Further Maths Unit Overview Year 13

Further Maths – Year 13 Autumn 1				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**What does mastery look like?**	**How does this build on prior learning?**	**What additional resources are available?**
Core Pure 2 - De Moivre's theorem, method of differences, improper integrals, volumes of revolution with parametrics (Ch1-4)	**Knowledge:** Express a complex number in its exponential form. Euler's relation. Multiply and divide complex numbers written in exponential form. De Moivre's theorem. Method of differences. Maclaurin series. Improper integrals, mean value of a function, differentiating and integrating inverse trig functions. Volumes of revolution. **Understanding:** Links between De Moivre's theorem and trigonometric identities, and between series and complex numbers. Modelling with volumes of revolution. **Skills:** Use De Moivre's theorem to simplify powers of complex numbers. Use de Moivre's theorem to derive trigonometric identities and to find the nth root of a complex number. Solve geometric problems using the nth roots of unity. Use the method of differences to prove series results. Use Maclaurins series to find the series expansions of compound functions.	In particular students should know when to apply De Moivre's theorem to solve a variety of problems. Apply calculaus techniques to inverse trigonometric functions Students will be able to model real-life applications of volumes of revolution.	Builds on Complex numbers work from Core Pure 1 (Yr12 Autumn 1), Binomial expansion Pure 1 (Y12 Autumn 2), Sums of series Core 2 (Yr13 Autumn 1), Knowledge of partial fractions Pure 2 (Yr12 Summer 2). Integration Pure 2 (Yr 13 Autumn 2). Further extends volumes of revolution work from Core pure (Yr 12 Autumn 2)	Core Pure 2 Textbooks SoL – guidance for each individual lesson Resources – outline PowerPoints with suggested examples and scaffolding activities For extension use: UKMT senior challenge, MAT and STEP materials

Further Maths - Year 13 Autumn 2				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**What does mastery look like?**	**How does this build on prior learning?**	**What additional resources are available?**
Core 2 - Polar coordinates, hyperbolic functions, first- and second-order differential equations (Ch5-8)	Knowledge: Format of polar coordinates. Formule for tangents and areas of polar curves. Definitions of hyperbolic functions and their derivatives. Integrating factors for first-order differential equations. Formats of auxiliary and complementary functions for second-order differential equations Understanding: How polar curves are formed from polar equations. Integrating polar curves gives a 'radar sweeping area'. Links between trig and hyperbolic identities (Osborn's rule). Why a complementary function is needed when solving non-homogeneous second-order differential equations. Modelling with differential equations, including simple harmonic motion. Skills: Apply calculus techniques to a wide variety of situations eg integrating polar curves, differentiating hyperbolic functions using chain rule.	Students will know the basic shapes of common polar curves Students will recognise when to tackle hyperbolic functions using the definition in terms of e or using identities Students will confidently apply calculus techniques to a much wider range of contexts	Polar co-ords can be linked to the idea of modulus and argument from complex numbers Core 1 Ch1. (Y12 Aut1) Hyperbolic functions build on knowledge of e (Pure 1 Ch14 – Maths Year12 Spr1) and trigonometry (Pure 2 Ch7 – Maths Year 13 Aut1) Calculus techniques are used heavily throughout all topics and build upon the work covered in FM Year 12 Summer 2.	Core 2 Textbooks SoL – guidance for each individual lesson Resources – outline PowerPoints with suggested examples and scaffolding activities Graph sketching for polar curves: https://www.desmos.com/calculator For extension use: UKMT senior challenge, MAT and STEP materials

Further Maths - Year 13 Spring 1				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**What does mastery look like?**	**How does this build on prior learning?**	**What additional resources are available?**
FP1 - solving geometrical problems with vectors, conic sections (ellipses and hyperbolas), modulus inequalities, Taylor series, advanced methods in calculus (Leibnitz, L'Hopital, Weierstrass) New chapters: 3, 6, 7, 9 Building on Y12 chapters: 1, 4, 5, 8	Knowledge: Cross-product vector equation of a line. Formulae and properties of ellipses and hyperbolas. Two form of the Taylor Series. Leibnitz theorem. L'Hopital's rule. The Weierstrass substitution. Simpson's rule. Understanding: Using vectors to solve geometrical problems. Manipulate geometrical situations to describe loci. Solve modelling problems with trigonometry and t-formulae. Using Taylor series to find limits. Solve problems modelled with reducible differential equations. Skills: Find tangents and normals to ellipses and hyperbolas. Solve inequalities involving modulus. Reduce first- and second-order differential equations using substitution.	Quick recall of the required formulae (eg t-formulae) Have a range or techniques to solve modelling problems (especially loci problems for conics) and being prepared to try alternatives if needed. Students will confidently apply calculus techniques to an even wider range of problems.	Much of this (especially Ch1, 4, 5, 8) obviously builds on the Year 12 work on FP1 (12FM Summer 1), with Ch3 conics also building on Ch2 covered in Year 12. Vectors work also uses Core1CH9 (12FMAut2) Taylor series has strong links to Maclaurin series Core2Ch2 (13FMAut1) The various calculus methods in Ch7 rely very heavily on the calculus covered in 12FMSum2. Differential equations work builds directly om Core2Ch7-8 (13FM Aut2)	FP1 Textbooks SoL – guidance for each individual lesson Resources – outline PowerPoints with suggested examples and scaffolding activities Graph sketching for conics and inequalities: https://www.desmos.com/calculator For revision: Core Practice papers For extension use: UKMT senior challenge, MAT and STEP materials

Further Maths - Year 13 Spring 2				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**What does mastery look like?**	**How does this build on prior learning?**	**What additional resources are available?**
D1 -Algorithms (planarity, complex route inspection, travelling salesman, simplex), resource histograms and scheduling for critical path analysis New chapters: 5,7 Building on Y12 chapters: 2, 4, 8	Knowledge: The planarity algorithm. Concept of the travelling salesman problem. The simplex algorithm, including two-stage simplex and the Big-M method. Resources histograms and scheduling diagrams. Understanding: Apply the route inspection algorithm to networks with more than four odd nodes. Use appropriate techniques to find upper and lower bounds for the travelling salesman problem. Appreciate why slack and surplus variables are needed in the simplex algorithm. Relate the steps of the simplex algorithm to a graphical solution in a simple case. Skills: Formulate linear programming problems from words. Accurately follow an algorithm to solve a problem.	Quick recall of the required algorithms, in particular differentiating between algorithms that do a similar job (eg Kruskal's and Prim's, various simplex methods). Clear and consistent presentation showing all required steps when using a given algorithm – although always important this is essential in D1 in order to gain marks in the exam. Accuracy in detail is especially important in D1.	Much of this (especially Ch2, 4, 8) obviously builds on the Year 12 work on D1 (12FM Spring 2), with Ch 7 simplex algorithm also building on Ch6 covered in Year 12. The travelling salesman problem uses spanning trees covered in Year 12 (12FM Spring 2) and also has links to computer science (example of an intractable problem using heuristic methods)	D1 Textbooks, including printable templates for answers. SoL – guidance for each individual lesson Resources – outline PowerPoints with suggested examples and scaffolding activities For revision: Core Practice papers FP1 specimen paper For extension use: UKMT senior challenge, MAT and STEP Foundation materials

Further Maths - Year 13 Summer 1				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**What does mastery look like?**	**How does this build on prior learning?**	**What additional resources are available?**
Structured revision and use of past papers (there may be 1-2 weeks of catchup from previous content as well)	Knowledge: revisiting and reconsolidating all knowledge from the 2 year course Understanding: building a deeper understanding of the course through regular review and practice Skills: a particular focus on ensuring exam technique is secure	Students can confidently tackle questions on a range of topics. Work is presented clearly in logical steps When faced with an unusual or difficult context students are not afraid to try several approaches to find a correct solution	This is all about consolidating and applying prior learning.	Core Practice Papers Specimen papers Mock papers FM SAM papers Past papers Bank of 'starter' questions (past exam questions on variety of topics – 1 easier and 1 more challenging) Revision PowerPoints and questions banks to help revise specific topics External online resources (such as crashmaths for exam style practice or TLMaths for revision videos)

Further Maths - Year 13 Summer 2				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**What does mastery look like?**	**How does this build on prior learning?**	**What additional resources are available?**
Structured revision and use of past papers	Knowledge: revisiting and reconsolidating all knowledge from the 2 year course Understanding: building a deeper understanding of the course through regular review and practice Skills: a particular focus on ensuring exam technique is secure	Students can confidently tackle questions on a range of topics. Work is presented clearly in logical steps When faced with an unusual or difficult context students are not afraid to try several approaches to find a correct solution	This is all about consolidating and applying prior learning.	Core Practice Papers Specimen papers Mock papers FM SAM papers Past papers Bank of 'starter' questions (past exam questions on variety of topics – 1 easier and 1 more challenging) Revision PowerPoints and questions banks to help revise specific topics External online resources (such as crashmaths for exam style practice or TLMaths for revision videos)