Year 13 A level Further Maths

	Focus	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
	Topic -Pure	**Vectors 1:** Equations of planes **Further algebra and graphs** **Matrices 1:** 3x3 determinants and inverses **Matrices 2:** Matrices and simultaneous equations **Matrices 3:** Factorisation of determinants **Conics:** Conics and further transformations	**Further calculus 1:** Improper integrals **Further calculus 2:** Inverse trigonometric functions **Further calculus 3:** Further integration **Polar coordinates:** Finding areas **Series and Limits 1:** Maclaurin series **Series and Limits 2:** Series and induction	**Further Matrices:** Eigenvalues and Eigenvectors **Hyperbolic Functions** **Further Integration** **Numerical Methods** **Complex Numbers 1:** Exponential form **Complex numbers 2:** De Moivre's Theorem **Complex Numbers 3:** Complex Roots	**Further vectors 1:** The vector product **Further vectors 2:** Lines and planes **First order differential equations** **Second order differential equations 1:** Homogeneous **Second order differential equations 2:** Non-homogeneous **Second order differential equations 3:** Modelling with 2nd order differential equations	Exam preparation	
	Topic - Applied	**Graphs and Networks 4-** Isomorphism, Kuratowski's Theorem **Further Network Flows** **Further Critical Path Analysis**	**Further Linear programming-** Simplex Method **Further Game Theory** **Further Binary operations-** Group Theory **Momentum and Power (including resolving)**	**Further Circular Motion-** vertical motion and using vectors **Centre of Mass and Moments**	Work on Pure content	Exam Preparation	
	Key concepts/ideas	**Pure:** Using vector equation of planes Working with matrices Working with graphs **Applied**: Proofs with Planar Graphs Extending network flows and CPA	**Pure**: Extending calculus Working with Polar coordinates Series **Applied:** Using the simplex algorithm, group theory and extending AS mechanics to resolving	**Pure**: Further work on Matrices and complex numbers and integration Hyperbolic functions Using numerical methods for integration and differential equations **Applied:** Complete mechanics with further vertical circular motion and then moments and centres of mass	**Pure**: Vector Geometry- lines and planes (equations, angles, intersections) Differential Equations- solving first and second order and then applications of these	Revising and practicing exam style questions	
	Key skills- Pure	1) Understand and use the vector and Cartesian forms of the equation of a plane. 2) Use the scalar product to express the equation of a plane and to calculate the angle between two planes and the intersection of two planes 3) Find the intersection of a line and a plane. 4) Modulus and reciprocal graphs 5) Equations and inequalities 6) Graphs with oblique asymptotes 7) Calculate determinants of 3×3 matrices (without a calculator) 8) Calculate and use the inverse of non-singular 3x3 matrices. (without a calculator) 9) Solve three linear simultaneous equations in three variables by use of the inverse matrix. 10) Interpret geometrically the solution and failure of solution of three simultaneous linear equations.	1) Evaluate improper integrals where either the integrand is undefined at a value in the range of integration or the range of integration extends to infinity. 2) Differentiate inverse trigonometric functions. 3) Integrate using partial fractions. 4) Be able to choose trigonometric substitutions to integrate associated functions. 5) Find the area enclosed by a polar curve. 6) Find tangents parallel to, or at right angles to, the initial line. 7) Polynomial approximations and Maclaurin series	1) Find eigenvalues and eigenvectors of 2 × 2 and 3 × 3 matrices. 2) Find and use the characteristic equation. 3) Understand the geometrical significance of eigenvalues and eigenvectors. 4) Diagonalisation of matrices 5) Hyperbolic functions 6) Identities 7) Reciprocal and further inverse hyperbolic functions 8) Calculus and hyperbolic functions 9) General Integration 10) Reduction Formulae 11) Curved lengths and surface areas 12) Mid-ordinate rule and Simpson's rule for integration.	1) Calculate and understand the properties of the vector product. 2) Understand and use the equation of a straight line in the vector product form 3) Use vector products to find the area of a triangle. 4) Find the intersection of a line and a plane and the angle between a line and a plane 5) Perpendicular distance from a point to the plane. 6) Calculate the angle between a line and a plane. 7) Use separation of variables to solve first order Des. 8) Find and use an integrating factor to solve differential equations.	Practise a variety of exam style questions	

		11) Factorisation of determinants using row and column operations on 3x3 matrices 12) Single transformations of curves involving translations, stretches parallel to coordinate axes and reflections in the coordinate axes and the lines y = ± x . 13) Extend to composite transformations including rotations and enlargements	8) Using Maclaurin series for standard functions 9) Evaluating limits 10) L'Hopitals rule 11) Applying the method of differences with partial fractions	13) Euler's step by step method for solving first order differential equations. 14) Improved Euler method for solving first order differential equations. 15) Summing series using de Moivre's Theorem and use it to find multiple angle formulae. 6) Use complex roots of unity to solve geometric problems.	9) Solve differential equations of the form y '' + ay' + by = 0 where a and b are constants, by using the auxiliary equation. 10) Solve differential equations of the form y '' + ay' + by = f(x) where a and b are constants by solving the homogeneous case and adding a particular integral to the complementary function. 11) Use differential equations in modelling in kinematics and in other contexts 12) Apply differential equations to SHM, damped harmonic motion and coupled equations		
	Key skills- Applied	1) Definitions and problem solving for planar graphs 2) Flow augmenting algorithm, restricted nodes, edges with upper and lower capacities 3) Gantt (cascade) diagrams, resource histograms, resource levelling	1) Apply the simplex to solve linear programming problems 2) Convert and solve higher order games to linear programming problems 3) Group axioms 4) Lagrange's theorem 5) Identify and use the generators of a group 6) Recognise and find isomorphism 7) Momentum in 2D with resolving 8) Power on slopes	1) Conical Pendulum 2) Vertical Circular motion 3) Use of vectors in circular motion 4) Centres of mass of systems of particles 5) Centres of mass of laminas 6) Centres of mass using integration 7) Sliding and Toppling			
	Key terms/vocab	Scalar product Isomorphic Kuratowski's Theorem Planar Graphs Cascade diagrams					
	Independent learning / wider reading	**Books:** Maths in minutes: 200 Key concepts explained in an instant by Paul Glendinning Professor Povey's Perplexing Problems by Thomas Povey Entertaining Mathematical Puzzles by Martin Gardner	**Youtube videos**: The mathematics of Love by Hannah Fry https://www.youtube.com/watch?v=yFVXsjVdvmY Why I fell in love with monster prime numbers by Adam Spencer https://www.youtube.com/watch?v=B4xOFsygwr4 Trig and Logarithms- Marcus du Sautoy	**Websites:** Interactive Mathematics Miscellany and Puzzles http://www.cut-the-knot.org/ Radio 4 Maths collection: https://www.bbc.co.uk/radio4/features/collections/mathematics/ Radio 4 Maths and Magic https://www.bbc.co.uk/programmes/b03ls7y2/clips		Old exam papers are also useful	

			https://www.youtube.com/watch?v=qEdUZg13Jlg&list=PLZt9bXMy6CcBIHHbdcwvuJmh9-sFzLB97				
	Assessment- Pure	Graphs with Oblique asymptotes, Factorising determinants Solving 3 equations in 3 unknowns 3x3 inverse matrices Equations of planes and angles between them Conic Transformations	Improper Integrals Polar curves and areas of regions Integration of Inverse trig functions Harder Integration Maclaurins series and Limits	Mock examinations on all topics completed so far in both year 12 and 13	Full Maclaurins Limits 2 important Hyperbolics inc calculus Hyperbolic identities Eigenvalues and Eigenvectors Diagonalisation of matrices	External exams	
	Assessment- Applied	binary operations (AS) impulse and momentum(AS) Collisions(AS)	Isomorphic graphs Kuratowskis Group Theory Simplex algorithm		centres of mass vertical circular motion network flows critical path analysis		
	Careers links	Electrical Engineering, Mechanical Engineering, Transport Industry, Operational Research, Computer Animation, Computer Programming, Meteorology, Construction, Event Planning, Project Management, Business, Economics, Biology, Political Science, Materials Science, Civil Engineering, Architecture, Aeronautical Engineering	As Aut 1	As Aut 1	As Aut 1	As Aut 1	As Aut 1