. Bayes' theorem. Conditional Expectations. Moment generating functions, characteristic functions, measures of central tendency: Kurtosis, skewness. Discrete and continuous distributions. Central limit theorem. Sample and Estimations. X^2 -, *t*- and *F*-distributions. Confidence intervals. Concepts of hypothesis testing.

MATH 1201C: ALGEBRA

Sets, relations and functions. Binary operations. Equivalence relations and equivalence classes. Groups, subgroups and cyclic groups. Isomorphism theorems.

COMP 1101C: COMPUTER PROGRAMMING I

Introduction to computer programming. Pseudo-codes and problem formulation. Basic data types, I/O. Control structures: selection and loops. Coding, testing and debugging. Simple file processing. Arrays and strings. Basic recursion. Implementation of simple algorithms.

COMM 1116C: COMMUNICATION SKILLS SEMINAR

Introduction to communication: the nature, basic concepts, forms and models of communication. Literary communication - specialised forms of writing: letter, editing and proof reading, minutes, reports, memos. Spoken communication: introduction, speaker, effective speaking, public speaking, persuasive speaking. Accent neutralisation: correct pronunciations of English vowels, intonation. Listening as communication: skills for effective listening. Internet and communications: introduction, issues to watch out for. Techniques for presentation, interviewing, report-writing, meetings, negotiations, drafting of contracts and tender/marketing document. Presentation skills. CV writing and job application preparation.

MATH 1333C: CALCULUS AND MATRIX ALGEBRA II

Vectors and matrices. Solution of linear systems of equations. Determinants. Rank of a matrix. Eigenvalues and eigenvectors. Diagonalisation. Dot product, cross product, lines and planes. Directional derivatives, gradient, divergence, curl. Polar, cylindrical and spherical coordinates. Partial differentiation. Multiple integrals and change of variables. Green's Theorem, Stokes' Theorem and the Divergence Theorem.

MATH 1211C: REAL ANALYSIS II

Differentiation: derivative, Mean Value theorem and applications, indeterminate forms, Taylor's theorem. Riemann integration and Riemann integrable functions. Integral mean value theorem. Fundamental theorem of calculus. Improper integrals. Sequence and series of functions: point-wise and uniform convergence, Weierstrass M-test, power series, radius of convergence.

STAT 1218C: PROBABILITY AND MATHEMATICAL STATISTICS II

Multivariate distributions, mean vectors and covariance matrices, Jacobian transformation formula. Functions of random variables: transformation techniques and joint distributions. Fisher information. Sufficiency and completeness. Consistency and unbiasedness. Exact and asymptotic pivotal method. Likelihood ratio test. Neyman-Pearson lemma. Weak law of large numbers. Central limit theorem, statement of multivariate CLT.

MATH 1212C: LINEAR ALGEBRA

Vector spaces and subspaces. Linear independence. Basis and Dimension. Orthogonal and orthonormal bases. Linear transformations and Matrices. Range and Kernel. Isomorphism. Change of basis. Determinants. Eigenvalue and eigenvector theory.

MATH 1315C: MECHANICS

Forces and equilibrium. Velocity and acceleration. Newton's laws of motion. Energy, work and power. Projectiles. Motion in a circle. Hooke's law. Simple harmonic motion.

MATH 1334C: LINEAR PROGRAMMING

Linear programming. Graphical method. The simplex method. Two-phase and big-M methods. Duality and sensitivity analysis. Transportation model and its variants. Integer linear programming. Network optimisation. PERT and CPM.

MATH 2208C: COMPLEX ANALYSIS

Complex numbers and functions. Cauchy-Riemann equations. Harmonic functions. Contour integration. Cauchy's theorems. Power series and Taylor series. Laurent series and residue integration. Rouché's theorem. Argument principle. Conformal mapping.

MATH 2316C: NUMERICAL COMPUTING

Computer arithmetic. Errors and error propagation. Numerical methods for solving linear and nonlinear systems. Interpolation and approximation. Numerical differentiation. Numerical integration and quadrature.

MATH 2318C: MATRIX COMPUTATIONS

Matrix multiplications. Operation counts. Linear systems. Elimination and decomposition methods. Norms and condition Numbers. Sensitivity of linear systems. Round-off errors and stability. Classical iterative methods. Least squares problems. Givens rotations. Householder transformations. Eigenvalue problems. Power method and its variants. Deflation processes. Singular value decomposition.

MATH 2302C: DIFFERENTIAL EQUATIONS

Laplace transforms. Fourier series. Classification and solution to partial differential equations. Heat, wave, and potential equations on bounded domains. Fourier integral applied to problems on unbounded domains.

STAT 2212C: LINEAR STATISTICAL MODELS

Correlation for discrete and continuous bivariate data. Nonparametric tests. Simple linear regression. Regression diagnostics. ANOVA. Introduction to multiple regression. Use of R package.

UTM 2101: LIFE SKILLS AND GOOD PRACTICES

Employability development skills. Good Governance. Prevention of corruption. Personal development skills and role of youth in addressing societal challenges. Coping skills. Addressing Societal Challenges including Substance Abuse, Poverty, Climate Change, Social Media and Family problems.

MATH 2213C: METRIC SPACES

Sequences. Cauchy sequences. Topology of a metric space. Bounded sets, open balls and neighbourhoods, limit points, open and closed sets. Continuity. Connected spaces. Compact spaces. Convergence in metric spaces. Equivalent metrics. Complete metric spaces.

MATH 2319C: NUMERICAL METHODS FOR ODEs

Initial Value problems. Single-step method. Multi-step method. Predictor-Corrector methods. Stability analysis. Stiff system. Boundary value problems. Finite difference methods.

MATH 2119C: WORK PLACEMENT
As per the Work Placement Guidelines of the University.

PROJ 2118C: MINI PROJECT

Demonstration of the ability to conduct rigorous research and reach to comprehensive conclusions for a specific problem. Topics to be covered: research process, ethics of research, research problems, developing research questions/hypotheses, choosing a research method, presenting & analysing findings and writing a research report. The teaching strategies will include 45 hours of face-to-face contact hours spread over two semesters.

MATH 3322C: NUMERICAL SOLUTION OF PDEs

Finite difference methods for Elliptic, Hyperbolic and Parabolic equations. Convection-diffusion equations. Consistency and Convergence. Stability analysis. Multi-dimension extensions and operator splitting. Systems of equations.

MATH 3320C: OPTIMISATION

Unconstrained optimisation. One-dimensional search methods. Gradient methods. Steepest descent method. Newton method. Conjugate direction methods. Quasi-Newton methods. Rank one correction formula. The Davidon-Fletcher-Powell method. The Broyden-Fletcher-Goldfarb-Shanno method. Linear systems: Kaczmarz's algorithm.

MATH 3214C: FUNCTIONAL ANALYSIS

Normed spaces. Banach spaces. Fundamental theorems for normed and Banach spaces. Inner product spaces. Hilbert spaces.

MATH 3335C: STOCHASTIC CALCULUS AND APPLICATIONS

Borel algebra. Probability space. Lebesgue integral. Brownian motion. Ito calculus. Stochastic differential equations. Numerical Solution to SDEs. Stochastic approach to Black-Scholes model. Risk neutral evaluation.

MATH 3321C: FLUID DYNAMICS

Conservation laws. Euler's and Bernoulli's equations. Potential functions. Complex variable methods. Irrotational flow in three dimensions. Viscosity. Navier-Stokes equation.

STAT 3301C: PROBABILITY MODELS

Random walk. Conditional expectations. Stochastic processes. Stochastic inventory models. Queueing systems. Discrete and continuous Markov chains. Markovian birth-death processes.

QFIN 3201C: FINANCIAL OPTION VALUATION

Options. Asset price model. Black-Scholes PDE and Formulas. Hedging. Risk Neutrality. Implied Volatility. Binomial method. Cash-or-nothing options. American options. Finite difference methods for option pricing.

MATH 3336C: PRACTICAL APPLIED MATHEMATICS

Delta function. Green's function. Sturm-Liouville systems. Adjoints. Fredholm alternatives. Integral Equations. Numerical Solution of Integral Equations.

STAT 3336C: APPLIED MULTIVARIATE STATISTICS

Plotting and display of multivariate data. Multivariate distributions. Wishart and Hotelling's distributions. Maximum likelihood estimators. Multivariate hypothesis testing. Multivariate regression analysis. Clustering methods and result interpretation.

PROJ 3112C: DISSERTATION
Dissertation guidelines will be given in the Dissertation Handbook.