St Benedict's Catholic High School
1971

Further Maths intent statement

Year 12:

Half term 1	Half term 2	Half term 3	Half term 4	Half term 5	Half term 6
Algorithms Graphs and networks Algorithms on networks Critical path analysis Complex numbers Matrices	Argand diagrams Series Route inspection Flow	Linear Programming Game Theory Allocation Linear transformations Proof by induction	Roots of Polynomials Vectors Volumes of revolution	Revision	Further Algorithms on Networks Further Route Inspection Travelling Salesman Simplex Algorithm

Year 13:

Half term 1	Half term 2	Half term 3	Half term 4	Half term 5
Further Flows in Networks Transportation Dynamic Programming Further Allocation Further Game Theory Decision analysis	Complex Numbers Series Volumes of revolution Hyperbolics	Differential equations Polar coordinates	Modelling with differential equations Methods in calculus Hyperbolic integration	Revision

Y12	Unit	Students will learn about:
Half term 1	Algorithms	• The idea of an algorithm • Bubble sorts, quick sorts and bin packing • The order of an algorithm
	Graphs and networks	• The language associated with graphs and networks • Using matrices to represent graphs and networks • Planar graphs and the planarity algorithm
	Algorithms on networks	• Prim's and Kruskal's algorithms for finding a minimum spanning tree • Dijkstra's algorithm for finding a shortest path
	Critical path analysis	• Precedence tables and activity networks including the use of Dummies • Early and late event time • Critical events, critical activities, critical paths and float • Gantt (cascade) charts, resource histograms and scheduling diagrams
	Complex numbers	• The definitions of imaginary and complex numbers • To perform the 4 operations on complex numbers including learning about the complex conjugate • To solve cubic or quartic equations that have complex roots
	Matrices	• The definition of a matrix • To add, subtract and multiply matrices including the conditions for the calculations and to multiply a matrix by a scalar
Half term 2	Argand diagrams	• What an Argand diagram is • To represent complex numbers, loci and regions on a n Argand diagram • About the modulus argument form of a complex number
	Series	• The standard results for summation and how to apply them
	Route inspection	• Eulerian and semi-Eulerian graphs

		• The route inspection algorithm for graphs with 2 or 4 odd vertices
	Flow	• The language and notation of flow • Cuts and calculating their value • Finding and improving flow patterns including using the maximum flow minimum cut theorem
Half term 3	Linear Programming	• Formulating linear programming problems • Graphing linear programming problems • Using the objective line method and vertex testing to solve linear programming problems including finding integer solutions when required
	Game Theory	• The concept of a zero sum game • Play safe strategies, stable solutions, reducing a payoff matrix and determining the optimal mixed strategy for a game with no stable solution
	Allocation	• The Hungarian algorithm and how to apply it • How to adapt a non-square allocation problem, a maximise problem, a problem with incomplete data or a mix of the about to use the Hungarian algorithm
	Linear transformations	• Using matrices to represent linear transformations in 2-D and 3-D • Invariant points and invariant lines
	Proof by induction	• The principle of proof by induction and how to apply it to prove results about sums of series, divisibility and matrices
Half term 4	Roots of Polynomials	• The relationships between the roots and coefficients of quadratic, cubic and quartic equations • Applying linear transformations to roots of polynomials
	Vectors	• The vector and Cartesian forms of an equation of a straight line in 3-D. • The vector and Cartesian forms of the equation of a plane. • The scalar product and use it to express the equation of a plane, and to calculate the angle between two lines, the angle between two planes and the angle between a line and a plane • To check whether vectors are perpendicular by using the scalar product. • Find the intersection of a line and a plane.

		• Calculate the perpendicular distance between two lines, from a point to a line and from a point to a plane.
	Volumes of revolution	• Calculating volumes of revolution for curves rotated around the x and the y axis, limited to Integrating functions of the form x^n (excluding n = −1) and related sums, differences and constant multiples
Half term 5	Revision	• Topic revision progressing to complete papers
Half term 6	Further Algorithms on Networks	• Floyds algorithm
	Further Route Inspection	• The route inspection algorithm for graphs more than 4 odd nodes
	Travelling Salesman	• The practical and classical travelling salesman problems • Determining upper and lower bounds using minimum spanning tree methods • The nearest neighbour algorithm
	Simplex Algorithm	• Formulating linear programming problems for use with the simplex algorithm including the use of slack, surplus and artificial variables • The Simplex algorithm and tableau for maximising and minimising problems with ≤ constraints • The two-stage Simplex and big-M methods for maximising and minimising problems which may include both ≤ and ≥ constraints