Year 12 Further Maths Curriculum Overview

Rationale: The Year 12 curriculum is designed to extend student's knowledge above and beyond A Level Mathematics, giving a firm grounding in Calculus, Statistics and Decision Mathematics. New concepts on topics including series, matrices, complex numbers and vectors ensure a deep understanding of the interconnectivity of mathematics, with proof showing the intellectual rigour underpinning these concepts. These will then form a solid foundation for future progress in year 13 and preparation for lifelong learning in University and beyond.

Term/Length of Time	Outline	Assessment/Teacher Feedback Opportunities	Homework and Literacy resources
Autumn Term 3 lessons per week for approximately 15 weeks. Approx 3-4 weeks	<u>Pure Mathematics</u> **The course extends students learning from A level maths and is taught concurrently. Students are expected to digest new and complex ideas and be able to apply them in a range of different contexts. Use of proof by induction will be an essential tool for understanding why mathematical ideas and formulae work.** **Complex Numbers** The course begins with complex numbers, building on the algebra, number and graphical skills learnt in Year 11. This topic will look at imaginary and real numbers, and the algebraic manipulation involved in their use. Students will know how to draw and find general solutions and regions using Argand diagrams. They will also see how complex numbers can be written in several ways, such as the modulus-argument form.	Assessments are spread out throughout the year. Students will complete 2 module tests approximately every 8 weeks, (1 from each side of the course), covering all content learnt so far. Students will also sit 2 summative tests, one in February and the other in June to measure overall progress. Following completion of Complex Numbers a Module test covering Complex numbers from Further Mathematics 1 will take place.	**Minimum homework expectation - to be set on G4S** *One piece of home learning lasting roughly an hour per lesson. These are self-marked, but teachers will check that they have been completed and that pupils do understand the content, and know how to correct any errors.* *FAR (Feedback, Action, Response) tasks are set roughly once per unit (twice for longer units) covering key concepts. These contain 20-30 marks worth of exam style questions on the topics, including a question which requires pupils to explain or critique a problem solving process. These are marked by teachers, with time given in a later lesson for pupils to refine their work and act on feedback.* **Links to aid revision:** Complex Numbers Module 1 Argand Diagrams Module 2 Students are expected to fully complete every question from the Chapter Exercises in the textbook.

Approx 2-3 weeks Approx 5 weeks	**Roots of Polynomials** When considering quadratics, cubics and general polynomials, what can we discover about their roots without actually solving the polynomial? This module covers the skills needed to be able to manipulate the roots of quadratic, cubic and quartic equations and see their properties. This module also links and builds from complex roots seen from the previous topic. **Matrices** Building on two way tables and vectors from GCSE, this topic gives a thorough base of the use of matrices in solving problems and their properties. This unit will cover the concept of a matrix and performing matrix arithmetic, including how to find the inverse of a matrix up to a 3x3 form. This will lead to manipulating matrices on a graph and how matrices transform shapes in both 2 and 3 dimensions.	Module test Covering Roots of Polynomials from Further Mathematics 1. Feedback and analysis given. Module test Covering Matrices and Transformations in Further Mathematics 1. Feedback and analysis given.	**Links to aid revision:** Roots of Polynomials Students are expected to fully complete every question from the Chapter Exercises in the textbook. **Links to aid revision:** Matrices Linear Transformations Students are expected to fully complete every question from the Chapter Exercises in the textbook. ***Literacy Resources*** *Students are strongly encouraged to read around the subject. Potential books to supplement learning include:* *Fermat's Last Theorem by Simon Singh*
Autumn Term 2 lessons per week for approximately 15 weeks.	**<u>Applied Mathematics – Decision Mathematics and Further Statistics</u>** The Further maths content also covers 2 applied maths courses – NLS covers Decision Maths 1 and Further Stats 1. These give an excellent base to really stretch students skills in logical reasoning and algorithms as well as a	As with Core, the Applied course also has assessments spread out throughout the year.	**For Autumn Term Applied**

	deeper understanding of the different statistical distributions and how they relate to real life problems. These lessons are taught in parallel with the Pure maths side of the course.		
Approx 3-4 weeks	**Decision – Algorithms and Graphs** This first module explores the concept of algorithms, sorting and flow charts, giving a good basis using simple examples such as the bubble sort and bin packing algorithms.		**Links to aid revision:** Algorithms and Graphs Graphs and Networks Students are expected to fully complete every question from the Chapter Exercises in the textbook.
Approx 304 weeks	**Decision - Algorithms on Graphs** Now exploring algorithms in more depth and how they can be displayed as a graph – this module covers Kruskal, Prim and Dijkstra's algorithms. This will lead into finding the most efficient paths for completion.		**Links to aid revision:** Algorithms on graphs Students are expected to fully complete every question from the Chapter Exercises in the textbook.
Approx 2 weeks	**Statistics –** **Discrete Random Variables** Beginning with discrete random variables, how these work and how to manipulate them, including finding the variance and expected values using real life examples.	Module test covering DRV's, Algorithms and Graphs from Further Stats and Decision Maths. Feedback and analysis given.	**Links to aid revision:** Discrete Random Variables Students are expected to fully complete every question from the Chapter Exercises in the textbook.
Approx 3 weeks	**The Poisson Distribution** One of several new distributions – where we see the Poisson distribution, how to model, and how to find the		**Links to aid revision:** Poisson Distribution Students are expected to fully complete every question from the Chapter Exercises in the textbook.

Approx 3 weeks	variance and mean. This also links to Statistics in the normal A level course, and how the Binomial distribution and the Poisson Distribution are related. **Decision - Critical Path Analysis** Returning to Decision – seeing how a task cannot be run efficiently without considering the critical path. This then leads to Gantt charts showing the fastest possible completion times using the most efficient number of workers.	Module test covering the Poisson Distribution and Algorithms on Graphs. Feedback and analysis given.	**Links to aid revision:** Critical Path Analysis Students are expected to fully complete every question from the Chapter Exercises in the textbook.
Spring Term 3 lessons per week for approximately 13 weeks.	**<u>Pure Mathematics</u>** **Volumes of Revolution** Building from A level pure - this topic will show how to find the volume of a curve rotated about either the x or y axes and how this relates to real life shapes and their volumes.		**Links to aid revision:** Volumes of Revolution Students are expected to fully complete every question from the Chapter Exercises in the textbook.
Approx 2 weeks	**Series** This topic covers understanding of the sigma notation and how to find sums of natural numbers, square, cubes and their variants. Recognising patterns and next steps will be vital here		**Links to aid revision:** Series Students are expected to fully complete every question from the Chapter Exercises in the textbook.
Approx 2 weeks	**Proof by Induction** One of the most important aspects of maths - a rigorous procedure showing how mathematics is based on solid foundations and how to prove various		**Links to aid revision:** Proof by Induction Students are expected to fully complete every question from the Chapter Exercises in the textbook.

	mathematics concepts using proof by induction. This links together all previous topics and will be used repeatedly throughout the course, so clear understanding and being able to apply this concept will be vital moveing forward in this course.	Module test covering Volumes of revolution, series and proof by induction from Further Mathematics 1. Feedback and analysis given.	
Approx 2 weeks	**Spring test revision** Time will be spent preparing students with exam style questions to prepare for the first summative test in the spring term.	Spring mock exam covering all units taught so far in Year 12, plus feedback. Feedback and analysis given.	**Links to aid revision:** Past paper Questions Links to previous topics
Approx 6 weeks	**Vectors** A far deeper understanding of vectors will be gained in this topic, building considerably on the normal A level maths course and what was seen in GCSE maths. Topics will include both 2d and 3d vectors, plane geometry, intersections of planes and lines; using the vector equation of a plane and a line. A thorough and rigorous understanding will be needed and this topic can be very challenging.	Module Test covering Vectors from Further Mathematics 1. Feedback and analysis given.	**Links to aid revision:** Vectors Students are expected to fully complete every question from the Chapter Exercises in the textbook. ***Literacy Resources*** *Students are strongly encouraged to read around the subject. Potential books to supplement learning include:* *The Music of the Primes by Marcus Du Sautoy*
Spring Term 2 lessons per week for	**Applied Mathematics – Decision Mathematics and Further Statistics** **Decision – Linear Programming**		**For Spring Term Applied:** **Links to aid revision:**

approximately 13 weeks. Approx 2 weeks Approx 2-3 weeks Approx 3-4 weeks	Using linear programming and graphs it is possible to find the optimal point when solving problems. This topic covers these ideas thoroughly and how they relate to real life problems **Statistics –** **Hypothesis testing with Binomial And Poisson** One of the key aspects of distributions is knowing how to perform Hypothesis tests accurately for real life problems. This topic covers this for Binomial and Poisson, building on the previous statistics chapter**.** **Statistics - Chi-Squared** Students should understand degrees of freedom and how to use the chi-squared family of distributions, as well as hypothesis testing and goodness of fit tests, relating to real life examples.	Module test covering Linear Programming, Poisson, Binomial and Hypothesis Testing. Feedback and analysis given.	Linear Programming Students are expected to fully complete every question from the Chapter Exercises in the textbook. **Links to aid revision:** Hypothesis testing Students are expected to fully complete every question from the Chapter Exercises in the textbook. **Links to aid revision:** Chi-Squared Students are expected to fully complete every question from the Chapter Exercises in the textbook.
Summer Term 3 lessons per week for approximately 11 weeks. Approx 3-4 weeks	**Pure Mathematics** **Preparation for summer progression exams** The year 12 course is now complete and time will be spent consolidating understanding and the use of past papers to ensure mastery of all exam style questions. We will go over key	Summer Progression exam covering all aspects of AS Further Mathematics. Feedback and analysis given. Feedback and analysis given.	**Links to aid revision:** Past paper Questions Links to previous topics

	topics and ensure students exam preparedness is as good as possible. **Following the summer progression exams, it is necessary to teach Year 13 A Level maths material to ensure students can fully access all Year 13 Further Maths materials. These 3 topics are:**		**Links to aid revision:** Past paper Questions Links to previous topics
Approx 3 weeks	**Trigonometry** All aspects of trigonometry is needed , including all formulae, manipulation, proof and how they can relate to real life problems	In class assessment covering A level maths content on Trigonometry, Differentiation and Integration with feedback given.	**Links to aid revision:** Trigonometry – all slides Extra exam questions on Trigonometry
Approx 3 weeks	**Differentiation** Calculus will cover all aspects of differentiation, including the product rule, quotient rule and applications of differentiation and the use of parametric equations.		**Links to aid revision:** Differentiation – all slides Extra exam questions on Differentiation
Approx 3 weeks	**Integration** Finally, integration will be needed. This will include hwo to integrate by substitution and by parts and ensure all students can quickly see how to integrate using reverse differentiation and apply this to parametric equations, area under the curve and real life problem solving.		**Links to aid revision:** Integration – all slides Extra exam questions on Integration

Summer Term 2 lessons per week for approximately 11 weeks. Approx 2-3 weeks Approx 3 weeks, then consolidation to end of term	**<u>Applied Mathematics – Decision Mathematics and Further Statistics</u>** **Decision And Further Statistics** The Chi Squared topic will be completed early in the summer term. **Exam Practice and Consolidation** The year 12 course is now complete and time will be spent consolidating understanding and the use of past papers to ensure mastery of all exam style questions. We will go over key topics and ensure students exam preparedness is as good as possible.	Module test on Chi-squared. Summer progression exam covering major aspects of AS Further Statistics and Decision Mathematics.	**For Summer Term Applied:** **Links to aid revision:** Chi-Squared Students are expected to fully complete every question from the Chapter Exercises in the textbook. **Links to aid revision:** Past paper Questions Links to previous topics ***Literacy Resources*** *Students are strongly encouraged to read around the subject. Potential books to supplement learning include:* *The Code Book by Simon Singh*