2020/1 - MTHA4003Y REAL ANALYSIS

Full Year, Level 4 module
(Maximum 100 Students)
UCU: 20 Organiser: Dr Helen Crowley
(UG) MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:E
Exam Paper(hrs):

We will explore the mathematical notion of a limit and see the precise definition of the limit of a sequence of real numbers and learn how to prove that a sequence converges to a limit. After studying limits of infinite sequences, we move on to series, which capture the notion of an infinite sum. We then learn about limits of functions and continuity. Finally, we will learn precise definitions of differentiation and integration and see the Fundamental Theorem of Calculus.

2020/1 - MTHA4006Y ALGEBRA 1

Full Year, Level 4 module
(Maximum 120 Students)
UCU: 20 Organiser: Dr Robert Gray
(UG) MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:H

Algebra plays a key role in pure mathematics and its applications. We will provide you with a thorough introduction and develop this theory from first principles. In the first semester, we consider linear algebra and in the second semester, we move on to group theory. In the first semester, we develop the theory of matrices, mainly (though not exclusively) over the real numbers. The material covers matrix operations, linear equations, determinants, eigenvalues and eigenvectors, diagonalization and geometric aspects. We conclude with the definition of abstract vector spaces. At the heart of group theory in Semester 2 is the study of symmetry and the axiomatic development of the theory. The basic concepts are subgroups, Lagrange's theorem, factor groups, group actions and the Isomorphism Theorem.

2020/1 - MTHA4007Y COMPUTATION AND MODELLING

Full Year, Level 4 module
(Maximum 120 Students)
UCU: 20 Organiser: Professor David Stevens
(UG) MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:F

WHILE TAKING THIS MODULE YOU MUST TAKE MTHA4001Y AND TAKE

MTHA4008Y

Computation and modelling are essential skills for the modern mathematician. While many applied problems are amenable to analytic methods, many require some numerical computation to complete the solution. The synthesis of these two approaches can provide deep insight into highly complex mathematical ideas. This module will introduce you to the art of mathematical modelling, and train you in the computer programming skills needed to perform numerical computations. A particular focus is classical mechanics, which describes the motion of solid bodies. Central to this is Newton's second law of motion, which states that a mass will accelerate at a rate proportional to the force imposed upon it. This leads to an ordinary differential equation to be solved for the velocity and position of the mass. In the simplest cases the solution can be constructed using analytical methods, but in more complex situations, for example motion under resistance, numerical methods may be required. Iterative methods for solving nonlinear algebraic equations are fundamental and will also be studied. Further examples drawn from pure mathematics and statistics demonstrate the power of modern computational techniques.

2020/1 - MTHA5004Y DIFFERENTIAL EQUATIONS AND APPLIED METHODS

Full Year, Level 5 module
(Maximum 90 Students)
UCU: 20 Organiser: Professor Emilian Parau
(UG) MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:C
Exam Paper(hrs):

BEFORE TAKING THIS MODULE YOU MUST TAKE MTHA4005Y
IN TAKING THIS MODULE YOU CANNOT TAKE MTHB5006A

(a) Ordinary Differential Equations: solution by reduction of order; variation of parameters for inhomogeneous problems; series solution and the method of Frobenius. Legendre's and Bessel's equations: Legendre polynomials, Bessel functions and their recurrence relations; Fourier series; Partial differential equations (PDEs): heat equation, wave equation, Laplace's equation; solution by separation of variables. (b) Method of characteristics for hyperbolic equations; the characteristic equations; Fourier transform and its use in solving linear PDEs; (c) Dynamical Systems: equilibrium points and their stability; the phase plane; theory and applications.

2020/1 - MTHA5006Y COMPLEX ANALYSIS

Full Year, Level 5 module
(Maximum 90 Students)
UCU: 20 Organiser: Dr David Aspero
(UG) MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:G2, E2/
Exam Paper(hrs): Exam Period:SPR-02

BEFORE TAKING THIS MODULE YOU MUST TAKE MTHA4003Y

This is a course in analysis. It is an introduction to the classical theory of the complex plain

2020/1 - MTHA5007Y INVISCID FLUID FLOW

Full Year, Level 5 module
(Maximum 90 Students)
UCU: 20 Organiser: Dr Mark Blyth
(UG) MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:A1, D2
Exam Paper(hrs): Exam Period:SPR-02

BEFORE TAKING THIS MODULE YOU MUST TAKE MTHA4008Y OR TAKE MTHA4005Y

This module introduces some of the fundamental physical concepts and mathematical theory needed to analyse the motion of a fluid, with the focus predominantly on inviscid, incompressible motions. You will examine methods for visualising flow fields, including the use of particle paths and streamlines. You will study the dynamical theory of fluid flow taking Newton's laws of motion as its point of departure, and the fundamental set of equations comprising conservation of mass and Euler's equations will be discussed. The reduction to Laplace's equation for irrotational flow will be demonstrated, and Bernoulli's equation is derived as a first integral of the equation of motion. Having established the basic theory, the way is set for a broader discussion of flow dynamics including everyday practical examples. Vector calculus will cover divergence, gradient, curl of vector field, the Laplacian, scalar potential and path-independence of line integral, surface integrals, divergence theorem and Stokes' theorem. Computational fluid dynamics will also be studied.

2020/1 - MTHA5008Y ALGEBRA II

Full Year, Level 5 module
(Maximum 90 Students)
UCU: 20 Organiser: Dr Sinead Lyle
(UG) MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:D1, E2\
Exam Paper(hrs):

BEFORE TAKING THIS MODULE YOU MUST TAKE MTHA4001B AND TAKE MTHA4006Y

The module offers an introduction to vector space theory in the first semester followed by ring theory in the second semester. For vector spaces you will learn about subspaces, basis and dimension, linear maps, rank-nullity theorem, change of basis and the characteristic polynomial. This is followed by an introduction to rings using integers as a model. We develop the theory with many examples related to familiar concepts such as substitution and

factorisation. Important examples of commutative rings include fields, domains, polynomial rings and their quotients.

2020/1 - MTHA6005Y MATHEMATICS PROJECT

Full Year, Level 6 module
(Maximum 20 Students)
UCU: 20 Organiser: Dr Robert Whittaker
(UG) MODULE - 40% PASS ON AGGREGATE
Module Type: Project
Timetable Slot:UNKNOWN

IN TAKING THIS MODULE YOU CANNOT TAKE MTHA5005Y

This module is reserved for students who have completed an appropriate number of Mathematics modules at levels 4 and 5. It is a project on a Mathematical topic supervised by a member of staff within the school, or in a closely related school. The focus of the project is on independent study - you will have the opportunity to undertake research in an area which is interesting to you. You will write an in-depth report on your chosen project, in the mathematical typesetting language LaTeX. There will also be a short oral presentation.

You will complete a fourth year dissertation on a mathematical topic that is a compulsory part of some Master of Mathematics degrees.

2020/1 - MTHF5031Y COMBINATORICS AND FURTHER LINEAR ALGEBRA

Full Year, Level 5 module
(Maximum 90 Students)
UCU: 20 Organiser: Dr Jonathan Kirby
(UG) MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:TBC
Exam Paper(hrs):

BEFORE TAKING THIS MODULE YOU MUST TAKE MTHA4002Y
WHILE TAKING THIS MODULE YOU MUST TAKE MTHA5003Y

Combinatorics is one of the most applicable and accessible part of mathematics, yet it is also full of challenging problems. We shall cover many basic combinatorial concepts including counting arguments (enumerative combinatorics) and Ramsey theory. Linear Algebra underpins much of modern mathematics and is the key to many applications. We will introduce bilinear forms and symmetric operators on vector spaces leading to the diagonalization of linear maps and the spectral theorem. This theorem is key to many applications in statistics and physics. Other topics covered will include polynomials of linear maps, the Cayley-Hamilton theorem and the Jordan normal form of a matrix.

2020/1 - MTHF5032Y MATHEMATICAL MODELLING

Full Year, Level 5 module
(Maximum 80 Students)
UCU: 20 Organiser: Dr Richard Purvis
(UG) MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:A
Exam Paper(hrs):

Mathematical modelling is concerned with how to convert real problems, such as those arising in industry or other sciences, into mathematical equations, and then solving them and using the results to better understand, or make predictions about, the original problem. This topic will look at techniques of mathematical modelling, examining how mathematics can be applied to a variety of real problems and give insight in various areas. The topics will include approximation and non-dimensionalising, and discussion of how a mathematical model is created. We will then apply this theory to a variety of models such as traffic flow as well as examples of problems arising in industry. We will consider population modelling, chaos, and aerodynamics.