

Mathematical methods (MST224) content listing

Unit 1 <i>Getting started</i>	This unit refreshes some key topics taught at Level 1, namely linear and quadratic functions, exponential and logarithm functions, trigonometric functions, complex numbers, differentiation and integration.
Unit 2 <i>First-order differential equations</i>	Analytic solution of first-order differential equations using either separation of variables or the integrating factor method. Direction fields and numerical solution by Euler's method.
Unit 3 <i>Second-order differential equations</i>	Solution of linear constant-coefficient second-order differential equations. Using the method of undetermined coefficients to find particular integrals for simple inhomogeneous differential equations.
Unit 4 <i>Vectors and matrices</i>	Vectors both geometrically and algebraically. Scalar and vector products. Matrices as linear transformations. Matrix algebra and matrix inversion. Evaluating determinants.
Unit 5 <i>Linear algebra</i>	Solving systems of linear equations using Gaussian elimination. Eigenvalues and eigenvectors.
Unit 6 <i>Systems of linear differential equations</i>	Solving first-order and second-order systems of linear differential equations by using the eigenvalues and eigenvectors of the coefficient matrix.
Unit 7 <i>Functions of several variables</i>	Visualising functions of several variables, contour maps and gradient along a path. Partial derivatives. The gradient vector. Taylor polynomials. Classifying stationary points.
Unit 8 <i>Non-linear differential equations</i>	Modelling interacting populations using non-linear differential equations. Qualitative solutions via phase plane plots. Equilibrium points. Using linearization to classify equilibrium points.
Unit 9 <i>Multiple integrals</i>	Area and volume integrals in Cartesian coordinates. Area integrals in polar coordinates. Volume integrals in cylindrical and spherical coordinates. Surface integrals.
Unit 10 <i>Fourier series</i>	Periodic functions. Odd and even functions. Representing periodic functions as Fourier series of sines and cosines. Pointwise convergence theorem. Gibbs phenomenon.
Unit 11 <i>Partial differential equations</i>	Separation of variables applied to partial differential equations. Application to the wave equation and heat equation.
Unit 12 <i>Vector calculus</i>	Gradient, divergence and curl in Cartesian, cylindrical and spherical coordinates. Line integrals of vector fields. Conservative fields and the curl test.