University of St Andrews - School of Mathematics and Statistics

This is a list of the 1000-level and 2000-level modules that were available to students during the 2019-2020 academic year. The School's sub-honours courses remain broadly the same from year to year, but this list of module offerings is for illustration purposes only and does not constitute a guarantee of the specific modules, module content or timetabling to be offered in future years.

1000-level modules

MT1001 Introductory Mathematics
MT1002 Mathematics
MT1003 Pure and Applied Mathematics
MT1007 Statistics in Practice
MT1010 Topics in Mathematics: Problem-solving Techniques

ID1003 Great Ideas 1

MT1901 Topics in Contemporary Mathematics (Evening degree programme only)

MT1001 Introductory Mathematics

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<td>Academic year</td>
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<tr>
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<td>9.00 am</td>
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Description

This module is designed to give students a secure base in elementary calculus to allow them to tackle the mathematics needed in other sciences. Students wishing to do more mathematics will be given a good foundation from which they can proceed to MT1002. Some of the work covered is a revision and reinforcement of material in the Scottish Highers and many A-Level syllabuses.
| **Prerequisites** | Higher or A-Level Mathematics (A/S level Mathematics with approval of Head of School). |
| **Antirequisites** | MT1003, MT2501-MT5999 |
| **Lectures and tutorials** | 5 lectures (weeks 1 - 10), 1 tutorial and 1 laboratory (weeks 2 - 11). |
| **Assessment** | Written Examination = 90% (2-hour final exam = 70%, 2 class tests = 10% each), Coursework = 10% |
| **Module coordinator** | Dr C V Tran |
| **Lecturer** | Dr V Archontis, Dr P Pagano, Dr C V Tran, Dr S Yardley |

**Syllabus**

- Basic properties of real numbers (real numbers, intervals, inequalities)
- Algebraic equations (including quadratic equations)
- Sequences and series (definitions, arithmetic and geometric series, binomial series)
- Functions (domain and range, odd and even, one to one, function composition, inverse functions)
- Exponential and logarithm (including expressions in different bases, solving equations involving exp and log)
- Trigonometry (basic functions, inverse functions, trigonometric identities, solving trigonometric equations)
- Curve sketching
- Geometry: straight lines and circles
- Limits and continuity
- Differentiation (introduction, derivatives of elementary functions, rules for calculating derivatives)
- Integration (introduction, connection with differentiation, techniques of integration)

**MT1002 Mathematics**

| **Credits** | 20.0 |
| **Semester** | Both |
| **Academic year** | 2019/20 |
| **Timetable** | 9.00 am |

This module is designed to introduce students to the ideas, methods and techniques which they will need for applying mathematics in the physical sciences or for taking the study of mathematics further. It aims to extend and
**Description**  
enhance their skills in algebraic manipulation and in differential and integral calculus, to develop their geometric insight and their understanding of limiting processes, and to introduce them to complex numbers and matrices.

**Prerequisites**  
MT1001 or B at Advanced Higher Mathematics or B at A-Level Mathematics or equivalent qualification

**Antirequisites**

**Lectures and tutorials**  
5 lectures (weeks 1 - 10), 1 tutorial and 1 laboratory (weeks 2 - 11).

**Assessment**  
Written Examination = 90% (2-hour final exam = 70%, 2 class tests = 10% each), Coursework = 10%

**Module coordinator**  
Dr A Wilmot-Smith (S1); Dr T Coleman (S2)

**Lecturer**  
Dr T Coleman, Prof C E Parnell, Dr M Todd, Dr A Wilmot-Smith (S1); Dr T Coleman, Dr A P Naughton, Dr A Wilmot-Smith (S2)

**Syllabus**

- Revision of integration techniques, hyperbolic functions and applications to integration;
- Limits of functions, l'Hospital's rule;
- Complex numbers: their arithmetic, Argand diagram, modulus-argument form, de Moivre's theorem, powers and roots, geometric and trigonometric applications;
- Differential equations: first order separable, first order linear, second order with constant coefficients both homogeneous and inhomogeneous;
- Matrices, determinants and linear equations: basic matrix operations, inverses including by row operations, determinants and their properties, solutions of systems of linear equations, including degenerate cases;
- Vectors: Vector operations, including scalar and vector product, geometrical applications including equations of lines and planes;
- Proof: the need for precision in mathematics, basic types of proof, including induction;
- Sequences and series: convergence of sequences, convergence of series, geometric series, tests for convergence, power series, Taylor-Maclaurin series, including standard examples (exp, sine, etc.).

**Reading list**

- K. E. Hirst *Numbers, Sequences and Series*, (Edward Arnold, 1995).
- K. E. Hirst *Vectors in 2 and 3 Dimensions*, (Edward Arnold, 1995).
The aim of this module is to provide students with a taste of both pure and applied mathematics, to give them insight into areas available for study in later years and to provide them with the opportunity to broaden their mathematical experience.

Prerequisites
MT1002

Antirequisites

Lectures and tutorials
5 lectures (weeks 1 - 10), 1 tutorial and 1 laboratory (weeks 2 - 11).

Assessment
Written Examination = 90% (2-hour final exam = 70%, 2 class tests = 10% each), Coursework = 10%

Module coordinator
Dr H Cammack

Lecturer
Dr C Bleak, Dr H Cammack

Syllabus
- Functions and Relations.
- Natural numbers and integers. Elementary number theory.
- Rational numbers, irrational numbers, real numbers.
- Groups. Permutations and geometric symmetries, subgroups.
- Graphs. Hamiltonian and Eulerian paths, planarity, trees.
- Discrete and continuous descriptions.
- Simple continuous mathematical models applied to mechanical, thermal and biological problems. Autonomous systems.
- Solution of difference equations with applications to economics and population dynamics. The logistic and related equations. Chaos.
- Difference equations as iterative methods for solving algebraic equations.
- Numerical solution of initial value problems using simple difference schemes.

Reading list
- *Advanced Engineering Mathematics* E Kreyszig; Wiley; 2001
MT1007  Statistics in Practice

Credits  20.0

Semester  2

Academic year  2019/20

Timetable  11.00 am

Description  This module provides an introduction to statistical reasoning, elementary but powerful statistical methodologies, and real world applications of statistics. Case studies, such as building an optimal stock portfolio, and data vignettes are used throughout the module to motivate and demonstrate the principles. Students get hands-on experience exploring data for patterns and interesting anomalies as well as experience using modern statistical software to fit statistical models to data.

Prerequisites  An A grade at GCSE or an A grade National 5 Mathematics or a C grade at AS level Mathematics or a C grade at Higher Mathematics.

Antirequisites

Lectures and tutorials  4 lectures (weeks 1 - 10), 1 tutorial and 1 laboratory (weeks 2 - 11).

Assessment  2-hour Written Examination = 50%, Coursework = 50%

Module coordinator  Dr M L Burt

Lecturer  Dr M L Burt, Dr C G Paxton

MT1010  Topics in Mathematics: Problem-solving Techniques

Credits  10.0

Semester  1

Academic year  2019/20

Timetable  10.00 am Mon (odd weeks), Wed and Fri
This module introduces some important basic concepts in mathematics and also explores problem-solving in the context of these topics. It is intended to strengthen the mathematical skills of an undergraduate entering on the Fast Track route into the MMath degree programme.

**Prerequisites**
Admission onto the Fast Track MMath degree programme

**Antirequisites**

**Lectures and tutorials**
1.5-hour lecture, 1 practical and 1 tutorial (x 10 weeks)

**Assessment**
1.5-hour Written Examination = 50%, Coursework = 50%

**Module coordinator**
Dr J N Reinaud

**Lecturer**
Dr T Coleman, Dr V M Popov, Dr J N Reinaud

This module is taken only by students on the Fast Track route through the MMath degree programme.

**Syllabus**

The syllabus splits into five blocks, each consisting of two weeks, covering:

1. Divisibility properties of integers, the Euclidean Algorithm;
2. Polynomials, their roots and divisibility properties;
3. Sequences and convergence (iterative schemes, Newton's Method, Euler Algorithm);
4. Euclidean geometry (possible topics including conic sections, equations of parabolae, ellipses, etc.);
5. Combinatorics and probability.

Block 5 will tie in with the material that students are covering during the semester in MT2504.

**Reading list**

**ID1003  Great Ideas 1**

**Credits**
20.0

**Semester**
1

**Academic year**
2019/20
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<th>Timetable</th>
<th>1.00 pm Mon, 1.00 pm Tue, 1.00 pm Thu</th>
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The aim of this module is to trace some of the major intellectual and societal threads in the development of modern civilisation: the 'canon' of modern thought. The module is in three sections.

Part 1 is "Arguments and Facts" and explores the fundamentals of logic, analysis and reasoning.

Part 2. "Rhetoric, Debate and Understanding" will explore how argument can be used to cajole, convert, persuade and entertain and emphasise the importance in understanding another person's position.

Part 3 "Applying Analysis" takes the learning and skills of the previous sections and applies them to some of the great texts and artworks of western civilisation.

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<th>Prerequisites</th>
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<td>Antirequisites</td>
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<tr>
<th>Lectures and tutorials</th>
<th>2 to 3 lectures and 1 tutorial.</th>
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<tr>
<th>Module coordinator</th>
<th>Dr C Paxton</th>
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<tr>
<th>Lecturer</th>
<th>Team taught</th>
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<tr>
<th>MT1901 Topics in Contemporary Mathematics</th>
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<td>Credits</td>
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<td>Timetable</td>
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This module will introduce areas of contemporary mathematics and statistics at a basic level. Topics may include chaos and fractals, the golden ratio, mathematical modelling of populations and analysis of the resulting equations. The statistical component will consider how to graph data, and will introduce probability, odds and betting, basic descriptive statistics and uncertainty and risk. The topics will be illustrated by simple examples and day-to-day situations.
**Prerequisites**

Entry to the Evening Degree programme. Basic algebraic manipulation, but not any knowledge of calculus, will be assumed. (Maths Standard Grade (Credit level) or Maths GCSE (Higher tier) would provide sufficient algebraic background.)

**Antirequisites**

Lectures and tutorials

1 x 3-hour session (lecture plus tutorial).

**Assessment**

Coursework = 100%

**Module coordinator**

TBC

**Lecturer**

TBC

This module runs in alternate years.

**Syllabus**

- Recurrence relations and applications, Fibonacci numbers;
- Newton’s mathematics;
- Fractals, chaos, Julia sets and the Mandelbrot set;
- Modern statistics, looking at data, basic probability;
- Statistical inference and hypothesis testing.

**Assumed knowledge**

Basic algebraic manipulation, but not any knowledge of calculus, will be assumed. (Maths Standard Grade (Credit level) or Maths GCSE (Higher tier) would provide sufficient algebraic background.) This material will be reviewed in the first session.

**Reading list**

This is a list of the 2000-level modules that were available to students during the 2019-2020 academic year. The School's sub-honours courses remain broadly the same from year to year, but this list of module offerings is for illustration purposes only and does not constitute a guarantee of the specific modules, module content or timetabling to be offered in future years.

2000-level modules

MT2501 Linear Mathematics
MT2502 Analysis
MT2503 Multivariate Calculus
MT2504 Combinatorics and Probability
MT2505 Abstract Algebra
MT2506 Vector Calculus
MT2507 Mathematical Modelling
MT2508 Statistical Inference
MT2901 Mathematical concepts through history

ID2003 Science Methods
ID2005 Scientific Thinking

MT2501 Linear Mathematics

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<td>Both</td>
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<td>2019/20</td>
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<td>Timetable</td>
<td>12.00 noon Mon (odd weeks), Wed and Fri [Semester 1]; 11.00 am on Mon (even weeks), Tue and Thu [Semester 2]</td>
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This module extends the knowledge and skills that students have gained concerning matrices and systems of linear equations. It introduces the basic
Description
theory of vector spaces, linear independence, linear transformations and
diagonalization. These concepts are used throughout the mathematical sciences
and physics. It is recommended that students in the Faculties of Arts and
Divinity take an even number of the 15-credit 2000-level MT modules.

Prerequisites
MT1002, or A at Advanced Higher Mathematics, or A at A-level Further
Mathematics, or A at both A-level Mathematics and A-level Physics

Antirequisites
MT2001

Lectures and
tutorials
2.5-hours lectures (x 10 weeks), 1 tutorial (x 4 weeks), 1 examples class (x 6
week)

Assessment
2-hour Written Examination = 70%, Coursework (including class test) = 30%

Module
coordinator
Prof N Ruskuc (S1), Dr A Wilmot-Smith (S2)

Lecturer
Prof N Ruskuc (S1), Dr A Wilmot-Smith (S2)

Continuous assessment

- Class test (50 minute): 15%
- Coursework problem sets: 15%

Syllabus

- Matrices and determinants: basic revision of matrices & relevant fields (especially complex
numbers); revision of e.r.o.'s; system of linear equations; determinants and their basic
properties; matrix inverses; solutions of systems of linear equations.
- Vector spaces: Definition of vector spaces; examples of vector spaces (with emphasis on
geometrical intuition); basic properties of vector spaces; subspaces.
- Linear independence and bases: spanning sets; linear independence, bases, dimension.
- Linear transformations: definition of linear transformation and examples (including trace), the
matrix of a linear transformation; rank and nullity (including proof of Rank-Nullity Theorem);
the rank of a matrix and reduced echelon form; rank and the matrix of a linear
transformation.
- Eigenvalues, eigenvectors and diagonalization: eigenvalues and eigenvectors; change of
basis; powers of matrices, symmetric matrices and quadratic forms.

Reading list


MT2502 Analysis
The main purpose of this module is to introduce the key concepts of real analysis: limit, continuity and differentiation. Emphasis will be placed on the rigorous development of the material, giving precise definitions of the concepts involved and exploring the proofs of important theorems. This module forms the prerequisite for all later modules in mathematical analysis. It is recommended that students in the Faculties of Arts and Divinity take an even number of the 15-credit 2000-level MT modules.

Prerequisites
MT1002 or A at Advanced Higher Mathematics or A at A-level Further Mathematics

Antirequisites
MT2002

Lectures and tutorials
2.5 hours lectures (x 10 weeks), 1-hour tutorial (x 5 weeks), 1-hour examples class (x 5 weeks)

Assessment
2-hour Written Examination = 70%, Coursework (including 1 class test) = 30%

Module coordinator
Dr J M Fraser

Lecturer
Dr J M Fraser

Continuous assessment
- Class tests (50 minute): 15%
- Fortnightly assessed tutorial questions: 5 x 3% = 15%

Syllabus
- The rationals and the reals: maximum & minimum, supremum & infimum, completeness.
- Sequences, series and convergence: the Bolzano-Weierstrass Theorem, tests for convergence - the ratio test, the root test, the comparison test, Cauchy sequences.
- Continuous functions: algebraic properties of continuous functions, the Intermediate Value Theorem.
- Differentiable functions: the chain rule, Rolle’s Theorem, the Mean Value Theorem, Taylor polynomials.

These topics will be introduced from a rigorous point of view, giving precise definitions, applying an $\varepsilon-\delta$ approach and giving examples.
MT2503  Multivariate Calculus

Credits 15.0

Semester 1

Academic year 2019/20

Timetable 12 noon Mon (even weeks), Tue and Thu

Description This module extends the basic calculus in a single variable to the setting of real functions of several variables. It introduces techniques and concepts that are used throughout the mathematical sciences and physics: partial derivatives, double and triple integrals, surface sketching, cylindrical and spherical coordinates. It is recommended that students in the Faculties of Arts and Divinity take an even number of the 15-credit 2000-level MT modules.

Prerequisites MT1002, or A at Advanced Higher Mathematics, or A at A-level Further Mathematics, or A at both A-level Mathematics and A-level Physics, or Co-requisite MT1010

Antirequisites MT2001

Lectures and tutorials 23 hours of lectures, 1-hour tutorial (x 4 weeks), 1-hour examples class (x 4 weeks)

Assessment 2-hour Written Examination = 70%, Coursework = 30% (including 1 class test)

Module coordinator Dr A P Naughton

Lecturer Prof A W Hood, Dr A P Naughton

Continuous assessment

- 50-minute class test: 15%
- Projects involving computer-based work: 15%

Syllabus

- Revision of basic differentiation rules: product rule, quotient rule, chain rule. Hyperbolic
functions & inverse hyperbolic function: graphs, derivatives, integrals & identities.

- Power series, including Taylor series about an arbitrary point. Limits, continuity & differentiability of functions on one variable (definitions). l'Hopital's Rule.
- Revision of vectors and dot product. Functions of several variables, representation as surfaces, surface sketching, and limits of functions of several variables, continuity and differentiability for functions of two variables.
- Partial derivatives, chain rule for functions of n-variables.
- Implicit differentiation and contours, higher order partial derivatives, derivatives in n-dimensions, tangent planes
- Taylor series for functions of two variables. Maxima and minima.
- Directional derivative and gradient. Lagrange multipliers.

Reading list


MT2504  Combinatorics and Probability

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<td>Academic year</td>
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<tr>
<td>Timetable</td>
<td>4pm Mon (odd weeks), Thu and Fri</td>
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**Description**

This module provides an introduction to the study of combinatorics and finite sets and also the study of probability. It will describe the links between these two areas of study. It provides a foundation both for further study of combinatorics within pure mathematics and for the various statistics modules that are available. It is recommended that students in the Faculties of Arts and Divinity take an even number of the 15-credit 2000-level MT modules.

**Prerequisites**

MT1002 or A at Advanced Higher Mathematics or A at A-level Further Mathematics, or Co-requisite MT1010

**Antirequisites**

MT2004 or MT2005

**Lectures and**

2.5 hours of lectures (x 10 weeks), 1-hour tutorial (x 4 weeks), 1-hour examples
### Continuous assessment

- Computer project: 15%
- Fortnightly assessed tutorial questions: $5 \times 3\% = 15\%$

### Syllabus

- Counting & elementary probability: definition of sets, unions of disjoint sets, pigeonhole principle, notation needed for probabilities (e.g., events, complement); axioms of probability and concept of probability using counting argument; Inclusion-Exclusion.
- Basic rules of probability (building on elementary counting), conditional probability, multiplication rule, Bayes Theorem, independence.
- Ordered pairs, double-counting, size of Cartesian products of sets, choosing with repetition; functions, permutations.
- Recursion and generating functions: Binomial numbers, recursively and via generating functions; Fibonacci numbers including some recursive formulae; Catalan numbers, including some recursive formulae; more on generating functions; counting partitions of a set.
- Random variables and distributions: definition of a discrete random variable (r.v.), probability mass functions, Bernoulli distribution, Binomial distribution, Poisson distribution, geometric distribution (including lack of memory property).
- Continuous r.v.s, probability density functions, uniform distribution; exponential distribution, normal distribution; cumulative distribution function (c.d.f., discrete & continuous cases), inverse c.d.f.
- Expectation; variance, introduction to probability generating functions; moment generating functions.
- Bivariate distributions: discrete/continuous distributions, joint, marginal and conditional probability mass/density functions; expectation, covariance and correlation, independence.

### Reading list

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<tr>
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<td><strong>Timetable</strong></td>
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**Description**

This main purpose of this module is to introduce the key concepts of modern abstract algebra: groups, rings and fields. Emphasis will be placed on the rigourous development of the material and the proofs of important theorems in the foundations of group theory. This module forms the prerequisite for later modules in algebra. It is recommended that students in the Faculties of Arts and Divinity take an even number of the 15-credit 2000-level MT modules.

**Prerequisites**

MT1002 or A at Advanced Higher Mathematics or A at A-level Further Mathematics

**Antirequisites**

MT2002

**Lectures and tutorials**

2.5 hours of lectures (x 10 weeks), 1-hour tutorial (x 5 weeks), 1-hour examples class (x 5 weeks)

**Assessment**

2-hour Written Examination = 70%, Coursework = 30%

**Module coordinator**

Dr M R Quick

**Lecturer**

Dr M R Quick

**Continuous assessment**

- Computer project: 15%
- Fortnightly assessed tutorial questions (4 weeks): 15%

**Syllabus**

- Preliminaries and prerequisites; equivalence relations
- The definitions and familiar examples of rings and fields
- The definition of a group, Cayley tables, elementary properties of groups
- Examples of groups: modular arithmetic including the Euclidean algorithm; permutation groups and symmetries
- The order of an element, subgroups, cyclic groups, alternating groups, cosets and Lagrange’s Theorem
- Homomorphisms and isomorphisms, normal subgroups, ideals, quotient groups and rings, the First Isomorphism Theorem

**Reading list**
MT2506 Vector Calculus

Credits 15.0

Semester 2

Academic year 2019/20

Timetable 9.00 am Mon (even weeks), Tue and Thu

Description This module introduces students to some of the fundamental techniques that are used throughout the mathematical modelling of problems arising in the physical world such as grad, div and curl as well as cylindrical and spherical coordinate systems. Fundamental theorems such as Green's Theorem, Stokes' Theorem and Gauss's Divergence Theorem will also be studied. It provides the foundation for many of the modules available in applied mathematics later in the Honours programme. It is recommended that students in the Faculties of Arts and Divinity take an even number of the 15-credit 2000-level MT modules.

Prerequisites MT2503

Antirequisites MT2003

Lectures and tutorials 2.5 hours of lectures (x 10 weeks), 1-hour tutorial (x 5 weeks), 1-hour examples class (x 5 weeks)

Assessment 2-hour Written Examination = 70%, Coursework (including class test) = 30%

Module coordinator Prof D G Dritschel

Lecturer Prof D G Dritschel

Continuous assessment

- Class test (50-minute): 15%
- Fortnightly assessed tutorial questions: 5 x 3% = 15%

Syllabus

- Revision of modulus, dot and scalar products (& derivation of cosine formula).
- Grad and directional derivatives of a scalar field; calculation of div and curl of vectors, and curl curl of a vector; verification of identities for div and curl of (scalar times vector); div and curl in cylindrical coordinates; derivatives of unit vectors in spherical coordinates; identity div curl = 0.
- Parametric line integrals in the (x,y) plane; potential function use in line integrals (result depends upon starting and finishing points only).
- Surface integrals of: scalars in spherical coordinates; vectors (in cartesians) using the method of projection; vectors in cylindrical coordinates.
- Green's Theorem in (x,y) with parametric integration; Stokes' Theorem in cartesian and spherical coordinates; Gauss' Divergence theorem in cartesian and cylindrical coordinates.

Reading list


**MT2507 Mathematical Modelling**

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<tr>
<td>Timetable</td>
<td>12.00 noon Mon (odd weeks), Wed and Fri</td>
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**Description**

This module provides an introduction to a variety of techniques that are used throughout applied mathematics. It discusses how to translate physical problems into mathematics and covers such topics as differential equations, dynamics, numerical methods and Fourier series. It illustrates how these are used when solving problems. It is recommended that students in the Faculties of Arts and Divinity take an even number of the 15-credit 2000-level MT modules.

**Prerequisites**

MT2503

**Antirequisites**

MT2003

**Lectures and tutorials**

2.5 hours of lectures (x 10 weeks), 1-hour tutorial (x 5 weeks), 1-hour examples class (x 5 weeks)

**Assessment**

2-hour Written Examination = 70%, Coursework = 30%

**Module coordinator**

Prof T Neukirch

**Lecturer**

Prof T Neukirch
Continuous assessment

- Three homework assignment: 3 x 5% = 15%
- Computer project: 15%

Syllabus

- Revision of ODEs: separable 1st order ODEs, integrating factors, homogeneous linear 2nd order ODEs with constant coefficients, inhomogeneous linear 2nd order ODEs with constant coefficients. Simple applications: radioactive decay, logistic ODE. Nonlinear coupled ODEs: application, e.g., predator-prey models, etc., stationary states, linearization.
- Phase plane analysis.
- Dynamics: Newton’s laws, motion under constant gravitational force (1D, 2D), friction, use of total energy.
- Numerical methods: applied to previous nonlinear ODEs, Newton-Raphson (1D, 2D) for calculating stationary states, solution of nonlinear ODEs with numerical methods to supplement phase plane analysis.
- Fourier series: Use of 2D Laplace equation for potential in Cartesian coordinates as motivation, sine and cosine as a system of orthogonal functions, definition of Fourier Coefficients, examples of Fourier series.

Reading list


MT2508  Statistical Inference

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<td>Semester</td>
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<td>2019/20</td>
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<tr>
<td>Timetable</td>
<td>12.00 noon Mon (even weeks), Tue and Thu</td>
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**Description**

This module provides an introduction to the mathematical models of randomness. These models are used to perform statistical analysis, where the aim is to evaluate our uncertainty on a certain quantity after observing data. Important topics in statistics are described including maximum likelihood estimation, confidence intervals and hypothesis testing, permutation tests, and linear regression. It forms a prerequisite for the statistics modules in the Honours programme. It is recommended that students in the Faculties of Arts
and Divinity take an even number of the 15-credit 2000-level MT modules.

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<th>Prerequisites</th>
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<tr>
<td>Antirequisites</td>
<td>MT2004 or EC2003</td>
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<td>Lectures and tutorials</td>
<td>2.5 hours lectures (x 10 weeks), 1-hour tutorial (x 5 weeks), 1-hour examples class (x 5 weeks)</td>
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<tr>
<td>Assessment</td>
<td>2-hour Written Examination = 70%, Coursework = 30%</td>
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<tr>
<td>Module coordinator</td>
<td>Dr H Worthington</td>
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<tr>
<td>Lecturer</td>
<td>Dr H Worthington</td>
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Continuous assessment

- Computer project performing statistical analysis using R: 15%
- Fortnightly assessed tutorial questions: 5 x 3% = 15%

Syllabus

- Difference between population and sample: Sample mean and variance as estimates of population mean and variance; sample covariance and correlation.
- Likelihood and maximum likelihood estimation: Discrete data and examples (sequence of binary trials, Poisson counts all with the same mean, Poisson with mean a function of a covariate); continuous data and example (n observations from \( N(m,s^2) \), m.l.e.s of mean and variance); invariance of m.l.e.s
- Confidence intervals and hypothesis testing: Unbiased and consistent estimators, interval estimation, hypothesis testing
- Basic properties of Normal distributions, Central Limit Theorem (statement and application to binomial and Poisson), assessing normality (normal scores)
- Hypothesis testing and interval estimation for normal distributions with \( s^2 \) known; \( c^2, t \) and \( F \) distributions and their basic properties; one-sample \( t \)-test, paired \( t \)-test; two-sample \( t \)-tests and confidence intervals for means of normal distributions; \( F \)-tests for equality of variances of normal distributions; permutation tests: 2-sample permutation test; perm test for matched pairs and one-sample test; randomization tests.
- Simple linear regression: Intro and least squares, normal linear regression, regression in R, CIs and PIs, checking assumptions.

Reading list

### ID2003  Science Methods

**Credits**  
10.0

**Semester**  
1

**Academic year**  
2019/20

**Timetable**  
1.00 pm Mon, 1.00 pm Tue, 4.00 pm Thu

**Description**  
This module provides an overview of the rationale, methods, history and philosophy of science. We explore the different definitions of science, the distinction between science and pseudo-science, the design of experiments, critical thinking, errors in reasoning, methods of making inferences and generalisations, the role of personal experience and anecdotes in science, the process of scientific publication and the role of anomalies in science. The module is collaboratively taught by staff from a number of schools in the university providing a useful methodological background for all science students.

**Prerequisites**

**Antirequisites**

**Lectures and tutorials**  
2x 1-hour lectures (x 11 weeks), 1-hour practical class (x 11 weeks)

**Assessment**  
1.5-hour Written Examination = 50%, Coursework = 50%

**Module coordinator**  
Dr C G M Paxton

**Lecturer**  
Team Taught

### ID2005  Scientific Thinking

**Credits**  
15.0

**Semester**  
1

**Academic year**  
2019/20

**Timetable**  
Lectures: 1.00 pm Mon, Tue, Wed Tutorials: 4.00 pm - 6.00 pm Thu

This module provides an overview of the rationale, methods, history & philosophy of science and is a more detailed, 15-credit version of ID2003. We explore the different definitions of science, the distinction between science and non-science, the design of experiments, errors in reasoning, critical thinking,
**Description**

personal experience & science, the grammar of graphics, the process of science, peer review, research reproducibility, data cataloguing, the treatment of anomalies & outliers, and ethics. The module is collaboratively taught by staff from a number of Schools of the University providing a useful methodological background for all science students.

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<thead>
<tr>
<th>Prerequisites</th>
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<tr>
<td>Antirequisites</td>
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<td>ID2003</td>
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<table>
<thead>
<tr>
<th>Lectures and tutorials</th>
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<tbody>
<tr>
<td>3 x 1-hour lectures (x 11 weeks), 1-hour tutorials (x 8 weeks), 1-hour seminar (x 1 week) 2-hour practical (x 1 week), 6 hours film/video viewing in total.</td>
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<tr>
<th>Assessment</th>
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<tr>
<td>1.75-hour Written Examination = 50%, Coursework = 50%</td>
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<th>Module coordinator</th>
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<tr>
<td>Dr C Paxton</td>
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<th>Lecturer</th>
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<td>Team taught</td>
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MT2901  Mathematical concepts through history

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<th>Academic year</th>
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<td>2020/21</td>
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<th>Timetable</th>
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<td>6.00 - 9.00 pm Wed</td>
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**Description**

This module will trace the historical origins and development of some fundamental mathematical concepts - such as ideas relating to number and shape - and processes such as proof, iteration and generalisation. The module views mathematics as a human activity, shaped by people's experience, need, and curiosity. Students will gain an understanding of the concepts and processes studied together with the historical and societal contexts that supported them. The evolving concept of number will create a timeline through the module from prehistoric times to the twentieth century. The selection of other topics in any year will be dependent on staff availability.

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<table>
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<tr>
<th>Lectures and tutorials</th>
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<tbody>
<tr>
<td>1 x 2.5-hour session: lectures, tutorials, seminars, presentations</td>
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<th>Assessment</th>
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<tbody>
<tr>
<td>Coursework = 100% (33% class test, 33% essay 1, 34% essay 2)</td>
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<td>Module coordinator</td>
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<td>Lecturer</td>
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