Key Stage 5: Year 12

Overall Curriculum Goals					
AQA – Teacher 1 Pure, Teacher 2 Discrete and Stats **A Level Further Maths aims to encourage learners to:** • Answer questions that test the content synoptically • apply the knowledge they have learnt throughout the course in unfamiliar areas					
Half Term 1	**Half Term 2**	**Half Term 3**	**Half Term 4**	**Half Term 5**	**Half Term 6**
KEY IDEAS/CONCEPTS **Complex Numbers (T1)** Properties and arithmetic, solving polynomial equations, Argand diagrams, Modulus-argument form and Loci **Roots of Polynomials (T1)** Roots of polynomials and forming polynomials with related roots **Networks and Network Flows (T2)** Minimum spanning trees, the route inspection problem, the travelling salesperson problem. Interpret flow problems, maximum flow minimum cut theorem **Graph Theory (T2)** Language of graphs, Eulerian, semi eulerian, Hamiltonian Eulers formula Bipartite graphs, adjacency matrix	**KEY IDEAS/CONCEPTS** **Inequalities and Rational Functions (T1)** Solving Inequalities Graphs of rational functions **Vectors (T1)** Vector equation of a line Scalar product Finding distances **Summations (T1)** Summing series Method of differences Maclaurin series **Critical Path Analysis (T2)** Activity network Critical activities and paths Limitations and working in context **Linear Programming (T2)** Optimisation problems Graphical representation **Game Theory (T2)** Zero Sum games Mixed strategy games	**KEY IDEAS/CONCEPTS** **Matrics (T1)** Properties and arithmetic Transformations, Systems of linear equations **Proof (T1)** Mathematical Induction **Calculus (T1)** Mean Values Volume of revolution **Discrete Random Variables (T2)** Discrete Distributions and expectations **Poisson Distribution (T2)** Poisson Distribution Know the Poisson formula and calculate Poisson probabilities Know mean, variance and standard deviation of a Poisson distribution. Understand the distribution of the sum of independent Hypothesis Testing Type I and Type II errors	**KEY IDEAS/CONCEPTS** **Polar Coordinates (T1)** Convert between polar and cartesian coordinates Sketch curves with r given as a function of θ, including use of trigonometric functions. **Hyperbolic Functions (T1)** Hyperbolic functions Inverse hyperbolic functions Derive and use the logarithmic forms of the inverse hyperbolic functions. Recall and use identities **Chi Tests for association (T2)** Contingency tables χ 2 statistic with appropriate degrees of freedom Expected values Sources of association **Confidence Intervals (T2)** Confidence intervals for the mean of a normal distribution with known variance	**KEY IDEAS/CONCEPTS** Review + consolidate knowledge learnt so far, practice applying knowledge to unfamiliar areas and prepare for Finals/ external exam After the AS External exam start A Level content: **Differential Equations (T1)** • Find and use an integrating factor to solve differential equations and recognise when it is appropriate to do so. (I1) • Find both general and particular solutions of differential equations (I2) • Use differential equations in modelling in kinematics and in other contexts (I3) **Exponential Distribution (T2)**	**KEY IDEAS/CONCEPTS** **Differential Equations (T1)** • Solve homogeneous differential equations by using the auxiliary equation (I4) • Solve non-homogeneous differential equations by solving the homogeneous case and adding a particular integral to the complementary function (I5) **CRV's (T2)**

Simple graphs, simple connected graphs and trees		**Continuous Random Variables (T2)** Probability density function Probability Median and Quartiles Mean, Variance and standard deviation expectation and variance of linear functions of CRVs	confidence intervals from large samples, of the mean of a normal distribution with unknown variance. Make inferences from constructed or given confidence intervals.		

Key Stage 5: Year 13

Overall Curriculum Goals

AQA – Teacher 1 Pure, Teacher 2 Discrete and Stats
A Level Further Maths aims to encourage learners to:

- Answer questions that test the content synoptically
- apply the knowledge they have learnt throughout the course in unfamiliar areas

Half Term 1	Half Term 2	Half Term 3	Half Term 4	Half Term 5	Half Term 6
KEY IDEAS/CONCEPTS **Complex Number (T1)** • **Understand de Moivre's Theorem and use it to find multiple angle formulae and sums of series (B8)** • **Know and use Euler's formula for complex numbers (B9)** • **Find the nth distinct roots of re^(itheta) for r not equal to 0 and know that they form the vertices of a regular n-gon in the Argand diagram. (B10)** • **Use complex roots of unity to solve geometric problems (B11)** **Hyperbolic Functions (T1)**	**KEY IDEAS/CONCEPTS** **Polar Graphs (T1)** • **Find the area enclosed by a polar curve (G3)** **Differential Equations (T1)** • **Find and use an integrating factor to solve differential equations and recognise when it is appropriate to do so. (I1)** • **Find both general and particular solutions of differential equations (I2)** • **Use differential equations in modelling in kinematics and in other contexts (I3)**	**KEY IDEAS/CONCEPTS** **Matrices (T1)** • **Calculate determinants of 2x2 matrices and 3x3 matrices and interpret as scale factors, including the effect on orientation (C5)** • **Understand and use singular and non-singular matrices; properties of inverse matrices. Calculate and use the inverse of non-singular 2x2 matrices and 3x3 matrices (C6)** • **Solve three linear simultaneous equations in three variables by use of**	**KEY IDEAS/CONCEPTS** Review + consolidate knowledge learnt so far, practice applying knowledge to unfamiliar areas and prepare for Finals	**KEY IDEAS/CONCEPTS** Review + consolidate knowledge learnt so far, practice applying knowledge to unfamiliar areas and prepare for Finals	**KEY IDEAS/CONCEPTS**

• Understand the definitions of hyperbolic functions including their domains and ranges and be able to sketch their graphs. Understand the definitions of the reciprocal hyperbolic functions including their domains and ranges (H1) • Differentiate and integrate hyperbolic functions (H2) • Understand and be able to use the definitions of the inverse hyperbolic functions and their domains and ranges (H3) • Derive and use the logarithmic forms of the inverse hyperbolic functions (H4) • Integrate functions using hyperbolic substitutions and be able to choose substitutions to integrate associated functions (H5) • Understand and use associated hyperbolic identities (H6) • Construct proofs involving hyperbolic functions and identities (H7) Improper integrals and inverse trigonometric functions (T1)	• Solve homogeneous differential equations by using the auxiliary equation (I4) • Solve non-homogeneous differential equations by solving the homogeneous case and adding a particular integral to the complementary function (I5) • Understand and use the relationship between cases when the discriminant of the auxiliary equation is positive, zero and negative and the form of solution of the differential equation (I6) SHM, modelling damped oscillations and coupled equations (T1) • Solve the equation for SHM and relate the solution to the motion (I7) • Model damped oscillations using second order differential equations and interpret their solutions. Understand light, critical and heavy damping and be able to determine when each will occur (I8)	the inverse matrix (C7) • Interpret geometrically the solution and failure of solution of three simultaneous linear equations (C8) • Factorisation of determinants using rows and column operations (C9) • Find eigenvalues and eigenvectors of 2x2 and 3x3 matrices. Find and use the characteristic equation. Understand the geometrical significant of eigenvalues and eigenvectors (C10) • Diagonalisation of matrices when the eigenvalues are real (C11) Vectors (T1) • Understand and use the vector and Cartesian forms of the equation of a plane (F2) • Calculate the scalar product and use it to calculate the angle between two lines, to express the equation of a plane, and to calculate the angle between two plans and the angle between a line and a plane (F3)			

• Evaluate improper integrals where either the integrand is undefined at a value in the range of integration of the range of integration extends to infinity (E1) • Integrate using partial fractions (extend to quadratic factors in the denominator) (E4) • Differentiate inverse trigonometric functions (E5) • Integrate functions using trigonometric substitutions and be ableto choose trigonometric substitutions to integrate associated functions (E6) • Arc length and area of surface of revolution for curves expressed in Cartesian or parametric coordinates (E7) • Derivation and use of reduction formulae for integration (E8) • Appropriate limits applied to improper integrals (E9) Further Curves (T1) • Modulus of functions and associated inequalities (D10) • Graphs of y = modulus of f(x), its reciprocal (D11)	• Analyse and interpret models of situations with one independent variable and two dependent variables as a pair of coupled first order simultaneous equations and be able to solve them, for example predator-prey models (I9) • Use of Hooke's law to formulate a differential equation for SHM (I10) • Use models for damped motion when samping force is proportional to the velocity (I11) Graph Theory and Game Theory (T2) • Use Kuratowski's Theorem to determine the planarity of graphs (DA4) • Recognise and find isomorphism between graphs (DA7) • Recap of game theory from year 12 Linear Programming (T2) • Use the Simple algorithm for optimising (maximising and minimising) an objective function including the use of slack variables (DD3)	• Calculate and understand the properties of the vector product. Use vector products to find the area of a triangle (F5) • Find the intersection of a line and a plane and calculate the perpendicular distance between two lines, from a point to a line and from a point to a plane (F6) Network Flows, Binary Operations and Group Theory(T2) • Augment flows and determine the maximum flow in a network (DC5) • Solve problems including arcs with upper and lower capacities (DC6) • Refine network flow problems including using nodes of restricted capacity (DC7) • Understand and use the language of groups including: order, period, subgroup, proper, trivial and non-trivial (DG7) • Understand and use the group axioms: closure, identity, inverses and associativity,			

• Graphs of rational functions including cases when some of these coefficients are zero; asymptotes parallel to coordinate axes; oblique asymptotes (D13) • Single transformations of curves involving translations, stretches parallel to coordinate axes and reflections in the coordinate axes and the lines y = x and y =-x. Extend to composite transformations including rotations and enlargements (D16) Hypothesis testing, Type I and II errors and Confidence Intervals (T2) • Test for the mean of a normal distribution with unknown variance using a t-statistic with appropriate degrees of freedom (SG1) • Construct symmetric confidence intervals for the mean of a normal distribution with known variance (SH1) • Construct symmetric confidence intervals from large samples, of the mean of a normal distribution	• Interpret a Simplex tableau (DD4) • Convert higher order games to linear programming problems and solve using Simplex algorithm (DF6)	including use of Cayley tables (DG8) • Recognise and use finite and infinite groups and their subgroups, including: groups of symmetries of regular polygons, cyclic groups and abelian groups (DG9) • Understand and use Lagrange's theorem (DG10) • Identity and use the generators of a group (DG11) • Recognise and find isomorphism between groups of finite order (DG12)			

with unknown variance (SH2) • **Make inferences from constructed or given confidence intervals (SH3)** • **Construct symmetric confidence intervals from small samples, of the mean of a normal distribution with unknown variance using the t-distribution (SH4)** • **Understand and use a cumulative distribution function F(x). Know the relationship between F(x) and f(x) (SD6)** • **Understand the rectangular distribution. Know the conditions for it to be used as a model. Calculate probabilities from a rectangular distribution. Know proofs of mean, variance and standard deviation for a rectangular distribution (SD7)** Chi Squared Tests and Mixed drv and crv (T2) • **Construction of nxm contingency tables (SE1)** • **Use of formula to calculate chi squared statistics with appropriate degrees of freedom (SE2)**					

Know and use the convention that Ei should be greater than 5 (SE3) **Identification of sources of association in the context of a question (SE4)** **Knowledge of when and how to apply Yates' correction (SE5)** **Find the mean, variance and standard deviation for functions of a DRV (SA5)** **Poisson Distribution (T2)** **Recap from year 12 coverage**					

CEIAGS and Co-Curricular
- UKMT   - Integral Maths Ritangle Team Competition   - SUMS - Steps to University for Maths Monthly Newsletter   - Introduction to STEP and Oxbridge style interviews in the Summer Term