Mathematical methods **(MST224)** content listing

Unit 1 *Getting started*	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 *First-order differential equations*	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 *Second-order differential equations*	Solution of linear constant-coefficient second-order differential equations Using the method of undetermined coeficients to find particular integrals for simple inhomogeneous differential equations
Unit 4 *Vectors and matrices*	Vectors both geometrically and algebraically. Scalar and vector products Matrices as linear transformations Matrix algebra and matrix inversion Evaluating determinants
Unit 5 *Linear algebra*	Solving systems of linear equations using Gaussian elimination Eigenvalues and eigenvectors
Unit 6 *Systems of linear differential equations*	Solving first-order and second-order systems of linear differential equations by using the eigenvalue and eigenvectors of the coefficient matrix Application to finding normal modes of oscillation
Unit 7 *Functions of several variables*	Visualising functions of several variables, contour maps and gradient along a path Partial derivatives The gradient vector Taylor polynomials Classifying stationary points
Unit 8 *Multiple integrals*	Area and volume integrals in Cartesian coordinates Area integrals in polar coordinates Volume integrals in cylindrical and spherical coordinates Surface integrals
Unit 9 *Differentiating scalar and vector fields*	Gradient of a scalar field Divergence and curl of a vector field.
Unit 10 *Integrating scalar and vector fields*	Line integrals of scalar and vector fields Conservative fields and the curl test Flux and the divergence theorem Circulation and the curl theorem
Unit 11 *Fourier series*	Periodic functions Representing periodic functions as Fourier series of sines and cosines Pointwise convergence theorem Gibbs phenomenon Complex exponential Fourier series
Unit 12 *Partial differential equations*	Separation of variables applied to partial differential equations Application to the diffusion/heat equation (derivation and solution for simple cases)
Unit 13 *Non-linear differential equations*	Modelling interacting populations using non-linear differential equations Qualitative solutions via phase plane plots Equilibrium points Using linearization to classify equilibrium points