School of Mathematics & Statistics

Important Degree Information:

B.Sc./M.A. Honours
The general requirements are 480 credits over a period of normally 4 years(and not more than 5 years) or part-time equivalent; the final two years being an approved honours programme of 240 credits, of which 90 credits are at 4000 level and at least a further 120 credits at 3000 and/or 4000 (H) levels. Refer to the appropriate Faculty regulations for lists of subjects recognised as qualifying towards either a B.Sc. or M.A. degree.

B.Sc./M.A. Honours with Integrated Year Abroad
The general requirements are 540 credits over a period of normally 5 years (and not more than 6 years) or part-time equivalent; the final three years being an approved honours programme of 300 credits, of which 60 credits are gained during the integrated year abroad, 90 credits are at 4000 level and at least a further 120 credits at 3000 and/or 4000 (H) levels. Refer to the appropriate Faculty regulations for lists of subjects recognised as qualifying towards either a B.Sc. or M.A. degree.

M.Sci. Honours (being phased out)
General requirements of 540 credits over a period of normally 4 years; of which 300 credits are in an approved honours programme. See earlier regulations.

M.Math. Honours
General requirements are 600 credits over a period of normally 5 years (and not more than 6 years) or part-time equivalent; the final three years being an approved honours programme of 360 credits, of which 120 credits are at 5000 level and at least a further 210 credits at 3000 and 4000 levels. General and Faculty of Science regulations apply. A special four year accelerated programme is available for students with Advanced Standing credits.

Other Information: In the case of students who spend part of the Honours Programme abroad on a recognised Exchange Scheme, the Programme Requirements will be amended to take into account courses taken while abroad.

The Honours syllabus is undergoing a major change commencing in 2002-03 and Programme requirements listed below are those for students entering the first year of the Honours Programme in 2002-03 or subsequently. Students entering the Second Year of the Honours programme in 2002-03 should refer to School Handbooks and consult Honours Advisers for the requirements of their honours programme.

Degree Programmes	Programme Requirements at:
(B.Sc. Honours or M.A. Honours): **Applied Mathematics (not available to entrants after 2002-03)**	**Single Honours Applied Mathematics Degree:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising a pass at 11 or better in both MT2001 and MT2003 **Level 3:** 60 credits comprising MT3501, MT3502, MT3503, MT3504 **Level 4(H):** At least 90 credits which must include: MT4601, MT4605; at least one of MT4111, MT4112; MT4599

Degree Programmes	Programme Requirements at:
(M.Math. Honours): **Applied Mathematics (M.Math Honours)**	**Single Honours M.Math. Applied Mathematics Degree:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising at least grade 15 in MT2001 and MT2003 **Level 3:** 60 credits comprising MT3501, MT3502, MT3503, MT3504 **Level 4(H):** 45-60 credits comprising MT4601, MT4605 at least one of MT4111, MT4112 **Level 5:** 120 credits comprising MT5999 and at least 60 credits from the level 5000 modules in Applied Mathematics
(B.Sc. Honours or M.A. Honours): **Mathematics** **Entrants in 2001 or before**	**Single Honours Mathematics Degrees:** **Level 1:** 20 credits comprising MT1002 **Level 2:** At least 60 credits comprising a pass at 11 or better in MT2001 or MT2101 and in one of MT2002 or MT2003 **Level 3:** 60 credits comprising MT3501, MT3502, MT3503, MT3504 **Level 4(H):** At least 90 credits which must include at least two of MT4601, MT4603, MT4604 and MT4605; MT4599; at least one of MT4111, MT4112.
(B.Sc. Honours or M.A. Honours): **Mathematics** **Entrants in 2002 and onwards**	**Single Honours Mathematics Degrees:** **Level 1:** 20 credits comprising MT1002 MT1007, MT1008, MT2004* *Gain credit in at least one of these three modules. **Level 2:** 60 credits comprising a pass at 11 or better in MT2001 or MT2101 and in one of MT2002, MT2003. **Level 3:** 60 credits comprising four of MT3501, MT3502, MT3503, MT3504, MT3606 **Level 4(H):** At least 90 credits which must include - at least two of MT4601, MT4603, MT4604 and MT4605; - MT4599; - at least one of MT4111, MT4112.
(B.Sc. Honours): **Mathematics and Physics**	**Mathematics element of Joint Degree:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 30-60 credits comprising passes at 11 or better in either (MT2001 and MT2003) or MT2101 **Level 3:** At least 30 credits comprising at least two of MT3501, MT3502, MT3503, MT3504; **Level 4(H):** At least 90 credits which must include from Mathematics - at least one of MT4601, MT4603, MT4604, MT4605; - at least one of MT4111, MT4112; - MT4599 but excluding MT4505

Degree Programmes	Programme Requirements at:
(B.Sc. Honours): **Mathematics and Computer Science, Chemistry, Economics, Geography, Internet Computing, Logic & Philosophy of Science, Management Science, Psychology.** (M.A. Honours): **Mathematics and Ancient History, Art History, Economics, Hebrew, Latin, Mediaeval History, Modern History, Philosophy, Psychology, Scottish History, Spanish^, Theological Studies.** ^ available also as 'with Integrated Year Abroad Degrees'	**Mathematics element of Joint Honours Degrees:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising Passes at 11 or better in MT2001 (or MT2101) and one of MT2002 or MT2003 **Level 3:** At least 30 credits comprising at least two of MT3501, MT3502, MT3503, MT3504; **Level 4(H):** At least 90 credits which must include from Mathematics - at least one of MT4601, MT4603, MT4604, MT4605; - at least one of MT4111, MT4112; - MT4599
(B.Sc. Honours): **Mathematics with French or German or Geography** (M.A. Honours) **Mathematics with Spanish**	**Mathematics element of Major Degree with a Modern Language:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising a pass at 11 or better in MT2001 or MT2101, and in one of MT2002 or MT2003 **Level 3:** 45 credits comprising at least three of MT3501 - MT3504; **Level 4(H):** At least 90 credits which must include from Mathematics - at least one of MT4601 – MT4605; - at least one of MT4111, MT4112; - MT4599
(B.Sc. Honours or M.A. Honours): **Mathematics and Statistics** **(no longer available to entrants after 2001-02)**	**Mathematics and Statistics Joint Honours Degree:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 90 credits comprising a pass at 11 or better in - MT2001 or MT2101 - MT2004 - and in one of MT2002, MT2003, MT2005 **Level 3:** At least 45 credits comprising MT3501; - at least one of MT3502, MT3503, MT3504; - MT3606 **Level 4(H):** At least 90 credits which must include - at least one of MT4601, MT4603, MT4604, and MT4605; - at least two of MT4607, MT4608,MT4609, MT4610; - at least one of MT4531, MT4606; - MT4599; - at least one of MT4111 and MT4112.

Degree Programmes	Programme Requirements at:
(M.Phys. Honours): **Mathematics and Theoretical Physics (applies to all students entering Third level 2002 onwards)**	**Mathematics and Theoretical Physics Joint M.Phys. Degree:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 30 - 60 credits comprising MT2101 or (MT2001 and MT2003) **Level 3:** 30 credits comprising MT3501 and MT3504 **Level 4(H):** At least 45 credits comprising at least three modules from MT4000 level, other than MT4505 **Level 5:** At least 70 credits comprising either MT5998 or PH5102 plus at least two at MT5000 level, other than MT5805
(M.Math Honours): **Pure Mathematics (M.Math Honours)**	**Single Honours M.Math Pure Mathematics Degree:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising at least grade 15 in one of MT2001, MT2101 together with grade 15 in MT2002 **Level 3:** 60 credits comprising MT3501, MT3502, MT3503, MT3504 **Level 4(H):** 45 credits comprising MT4603, MT4604; - at least one of MT4111, MT4112 **Level 5:** 120 credits comprising MT5999 and at least 60 credits from the level 5000 modules in Pure Mathematics
(M.Math Honours): **Mathematics (M.Math Honours)**	**Single Honours M.Math Mathematics Degree:** **Level 1:** 20 credits comprising MT1002 MT1007*, MT1008*, MT2004* * gain credit from one of these 3 modules **Level 2:** 90 credits comprising at least grade 15 in one of MT2001, MT2101, together with grade 15 in two of MT2002, MT2003, and MT2005 **Level 3:** 60 credits comprising four of MT3501, MT3502, MT3503, MT3504, MT3606 **Level 4(H):** 45 credits comprising at least 2 of MT4601, MT4603, MT4604, MT4605, MT4606 - at least one of MT4111, MT4112 **Level 5:** 120 credits comprising MT5999 and at least 80 credits from level 5000 modules
(B.Sc. Honours or M.A. Honours): **Pure Mathematics (no longer available to entrants after 2002-03)**	**Single Honours Pure Mathematics Degrees:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising passes at 11 or better in both (MT2001 or MT2101) and MT2002 **Level 3:** 60 credits comprising MT3501 - MT3504 **Level 4(H):** At least 90 credits which must include: MT4603, MT4604; at least one of MT4111, MT4112, MT4599

Degree Programmes	Programme Requirements at:
(B.Sc. Honours): **Quantitative Ecology (not available to entrants after 2001-02)**	**Single Honours Quantitative Ecology Degree:** **Level 1:** 20 credits comprising pass at 11 or better in MT1006 or MT1007 **Level 2:** 120 credits comprising passes at 11 or better in MT2001, MT2004, BL2001 and either BL2004 or BL2005. It is recommended that students take BL2005. **Level 3:** 45 credits comprising MT3501, MT3504, MT3606; at least 60 credits from BL3000 level modules **Level 4(H):** At least 90 credits including MT4599
(M.Math Honours): **Statistics (M.Math Honours)**	**Single Honours Statistics M.Math. Degree:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 30 credits comprising passes at 15 or better in MT2001 (or MT2101) and MT2004 **Level 3:** 30 credits comprising MT3501, MT3606 **Level 4(H):** At least 15 credits comprising at least one of MT4531, MT4606 **Level 5:** 120 credits comprising MT5999 and at least 60 credits from level 5000 modules in Statistics
(B.Sc. Honours): **Statistics and one of Computer Science, Economics, Geography, Logic & Philosophy of Science, Management Science.** (M.A. Honours): **Statistics and one of Economics, Philosophy**	**Statistics element of Joint Honours Degrees:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising passes at 11 or better in MT2001 (or MT2101) and MT2004 **Level 3:** 30 credits comprising MT3501; MT3606 **Level 4(H):** At least 90 credits which must include at least two of MT4531, MT4606, MT4607, MT4608, MT4609, MT4610; MT4599
(B.Sc. Honours): **Statistics with French or German**	**Statistics element of a Major Degree with a Modern Language:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising passes at 11 or better in MT2001 (or MT2101) and MT2004 **Level 3:** 30 credits comprising MT3501; MT3606. **Level 4(H):** At least 90 credits which must include - at least one of MT4531, MT4606; - at least two of MT4607 – MT4610; - MT4599
(B.Sc. Honours): **Statistics (not available to entrants after 2002-03)** (M.A. Honours): **Statistics (not available to entrants after 2002-03)**	**Single Honours Statistics Degrees:** **Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising passes at 11 or better in MT2001 (or MT2101) and MT2004 **Level 3:** 30 credits comprising MT3501, MT3606 **Level 4(H):** At least 90 credits which must include: at least one of MT4531, MT4606, at least 3 of MT4607, MT4608, MT4609, MT4610; MT4599

Degree Programmes	Programme Requirements at:
(M.Sci. Honours): **Applied Mathematics** **before 2001/02**	**Applied Mathematics (entrants in 2001 or earlier)** **Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising a pass at 17 or better in both MT2001 and MT2003 **Level 3:** 60 credits comprising MT3501 - MT3504 **Level 4(H):** 30 credits comprising MT4601, MT4605 **Level 5:** at least one of MT5611 and MT5612; - MT5999; - at least 120 credits from MT5803 – MT5850
(M.Sci. Honours): **Mathematics(M.Sci.) (entrants in 2001 or earlier)** **before 2001/02**	**Mathematics (entrants in 2001 or earlier)** **Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising passes at 17 or better in (MT2001 or MT2101) and one of MT2002 or MT2003 **Level 3:** 60 credits comprising MT3501 - MT3504; **Level 4(H):** 30 credits comprising at least two of MT4601 - MT4605 **Level 5:** 180 credits comprising at least one of MT5611 and MT5612; - MT5999; - at least 120 credits from MT5803 – MT5850
(M.Sci. Honours): **Mathematics and Statistics (M.Sci. Honours):** **(entrants in 2001 or earlier)** **before 2001/02**	**Level 1:** 20 credits comprising MT1002 **Level 2:** 90 credits comprising passes at 17 or better in both (MT2001 or MT2101) and MT2004 and also in one of MT2002, MT2003 or MT2005 **Level 3:** 30 credits comprising MT3501; at least one of MT3502 - MT3504; **Level 4(H):** At least 60 credits comprising one of MT4601 – MT4605, - - MT4606 or MT5701 - at least two of (MT4607 or MT5702), MT4610, (MT4608 or MT5704), (MT4609 or MT5705); **Level 5:** 180 credits comprisingMT4606 or MT5701 - at least two of (MT4607 or MT5702), (MT4608 or MT5704), (MT4609 or MT5705); - at least one of MT5611 or MT4612; - MT5999; - at least 120 credits from MT5701 – MT5850

Degree Programmes	Programme Requirements at:
(M.Sci. Honours): **Mathematics and Theoretical Physics (entrants 2000 or earlier)**	**(available only to those admitted to the University in September 2000 or earlier)** **Level 1:** 20 credits comprising MT1002 **Level 2:** 30 - 60 credits comprising passes in either MT2101 or (MT2001 and MT2003) plus the Physics requirements, the Mathematics passes being at 17 or better and the Physics passes being at 15 or better **Level 3:** (Mathematics element only) 60 credits comprising MT3501 and MT3504; either MT3502 or a level 4 module as specified below; either MT3503 or a level 4 module as specified below. **Level 4(H):** (Mathematics element only) subject to fulfilling prerequisite, any level 4 module other than MT4505 **Level 5:** (Mathematics element only) 80 credits comprising at least four modules from MT5611 – MT5850 other than MT5805; 30 credits from either MT5998 or physics equivalent.
(M.Sci. Honours): **Pure Mathematics (M.Sci. Honours) (entrants in 2001 or earlier)** **before 2001/02**	**Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising passes at 17 or better in both (MT2001 or MT2101) and MT2002 **Level 3:** 60 credits comprising MT3501 - MT3504; **Level 4(H):** 30 credits comprising MT4603, MT4604. **Level 5:** 180 credits comprising at least one of MT5611 and MT5612; - MT5999; - at least 120 credits from MT5803 – MT5850.
(M.Sci. Honours): **Statistics (M.Sci. Honours) (entrants in 2001 or earlier)** **before 2001/02**	**Level 1:** 20 credits comprising MT1002 **Level 2:** 60 credits comprising passes at 17 or better in MT2001 (or MT2101) and MT2004 **Level 3:** 15 credits comprising MT3501 **Level 4(H):** (MT4606 or MT5701), - (MT4607 or MT5702), - MT4610, - (MT4608 or MT5704), - (MT4609 or MT5705); **Level 5:** 180 credits comprising MT5999; - at least 140 credits from MT5701 – MT5850

Modules

Normally the prerequisite for each of the following Honours modules is entry to the Honours Programme(s) for which they are specified, as well as any additional specific prerequisite(s) given.

General degree and non-graduating students wishing to enter 3000 or 4000 level modules must consult with the relevant Honours Adviser within the School before making their selection.

The Prerequisite for each of the following 5000 modules is entry to the MSci , MPhys or MMath Programme(s) for which they are specified, as well as any additional specific prerequisite(s) given. An anti-requisite for each module is the corresponding 3000 or 4000 module.

MT3501 Linear Mathematics

Credits: 15.0 Semester: 1

Prerequisite: MT2001 or MT2101

Description: This module aims to show the importance of linearity in many areas of mathematics ranging from linear algebra through to geometric applications to linear operators and special functions. The main topics covered are: linear dependence and independence; change of basis; inner product spaces; inequalities; convergence in Euclidean spaces; Fourier series and adjoint and self-adjoint operators.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 10%, 2 Hour Examination = 90%

MT3502 Foundations of Calculus

Credits: 15.0 Semester: 2

Prerequisite: MT2001 or MT2101

Description: This module gives a rigorous treatment of topics in the calculus, some of which will already have been encountered from the point of view of calculation and application without considering questions of validity. Topics, which will be illustrated by many examples and counter-examples, may include: convergence of sequences and series, continuity, differentiability and applications to Taylor series, analysis in n dimensions, partial derivatives, the inverse function theorem.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 10%, 2 Hour Examination = 90%

MT3503 Complex Analysis

Credits: 15.0 Semester: 1

Prerequisite: MT2001 or MT2101

Description: This module aims to introduce students to analytic function theory and applications. The topics covered include: analytic functions; Cauchy-Riemann equations; harmonic functions; multivalued functions and the cut plane; singularities; Cauchy's theorem; Laurent series; evaluation of contour integrals; fundamental theorem of algebra; Argument Principle; Rouche's Theorem.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 10%, 2 Hour Examination = 90%

MT3504 Differential Equations

Credits: 15.0 Semester: 1

Prerequisite: MT2001 or MT2101

Description: The object of this module is to provide a broad introduction to analytical methods for solving ordinary and partial differential equations and to develop students' understanding and technical skills in this area. This module is a prerequisite for several other honours options. The syllabus includes: existence and uniqueness of solutions to initial-value problems; series solutions of second-order o.d.e.'s; examples including Bessel, Legendre and Airy equations; nonlinear o.d.e.'s; classification of second order linear p.d.e.'s; method of separation of variables; eigenvalues for boundary conditions of mixed type; characteristics and reduction to canonical form.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 10%, 2 Hour Examination = 90%

MT3606 Statistical Methods

Credits: 15.0 Semester: 1

Prerequisite: MT2004

Description: This module provides a bridge between second year and Honours modules in statistics. Topics covered include analysis of binomial and Poisson data, likelihood-based methods (including maximum likelihood estimation), introduction to Bayesian inference, continuous distributions, distributions of functions of random variables, the Central Limit Theorem, and nonparametric methods. The module covers some of the basic tools used by statisticians to develop a wide range of statistical methods.

Class Hour: 11.00 am.

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4111 Symbolic Computation

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2001 or MT2101

Anti-requisite: MT3611

Description: This module aims to enable students to use Maple as a tool in their other modules and to turn naturally to such a package when solving mathematical problems. The module aims to illustrate the following points: a symbolic computation package allows one to conduct mathematical experiments; a symbolic computation package allows one to collect data about a problem being studied. This is similar to the way other scientists work. It is easier to try several different approaches to a problem and see which works. The machine is stupid. Intelligence comes from the user. The user thinks, the user interprets, the computer calculates.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 30%, 2 Hour Examination = 70%

MT4112 Computing in Mathematics

Credits: 15.0 Semester: 2

Availability: 2003-04

Prerequisites: (MT2001 or MT2101), MT2003

Anti-requisites: MT3612, Honours or Joint Honours Programme in Computer Science.

Description: This module is intended to introduce students to FORTRAN and the writing of computer codes to implement mathematical algorithms. The module includes a basic introduction to FORTRAN, and the implementation of mathematical algorithms in a well-documented FORTRAN program. Students are required to complete a project in addition to sitting the examination.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project = 30%, 2 Hour Examination = 70%

MT4501 Topics in the History of Mathematics

Credits: 15.0 Semester: 2

Prerequisite: MT1002

Anti-requisite: MT3801

Description: The aim of this module is to give students an insight into the historical development of mathematics. Topics to be covered may include some of: the development of algebra, the origins of the calculus, the history of logarithms, the work of some individual mathematicians.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4502 Numerical Analysis

Credits: 15.0 Semester: 1

Prerequisites: MT2001 or MT2101

Anti-requisite: MT3802

Description: The module will introduce students to some topics in numerical analysis, including interpolation, best approximation, numerical integration, the numerical solution of ordinary differential equations, solution of systems of linear equations by elimination and by iterative methods.

Class Hours: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4503 Interpolation and Approximation

Credits: 15.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2001 or MT2101

Anti-requisite: MT3803

Description: This module aims to present some of the key ideas in interpolation and approximation. Topics may include Chebyshev polynomials and optimal interpolation points; Peano's theorem; Bernstein polynomials and Bernstein's proof of the Weierstrass theorem, rational approximation and Gaussian quadrature.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4504 The Sun

Credits: 15.0 Semester: 1

Prerequisites: MT2003, MT3601 or MT4601

Anti-requisite: MT3804

Description: This module is intended to introduce the basic observations and theories of solar physics, paying particular attention to solar magnetohydrodynamics. The syllabus includes: an outline of observational properties ranging from the solar interior to the Sun's outer atmosphere; theoretical aspects of solar magnetohydrodynamics; magnetic equilibria; MHD waves; coronal heating.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4505 Electromagnetism

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT3601 or MT4601

Anti-requisite: MT3805

Description: This module is intended to introduce students to the properties of electromagnetic waves, including the propagation of plane waves and guided waves, and the generation of waves by antennas, and to give an introduction to the motion of charged particles in electric and magnetic fields and some applications to plasma physics.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4506 Numerical Solution to Partial Differential Equations

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT3504 or MT3605 or MT4605

Anti-requisite: MT3806

Description: This module is intended to introduce students to some of the ideas, techniques and constraints that underpin modern approaches to the numerical modelling of physical processes that may be described by partial differential equations. The syllabus includes: convergence and stability of finite-difference approximations to initial value problems in one and two space dimensions; the investigation of dispersion and dissipation in the approximation of conservative laws.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4507 Classical Mechanics

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2003

Anti-requisite: MT3807

Description: The object of this module is to introduce students to some of the ideas and mathematical techniques used in understanding the behaviour of dynamical systems that obey Newton's Laws. These notions are arguably the foundations of physics and applied mathematics. The module will include: Newton's laws of motion; conservative forces; central forces; non-inertial/accelerating frames of reference; dynamics of a system of particles; mechanics of a rigid body; Euler's equations; Lagrange's equations; Hamilton's equations.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4508 Dynamical Systems

Credits: 15.0 Semester: 2

Availability: 2003-04

Prerequisite: MT3504

Anti-requisite: MT3808

Description: This module aims to introduce students to the basic ideas of the modern theory of dynamical systems and to the concepts of chaos and strange attractors. The module will include: period doubling; intermittency and chaos; geometrical approach to differential equations; homoclinic and heteroclinic orbits; Poincaré sections; the Smale horseshoe mapping; centre manifold theory.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4509 Fluid Dynamics

Credits: 15.0 Semester: 2

Prerequisite: MT3601 or MT4601

Anti-requisite: MT3809

Description: This module provides an introduction to the theory of incompressible fluid dynamics, which describes the motion of liquids and gases at speeds small compared to the sound speed. Topics include: review of basic fluid properties, conservation laws, potential flows, free surface flows, vorticity evolution, fundamentals of atmosphere and ocean fluid dynamics.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4511 Aysmptotic Methods

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT3504

Anti-requisite: MT3811

Description: This module is designed to introduce students to asymptotic and perturbation methods that give analytical approximations to integrals and solutions of differential equations. The module will include: definitions of asymptotic series and expansions; proof of Watson's lemma; Laplace's method; method of stationary phase; regular and singular perturbation methods for differential equations; boundary layer equations and the method of matched asymptotic expansions; WKB method.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4513 Fractal Geometry

Credits: 15.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2001 or MT2101

Anti-requisite: MT3813

Description: The aim of this module is to introduce the mathematics used to describe and analyse fractals and to show how the theory may be applied to examples drawn from across mathematics and science. The module discusses the philosophy and scope of fractal geometry; and may include topics such as dimension, representation of fractals by iterated function systems, fractals in other areas of mathematics such as dynamical systems and number theory, Julia sets and the Mandelbrot set.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4514 Graph Theory

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT1002

Anti-requisite: MT3814

Description: The aim of this module is to introduce students to the study of Graph Theory as a tool for representing connections between data. Topics to be covered may include: basic theory and applications, Eulerian graphs, Hamiltonian graphs, planar graphs, spanning trees and applications, networks, matching problems.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4515 Functional Analysis

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2002

Anti-requisite: MT3815

Description: This object of this module is to familiarise students with the basic notions of functional analysis, that is analysis on normed spaces and Hilbert space. The module will cover normed spaces, convergence and completeness, operators, Hilbert spaces and may include topics such as spectral theory and the Hahn-Banach theorem.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4516 Finite Mathematics

Credits: 15.0 Semester: 2

Availability: 2003-04

Prerequisite: MT1002

Anti-requisite: MT3816

Description: The aim of this module is to introduce students to some topics in the mathematics of combinatorial structures. This theory has wide applications, both in classical mathematics and in theoretical computer science. Topics to be covered may include: coding theory, finite geometries, Latin squares, designs.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4517 Rings and Fields

Credits: 15.0 Semester: 1

Availability: 2002-03

Prerequisite: MT2002

Anti-requisite: MT3817

Description: Historically, rings have appeared as generalisations of number systems (integers, in particular) with the intention of gaining deeper insight into number systems themselves. This will be reflected in this module, where students will study familiar concepts, such as factorisation, primeness, divisibility etc., in a new, more general, setting of commutative rings. In addition, the module may include topics from: rings of quotients, finite fields and extensions of fields.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4518 Topics in Geometry

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2002

Anti-requisite: MT3818

Description: The aim of this module is to introduce students to the field of Geometry and in particular to use the knowledge they have gained of Modern Algebra in other modules to elucidate both the areas of Euclidean and non-Euclidean geometry. The axiomatic approach to geometry originally introduced by the Ancient Greeks was modified in the 19th Century following the discovery of non-Euclidean geometries. A geometry can be regarded as being determined by its group of allowable transformations and in this module we will emphasise this approach. Topics to be covered may include: Euclidean geometry and the Euclidean group in R^2 and R^3, Projective geometry, Elliptic geometry, Hyperbolic geometry, an introduction to the topology of surfaces.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4519 Number Theory

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2002

Anti-requisite: MT3819

Description: The aim of this module is to introduce students to some topics in elementary number theory, ranging from problems first considered in ancient times to work stimulated by recent advances in computers. Topics to be covered may include: prime numbers, cryptography, continued fractions, Pell's equation, the Gaussian integers and writing numbers as sums of squares.

Class Hour: 10.00am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4520 Linear Algebra

Credits: 15.0 Semester: 1

Availability: 2003-04

Prerequisite: MT2002

Anti-requisite: MT3820

Description: This module extends the theory of vector spaces and linear mappings. The syllabus includes bases, the dimension theorem, eigenvalues and eigenvectors, the Cayley-Hamilton theorem, minimum polynomials, sums and direct sums of subspaces, the primary decomposition theorem, diagonalisation, similarity, various canonical forms.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4522 Metric and Topological Spaces

Credits: 15.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2002

Anti-requisite: MT3822

Description: This module extends ideas of convergence and continuity to the very general settings of metric spaces and topological spaces. Topics to be covered may include complete metric spaces and the contraction mapping theorem, compactness in metric spaces, topological spaces axiomatized via open sets, compactness and connectedness in topological spaces. Many examples and applications will be given.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4523 Semigroups

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2002

Anti-requisite: MT3823

Description: Semigroup theory is one of the newer algebraic disciplines, and is related to a number of fields of mathematics such as groups, theoretical computer science and universal algebra. In the first part of the module the students will learn fundamental concepts of semigroup theory, including those of subsemigroups, homomorphisms, congruences, as well as Green's structure theory. In the second part of the module this theory will be applied to study various kinds of semigroups such as: simple semigroups, inverse semigroups, regular semigroups, etc. Semigroup theory is one of the active research areas in the School, and the choice of topics will reflect this.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4524 Topics in Groups

Credits: 15.0 Semester: 2

Availability: 2003-04

Prerequisite: MT3603 or MT4603

Anti-requisite: MT3824

Description: This module continues the study of groups begun in MT3603. The main aim of this module is for students to get a deeper understanding of the internal structure of groups, and of different ways the groups may appear. The module may include topics from: the theory of permutation groups, representations of groups by matrices, soluble and nilpotent groups, group presentations and computational group theory. Group theory is one of the active research areas in the School, and the choice of topics will reflect this.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4525 Topics in Modern Analysis

Credits: 15.0 Semester: 2

Availability: 2003-04

Prerequisite: MT3604 or MT4604

Anti-requisite: MT3825

Description: This module introduces some of the powerful techniques and ideas of modern mathematical analysis that are important both in analysis in its own right and in its many applications in mathematics and science. Topics to be covered may include: measure theory, the ergodic theorem, martingale theory, Fuchsian groups. Analysis is one of the active research areas in the School, and the choice of topics will reflect this.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4527 Forecasting

Credits: 15.0 Semester: 1

Availability: 2002-03

Prerequisite: MT2004

Anti-requisite: MT3827

Description: This module is intended to compare the relative merits of ‘classical’ moving average and exponential smoothing techniques and the Box-Jenkins approach to forecasting time series. The syllabus includes: introduction to time series models; simple models; exponential smoothing; linear trend processes; seasonal models; moments for stochastic processes; stationary processes; white noise processes; mixed models; non-stationary models; partial autocorrelation (PACF); the estimation stage of ARMA modelling; diagnostic checking using residuals; point and interval predictions.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4530 Population Genetics

Credits: 15.0 Semester: 1

Availability: 2003-04

Prerequisite: MT1004 or MT2004

Anti-requisite: MT3830

Description: This module aims to show how mathematical models may be used to study the evolution of populations and how statistical techniques may be used to investigate model validity. The syllabus includes: an introduction to Mendelian genetics; dominance; pairs of alleles; the Hardy-Weinberg principle; non-random mating populations; selfing; selection; mutation.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4531 Bayesian Inference

Credits: 15.0 Semester: 2

Availability: 2003-04

Prerequisite: MT3701 or MT3606

Anti-requisite: MT3831

Description: This module is intended to offer a re-examination of standard statistical problems from a Bayesian viewpoint and an introduction to areas, such as sequential estimation and sequential hypothesis testing, to which the Bayesian decision theoretic approach is ideally suited. The syllabus includes: Bayes theorem (discrete and continuous cases); inference based on the normal distribution; statistical decision theory; Bayes actions and Bayes rules; computational Bayes methods.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial and practical classes.

Assessment: Continuous Assessment = 20%, 2 Hour Examination = 80%

MT4532 Mathematical Programming

Credits: 15.0 Semester: 2

Availability: 2003-04

Prerequisites: MT1002, MT2001

Anti-requisite: MT3832

Description: The aim of this module is to introduce students to the formulation and solution of various linear programming problems. The subject matter will be illustrated by applying the methods of solution to real examples. The syllabus includes: formulation of linear problems; solution graphically and by simplex algorithm; sensitivity analysis; duality; transportation and transshipment; the assignment problem; non-linear programming; integer programming.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4533 Utilities, Decisions and Inventories

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT1004 or MT2004

Anti-requisite: MT3833

Description: This module is intended to provide an introduction to the formulation and solution of problems of decision-taking and problems in the management of inventory systems for a single item, to motivate the need for utility functions, and to explain how they are assessed and employed. The syllabus includes: decision theory; maximum and Bayesian approaches; Bayes theorem; Bellman’s optimality principle; utility theory; utility functions; inventory theory.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4534 Ecological Modelling

Credits: 15.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2001 or MT2101

Anti-requisite: MT3834

Description: This module is intended to introduce the key concepts in theoretical population biology through a series of case studies, in order to give students the tools with which to build and analyse their own models. Topics will be drawn from: differential equations, matrix models, individual-based models, cellular automata; equilibria and stability; linearisation; non-linear dynamics and chaos; model formulation; parameter estimation; validation and prediction; sensitivity analysis; inverse problems; demographic and environmental stochasticity; structured populations; spatially explicit models.

Class Hour: 10.00 am

Teaching: Two lectures and one laboratory.

Assessment: Essay = 10%, 2 Hour Examination = 90%

MT4535 Wildlife Population Assessment

Credits: 15.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2004

Anti-requisite: MT3835

Description: This module is intended to enable students to design appropriate surveys for assessing abundance of an animal population, to formulate simple statistical models for survey data and derive estimators, to analyse data competently, and to conduct a small survey from conception to final report. The syllabus includes: likelihood framework for distance sampling; general estimating equation; line and point transects; hazard-rate formulations; clustered populations and size-biased sampling; stratification and covariates; variance and interval estimation; the bootstrap; estimation when detection at the line or point is not certain; survey design; field methods; related methods; including strip transects, quadrat counts; cue-counting, trapping webs and migration counts; monitoring trends in abundance; mark-recapture and recovery methods; removal methods; catch per unit effort; change-in-ratio.

Class Hour: 11.00 am

Teaching: Two lectures and one laboratory.

Assessment: Project Report = 25%, 2 Hour Examination = 75%

MT4538 Robust Statistical Methods

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2004

Anti-requisite: MT3838

Description: Classical and modern robust methods for data analysis are described. Permutation tests and intervals and Monte Carlo tests, which span both classical methods and modern, computer-intensive methods, are covered, as are some more recent computer-intensive methods, notably the bootstrap. Illustrations are given of the application of modern methods to standard statistical problems; the emphasis for classical methods is on order statistics and ranking methods.

Class Hour: 11.00 am

Teaching: Two lectures and one laboratory.

Assessment: Continuous Assessment = 30%, 2 Hour Examination = 70%

MT4550 Lattice Theory

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2002

Anti-requisite: MT3850

Description: The aim of the module is to introduce students to the basic ideas of ordered sets and lattices, with particular emphasis on various types of distributive lattices. The syllabus comprises: ordered sets and isotone mappings; infima and suprema; lattices and lattice morphisms; complete lattices; modular lattices, distributive lattices, and their Birkhoff characterisations; representation of a distributive lattice as a ring of sets; join-irreducible elements and finite duality; complementation and Boolean algebras; connection with boolean rings; the Lindenbaum-Tarski theorem; congruences; principal congruences, the lattice of congruences; implicative lattices and pseudocomplemented lattices.

Class Hour: To be arranged.

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4551 Financial Mathematics

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2001

Anti-requisite: MT3851

Description: Students are introduced to the application of mathematical models to financial instruments. The course will include an overview of financial markets and the terminology in common usage but the emphasis will be on the mathematical description of risk and return as a means of pricing contracts and options.

Class Hour: To be arranged.

Teaching: 2 lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4599 Project in Mathematics/Statistics

Credits: 15.0 Semester: Whole Year

Anti-requisite: MT3999

Description: The student will choose a project from a list published annually although a topic outwith the list may be approved. Students will be required to report regularly to their supervisor and a report of no more than 5,000 words must be submitted by the end of the April.

Assessment: Project = 100%

MT4601 Fundamentals of Applied Mathematics

Credits: 15.0 Semester: 1

Prerequisites: (MT2001 and MT2003) or MT2101

Anti-requisite: MT3601

Description: This module is designed to introduce students to the mathematical methods which are needed to go on to further study of fluid mechanics, magnetohydrodynamics and electromagnetism. It consists of a revision of the techniques of vector calculus, followed by a discussion of the basic equations of fluid dynamics and electromagnetism. The properties of these equations are then illustrated by considering some basic properties of fluid flow and of magnetohydrodynamics.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4603 Groups

Credits: 15.0 Semester: 1

Prerequisite: MT2002

Anti-requisite: MT3603

Description: This module introduces students to group theory, which is one of the central fields of the 20th century mathematics. The main theme of the module is classifying groups with various additional properties, and the development of tools necessary in this classification. In particular, the students will meet the standard algebraic notions, such as substructures, homomorphisms, quotients and products, and also various concepts peculiar to groups, such as normality, conjugation and Sylow theory. The importance of groups in mathematics, arising from the fact that groups may be used to describe symmetries of any mathematical object, will be emphasised throughout the module.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4604 Real Analysis

Credits: 15.0 Semester: 1

Prerequisite: MT2002

Anti-requisite: MT3604

Description: This module continues the development of real analysis started in MT2002. Topics that will be treated from a rigorous point of view may include: differentiation, Riemann integration, uniform convergence, function spaces.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4605 Linear and Nonlinear Waves

Credits: 15.0 Semester: 1

Prerequisites: MT2003, MT2001 or MT2101

Anti-requisite: MT3605

Description: This module gives an introduction to wave motion and its importance in many areas of applied mathematics. It begins with a discussion of the linear approximation for small amplitude waves and discusses properties of these such as dispersion relations, phase and group velocities, dissipation and dispersion. Some nonlinear effects such as wave steepening are then treated and an introduction given to some of the equations, for example Burger's and Korteweg de Vries, which are used to model nonlinear wave propagation.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4606 Statistical Inference

Credits: 15.0 Semester: 1

Prerequisites: (MT2001 or MT2101), MT2004, (and MT3606 from 2003-04)

Anti-requisite: MT3701

Description: This module aims to show how the methods of estimation and hypothesis testing met in first and second year can be justified and derived; to extend those methods to a wider variety of situations; to show how different point estimators can be compared; to provide an introduction to the Bayesian approach to inference. The syllabus includes: distribution theory; point estimation; mean square error; unbiasedness; Fisher information; the Cramer-Rao lower bound; maximum likelihood estimation; hypothesis-testing; Bayesian inference.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4607 Generalized Linear Models and Data Analysis

Credits: 15.0 Semester: 1

Prerequisite: MT2004

Co- (or pre-)requisite:MT3501

Anti-requisite: MT3702

Description: This module aims to demonstrate the power and elegance of unifying a large number of simple statistical models within the general framework of the generalized linear model. It will train students in the interpretation, analysis and reporting of data, when a single response measurement is interpreted in terms of one or a number of other variables.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial and practical classes.

Assessment: Project = 20%, 2 Hour Examination = 80%

MT4608 Sampling Theory

Credits: 15.0 Semester: 2

Availability: 2002-03

Prerequisite: one of MT1004, MT1006, MT1007 or MT2004

Anti-requisite: MT3704

Description: The aims of this module are to introduce students to and interest them in the principles and methods of design-based inference, to convince them of the relevance and utility of the methods in a wide variety of real-world problems, and to give them experience in applying the principles and methods themselves. By the end of the module students should be able to recognise good and poor survey design and analysis, to decide upon and implement the main types of survey design in relatively straightforward settings, and analyse the resulting survey data appropriately. The syllabus includes fundamentals of design based *vs* model-based inference, simple random sampling, sampling with replacement, ratio and regression estimators, stratified sampling, cluster sampling, unequal probability sampling and questionnaire design.

Class Hour: 12.00 noon

Teaching: Two lectures, one tutorial and practical classes.

Assessment: Project = 15%, 2 Hour Examination = 85%

MT4609 Multivariate Analysis

Credits: 15.0 Semester: 1

Availability: 2002-03

Prerequisites: MT2004 and (MT2001 or MT3501)

Anti-requisite: MT3705

Description: This module aims to introduce students to the ideas and techniques of multivariate statistical analysis. The syllabus includes mean vectors, covariance matrices, correlation matrices; basic properties of multivariate normal distributions; checking multivariate normality; the likelihood ratio and union-intersection principles for constructing multivariate tests; the one-sample and two-sample Hotelling's T-squared tests; tests on covariance matrices, tests of independence; linear discriminant analysis; principal components analysis; canonical correlation.

Class Hour: 9.00 am

Teaching: Two lectures, one tutorial and practical classes.

Assessment: 2 Hour Examination = 100%

MT4610 Markov Chains and Processes

Credits: 15.0 Semester: 1

Availability: 2003-04

Prerequisite: MT2004

Anti-requisite: MT3706

Description: This module provides an introduction to the theory of stochastic processes and to their use as models, including applications to population processes and queues. The syllabus includes the Markov property, the Chapman-Kolmogorov equations, classification of states of Markov chains, decomposition of chains, stationary distributions, random walks, branching processes, the Poisson process, birth-and-death processes and their transient behaviour, embedded chains, Markovian queues.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT5611 Advanced Symbolic Computation

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2001 or MT2101

Anti-requisite: MT4611

Description: This module aims to enable students to use Maple as a tool in their other modules and to turn naturally to such a package when solving mathematical problems. The module aims to illustrate the following points: a symbolic computation package allows one to conduct mathematical experiments; a symbolic computation package allows one to collect data about a problem being studied. This is similar to the way other scientists work. It is easier to try several different approaches to a problem and see which works. The machine is stupid. Intelligence comes from the user. The user thinks, the user interprets, the computer calculates. Students will undertake a more substantial project than that required for MT4111.

Class Hour: 9.00 am

Teaching: Two lectures, one tutorial

Assessment: Project = 45%, 2 Hour Examination = 55%

MT5612 Advanced Computing in Mathematics

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisites: (MT2001 or MT2101), MT2003

Anti-requisite: MT4612

Description: This module consists of MT4112 with the addition of directed study on more advanced topics not covered in MT4112, for example, the use of NAG libraries and graphics packages plus aspects of Fortran 90 like dynamic allocatable arrays. In addition, the computing project will be more demanding than the project for MT4112. The syllabus includes: an introduction to good programming style through examples; the construction of a well documented Fortran program that implements a numerical algorithm; use of the advanced features of Fortran to, for example, (i) manipulate matrices, (ii) read and write to data files, (iii) implement library routines and (iv) use graphics packages. The students will also complete an advanced project that contributes up to 35% of the final marks for the module.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project = 35%, 2 Hour Examination = 65%

MT5701 Advanced Statistical Inference

Credits: 20.0 Semester: 1

Prerequisites: (MT2001 or MT2101), MT2004, (and MT3606 from 2003-04)

Anti-requisite: MT4701

Description: This module consists of MT4606 with the addition of directed reading on more advanced aspects of the subject and a requirement to write a review essay on an aspect of the subject. The syllabus will include: distribution theory – negative binomial, multinomial, gamma, beta, t and F distributions; point estimation – Mean square error; unbiasedness; sufficiency; the efficient score; Fisher Information; the Cramér-Rao lower bound; exponential families; attainment of the Cramér-Rao lower bound; multi-dimensional Cramér-Rao inequality; maximum likelihood estimation; consistency and asymptotic efficiency; hypothesis testing – Neyman-Pearson Lemma; uniformly most powerful tests; likelihood ratio tests; confidence sets – Pivotal quantities; Bayesian Inference – Bayes Theorem; highest posterior density intervals; Bayes estimators; prior distributions and subjective probability; conjugate priors.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project = 25%, 2 Hour Examination = 75%

MT5702 Advanced Generalized Linear Models and Data Analysis

Credits: 20.0 Semester: 1

Prerequisite: MT2004

Co-requisite: MT3501

Anti-requisite: MT4702

Description: This module aims to demonstrate the power and elegance of unifying a large number of simple statistical models within the framework of the generalized linear model. It will train students in the interpretation, analysis and reporting of data, when a single response measurement is interpreted in terms of one or a number of other variables. As well as studying the material covered in MT4607, students will undertake a substantial piece of project work.

Class Hour: 11.00 am

Teaching: 2 lectures, 1 tutorial, practical classes and project related tutorials.

Assessment: Project = 40%, 2 Hour Examination = 60%

MT5704 Advanced Sampling Theory

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisite: MT1004 or MT1007 or MT2004

Anti-requisite: MT4704

Description: This module comprises MT4608 but with a more advanced project which will require some or all of the following: supplementary reading, a literature review, a critique of a survey, questionnaire and survey design, survey implementation, and data analysis. The primary goal of the advanced project will be to have students investigate in greater depth one or more specific topics encountered in MT4608.

Class Hour: 12.00 noon

Teaching: Two lectures, one tutorial and practical classes.

Assessment: Project = 25%, 2 Hour Examination = 75%

MT5705 Advanced Multivariate Analysis

Credits: 20.0 Semester: 1

Availability: 2002-03

Prerequisites: MT2004, (MT2001 or MT3501)

Anti-requisite: MT4705

Description: This module consists of MT4609 with the addition of directed reading on more advanced aspects of the subject and the requirement for students to analyse a data set. The syllabus includes: properties of the mutlivariate normal distribution; checking mutlivariate normality; hypothesis testing; the likelihood ratio and union-intersection principles; one-sample and two-sample Hotelling T^2 tests; tests on covariance matrices; tests of independence; discriminant analysis; principal components analysis; canonical correlation; analysis of data using a computer package.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project = 25%, 2 Hour Examination = 75%

MT5803 Advanced Interpolation and Approximation

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2001 or MT2101

Anti-requisite: MT4803

Description: This module covers the material of MT4503, with the addition of topics, covered by directed reading and/or additional lectures, requiring a much more mature understanding of analysis.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5804 Advanced - The Sun

Credits: 20.0 Semester: 1

Prerequisite: MT2003 or MT3601 or MT4601

Anti-requisite: MT4804

Description: This module consists of MT4504 with the addition of directed reading on more advanced aspects of the subject and a requirement for students to carry out a detailed analytical investigation of a particular system or a detailed literature survey of a specific area. The syllabus includes: observations of the Sun and its magnetic phenomena; the equations of magnetohydrodynamics, their properties and application to solar magnetism; convection and diffusion of magnetic field; magnetic equilibria, force-free fields, magnetic flux tubes; MHD waves; waves in magnetic flux tubes, intense tubes, sunspots, coronal loops; coronal heating; prominences; Solar wind; helioseismology.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5805 Advanced Electromagnetism

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisite: MT3601 or MT4601

Anti-requisite: MT4805

Description: This module is an extension of MT4505 to include (i) the application of particle orbit theory to plasmas, (ii) the propagation of waves in plasmas. The syllabus also includes: electric and magnetic fields and polarisation; Maxwell's equations; wave equation for fields, properties of plane waves and Fresnel's relations; Poynting's theorem and energy flow; scalar and vector potential and the inhomogeneons wave equation; Green's function solution and retarded potentials; radiation from dipole and half wave antennas, and arrays of antennas; wave guides; motion of charged particles, adiabatic invariants and guiding centre drifts; particle orbit theory and its use in plasma physics; wave propagation in plasmas, cold plasm dispersion relation, cut-offs and resonances, CMA diagram, warm plasma modifications of cold plasma theory.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5806 Advanced Numerical Solution of Partial Differential Equations

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisite: MT3504 or MT3605 or MT4605

Anti-requisite: MT4806

Description: This module consists of MT4506 with the addition that students will be required to gain expertise in a programming language and undertake computational projects. The syllabus includes: convergence and stability of finite-difference approximations to initial value problems in one and two space dimensions; the investigation of dispersion and dissipation in the approximation of conservative laws.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Project = 25%, 2 Hour Examination = 75%

MT5807 Advanced Classical Mechanics

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2003

Anti-requisite: MT4807

Description: The module consists of MT4507 with the addition of directed reading on advanced topics. The students will be asked to complete extra tutorial sheets covering the advanced material. The following material will also be covered: Newton's laws of motion – dynamics of a particle; momentum and energy; conservative forces – energy conservation; central forces – angular momentum conservation – planetary orbits; non-inertial/accelerating frames of reference, principle of equivalence, coriolis and centrifugal forces; dynamics of a system of particles; mechanics of a rigid body, moments and products of inertia, principal axes, impulsive forces, Euler's equations; Lagrange's equations, principle of least action, generalised co-ordinates, Euler's angles, Hamilton's equations.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5808 Advanced Dynamical Systems

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT3504

Anti-requisite: MT4808

Description: This module consists of MT4508 with the addition of directed reading on more advanced or technical aspects of the subject and a requirement for students to carry out a detailed analytic and numerical investigation of a particular system. The syllabus includes: discrete and continuous dynamical systems; period doubling, intermittency, bifurcations and chaos in mappings and differential systems; homoclinic and heteroclinic points and orbits and their role in the development of chaos; the Smale horseshoe mapping and symbolic dynamics; the bifurcations of codimension one and the use of centre manifold theory; Melnikov's method; Strange attractors, dimension and Lyapunov exponents; Hamiltonian dynamics and the Kolmogorov-Arnold-Moser theorem.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project = 25%, 2 Hour Examination = 75%

MT5809 Advanced Fluid Dynamics

Credits: 20.0 Semester: 2

Prerequisite: MT3601 or MT4601

Anti-requisite: MT4809

Description: This module consists of the module MT4509 with the addition of directed reading on more advanced aspects of the subject such as, compressible flow. Topics covered in MT3809 include: review of basic fluid properties, conservation laws, potential flows, free surface flows, vorticity evolution, fundamentals of atmosphere and ocean fluid dynamics.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5811 Advanced Asymptotic Methods

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisites: MT3503, MT3504

Anti-requisite: MT4811

Description: This module consists of MT4511 with the addition of directed reading on more advanced topics in both Asymptotic Analysis and Perturbation Theory. The advanced topics may include, for example, the method of steepest descents, advanced boundary layer methods and the Langer transformation for two turning point problems in WKB theory. Students will be asked to complete more demanding tutorial sheets and carry out detailed calculations using these more advanced techniques. The syllabus will include that for MT4511 plus advanced asymptotic and perturbation methods. For example, additional methods could be chosen from (i) the method of steepest descents, (ii) advanced boundary layer methods and (iii) Langer transformations for turning point problems.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5813 Advanced Fractal Geometry

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisites: MT2001 or MT2101

Anti-requisite: MT4813

Description: This module consists of MT4513 with the addition of tutorials and directed reading on extensions of the subject and more sophisticated mathematical analysis. The aim of this module is to introduce the mathematics used to describe and analyse fractals and to show how the theory may be applied to examples drawn from across mathematics and science. The module discusses the philosophy and scope of fractal geometry; and covers concepts such as dimension, representation of fractals by iterated function systems, fractals in other areas of mathematics such as dynamical systems and number theory, Julia sets and the Mandelbrot set.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5814 Advanced Graph Theory

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisite: MT1002

Anti-requisite: MT4814

Description: This module includes and extends the contents of MT4514. Additional topics to be covered may include: applications of graphs to groups and other algebraic structures, automorphism groups, further algorithms, complexity of algorithms.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project = 25%, 2 Hour Examination = 75%

MT5815 Advanced Functional Analysis

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2002

Anti-requisite: MT4815

Description: This module consists of MT4515 with additional advanced material leading to a project. The module will familiarise students with the basic notions of functional analysis, that is analysis on normed spaces and Hilbert space. The module will cover normed spaces, convergence and completeness, operators, Hilbert spaces and topics such as spectral theory and the Hahn-Banach theorem.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Project =25%, 2 Hour Examination = 75%

MT5816 Advanced Finite Mathematics

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT1002

Anti-requisite: MT4816

Description: This module includes and extends the contents of MT4516. Additional topics to be covered may include: Boolean algebras, further combinatorial structures.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial

Assessment: 2 and-a-half Hour Examination = 100%

MT5817 Advanced Rings and Fields

Credits: 20.0 Semester: 1

Availability: 2002-03

Prerequisite: MT2002

Anti-requisite: MT4817

Description: This module consists of MT4517 together with additional advanced material, which is designed to give students a deeper understanding of the structure of rings and fields and their applications. It may include topics from radical theory, semisimplicity, Galois theory and primary ideals and decompositions.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project =25%, 2 Hour Examination = 75%

MT5818 Advanced Topics in Geometry

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2002

Anti-requisite: MT4818

Description: This module includes and extends the contents of MT4518. Additional topics to be covered may include: crystallographic and frieze groups and their classification, an introduction to algebraic topology.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half hour examination = 100%

MT5819 Advanced Number Theory

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2002

Anti-requisite: MT4819

Description: This module includes and extends the contents of MT4519. Additional topics to be covered may include: quadratic reciprocity, quadratic forms, arithmetic functions, further Diophantine equations.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half hour examination = 100%

MT5820 Advanced Linear Algebra

Credits: 20.0 Semester: 1

Availability: 2003-04

Prerequisite: MT2001

Anti-requisite: MT4820

Description: This module consists of MT4520 with the addition of more advanced material. The syllabus includes bases, the dimension theorem, eigenvalues and eigenvectors, the Caley-Hamilton theorem, minimum polynomials, sums and direct sums of subspaces, the primary decomposition theorem, diagonalisation , similarity, various canonical forms.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5822 Advanced Metric and Topological Spaces

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2002

Anti-requisite: MT4822

Description: This module consists of MT4522 with additional advanced material leading to a project. This module extends ideas of convergence and continuity to very general settings. Topics include metric spaces, completeness and the contraction mapping theorem, compactness, topological spaces axiomatized via open sets, compactness and connectedness.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project = 25%, 2 Hour Examination = 75%

MT5823 Advanced Semigroups

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2002

Anti-requisite: MT4823

Description: This module will consist of MT4523, together with additional advanced material, designed to take students to the frontiers of current research in semigroup theory. It may contain topics from: semigroup presentations, decidability problems, finiteness conditions, amalgamation, matrix semigroups and semigroup varieties.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5824 Advanced Topics in Groups

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT3603

Anti-requisite: MT4824

Description: This module will consist of MT4524 together with additional advanced material, in which the results from the basic part of the module will be used to obtain deeper information about finite groups of small orders, simple groups, solubility problems for finitely presented groups and Burnside type problems. This additional part of the module will be designed so as to give students a taste of the current research in group theory.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project =25%, 2 Hour Examination = 75%

MT5825 Advanced Topics in Modern Analysis

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT3604 or MT4604

Anti-requisite: MT4825

Description: This module consists of MT4525 with additional advanced material leading to a project. This module introduces some of the powerful techniques and ideas of modern mathematical analysis that are important both in analysis in its own right and in its many applications in mathematics and science. The module will include topics such as: measure theory, the ergodic theorem, martingale theory, Fuchsian groups. Analysis is one of the active research areas at the school, and the choice of topics will reflect this.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project =25%, 2 Hour Examination = 75%

MT5831 Advanced Bayesian Inference

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT3701 or MT4606

Description: This module consists of MT4531 with an additional project which will give consideration to some more advanced aspects of the theory or to the application of Bayesian techniques. This may involve either directed reading or the use of the computer for simulation or data-based analyses. Foundations include: Bayes theorem (discrete and continuous cases); summarising posterior distributions; prediction; sufficiency; non-informative priors. Inference based on the Normal distribution includes: inference and prediction for a Normal sample; inverse gamma and Normal-gamma distributions; univariate Normal linear regression; prediction of observations satisfying a fitted linear model. Statistical Decision Theory includes: Bayes actions and Bayes rules; sampling costs; initial determination of sample size; one-step-look-ahead rules; optimal bounded sequential procedures; unbounded decision problems; approximation of optimal procedures by bounded procedures; computational Bayes methods.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial and practical classes.

Assessment: Project = 40%, 2 Hour Examination = 60%

MT5832 Advanced Mathematical Programming

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisites: MT1002, MT2001

Anti-requisite: MT4832

Description: This module consists of MT4532 with the addition of directed reading on more advanced aspects of the subject and a requirement for students to carry out a project. The syllabus includes: formulation of linear programming problems; solution graphically and by use of the simplex algorithm; sensitivity analysis; the dual problem and its relation to the primal problem; the transportation problem and its solution using the North West Corner method and Vogel's rule; the assignment problem and its solution; transshipment; nonlinear programming; integer programming.

Class Hour: 12.00 noon

Assessment: Project = 25%, 2 Hour Examination = 75%

MT5834 Advanced Ecological Modelling

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2001 or MT2101

Anti-requisite: MT4834

Description: This module consists of MT4534 with the addition of an advanced project, in the form of a literature review or a project on some aspect of modelling.

Class Hour: 10.00 am

Teaching: Two lectures and one laboratory.

Assessment: Essay = 10%, Advanced Project Report = 25%, 2 Hour Examination = 65%

MT5835 Advanced Wildlife Population Assessment

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2004

Anti-requisite: MT4835

Description: This module consists of MT4535 with the addition of an advanced project, which might cover any aspect of the module.

Class Hour: 11.00 am

Teaching: Two lectures and one laboratory.

Assessment: Advanced Project Report = 45%, 2 Hour Examination = 55%

MT5838 Advanced Robust Statistical Methods

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisite: MT2004

Anti-requisite: MT4838

Description: This module consists of MT4538 with the addition of an advanced project, which might cover any aspect of the module.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 20%, Advanced Project = 25%, 2 Hour Examination = 55%

MT5850 Advanced Lattice Theory

Credits: 20.0 Semester: 2

Availability: 2002-03

Prerequisites: MT2002

Anti-requisite: MT4850

Description: This module consists of MT4550 with the addition of more advanced material. The aim of the module is to introduce students to the basic ideas of ordered sets and lattices, with particular emphasis on various types of distributive lattices. The syllabus includes: ordered sets and isotone mappings; infima and suprema; lattices and lattice morphisms; complete, modular, and distributive lattices and their Birkhoff characterisations; representation of a distributive lattice as a ring of sets; join-irreducible elements and finite duality; complementation and Boolean algebras; connection with boolean rings; the Lindenbaum-Tarski Theorem; congruences, principal congruences, the lattice of congruences; implicative and pseudo-complemented lattices; introduction to Ockham algebras.

Class Hour: To be arranged.

Teaching: Two lectures and one tutorial.

Assessment: Project = 25%, Two Hour Examination = 75%

MT5998 Advanced Project in Mathematics/Statistics

Credits: 30.0 Semester: Whole Year

Prerequisite: Entry to the MSci or MPhys degree in Mathematics and Theoretical Physics

Anti-requisites: MT4998, MT4999, MT5999

Description: The project will be chosen from an approved list of topics and the credit rating will reflect the content and depth of an investigation involved.

Assessment: Project = 100%

MT5999 Advanced Project in Mathematics/Statistics

Credits: 40.0 Semester: Whole Year

Anti-requisites: MT4998, MT5998, MT4999

Description: This is a more substantial project which, for M.Sci. students will replace the existing Honours project. The project will be chosen from an approved list of topics. The student may be required to review current literature and investigate a topic in some depth.

Assessment: Project = 100%