

Essential mathematics 2 (MST125) content listing

Unit 1 <i>Key techniques</i>	Functions, trigonometry, vectors, matrices, differentiation, integration and using a computer algebra system (Maxima)
Unit 2 <i>Mathematical typesetting</i>	How to typeset mathematics from a choice of typesetting packages: LaTeX, Microsoft Word or Libre Office
Unit 3 <i>Number theory</i>	Euclid's algorithm and congruences, division theorem, Bezout's identity, residue classes Modular arithmetic, Fermat's Little Theorem, divisibility tests and check digits Multiplicative inverses, linear congruences and affine ciphers
Unit 4 <i>Conics</i>	Conic sections, definitions, properties and applications of parabolas, ellipses and hyperbolas, conics not in standard position Parametric equations
Unit 5 <i>Statics</i>	Forces including weights, tensions, normal reactions and friction Systems in equilibrium. Particle on an inclined plane Pulley systems
Unit 6 <i>Geometric transformations</i>	Transformations of the plane, composite and inverse transformations Isometries, linear transformations and affine transformations
Unit 7 <i>Topics in calculus</i>	Revision of integration by substitution and by parts, partial fractions of proper and improper rational expressions Graphs of rational functions Integration methods using trigonometric expressions and substitutions and applications Hyperbolic functions and their inverses, hyperbolic identities, differentiation and integration of hyperbolic functions and hyperbolic substitutions
Unit 8 <i>Differential equations</i>	Solution of differential equations by direct integration and separation of variables Applications including population modelling, radioactive decay and Newton's law of cooling Linear differential equations and the integrating factor method Direction fields, numerical solutions of differential equations and solving differential equations using a computer
Unit 9 <i>Mathematical language and proof</i>	Mathematical statements, counter-examples, proof by exhaustion Negating and combining statements, implications and equivalence Direct proofs, deduction, proving an implication, proving an equivalence, proving a statement that is neither an implication nor an equivalence Mathematical induction Indirect proofs – proof by contradiction and contraposition Proving Fermat's little theorem
Unit 10 <i>Dynamics</i>	Position, velocity and acceleration in 1, 2 and 3 dimensions Newton's second law of motion, projectiles.
Unit 11 <i>Eigenvalues</i>	Finding the eigenvalues and eigenvectors of a 2x2 matrix (and higher order matrices using software) Eigenvalues and eigenvectors of triangular matrices, flattenings, rotations, reflections and generalised scalings Diagonalisation and powers of matrices, predator-prey system Systems of differential equations, coupled and decoupled systems
Unit 12 <i>Combinatorics</i>	Principles of counting, the addition, subtraction and multiplication principles Sequences, permutations and combinations, connections with probability First order recurrence systems, arithmetic and geometric sequences Solving first-order recurrence systems, finding recurrences for counting problems Second order recurrence systems and their solution The Fibonacci sequence and its closed form Finding second-order recurrence systems for counting problems