Course Outline: **Year 12 Further Maths**

	CONTENT	KEY/FUNDAMENTAL CONCEPTS	ASSESSMENT
Autumn Term	AS-Level – Trigonometry	Sine/Cosine rules	Baseline assessment
		Trig graphs and solving trig equations	
		Trig identities	
		Radians	
		Small angle approximations	
	AS-Level – Algebra and functions	Surds and Indices	
		Quadratic functions	
		Simultaneous equations	
		Inequalities	
		Polynomial division and Factor theorem	
		Factor theorem	
		Graphs incl transformations	
	AS-Level – Coordinate geometry	Binomial theorem and expansion	
	AS-Level – Differentiation	Straight lines	
		Circles	
		Differentiate polynomials	
		Use derivative to find gradient including stationary points	
	AS-Level – Exponentials and logs	Increasing/decreasing functions	
		Differentiate from 1st principles	
		Definitions, graphs and laws of logarithms	
		Solve equations	
		Exponential growth and decay	
		Curve fitting	
	Half-term		
	AS-Level – Integration	Integrate polynomials	Mixed assessment
		Evaluate definite integrals	
		Integrate to find areas	
	AS and A-Level – Vectors	Use vectors in 2D and 3D	
		Magnitude and direction of a vector	
	AS-Level - Mechanics	Kinematics and travel graphs	
		Constant acceleration formulae	
		Calculus in kinematics	
		Motion under gravity	
		Forces and Newton's laws	
		Connected particles	
	AS-Level - Statistics	Sampling	
		Presenting data, including Scatter diagrams	
	Further Pure - Matrices	Averages and spread of data	
		Matrix arithmetic	
		Matrix transformations	
		Determinant and inverse of 2x2 matrices	
	AS and A-level - Proof	Invariant lines and lines of invariant points	
		Analytical proof	
		Proof by exhaustion	
		Proof by counter example	
		Proof by contradiction	
	Christmas Holiday		
Spring Term	A-Level – Differentiation	Differentiating parametric equations	Mixed assessment
		Implicit differentiation	
	A-Level – Integration	Integration by inspection	Further Mixed assessment
		Integration by substitution	
		Integration by parts	
		Integration involving natural logs	
	AS-Level – Statistics	Binomial distribution and hypothesis tests	

	A-Level – Mechanics	Hypothesis tests including PMCC Kinematics in 2 dimensions Inclined planes Friction Moments Projectiles	
	Further Pure – Complex numbers	Arithmetic with complex numbers Modulus-argument form Argand diagrams	
	AS-Level - Statistics	Loci in the complex plane Conditional probability Modelling with probability	
Half-term		
	A-Level – Statistics	Normal distribution	Mixed Calculus assessment
	A-Level – Trigonometry	Reciprocal trig functions and identities Compound and double angle formulae Rcos(x+a) and Rsin(x+a)	
	A-Level – Differentiation	Differentiate trig functions Convex and concave functions Points of inflection Chain, product and quotient rules Connected rates of change	
	A-Level – Partial fractions	Partial fractions	
	A level - Integration	Differential equations	
	A-Level – Sequences and series	Iterative sequences and other sequences Arithmetic sequences and series	
	A-Level – Numerical methods	Geometric sequences, series sum to infinity Change of sign and iterative methods Newton-Raphson Trapezium rule	
Easter Holiday		
	A-Level – Functions	Composite and inverse functions Modulus functions and equations Composite transformations	Year 12 mocks
	A-Level – Statistics	Large data set	
	Further Pure – Vectors	Vector and Cartesian equation of a 3D line and equation of a plane Scalar product Intersection of planes	
	Further Pure - Induction	Proof of sum of series and divisibility	
Half-term		
Summer Term	Further Pure– Algebra and functions	Roots of polynomials Transformed polynomials Sketching rational functions Inequalities of rational functions	Functions assessment
	Further Pure - Series	Series based on integers, squares and cubes	
	Further Pure – Maclaurin series	Method of differences Maclaurin series	
	Further Mechanics – Work, energy and power	Evaluate limits using Maclaurin l'Hôpital's rule Work done by a force Gravitational potential energy Conservation of energy problems Kinetic energy Hooke's Law Work done by a variable force	
	Further Pure – Further calculus	Elastic potential energy Power Improper integrals Volumes of revolution Mean of a function	

Course Outline: **Year 13 Further Maths**

	CONTENT	KEY/FUNDAMENTAL CONCEPTS	ASSESSMENT
Autumn Term	Further Pure – Matrices	Determinant and inverse of 3x3	Mixed assessment
		Row and column operations	
	Further Pure – Vectors	Vector product	
		Intersection of and distance between lines	Further Complex numbers and Matrices assessment
	Further Statistics - Poisson	Poisson distribution	
		Poisson Hypothesis testing	
	Further Pure – Hyperbolic functions	Definitions of hyperbolics	
		Graphs of hyperbolics	
		Differentiate and integrate hyperbolics	
		Inverse hyperbolics incl domain and range	
		Logarithmic form of inverse hyperbolics	
		Integrate using hyperbolic substitutions	
		Hyperbolic identities	
	Further Pure – Conics	Parabolas, hyperbolas and ellipses	
		Transformations of curves	
	Further Pure – Integration	Partial fractions	
		Inverse trigonometric functions	
		Substitutions associated with inverse trigonometric functions	
	Further Pure – Further matrices	Eigenvalues and eigenvectors	
		Row and column operations	
		Diagonal form	
		Geometric interpretation of SEs	
	Further Pure – Further vectors	Vector product	
		Intersection of lines	
		Distance between lines, points and planes	
	Further Mechanics – Dimensional analysis	Find dimensional quantities	
		Check dimensional consistency	
		Prediction of formulae	
		Find powers in potential formulae	
	Further Pure – Numerical Methods	Mid-ordinate rule	
		Simpson's rule	
		Euler's method and improved Euler's	
Half-term			
	Further Statistics – DRVs	Find averages and spread of DRVs	Year 13 mocks
	Further Statistics – CRVs	Use probability density function	
		Find averages and spread of CRVs	
		Use distributions for part discrete and part continuous variables	
		Sum of independent CRVs	
		Cumulative distribution function	
		Rectangular distribution	
	Further Pure – Further algebra and functions	Rational functions – linear	
		Rational functions – quadratic	
		Asymptotes	
		Stationary points	
		Arc length	
	Further Pure – Further calculus	Surface area of revolution	
		Reduction formulae	
		Limits of improper integrals	
	Further Mechanics – Momentum and collisions	Conservation of momentum	
		Coefficient of restitution and Newton's experimental law	

		Impulse in one or two dimensions	
	Further Pure – Further complex numbers	Impulse for variable forces de Moivre's theorem Exponential form Nth roots and roots of unity	
		Christmas Holiday	
Spring Term	Further Pure – Differential equations	Integrating factor to solve first order DEs General and particular solutions of DEs Differential equations in modelling Second order DEs Using complementary functions Using auxiliary Simple harmonic motion and damping Use Hooke's law Coupled first order simultaneous equations	Trigonometry and Differentiation assessment Further Vectors assessment
	Further Statistics – Errors Further Statistics – Chi squared Further Statistics – Confidence intervals Further Statistics – t distribution Further Mechanics – Circular motion	Type I and II errors and power of a test Calculate chi squared test statistic Construct confidence intervals t-tests and t distribution for Normal and Confidence intervals Motion in a circle with constant speed Angular speed Vectors and circular motion Conical pendulum Circular motion in vertical plane Conservation of energy	
		Half-term	
	Further Pure – Polar coordinates Further Statistics – Exponential distribution Further Mechanics – Centres of mass and moments	Convert between polar and Cartesian Sketch curves Find areas enclosed by polar curves Calculate probabilities using F(x) and f(x) Proofs of mean, variance and SD Centre of mass for a system of particles, compositive bodies and laminas Centre of mass rotated about x axis Sliding and toppling Moments and couples	Integration assessment Further Statistics assessment
		Easter Holiday	
Summer Term	Revision		