A level Further Mathematics Curriculum Overview (Year 13)

Introduction
Edexcel specification: https://qualifications.pearson.com/en/qualifications/edexcel-a-levels/mathematics-2017.html#%2Ftab-AlevelFurtherMathematics **Extension links** UKMT senior challenge (https://ukmt.org.uk/senior-challenges) MAT (https://www.maths.ox.ac.uk/study-here/undergraduate-study/maths-admissions-test) STEP modules (https://maths.org/step/assignments)

Term 1 Half Term 1				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
De Moivre's theorem Method of differences Maclaurin's series Improper integrals Volumes of revolution with parametrics	**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 Maclaurin's series to find the series expansions of compound functions.	**Formal homeworks:** Chapter 1 Assessment Chapter 2 Assessment Chapter 3 Assessment Chapter 4 Assessment **Exam conditions:** Chapter 1-4 Test	Edexcel Core 2 Textbook Note: 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)	Scheme of Learning – guidance on key learning points and selected questions for each individual lesson Outline PowerPoints with suggested examples and scaffolding activities Practice questions (and markschemes) covering topics using previous exam questions available for each chapter via SharePoint. For extension: UKMT senior challenge, MAT and STEP Foundation materials Online resource: https://sites.google.com/view/tlmaths/home/a-level-further-maths

Term 1 Half Term 2

What are we learning?	What knowledge, understanding and skills will we gain?	Evaluation and assessment methods	Implementation	What additional resources are available?
Polar coordinates Hyperbolic functions, First- and second-order differential equations	**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.	**Formal homeworks:** Chapter 5 Assessment Chapter 6 Assessment Chapter 7-8 Assessment **Exam conditions:** Year 13 Mock (Full set of core papers)	Edexcel Core 2 Textbook Note: Polar coords 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.	Scheme of Learning – guidance on key learning points and selected questions for each individual lesson Outline PowerPoints with suggested examples and scaffolding activities Practice questions (and markschemes) covering topics using previous exam questions available for each chapter via SharePoint. For extension: UKMT senior challenge, MAT and STEP Foundation materials Online resource: https://sites.google.com/view/tlmaths/home/a-level-further-maths

Term 2 Half Term 1				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Further Pure: Solving geometrical problems with vectors Conic sections (ellipses and hyperbolas) Modulus inequalities Taylor series Advanced methods in calculus (Leibnitz, L'Hopital, Weierstrass)	**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 substituion.	**Formal homeworks:** Chapter 3 Assessment Chapter 6 Assessment Chapter 7 Assessment Chapter 9 Assessment	Edexcel Further Pure 1 Textbook Note: 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)	Scheme of Learning – guidance on key learning points and selected questions for each individual lesson Outline PowerPoints with suggested examples and scaffolding activities Practice questions (and markschemes) covering topics using previous exam questions available for each chapter via SharePoint. For extension: UKMT senior challenge, MAT and STEP Foundation materials Online resource: https://sites.google.com/view/tlmaths/home/a-level-further-maths

Term 2 Half Term 2				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Decision Mathematics : Algorithms (planarity, complex route inspection, travelling salesman, simplex) Resource histograms and scheduling for critical path analysis	**Knowledge**: The planarity algorithm. Concept of the travelling salesman problem. The simplex algorithm, including two-stage simplex and the Big-M method. Reources 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 alogorithm. 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.	**Formal homeworks:** Chapter 5 Assessment Chapter 7 Assessment	Edexcel Decision Mathematics 1 Textbook Note: 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)	Scheme of Learning – guidance on key learning points and selected questions for each individual lesson Outline PowerPoints with suggested examples and scaffolding activities Practice questions (and markschemes) covering topics using previous exam questions available for each chapter via SharePoint. For extension: UKMT senior challenge, MAT and STEP Foundation materials Online resource: https://sites.google.com/view/tlmaths/home/a-level-further-maths

Term 3 Half Term 1				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**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	Past papers	Revision of specific topics using banks of past exam questions	Specimen papers Mock papers Past papers

Term 3 Half Term 2				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**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	Past papers	Revision of specific topics using banks of past exam questions	Specimen papers Mock papers Past papers