Mathematics and Music Technology

BSc (Hons)

COURSE DETAILS

- A level requirements: ABB
- UCAS code: G1W3
- Study mode: Full-time
- Length: 3 years

KEY DATES

- Apply by: 29 January 2025
- Starts: 22 September 2025

Course overview

This programme combines Mathematics and Music Technology as a Joint Honours programme.

INTRODUCTION

The Music and Technology programme allows you to specialise in the vocational areas of recording and production, electronic music, sound design and composition for film and video gaming. In year one, core modules look at the foundations of creative music technology, sound, and production. In your second and final years, you will have a free choice of modules in both subjects, but this will include an independent project in Creative Music Technology.

WHAT YOU'LL LEARN

- Advanced understanding of sound and music technology theory
- Practical and vocational skills in sound recording and production
- Academic research skills
- Critical and cultural awareness
- Written and oral communication and presentation
- Creativity

Course content

Discover what you'll learn, what you'll study, and how you'll be taught and assessed.

YEAR ONE

You will take seven compulsory modules – four in Music Technology, and three in Mathematics – and choose one optional module in Mathematics.

COMPULSORY MODULES

CALCULUS I (MATH101)

Credits: 15 / Semester: semester 1

At its heart, calculus is the study of limits. Many quantities can be expressed as the limiting value of a sequence of approximations, for example the slope of a tangent to a curve, the rate of change of a function, the area under a curve, and so on. Calculus provides us with tools for studying all of these, and more. Many of the ideas can be traced back to the ancient Greeks, but calculus as we now understand it was first developed in the 17th Century, independently by Newton and Leibniz. The modern form presented in this module was fully worked out in the late 19th Century. MATH101 lays the foundation for the use of calculus in more advanced modules on differential equations, differential geometry, theoretical physics, stochastic analysis, and many other topics. It begins from the very basics – the notions of real number, sequence, limit, real function, and continuity – and uses these to give a rigorous treatment of derivatives and integrals for real functions of one real variable.

CALCULUS II (MATH102)

Credits: 15 / Semester: semester 2

This module, the last one of the core modules in Year 1, is built upon the knowledge you gain from MATH101 (Calculus I) in the first semester. The syllabus is conceptually divided into three parts: Part I, relying on your knowledge of infinite series, presents a thorough study of power series (Taylor expansions, binomial theorem); part II begins with a discussion of functions of several variables and then establishes the idea of partial differentiation together with its various applications, including chain rule, total differential, directional derivative, tangent planes, extrema of functions and Taylor expansions; finally, part III is on double integrals and their applications, such as finding centres of mass of thin bodies. Undoubtedly, this module, together with the other two core modules from Semester 1 (MATH101 Calculus I and MATH103 Introduction to linear algebra), forms an integral part of your ability to better understand modules you will be taking in further years of your studies.

INTRODUCTION TO LINEAR ALGEBRA (MATH103)

Credits: 15 / Semester: semester 1

Linear algebra is the branch of mathematics concerning vector spaces and linear mappings between such spaces. It is the study of lines, planes, and subspaces and their intersections using algebra.

Linear algebra first emerged from the study of determinants, which were used to solve systems of linear equations. Determinants were used by Leibniz in 1693, and subsequently, Cramer's Rule for solving linear systems was devised in 1750. Later, Gauss further developed the theory of solving linear systems by using Gaussian elimination. All these classical themes, in their modern interpretation, are included in the module, which culminates in a detailed study of eigenproblems. A part of the module is devoted to complex numbers which are basically just planar vectors. Linear algebra is central to both pure and applied mathematics. This module is an essential pre-requisite for nearly all modules taught in the Department of Mathematical Sciences.

INTRODUCTION TO DIGITAL AUDIO WORKSTATIONS (MUSI109)

Credits: 15 / Semester: semester 1

This module is an introduction to MIDI sequencing in Logic Pro and Ableton Live. It is suitable for complete beginners and intermediate users of Logic. Through lectures and workshops, both of which involve much hands on practice, students learn about MIDI sequencing, software instruments and Digital Audio Workstations (DAW). Topics and techniques covered include recording and editing MIDI; use of effects processors and mixing, software synthesis and sampler instruments. Two creative coursework projects, concentrating on differing compositional approaches and styles, enable students to demonstrate the technical and compositional skills taught and practiced during the module.

INTRODUCTION TO SOUND AND TECHNOLOGY (MUSI171)

Credits: 15 / Semester: semester 1

The module introduces students to the basic principles of sound, acoustics and music technology. They will learn about many of the core concepts, relevant terminology and theories essential to modern music technology studies. Subjects covered will include acoustics and sound propagation, analogue and digital audio theory, key electronics theories and sound measurement systems. The module includes some practical work at a digital audio workstation. Normally, the module will include a visit to the University's Acoustics Research Unit.

INTRODUCTION TO SOUND RECORDING AND PRODUCTION (MUSI108)

Credits: 15 / Semester: semester 2

This module introduces students to Sound, Recording and Production techniques in the University Recording Studio. This is a practised based module where teaching is delivered through hands on workshops and lectures. Lectures will discuss recording, audio editing and effects processing techniques in Pro Tools. The weekly workshops, which are in small groups, will be led by the module leader who will demonstrate production techniques and then set group tasks which will allow students to practice key skills during the workshop sessions. By the end of the module the student will be competent enough to use the studio independently and effectively.

Students will complete two assessments. The first is an individual mixing assignment to be completed in the Mac Suites. Assignment 2 is a group recording project carried out in a University Studio and includes a group presentations about the project.

THE HISTORY OF ELECTRONIC MUSIC (MUSI172)

Credits: 15 / Semester: semester 2

Content will include but not limited to:

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Musique concrete,
ElektronischeMusik,
American Experimentalism,
Tape composition,
Analogue Synthesizers,
Computer Music,
BBC Radiophonic Workshop
Electronic music in rock and jazz,
Noise Music – Japanoise, Noise in Rock, Metal, Punk and Hardcore
Hardware Hacking – Reed Ghazala and Nicholas Collins
Minimalism – Tape Looping and minimalist compositional practices
Sound Design in Cinema.

OPTIONAL MODULES

INTRODUCTION TO STATISTICS USING R (MATH163)

Credits: 15 / Semester: semester 2

Students will learn fundamental concepts from statistics and probability using the R programming language and will learn how to use R to some degree of proficiency in certain contexts. Students will become aware of possible career paths using statistics.

NEWTONIAN MECHANICS (MATH122)

Credits: 15 / Semester: semester 2

This module is an introduction to classical (Newtonian) mechanics. It introduces the basic principles like conservation of momentum and energy, and leads to the quantitative description of motions of bodies under simple force systems. It includes angular momentum, rigid body dynamics and moments of inertia. MATH122 provides the foundations for more advanced modules like MATH228, 322, 325, 326, 423, 425 and 431.

NUMBERS, GROUPS AND CODES (MATH142)

Credits: 15 / Semester: semester 2

A group is a formal mathematical structure that, on a conceptual level, encapsulates the symmetries present in many structures. Group homomorphisms allow us to recognise and manipulate complicated objects by identifying their core properties with a simpler object that is easier to work with. The abstract study of groups helps us to understand fundamental problems arising in many areas of mathematics. It is moreover an extremely elegant and interesting part of pure mathematics. Motivated by examples in number theory, combinatorics and geometry, as well as applications in data encryption and data retrieval, this module is an introduction to group theory. We also develop the idea of mathematical rigour, formulating our theorems and proofs precisely using formal logic.

Programme details and modules listed are illustrative only and subject to change.

YEAR TWO

In your second year, you will take entirely optional modules in both Music Technology and Mathematics.

• You must take at least four of the following: **MUSI205, MUSI208, MUSI209, MUSI213, MUSI214, MUSI243**.
• You must choose two from **MATH225, MATH243, MATH244, MATH253**.
• You must choose two from **MATH122, MATH142, MATH163, MATH221, MATH226, MATH228, MATH242, MATH247, MATH254, MATH260, MATH269**.

OPTIONAL MODULES

CLASSICAL MECHANICS (MATH228)

Credits: 15 / Semester: semester 2

This module is concerned with the motion of physical bodies both in everyday situations and in the solar system. To describe motion, acceleration and forces you will need background knowledge of calculus, differentiation, integration and partial derivatives from MATH101 (Calculus I), MATH102 (Calculus II) and MATH103 (Introduction to Linear Algebra). Classical mechanics is important for learning about modern developments such as relativity (MATH326), quantum mechanics (MATH325) and chaos and dynamical systems (MATH322). This module will make you familiar with notions such as energy, force, momentum and angular momentum which lie at the foundations of applied mathematics problems.

COMMUTATIVE ALGEBRA (MATH247)

Credits: 15 / Semester: semester 2

The module provides an introduction to the theory and methods of the modern commutative algebra (commutative groups, commutative rings, fields and modules) with some applications to number theory, algebraic geometry and linear algebra.

COMPLEX FUNCTIONS (MATH243)

Credits: 15 / Semester: semester 1

This module introduces students to a surprising, very beautiful theory having intimate connections with other areas of mathematics and physical sciences, for instance ordinary and partial differential equations and potential theory.

COMPOSITION FOR FILM AND TELEVISION (MUSI205)

Credits: 15 / Semester: semester 2

Students will learn how to effectively compose and arrange music for film and television. The module will cover practical issues such as: working in a software programme such as Logic Pro to compose with synchronised video clips; arranging instrumental parts using sample libraries, working with tempo, speed and appropriate harmonic languages. The coursework will involve a series of compositions to written briefs and video clips, totalling 4-8 minutes in duration. Each composition assignment will address a different challenge and style aspect of film or TV music and be accompanied by a written commentary explaining the reasons for the approach and style taken in the music.

DIFFERENTIAL EQUATIONS (MATH221)

Credits: 15 / Semester: semester 2

Differential equations play a central role in mathematical sciences because they allow us to describe a wide variety of real-world systems and the mathematical techniques encountered in this module are useful to a number of later modules; this is why MATH201 is compulsory for a number of degree programmes. The module will aim to stress the importance of both theory and applications of ordinary differential equations (ODEs) and partial differential equations (PDEs), putting a strong emphasis on problem solving and examples. It has broadly 5 parts and each part contains two types of equations: those that can be solved by specific methods and others that cannot be solved but can only be studied to understand some properties of the underlying equations and their solutions. The main topics are first order ODEs, second order ODEs, systems of ODEs, first-order PDEs and some of the most well-known second-order PDEs, namely the wave, heat and Laplace equations.

FINANCIAL MATHEMATICS (MATH260)

Credits: 15 / Semester: semester 2

Mathematical Finance uses mathematical methods to solve problems arising in finance. A common problem in Mathematical Finance is that of derivative pricing. In this module, after introducing the basic concepts in Financial Mathematics, we use some particular models for the dynamic of stock price to solve problems of pricing and hedging derivatives. This module is fundamental for students intending to work in financial institutions and/or doing an MSc in Financial Mathematics or related areas.

INTRODUCTION TO STATISTICS USING R (MATH163)

Credits: 15 / Semester: semester 2

Students will learn fundamental concepts from statistics and probability using the R programming language and will learn how to use R to some degree of proficiency in certain contexts. Students will become aware of possible career paths using statistics.

LINEAR ALGEBRA AND GEOMETRY (MATH244)

Credits: 15 / Semester: semester 1

Linear algebra provides a toolbox for analysing phenomena ubiquitous in many areas of mathematics: linear maps, or linearity in general. In all of these situations it is essential to first identify the kind of objects which are mapped or behave in a linear way. To cover the many different possibilities the concept of an abstract vector space is introduced. It generalizes the real vector spaces introduced in MATH103 (Introduction to Linear Algebra) and the calculational techniques developed there can still be used. Applications of ideas from Linear Algebra appear in Geometry (MATH201, MATH349), in Algebra (MATH247, MATH343), in solving Differential Equations (MATH201, MATH221), which in turn model many physical systems (MATH323, MATH324), in Physics, especially Quantum Mechanics (MATH325, MATH421), in Biology (MATH335, MATH426) and in Statistics (MATH363).

LIVE SOUND (MUSI214)

Credits: 15 / Semester: semester 1

This module introduces students to Live Sound technology and the practical skills needed to competently and safely operate a Live Sound system. Students will receive lectures on live sound equipment and its applications, along with relevant electronics and acoustics theory. They will also have weekly practical workshops in the Music Hub, where they will learn to operate the Hub P.A. system. They will cover front of house mixing and stage monitor mixing techniques, as well as microphone techniques for live sound and learn about ancillary equipment requirements for live sound. The module also covers very basic lighting set-up and control.

MAX AND ABLETON LIVE (MUSI209)

Credits: 15 / Semester: semester 2

Students will be introduced to Ableton's Live software for music creation, and they will learn how to create simple effects plugins using Max for Live. They will create electronic music in Live that utilises effects they have created with MAX, as well as learn how to use both the session and arrange windows to compose and structure musical material. They will learn how to mix music in Live and discover the new options Live offers for music production, compared to other common digital audio workstations.

METRIC SPACES AND CALCULUS (MATH242)

Credits: 15 / Semester: semester 2

This is a foundational module aimed at providing the students with the basic concepts and techniques of modern real Analysis. The guiding idea will be to start using the powerful tools of analysis, familiar to the students from the first year module MATH101 (Calculus I) in the context of the real numbers, to vectors (multivariable analysis) and to functions (functional analysis). The notions of convergence and continuity will be reinterpreted in the more general setting of metric spaces. This will provide the language to prove several fundamental results that are in the basic toolkit of a mathematician, like the Picard Theorem on the existence and uniqueness of solutions to first order differential equations with an initial datum, and the implicit function theorem. The module is central for a curriculum in pure and applied mathematics, as familiarity with these notions will help students who want to take several other subsequent modules as well as many projects. This module is also a useful preparation (although not a formal prerequisite) for MATH365 Measure theory and probability, a very useful module for a deep understanding of financial mathematics.

MUSIC AND SPORT (MUSI222)

Credits: 15 / Semester: semester 2

This module provides a critical understanding of music's role and prominence in sport, encompassing perspectives from practical sporting experience to mediatised sport, and in linkages between music and sport as components of the entertainment industry. An innovative inclusion to the curriculum, it will encourage interdisciplinary questioning as a key component of critical engagement required for the module, through historical and contemporary case studies, supported by scholarly literature. This will enable students to develop knowledge through real-world case studies focused on music in relation to specific sports and sporting events, explicating how music features in the experience of sport as viewers, practitioners and fans. As a result, it will explore concurrent themes in music and sport such as performance and representation, gender and race, and more broadly, intersections of music and sport in interrogations from varied studies on media, politics, sociology, psychology and anthropology.

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NUMERICAL METHODS FOR APPLIED MATHEMATICS (MATH226)

Credits: 15 / Semester: semester 2

Most problems in modern applied mathematics require the use of suitably designed numerical methods. Working exactly, we can often reduce a complicated problem to something more elementary, but this will often lead to integrals that cannot be evaluated using analytical methods or equations that are too complex to be solved by hand. Other problems involve the use of 'real world' data, which don't fit neatly into simple mathematical models. In both cases, we can make further progress using approximate methods. These usually require lengthy iterative processes that are tedious and error prone for humans (even with a calculator), but ideally suited to computers. The first few lectures of this module demonstrate how computer programs can be written to handle calculations of this type automatically. These ideas will be used throughout the module. We then investigate how errors propagate through numerical computations. The focus then shifts to numerical methods for finding roots, approximating integrals and interpolating data. In each case, we will examine the advantages and disadvantages of different approaches, in terms of accuracy and efficiency.

OPERATIONAL RESEARCH (MATH269)

Credits: 15 / Semester: semester 2

The term "Operational Research" came in the 20th century from military operations. It describes mathematical methods to achieve the goal (or to find the best possible decision) having limited resources. This branch of applied mathematics makes use of and has stimulated the development of optimisation methods, typically for problems with constraints. This module can be interesting for any student doing mathematics because it concentrates on real-life problems.

PROFESSIONAL AND CAREER DEVELOPMENT (SOTA260)

Credits: 15 / Semester: semester 1

The module aims to prepare students for a smooth transition into a work placement year and, more broadly, to develop lifelong skills, attitudes and behaviours and support students in their continuing professional development. This will help students lead flexible, fulfilling careers working as a professional in their field, and enable them to contribute meaningfully to society.

SAMPLING AND REMIXING (MUSI213)

Credits: 15 / Semester: semester 1

In this module students learn techniques for mixing and remixing, using samples, stems or tracks from exiting songs. Using Apple's Logic audio editing and sampling techniques are explored, as well as mixing techniques suitable for EDM and electronic music. There will also be a focus on correctly using relevant software instruments and effects plugins available in Logic.

FOLEY AND SOUND DESIGN (MUSI208)

Credits: 15 / Semester: semester 1

This module will introduce the student to sound recording, audio editing and sound transformation in a DAW in the context of sound design for the moving image. Students will learn a variety of recording techniques, audio editing and sound transformation skills in the studio a DAW and third-party applications to produce the foley for a video clip and also produce the sound design for number of idents. The module will be delivered via lectures in the Mac Suites and workshops in the studio.

SOUND RECORDING AND PRODUCTION 2 (MUSI243)

Credits: 15 / Semester: semester 1

This module will extend students' knowledge of studio recording and production techniques, including stereo recording; editing; mixing tracks with problems (poor quality recordings, unwanted noise, poor performances); making timing and tuning adjustments; audio quantisation; comping; and working with large multitrack projects.

STATISTICS AND PROBABILITY I (MATH253)

Credits: 15 / Semester: semester 1

Analysis of data has become an essential part of current research in many fields including medicine, pharmacology, and biology. It is also an important part of many jobs in e.g. finance, consultancy and the public sector. This module provides an introduction to statistical methods with a strong emphasis on applying and interpreting standard statistical techniques. Since modern statistical analysis of real data sets is performed using computer power, a statistical software package is introduced and employed throughout.

STATISTICS AND PROBABILITY II (MATH254)

Credits: 15 / Semester: semester 2

This module provides an introduction to probabilistic methods that are used not only in actuarial science, financial mathematics and statistics but also in all physical sciences. It focuses on discrete and continuous random variables with values in one and several dimensions, properties of the most useful distributions (e.g. geometric, exponential, and normal), their transformations, moment and probability generating functions and limit theorems. This module will help students doing MATH260 and MATH262 (Financial mathematics). This module complements MATH365 (Measure theory and probability) in the sense that MATH365 provides the contradiction-free measure theoretic foundation on which this module rests.

VECTOR CALCULUS WITH APPLICATIONS IN FLUID MECHANICS (MATH225)

Credits: 15 / Semester: semester 1

This module provides an introduction to the subjects of fluid mechanics and electromagnetism, to the various vector integrals, the operators div, grad and curl and the relations between them and to the many applications of vector calculus to physical situations.

Programme details and modules listed are illustrative only and subject to change.

FINAL YEAR

Your final year will include an independent project in Creative Music Technology, while your remaining modules will be taken from a selection.

- You must take either **MUSI305** or **MUSI308**.
- You must take two from MATH322, MATH323, MATH324, MATH325, MATH326, MATH343, MATH344, MATH362, MATH363, MATH365, MATH367, MATH399.
- You must take three from **MATH327, MATH331, MATH332, MATH336, MATH342, MATH345, MATH346, MATH349, MATH360, MATH361, MATH364, MATH366, MATH399**.

COMPULSORY MODULES

INDEPENDENT PROJECT: CREATIVE MUSIC TECHNOLOGY (MUSI396)

Credits: 30 / Semester: whole session

Student are allowed to design their own project to carry out across semesters 1 & 2 of Year 3. In consultation with their allocated supervisor, they will agree a programme of research which will lead to a pilot project submission in Semester 1 and a short presentation. In semester 2, students will produce a 12-15 minute portfolio, as well as a commentary that contextualises their work. The content of the portfolio is intended to be a tool for seeking future employment and may have a technical focus, be more concentrated on composition projects or have research focus on a practical music technology related area, depending on the student's career aspirations.

OPTIONAL MODULES

APPLIED PROBABILITY (MATH362)

Credits: 15 / Semester: semester 1

This module studies discrete-time Markov chains, as well as introducing the most basic continuous-time processes. The basic theory for these stochastic processes is considered in detail. This includes the Chapman Kolmogorov equation, communication of states, periodicity, recurrence and transience properties, asymptotic behaviour, limiting and stationary distributions, and an introduction to Poisson processes. Applications in different areas, in particular in insurance, are considered.

APPLIED STOCHASTIC MODELS (MATH360)

Credits: 15 / Semester: semester 1

Stochastic processes are ways of quantifying the dynamic relationships of sequences of random events. Stochastic models play an important role in elucidating many areas of the natural and engineering sciences. They can be used to analyse the variability inherent in biological and medical processes, to deal with uncertainties affecting managerial decisions and with the complexities of psychological and social interactions, and to provide new perspectives, methodology, models and intuition to aid in other mathematical and statistical studies. This module is intended as a beginning course in introducing continuous-time stochastic processes for students familiar with elementary probability. The objectives are: (1) to introduce students to the standard concepts and methods of stochastic modelling; (2) to illustrate the rich diversity of applications of stochastic processes in the science; and (3) to provide exercises in the applications of simple stochastic analysis to appropriate problems.

CARTESIAN TENSORS AND MATHEMATICAL MODELS OF SOLIDS AND VISCOUS FLUIDS (MATH324)

Credits: 15 / Semester: semester 1

This module provides an introduction to basic concepts and principles of continuum mechanics. Cartesian tensors are introduced at the beginning of the module, bringing simplicity and versatility to the analysis. The module places emphasis on the importance of conservation laws in integral form, and on the fundamental role integral conservation laws play in the derivation of partial differential equations used to model different physical phenomena in problems of solid and fluid mechanics.

CHAOS AND DYNAMICAL SYSTEMS (MATH322)

Credits: 15 / Semester: semester 1

 Math322 introduces the novel findings concerning the solving techniques and nature of solutions occurring in nonlinear difference and differential equations. The (counterpart) theory of linear equations is covered in Math122 (Dynamic Modelling) and Math201 (Differential Equations). The modern theory of fractals (occurred only in 1970s) is delivered and many examples of fractal objects, including the Mandelbrot set, are demonstrated. The classification of possible solutions occurring in dynamical systems together with the bifurcation theory is provided. The emphasis is made to the bifurcations leading to chaotic solutions. Detailed analysis of chaotic solutions (their nature and impact in understanding the universe) is provided. The qualitative analysis technique for solving nonlinear systems of difference/differential equations is introduced.

COMPOSITION FOR DIGITAL GAMES (MUSI305)

Credits: 15 / Semester: semester 1

This module provides an introduction to the design and implementation of sound and music in video games. Students engage with game music scholarship and case studies, then apply their knowledge to create original sounds and music for premade game projects.

COMBINATORICS (MATH344)

Credits: 15 / Semester: semester 2

Combinatorics is a part of mathematics in which mathematicians deal with discrete and countable structures by means of various combinations, such as permutations, ordered and unordered selections, etc. The seemingly simple methods of combinatorics can raise highly non-trivial mathematical questions and lead to deep mathematical results, which are, in turn, closely related to some fundamental phenomena in number theory

DIFFERENTIAL GEOMETRY (MATH349)

Credits: 15 / Semester: semester 1

Differential geometry studies distances and curvatures on manifolds through differentiation and integration. This module introduces the methods of differential geometry on the concrete examples of curves and surfaces in 3-dimensional Euclidean space. The module MATH248 (Geometry of curves) develops methods of differential geometry on examples of plane curves. This material will be discussed in the first weeks of the course, but previous familiarity with these methods is helpful. Students following a pathway in theoretical physics might find this module interesting as it discusses a different aspect of differential geometry, and might take it together with MATH326 (Relativity). MATH410 (Manifolds, homology and Morse theory) and MATH446 (Lie groups and Lie algebras).

FURTHER METHODS OF APPLIED MATHEMATICS (MATH323)

Credits: 15 / Semester: semester 1

Ordinary and partial differential equations (ODEs and PDEs) are crucial to many areas of science, engineering and finance. This module addresses methods for, or related to, their solution. It starts with a section on inhomogeneous linear second-order ODEs which are often required for the solution of higher-level problems. We then generalize basic calculus by considering the optimization of functionals, e.g., integrals involving an unknown function and its derivatives, which leads to a wide variety of ODEs and PDEs. After those systems of two linear first-order PDEs and second-order PDES are classified and reduced to ODEs where possible. In certain cases, e.g., `elliptic' PDEs like the Laplace equation, such a reduction is impossible. The last third of the module is devoted to two approaches, conformal mappings and Fourier transforms, which can be used to obtain solutions of the Laplace equation and other irreducible PDEs.

GAME THEORY (MATH331)

Credits: 15 / Semester: semester 2

In this module you will explore, from a game-theoretic point of view, models which have been used to understand phenomena in which conflict and cooperation occur and see the relevance of the theory not only to parlour games but also to situations involving human relationships, economic bargaining (between trade union and employer, etc), threats, formation of coalitions, war, etc.

GROUP THEORY (MATH343)

Credits: 15 / Semester: semester 1

The module provides an introduction to the modern theory of finite non-commutative groups. Group Theory is one of the central areas of Pure Mathematics. Being part of Algebra, it has innumerable applications in Geometry, Number Theory, Combinatorics and Analysis, but also plays a very important role in Theoretical Physics, Mechanics and Chemistry. The module starts with basic definitions and some well-known examples (the symmetric group of permutations and the groups of congruence classes modulo an integer) and builds up to some very interesting and non-trivial constructions, such as the semi-direct product, which makes it possible to construct more complicated groups from simpler ones. In the final part of the course, the Sylow theory and its applications to the classification of groups are considered.

LINEAR STATISTICAL MODELS (MATH363)

Credits: 15 / Semester: semester 1

This module extends earlier work on linear regression and analysis of variance, and then goes beyond these to generalised linear models. The module emphasises applications of statistical methods. Statistical software is used throughout as familiarity with its use is a valuable skill for those interested in a career in a statistical field.

MATHEMATICAL RISK THEORY (MATH366)

Credits: 15 / Semester: semester 2

To provide an understanding of the mathematical risk theory used in practise in non-life actuarial depts of insurance firms, to provide an introduction to mathematical methods for managing the risk in insurance and finance (calculation of risk measures/quantities), to develop skills of calculating the ruin probability and the total claim amount distribution in some non - life actuarial risk models with applications to insurance industry, to prepare the students adequately and to develop their skills in order to be exempted for the exams of CT6 subject of the Institute of Actuaries (MATH366 covers 50% of CT6 in much more depth).

MEASURE THEORY AND PROBABILITY (MATH365)

Credits: 15 / Semester: semester 2

This module is important for students who are interested in the abstract theory of integrating and in the deep theoretical background of the probability theory. It will be extremely useful for those who plan to do MSc and perhaps PhD in Probability, including financial applications. If you plan to take level 4 module(s) on Financial Mathematics next year, MATH365 can be very helpful.

MEDICAL STATISTICS (MATH364)

Credits: 15 / Semester: semester 2

In recent years a culture of evidence-based practice has become the norm in the medical profession. Central to this is the medical statistician, who is required to not only analyse data, but to design research studies and interpret the results. The aim of MATH364 is to provide the student with the knowledge to become part of a "team" to enhance and improve medical practice. This is done by demonstrating the design of studies, methods of analysis and interpretation of results through a number of real-world examples, covering epidemiology, survival analysis, clinical trials and meta-analysis.

COMPOSING ELECTRONIC MUSIC (MUSI308)

Credits: 15 / Semester: semester 1

This module will develop students' knowledge of experimental approaches to electronic music composition, to an advanced level. Building on the sound design skills acquired MUSI208, the first half of the module will focus on developing the students' sound organisation and transformation skills to an advanced level through production of an acousmatic composition, advanced sound processing such as granular synthesis will be covered. The second half will develop the students' knowledge of synthesis to an advanced level by focusing on modular synthesis and non-linear composition such as building a modular instrument or creating a generative composition.

NETWORKS IN THEORY AND PRACTICE (MATH367)

Credits: 15 / Semester: semester 2

MATH367 aims to develop an appreciation of optimisation methods for real-world problems using fundamental tools from network theory; to study a range of 'standard problems' and techniques for solving them. Thus, network flow, shortest path problem, transport problem, assignment problem, and routing problem are some of the problems that are considered in the syllabus. MATH367 is a decision making module, which fits well to those who are interested in receiving knowledge in graph theory, in operational research, in economics, in logistics and in finance.

NUMBER THEORY (MATH342)

Credits: 15 / Semester: semester 1

Number theory begins with, and is mainly concerned with, the study of the integers. Because of the fundamental role which integers play in mathematics, many of the greatest mathematicians, from antiquity to the modern day, have made contributions to number theory. In this module you will study results due to Euclid, Euler, Gauss, Riemann, and other greats: you will also see many results from the last 10 or 20 years.Several of the topics you will study will be familiar from MATH142 (Numbers, groups, and codes). We will go into them in greater depth, and the module will be self-contained from the point of view of number theory. However, some background in group theory (no more than is in MATH142) will be assumed.

NUMERICAL METHODS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS (MATH336)

Credits: 15 / Semester: semester 2

Many real-world systems in mathematics, physics and engineering can be described by differential equations. In rare cases these can be solved exactly by purely analytical methods, but much more often we can only solve the equations numerically, by reducing the problem to an iterative scheme that requires hundreds of steps. We will learn efficient methods for solving ODEs and PDEs on a computer.

POPULATION DYNAMICS (MATH332)

Credits: 15 / Semester: semester 2

Understanding the behaviour of populations is essential for understanding extinctions, population growth, maintaining the security of our food supplies as well as controlling invasive species and th e spread of infectious diseases. Many aspects of dynamical systems theory arise in the study of population dynamics, making the mathematics in this module widely applicable. We will take a deterministic approach to populations and will construct simple models to represent the essential controlling features. By analysing these models, significant insights can be obtained with implications for real-world population dynamics.

PROJECTS IN MATHEMATICS (MATH399)

Credits: 15 / Semester: whole session

Research is performed in an interesting topic in a particular area of Mathematics under the supervision of a member of staff, which is followed by preparation of a report and an oral presentation. It is hoped that this will provide insights into more advanced subjects and experience in handling specialist literature.

QUANTUM MECHANICS (MATH325)

Credits: 15 / Semester: semester 1

The development of Quantum Mechanics, requiring as it did revolutionary changes in our understanding of the nature of reality, was arguably the greatest conceptual achievement of all time. The aim of the module is to lead the student to an understanding of the way that relatively simple mathemactics (in modern terms) led Bohr, Einstein, Heisenberg and others to a radical change and improvement in our understanding of the microscopic world.

RELATIVITY (MATH326)

Credits: 15 / Semester: semester 1

Einstein's theories of special and general relativity have introduced a new concept of space and time, which underlies modern particle physics, astrophysics and cosmology. It makes use of, and has stimulated the development of modern differential geometry. This module develops the required mathematics (tensors, differential geometry) together with applications of the theory to particle physics, black holes and cosmology. It is an essential part of a programme in theoretical physics.

STATISTICAL PHYSICS (MATH327)

Credits: 15 / Semester: semester 2

Statistical Physics is a core subject in Physics and a cornerstone for modern technologies. To name just one example, quantum statistics is informing leading edge developments around ultra-cold gases and liquids giving rise to new materials. The module will introduce foundations of Statistical Physics and will develop an understanding of the stochastic roots of thermodynamics and the properties of matter. After successfully completing this module students will understand statistical ensembles and related concepts such as entropy and temperature, will understand the properties of classical and quantum gases, will be know the laws of thermodynamics and will be aware of advanced phenomena such as phase transition. The module will also develop numerical computer programming skills for the description of macroscopic effects such as diffusion by an underlying stochastic process.

THE FILM MUSIC OF JOHN WILLIAMS (MUSI370)

Credits: 15 / Semester: semester 2

This module examines the film-music output of the composer John Williams. It considers the historical development of John Williams' compositional style, in the context of Hollywood convention and the evolution of the 'blockbuster'. It situates his style in relation to classical and other relevant influences (especially late romantic and early modernist techniques). It considers the relevance of his close relationship with particular directors (e.g. Lucas and Spielberg). It relates particular compositional techniques (such as leitmotif) to the filmic and narrative context. Delivery incorporates lectures, workshop, and directed activity. Assessment incorporates a discursive essay and a portfolio of case-study analyses. The module assumes the study and discussion of case-study examples, but is delivered and assessed in a manner which does not require technical music skills (i.e. notational literacy or formal analytical method).

THEORY OF STATISTICAL INFERENCE (MATH361)

Credits: 15 / Semester: semester 2

This module introduces fundamental topics in mathematical statistics, including the theory of point estimation and hypothesis testing. Several key concepts of statistics are discussed, such as sufficiency, completeness, etc., introduced from the 1920s by major contributors to modern statistics such as Fisher, Neyman, Lehmann and so on. This module is absolutely necessary preparation for postgraduate studies in statistics and closely related subjects.

THE MAGIC OF COMPLEX NUMBERS: COMPLEX DYNAMICS, CHAOS AND THE MANDELBROT SET (MATH345)

Credits: 15 / Semester: semester 2

A "dynamical system" is a system that changes over time according to a fixed rule. In complex dynamics, we consider the case where the state of the system is described by a single (complex) variable, and the rule of evolution is given by a holomorphic function. It turns out that this seemingly simple setting leads to very rich, subtle and intricate problems, some of which are still the subject of ongoing mathematical research, both at the University of Liverpool and internationally. This module will provide an introduction to this fascinating subject, and introduce students to some of these problems. In the course of this study, we will encounter many results about complex functions that may seem "magic" when compared with what might be expected from real analysis. A highlight of this kind is the theorem that every polynomial is "chaotic" on its Julia set. We will also see how this "magic" can help us understand phenomena that at first seem to have no connection with complex numbers at all.

TOPOLOGY (MATH346)

Credits: 15 / Semester: semester 2

Topology is the mathematical study of space. It is distinguished from geometry by the fact that there is no consideration of notions of distance, angle or other similar quantities. For this reason topology is sometimes popularly referred to as 'rubber sheet' geometry. It was introduced by Poincaré, under the name of analysis situs, in 1895 and became one of the most successful areas of 20th century mathematics. It continues to be an active research area to this day, and its insights and methods underlie many areas of modern mathematics. More recently, new applications of topological ideas outside mathematics have been developed, in particular to provide qualitative analysis of large data sets. This module introduces the basic notions of topological space and continuous map, illustrating them with many examples from different areas of mathematics. It also introduces homotopy theory, the study of paths in a space, which has become one of the most fundamental areas of modern mathematics.

Programme details and modules listed are illustrative only and subject to change.

HOW YOU'LL LEARN

Your learning activities will consist of lectures, tutorials, practical classes, problem classes, private study and supervised project work. In Year One, lectures are supplemented by a thorough system of group tutorials and computing work is carried out in supervised practical classes. Key study skills, presentation skills and group work start in first-year tutorials and are developed later in the programme. The emphasis in most modules is on the development of problem solving skills, which are regarded very highly by employers. Project supervision is on a one-to-one basis, apart from group projects in Year Two.

HOW YOU'RE ASSESSED

Most modules are assessed by a two and a half hour examination in January or May, but many have an element of coursework assessment. This might be through homework, class tests, mini-project work or key skills exercises.

LIVERPOOL HALLMARKS

We have a distinctive approach to education, the Liverpool Curriculum Framework, which focuses on research-connected teaching, active learning, and authentic assessment to ensure our students graduate as digitally fluent and confident global citizens.

Careers and employability

A mathematically-based degree opens up a wide range of career opportunities, including some of the most lucrative professions.

Recent employers of our graduates are:

- Barclays Bank plc
- Deloitte
- Forrest Recruitment
- Marks and Spencer
- Mercer Human Resource Consulting Ltd.
- Venture Marketing Group.
- BAE Systems
- BT
- Guardian Media Group
- Royal Bank of Scotland
- Siemens
- Unilever.

80% OF MUSIC STUDENTS WILL GO ON TO WORK AND/OR FURTHER STUDY 15 MONTHS AFTER GRADUATION.

Discover Uni, 2018-19.

Fees and funding

Your tuition fees, funding your studies, and other costs to consider.

TUITION FEES

UK fees (applies to Channel Islands, Isle of Man and Republic of Ireland)	
Full-time place, per year	£9,250
Year in industry fee	£1,850
Year abroad fee	£1,385

International fees	
Full-time place, per year	£24,800
Year in industry fee	£1,850
Year abroad fee	£12,400

Fees shown are for the academic year 2024/25. Please note that the Year Abroad fee also applies to the Year in China.
Tuition fees cover the cost of your teaching and assessment, operating facilities such as libraries, IT equipment, and access to academic and personal support. [Learn more about paying for your studies.](.).

ADDITIONAL COSTS

We understand that budgeting for your time at university is important, and we want to make sure you understand any course-related costs that are not covered by your tuition fee. This could include buying a laptop, books, or stationery.

Find out more about the [additional study costs](#) that may apply to this course.

SCHOLARSHIPS AND BURSARIES

We offer a range of scholarships and bursaries to provide tuition fee discounts and help with living expenses while at university.

Check out our [Liverpool Bursary](#), worth up to £2,000 per year for eligible UK students. Or for international students, our [Undergraduate Global Advancement Scholarship](#) offers a tuition fee discount of up to £5,000 for eligible international students starting an undergraduate degree from September 2024.

[Discover our full range of undergraduate scholarships and bursaries](#)

Entry requirements

The qualifications and exam results you'll need to apply for this course.

Your qualification	Requirements [About our typical entry requirements](#)
A levels	ABB Applicants with the Extended Project Qualification (EPQ) are eligible for a reduction in grade requirements. For this course, the offer is **ABC** with **A** in the EPQ. You may automatically qualify for reduced entry requirements through our [contextual offers scheme](#).
GCSE	4/C in English and 4/C in Mathematics
Subject requirements	For applicants from England: Where a science has been taken at A level (Chemistry, Biology or Physics), a pass in the science practical of each subject will be required.
BTEC Level 3 National Extended Diploma	D*DD in relevant diploma, when combined with A Level Mathematics grade A
International Baccalaureate	33 including 6 in each of Higher Level Mathematics and Higher Level Music.
Irish Leaving Certificate	H1, H2, H2, H2, H3, H3 including Mathematics at H1 and Music at H2
Scottish Higher/Advanced Higher	Advanced Highers accepted at grades ABB including grade A in Mathematics and grade B in Music

Your qualification	Requirements [About our typical entry requirements](#)
Welsh Baccalaureate Advanced	Acceptable at grade B alongside AB at A level including grade A in Mathematics and grade B in Music or Music Technology.
Access	45 Level 3 credits in graded units in a relevant Diploma, including 39 at Distinction and a further 6 with at least Merit. 15 Distinctions are required in Mathematics. A Level grade B in Music or Music Technology, or ABRSM Grade 8 in Music Theory at Distinction also required.
International qualifications	Many countries have a different education system to that of the UK, meaning your qualifications may not meet our direct entry requirements. Although there is no direct Foundation Certificate route to this course, completing a Foundation Certificate, such as that offered by the [University of Liverpool International College](#), can guarantee you a place on a number of similar courses which may interest you.

ALTERNATIVE ENTRY REQUIREMENTS

- If your qualification isn't listed here, or you're taking a combination of qualifications, [contact us](#) for advice

- [Applications from mature students](#) are welcome.

THE ORIGINAL

REDBRICK