

MATHS 153 syllabus

Below is the list of topics in MATHS 153. Not all of these topics will be examinable: those in round brackets may not be lectured every year, those in square brackets will be left as reading only.

Calculus

Sets, intervals and inequalities, the absolute value. Domain, range, and inverses of functions, including trigonometric, hyperbolic, exponential and logarithmic functions. Trigonometric equations.

Limits and limit theorems. Squeeze Theorem. Continuity of functions. The Intermediate Value Theorem. Limits at infinity and asymptotes of functions.

Tangents and rates of change. Derivatives of functions, differentiability. Differentiation rules, the chain rule. Implicit differentiation. Related rates. Maxima and minima, the Extreme Value Theorem, [Fermat's, Rolle's and the Mean Value Theorems]. First and second derivative tests. Curve sketching, optimisation. [Introduction to functions of two variables: domain, level curves, partial derivatives, differentiability and local linearity.]

Antiderivatives. Area, Riemann Sums and the definite integral. The Fundamental Theorem of Calculus. Indefinite integrals. Integration by substitution, by parts, and by partial fractions. Integration using inverse trigonometric substitutions. Solving first order differential equations by the methods of integrating factors and separation of variables. Slope fields and Euler's method. Modelling with first order differential equations. (Introduction to second order differential equations.)

Linear Algebra

Vectors in $\mathbb{R}^n$, norms, angles, the dot product, orthogonality and orthogonal projections onto a line. Linear combinations of vectors. Vector and parametric vector equations of lines and planes in $\mathbb{R}^3$. Intersections and angles between lines and planes in $\mathbb{R}^3$. Normal vectors, and Cartesian equations of planes.

Linear systems, augmented matrices and elementary row operations. Echelon forms, Gaussian elimination and back substitution. Some applications of linear systems. Matrices and matrix algebra. Linear transformations on $\mathbb{R}^2$. The matrix of a linear transformation on $\mathbb{R}^n$. Operations on matrices, algebraic properties of matrices, matrix inverses.

Determinants by cofactor expansion, properties of determinants, geometric interpretation of determinants. The cross product. [Introduction to eigenvalues and eigenvectors.]