

**School of Mathematics
University of Manchester**

Mathematical Themes

The School offers a large range of optional undergraduate course units at level 2 and level 3 and this document groups the course units into mathematical themes as a guide to choosing optional course units.



**Academic Year
2019/20**

Algebra

These modules build on the ideas in [MATH20201: Algebraic Structures 1](#), introducing new kinds of algebraic objects, studying the structure of groups and rings more deeply and exploring their applications across many parts of pure and applied mathematics.

Level 2 optional course units

- **MATH20122: Metric Spaces**
- **MATH20212: Algebraic Structures 2**

Level 3 optional course units

- **MATH32001: Group Theory**
- **MATH32011: Commutative Algebra**
- **MATH32032: Coding Theory**
- **MATH32062: Algebraic Geometry**
- **MATH32072: Number Theory**
- **MATH32091: Combinatorics and Graph Theory**

MATH35082: Symmetry in Groups and Nature – this course unit is listed under applied mathematics and if timetable allows you might want to consider this course unit if you are interested in Algebra.

Analysis

The rigorous approach to calculus introduced in, for example, [MATH10242: Sequences & Series](#) and [MATH20101: Real & Complex Analysis](#) is the just beginning of a long story that involves deep, far-reaching generalisations of such basic ideas as continuity and distance and—as the list of electives shows—has applications across much of modern mathematics.

Level 2 optional course units

- **MATH20122: Metric Spaces**
- **MATH20132: Calculus of Several Variables**
- **MATH20142: Complex Analysis (for joint honours students who did not take MATH20101)**

Level 3 optional course units

- **MATH31001: Linear Analysis**
- **MATH31042: Fractal Geometry**
- **MATH31052: Topology**

Applied Mathematics

The core courses listed below build on such modules as [MATH10222: Calculus & Applications A](#) ([MATH10232: Calculus & Applications B](#)) and [MATH20401: PDE's & Vector Calculus A](#) ([MATH20411:PDE's & Vector Calculus B](#)) to describe the mechanics of fluids and such deformable solids as rubber and steel, while the electives combine the development of sophisticated analytical tools with applications that range across the natural world.

Level 2 optional course units

- **MATH20502: Fluid Mechanics**
- **MATH20512: Classical Mechanics**
- **MATH20522: Principles of Mathematical Modelling**

Level 3 optional course units

- **MATH35001: Viscous Fluid Flow**
- **MATH35021: Elasticity**
- **MATH35012: Wave Motion**
- **MATH35032: Mathematical Biology**
- **MATH35082: Symmetry in Groups and Nature**
- **MATH34001: Applied Complex Analysis**
- **MATH34032: Green's Functions, Integral Equations and Calculus of Variations**

Financial Mathematics

These modules apply ideas from probability to model the pricing of financial instruments. Fundamental early results in this area, proved in the 1970's, lead to the development of a galaxy of new products that are now so numerous and valuable that, for example, the volume of trade in financial derivatives dwarfs that of the underlying commodities and stocks on which they depend.

Level 2 optional course units

- **MATH20802: Statistical Methods**
- **MATH20912: Introduction to Financial Mathematics**

Level 3 optional course units

- **MATH37001: Martingales with Applications to Finance**
- **MATH38032: Time Series Analysis**
- **MATH38172: Financial Generalised Linear Models**
- **MATH39032: Mathematical Modelling in Finance**

Geometry

Geometry is among the most ancient parts of mathematics and its basic objects results—curves and surfaces, their properties and their many modern generalisations—touch on almost every part of mathematics and its applications. The modules listed below reflect this richness and would be enjoyable for students with a solid grounding in both rigorous calculus and linear algebra.

Level 2 optional course units

- **MATH20122: Metric Spaces**
- **MATH20132: Calculus of Several Variables**
- **MATH20212: Algebraic Structures 2**

Level 3 optional course units

- **MATH31042: Fractal Geometry**
- **MATH31052: Topology**
- **MATH31082: Riemannian Geometry**
- **MATH32051: Hyperbolic Geometry**
- **MATH32062: Algebraic Geometry**

Logic

Logic is the study of arguments: what they are and what it means to say that they are sound. As such it's central to Mathematics and the School has a strong tradition in the area. Manchester's first great logician, Alan Turing, is famous for his cryptographic work in the Second World War, but mathematicians also know his visionary work on logic and the foundations of computation. The modules listed below provide a solid grounding in formal logic.

Level 2 optional course unit

- **MATH20302: Introduction to Logic**

Level 3 optional course unit

- **MATH33011: Mathematical Logic**

Numerical Analysis

Numerical analysis is the study of algorithms and approximations for solving the problems of continuous mathematics, that is, problems involving real or complex numbers. For such problems, which include many key applications in science, engineering and finance, exact, closed-form solutions often do not exist or are not readily obtainable, so numerical analysts develop and analyse algorithms that compute numerical approximations. The best work in the subject blends essentially pure-mathematical work on foundations with a solid grounding in the practicalities of practical computation and this is reflected in the lists of modules below, which include both programming courses and such theoretical modules as Matrix Analysis.

Level 2 optional course units

- **MATH20602: Numerical Analysis I**
- **MATH20621: Programming in Python**

MATH20902 Discrete Mathematics - if timetable allows you might want to consider this course unit if you are interested in Numerical Analysis.

Level 3 optional course units

- **MATH36001: Matrix Analysis**
- **MATH36022: Numerical Analysis II**
- **MATH36061: Convex Optimization**
- **MATH36032: Problem Solving by Computer**

Probability

Probability is the part of mathematics that enables us to reason about chance and uncertainty. Its theorems and methods are central to problems across the whole of science, engineering and economics and—in addition to the many beautiful, powerful methods and results of its own - has illuminated many other parts of modern mathematics. The modules listed below build on **MATH10141: Probability 1** and **MATH20701: Probability 2**.

Level 2 optional course units

- **MATH20712: Random Models**
- **MATH20722: Foundations of Modern Probability**

Level 3 optional course units

- **MATH37001: Martingales with Applications to Finance**
- **MATH37012: Markov Processes**

Statistics

Statistics is the science of data and its interpretation and so combines rigorous analysis (in the sense of the Analysis theme above) with the development of methods and tools suited to specific, real-world problems. Thus, as in the Numerical Analysis theme, the electives include both practical, computational modules as well as conventional lecture courses such as Time Series and Generalised Linear Models that introduce standard approaches to statistical modelling.

Level 2 course units

- **MATH20802: Statistical Methods**
- **MATH20811: Practical Statistics**

Level 3 course units

- **MATH38161: Multivariate Statistics and Machine Learning**
- **MATH38032: Time Series**
- **MATH38172: Financial Generalised Linear Models**
- **MATH38072: Medical Statistics**