

Mathematics (Core) Unit Content

Main Topic	Subtopics
Algebra	<p>Roots of a quadratic equation; Proof of the quadratic formula; The nature of the roots of a quadratic equation; Relationship between the roots and coefficients of a quadratic equation;</p> <p>Remainder Theorem And Factor Theorem;</p> <p>The Binomial Theorem; Use of the binomial theorem for approximation and error analysis;</p>
Differentiation	<p>An algebraic and geometric definition of the derivative of a function;</p> <p>The derivative of basic algebraic expressions; The derivative of trig functions, exponentials, and logs;</p> <p>Rules of Differentiation : The chain rule, The product rule, The quotient rule;</p> <p>Stationary Values, Turning Points, Maxima and Minima; Applications of stationary values : Optimisation;</p> <p>Derivatives of Implicit Functions;</p> <p>Tangents and Normals;</p>
Integration	<p>Integration as the Process of Summation; Integration as the Reverse of Differentiation;</p> <p>Techniques of Integration : Integration of Trigonometric Functions and Expressions; Integration of Exponential and Log functions; Integration of functions leading to inverse trig functions; Integration by substitution; Integration of Products : Integration by parts; Integrating fractions;</p> <p>Applications of Integration : Areas Bounded by Curves and Volumes of Revolution; The area</p>

	<p>under a curve; Areas bounded between two curves; Areas bounded between two curves; Volumes of revolution; Volumes bounded by two functions.</p>
Series	<p>Arithmetic Progressions : The sum of an arithmetic progression;</p> <p>Geometric Progressions : The sum of a geometric progression; Sum to Infinity of a Geometric Progressions;</p> <p>Method of differences;</p> <p>Proof by Induction;</p>
Vectors	<p>Vectors and scalars; Position vectors; Cartesian components of a vector; directions cosines of a vectors;</p> <p>Dot product and vector product of two vectors;</p> <p>Vector equations of lines and plains;</p>
Complex Numbers	<p>Definition of a Complex Number; Basic Arithmetic on Complex Numbers;</p> <p>Argand Diagram And The Polar Form Of A Complex Numbers;</p> <p>DeMoivre's Thereom; Polar form of a complex number; Finding roots of a complex number using DeMoivre's theorem;</p> <p>Properties Of Complex Numbers.</p>
Ordinary Differential Equation	<p>1st Order Ordinary Differential Equations : Separation of variables; Boundary conditions; Use of substitutions in reducing to a separable ODE; Exact differential equations; Integrating Factor;</p> <p>2nd Order Ordinary Differential Equations : General solution to the 2nd order homogeneous ODE with real/distinct, real/equal and complex roots.</p> <p>2nd Order ODEs : Inhomogeneous equations : The Method Of Undetermined Coefficients</p>

Mathematics (Advanced) Unit Content

The advanced mathematics syllabus covers everything the core syllabus covers, along with the some more advanced topics (highlighted in red in the table below). However the list of advanced topics is not exclusive, and some topics may be changed in the light of circumstances.

Main Topic	Subtopics
Algebra	<p>Roots of a quadratic equation; Proof of the quadratic formula; The nature of the roots of a quadratic equation; Relationship between the roots and coefficients of a quadratic equation;</p> <p>Remainder Theorem And Factor Theorem;</p> <p>The Binomial Theorem; Use of the binomial theorem for approximation and error analysis;</p> <p>More complicated exercises on algebra; Derived functions and Taylor's theorem; Extended versions of remainder and factor theorems (for repeated factors).</p>
Differentiation	<p>An algebraic and geometric definition of the derivative of a function;</p> <p>The derivative of basic algebraic expressions; The derivative of trig functions, exponentials, and logs;</p> <p>Rules of Differentiation : The chain rule, The product rule, The quotient rule;</p> <p>Stationary Values, Turning Points, Maxima and Minima; Applications of stationary values : Optimisation;</p> <p>Derivatives of Implicit Functions;</p> <p>Tangents and Normals;</p> <p>More complicated exercises on differentiation; Either theoretical study of limits, i.e. $x - c < \delta \Leftrightarrow f(x) - L < \varepsilon$, and related exercises, Or Leibniz's formula, Taylor's theorem and Mean value theorem (depending on which topic we covered in class/tutorials)</p>
Integration	<p>Integration as the Process of Summation; Integration as the Reverse of Differentiation;</p> <p>Techniques of Integration : Integration of</p>

	<p>Trigonometric Functions and Expressions; Integration of Exponential and Log functions; Integration of functions leading to inverse trig functions; Integration by substitution; Integration of Products : Integration by parts; Integrating fractions;</p> <p>Applications of Integration : Areas Bounded by Curves and Volumes of Revolution; The area under a curve; Areas bounded between two curves; Areas bounded between two curves; Volumes of revolution; Volumes bounded by two functions.</p> <p>More complicated exercises on integration; Reduction formulae; Gamma and Beta functions.</p>
Series	<p>Arithmetic Progressions : The sum of an arithmetic progression;</p> <p>Geometric Progressions : The sum of a geometric progression; Sum to Infinity of a Geometric Progressions;</p> <p>Method of differences;</p> <p>Proof by Induction;</p> <p>More complicated series exercises; Test for convergence of series.</p>
Vectors	<p>Vectors and scalars; Position vectors; Cartesian components of a vector; directions cosines of a vectors;</p> <p>Dot product and vector product of two vectors;</p> <p>Vector equations of lines and plains;</p>
Complex Numbers	<p>Definition of a Complex Number; Basic Arithmetic on Complex Numbers;</p> <p>Argand Diagram And The Polar Form Of A Complex Numbers;</p> <p>DeMoivre's Thereom; Polar form of a complex number; Finding roots of a complex number using DeMoivre's theorem;</p> <p>Properties Of Complex Numbers.</p> <p>More complicated complex numbers exercises; Locii problems. Exponential form of a complex number; Functions of a complex variable;</p>

<p>Ordinary Differential Equation</p>	<p>1st Order Ordinary Differential Equations : Separation of variables; Boundary conditions; Use of substitutions in reducing to a separable ODE; Exact differential equations; Integrating Factor;</p> <p>2nd Order Ordinary Differential Equations : General solution to the 2nd order homogeneous ODE with real/distinct, real/equal and complex roots.</p> <p>2nd Order ODEs : Inhomogeneous equations : The Method Of Undetermined Coefficients;</p> <p>More complicated ODE exercises; Bernoulli type ODEs; ODEs with variable coefficients (if this topic was covered in class); the method of variation of parameters (if this topic was covered in class); Laplace transforms (if this topic was covered in class);</p>

Some details of the syllabus may be subject to change.