



WOLMER'S BOYS' SCHOOL

Department of Mathematics

6B

Pure Mathematics

Course Outline 2023-2024

RATIONALE:

This syllabus will contribute to the development of the Ideal Caribbean Person as articulated by the CARICOM Heads of Government in the following areas: “demonstrate multiple literacies, independent and critical thinking and innovative application of science and technology to problem solving. Such a person should also demonstrate a positive work attitude and value and display creative imagination and entrepreneurship”.

GOALS:

The syllabus aims to:

1. Provide understanding of mathematical concepts and structures, their development and the relationships between them;
2. Enable the development of skills in the use of mathematical and information, communication and technology (ICT) tools;

3. Develop an appreciation of the idea of mathematical proof, the internal logical coherence of Mathematics, and its consequent universal applicability;
4. Develop the ability to make connections between distinct concepts in Mathematics, and between mathematical ideas and those pertaining to other disciplines;
5. Develop a spirit of mathematical curiosity and creativity, as well as a sense of enjoyment;
6. Enable the analysis, abstraction and generalisation of mathematical ideas;
7. Develop in students the skills of recognising essential aspects of concrete, real-world problems, formulating these problems into relevant and solvable mathematical problems and mathematical modelling;
8. Develop the ability of students to carry out independent or group work on tasks involving mathematical modelling;
9. Integrate ICT tools and skills;
10. Provide students with access to more advanced courses in Mathematics and its applications at tertiary institutions.

CHRISTMAS TERM:

Wee k	Modu le	Topics	Lesson/Method of Delivery	Use of ICT	Student Assessment
1	1	Discrete Mathemat ics	Reasoning and logics -simple statement, connectives and compound statements. -truth table for all connectives -truth table for compound propositions . -converse and contra positive of statements -logical equivalence	1. Browse the internet for videos and presentations explaining concepts. Youtube link: https://www.youtube.com/channel/UCfUTjVZs259PWKnBP1N2aXw/playlists?view_as=subscriber	Completion of worksheets and group activities. Due Date: Sept 12

Wee k	Modu le	Topics	Lesson/Method of Delivery	Use of ICT	Student Assessment
			-identities involving propositions		
1			Tautologies & Fallacies Validity of Arguments		
2	1	Discrete Mathemat ics	Propositional calculus - Idempotent laws - Associative laws - Commutative laws - Distributive laws - Identity laws -Involution law - Complement laws - DeMorgan's laws	1. Browse the internet for videos and presentations explaining concepts Google Classroom quiz	Completion of worksheets and group activities. Graded Quiz: Sept 20
3			Prove Mathematical Statements by Mathematical Induction -problems involving use of the sigma notation \sum_r Prove Mathematical Statements by Mathematical Induction -problems involving the Divisibility Tests - methods of proof - direct counter example, exhaustive		Graded Classwork Due Date: Sept 30

Wee k	Modu le	Topics	Lesson/Method of Delivery	Use of ICT	Student Assessment
4	1	Differenti al Calculus	<p>Limits & Continuity</p> <p>1. Describe the behaviour of a function $f(x)$ as x gets arbitrarily close to some given fixed number, using a descriptive approach;</p> <p>2. Use the limit notation $\lim_{x \rightarrow a} f(x) = L, f(x) \rightarrow L, \text{ as } x \rightarrow a.$</p> <p>3. Use the simple limit theorems:</p> <p>If $\lim_{x \rightarrow a} f(x) = F$, $\lim_{x \rightarrow a} g(x) = G$ and k is a constant then (i) $\lim_{x \rightarrow a} kf(x) = kF$, (ii) $\lim_{x \rightarrow a} f(x)g(x) = FG$, (iii) $\lim_{x \rightarrow a} \{f(x) \pm g(x)\} = F \pm G$, and (iv) $\lim_{x \rightarrow a} \frac{f(x)}{g(x)} = \frac{F}{G}$, provided $G \neq 0$.</p> <p>4. Use limit theorems in simple problems;</p>	<p>Browse the internet for videos and presentations explaining concepts</p> <p>https://www.youtube.com/watch?v=-ihZrztozJ0&list=PLBhuK8T1UID2X7BBadneAY69fXVACeiD</p> <p>Use of Geogebra Software to explore the nature of functions and limits</p>	<p>Completion of worksheets and group activities</p> <p>Due Date: Oct 6</p>
5			<p>5. Use the fact that $\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$ can be demonstrated by a geometric approach;</p> <p>6. Define Continuity at a point</p> <p>7. Identify the points for which a function is continuous;</p>		

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			<p>8. Identify the point(s) for which a function is (un)defined</p> <p>9. Use the concept of left-handed or right-handed limit, and continuity.</p> <p>10. Identify the point(s) where a function is discontinuous</p>		
6			<p>Differentiation I</p> <ol style="list-style-type: none"> 1. Define the derivative of a function at a point as a limit 2. Differentiate, from first principles, polynomials and simple trig. Functions 3. Apply the chain rule in the differentiation of composite functions and parametric equations 4. Differentiate sums, products and quotients of Polynomials and trig functions 		<p>Group Presentation (Graded)</p> <p>Oct 17 – 21</p>
7			<p>Applications of Differentiation</p> <ol style="list-style-type: none"> 1. Solve problems involving rates of change 2. Use the sign of the derivative to investigate where a function is increasing or decreasing 		<p>Graded Quiz on Differentiation</p> <p>Oct 27</p>

Wee k	Modu le	Topics	Lesson/Method of Delivery	Use of ICT	Student Assessment
			3. <i>Apply the concept of stationary (critical) points</i> 4. Calculate second derivatives 5. Use the sign of the second derivative to determine the nature of stationary points		
8	1	ALGEBRA	6. <i>sketch graphs of polynomials, rational functions and trigonometric functions using the features of the function and its first and second derivatives (including horizontal and vertical asymptotes);</i> 7. obtain equations of tangents and normals to curves.	Browse the internet for videos and presentations explaining concepts: https://www.youtube.com/channel/UCfUTjVZs259PWKnBP1N2aXw/playlists?view_as=subscriber Geogebra to explore sketching of graphs and investigate asymptote	Completion of worksheets and group activities Due Date: Nov 2
9			- The Real number system -definition of binary operation -commutativity, associativity, distributivity, identity, inverse and closure. -axioms of the system- including commutative, associative and distributive laws, non-existence of the multiplicative inverse of zero.		
10			- perform operations involving surds		

EASTER TERM

Week	Module	Topics	Lesson/Method of Delivery	Use of ICT	Student Assessment
1	3	INTEGRAL CALCULUS	<p style="text-align: center;">Integration I</p> <p>1. Recognise the concept that integration is the reverse process of differentiation</p> <p>2. Understand the concept of the indefinite integral and use the notation $\int f(x) dx$</p>	<p>1. Browse the internet for videos and presentations explaining concepts</p> <p>2. https://www.youtube.com/channel/UCfUTjVZs259PWKnP1N2aXw/playlists?view_as=subscriber</p> <p>3. Building models to explain real life concepts while applying the concept of the derivative.</p> <p>Use geogebra to explore concept of integration as area under the curve</p>	Completion of worksheets and group activities.
1			<p>3. Show that the indefinite integral represents a family of functions which differ by constants</p> <p>4. Demonstrate use of the following integration theorems</p> <p>(a) $\int cf(x) dx = c \int f(x) dx$, where c is a constant</p> <p>(b) $\int \{f(x) \pm g(x)\} dx = \int f(x) dx \pm \int g(x) dx$</p>		
2			<p>5. (a) find indefinite integrals using the integration theorems</p> <p>(b) integrate polynomial functions</p> <p>(c) integrate simple trig. Functions</p> <p>6. Integration by substitution</p>		

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3	3	Definite Integrals	<p>7. Use the results</p> <p>(a) $\int_a^b f(x) dx = \int_a^b f(t) dt$,</p> <p>(b) $\int_0^a f(x) dx = \int_0^a f(x-a) dx$ for $a > 0$,</p> <p>(c) $\int_a^b f(x) dx = F(b) - F(a)$, where $F'(x) = f(x)$</p>	<p>Browse the internet for videos and presentations explaining concepts:</p> <p>https://www.youtube.com/channel/UCfUTjVZs259PWKnbP1N2aXw/playlists?view_as=subscriber</p> <p>Use Geogebra to generate the concept of volume of revolution.</p>	Completion of worksheets and group activities.
4			<p>- 8. Applications of Integration</p> <p>(a) Area under a curve</p> <p>(b) Area between two curves</p> <p>(c) volumes of revolution of regions rotated about either the x or y axis</p>		
5	3		<p>9. Differential equations</p> <p>(a) Formulate equations of the form $y' = f(x)$ or y''</p>	<p>Browse the internet for videos and presentations explaining concepts.</p>	Completion of

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			(b) Solve equations from (a) and interpret the result where applicable	https://www.youtube.com/channel/UCfUTjVZs259PWKnbP1N2aXw/playlists?view_as=subscriber	worksheets and group activities.
6	1	Functions	1 Functions <ol style="list-style-type: none"> 1. Define mathematically the terms: function, domain, range, injective function, surjective function, bijective function, composition and inverse of functions 2. Prove whether or not a given simple function is one-to-one or onto and if its inverse exists 3. Defined a function as a set of ordered pairs 4. Use the fact that if g is the inverse function of f, then $f[g(x)] = x$, for all x, in the domain of g; 5. Illustrate by means of graphs, the relationship between the function $y = f(x)$ given in graphical form and $y = f(x)$ and the inverse of $f(x)$, 	2. Building models to explain real life concepts while applying the concept of the differential equation Investigate the concept of Functions using Geogebra Software	
7			The Modulus Function <ol style="list-style-type: none"> 1. Define the modulus function 		

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			2. Use the properties of the modulus function 3. Solve equations and inequalities involving the modulus function, using algebraic or graphical		

SUMMER TERM:

Week	Module	Topics	Lesson/Method of Delivery	Use of ICT	Student Assessment
8	1	Functions	Exponential and Logarithmic Functions 1. Define an exponential function $y = a^x$ for $a \in \mathbb{R}$ 2. Sketch the graph of $y = a^x$ 3. Define a logarithmic function as the inverse of an exponential function 4. Define the exponential functions $y = e^x$ and its inverse $y = \ln x$, where $\ln x \equiv \log_e x$;	Browse the internet for videos and presentations explaining concepts Use Geogebra to explore the concept of exponential and logarithmic functions Google classroom quiz	Completion of worksheets and group activities.

Week	Module	Topics	Lesson/Method of Delivery	Use of ICT	Student Assessment
			<ol style="list-style-type: none"> 5. Use the fact that $y = \ln x \Leftrightarrow x = e^y$; 6. Simplify expressions by using laws of logarithms 7. use logarithms to solve equations of the form $a^x = b$ 8. solve problems involving changing of the base of a logarithm 	<p>Examines different curves in Geogebra</p> <p>https://www.youtube.com/channel/UCfUTjVZs259PWKnbP1N2aXw/playlists?view_as=subscriber</p>	
9	2	Coordinate Geometry	<p>Coordinate Geometry of the Conic Sections</p> <ol style="list-style-type: none"> 1. Find equations of tangents and normals to circles 2. Find the points of intersection of a curve with a straight line 3. find the points of intersection of two curves 4. Obtain the Cartesian equation of a curve given its parametric representation 5. Obtain the parametric representation of a curve given its Cartesian equation 6. <i>determine the loci of points satisfying given properties</i> 		

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10	2	Vectors	<ol style="list-style-type: none"> 1. Express a vector as a column matrix or a linear combination of the unit vectors i, j, k in the form $ai + bj + ck$ 2. Define equality of two vectors; 3. Add and subtract vectors 4. Multiply a vector by a scalar quantity 5. Derive and use unit vectors, position vectors and displacement vectors 6. Find the magnitude and direction of a vector 7. Find the angle between two given vectors using scalar product 8. Find the equation of a line in vector form, parametric form, Cartesian form, given a point on the line and a vector parallel to the line 	<p>Explore vectors using Geogebra 3D</p> <p>Youtube link: https://www.youtube.com/channel/UCfUTjVZs259PWKnbP1N2aXw/playlists?view_as=subscriber</p>	
4	2	Vectors	<ol style="list-style-type: none"> 9. Determine whether two lines are parallel, intersecting, or skewed 10. Find the equation of the plane, in the form $x\mathbf{i} + y\mathbf{j} + z\mathbf{k} = d$, $\mathbf{r} \cdot \mathbf{n} = d$, given a point in the plane 		

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5	2	Trigonometry	<p>Trigonometry</p> <ol style="list-style-type: none"> Evaluate sine, cosine and tangent for angles of any size given either in degrees or radians; Evaluate the exact values of the sine, cosine and tangent for angles $\frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{3}, \frac{\pi}{2}, \frac{\pi}{6}, 2\pi, \frac{\pi}{6}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{4}, \frac{5\pi}{4}, \dots$ etc. Graph the functions of $\sin kx, \cos kx$ and $\tan kx$ for $k = 1, 2$ and $0 \leq x \leq 2\pi$ Derive the identities $\tan \theta = \frac{\sin \theta}{\cos \theta}, \sin^2 \theta + \cos^2 \theta = 1,$ $1 + \tan^2 \theta = \sec^2 \theta \text{ and } 1 + \cot^2 \theta = \operatorname{cosec}^2 \theta$ The reciprocal trig functions $\cot x, \sec x, \operatorname{cosec} x$. Properties of complementary and supplementary angles Compound-angle formulae for $\sin (A \pm B), \cos (A \pm B), \tan (A \pm B)$. Derive the Double Angle Formula Derive the Half Angle Formula Sum and product formulae $\sin A \pm \sin B,$ $\cos A \pm \cos B$ 	<p>Use Geogebra to sketch and derive the properties of trig graphs</p> <p>Youtube link: https://www.youtube.com/channel/UCfUTjVZs259PWKnbP1N2aXw/playlists?view_as=subscriber</p>	

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			11 Prove identities using 8,9 and 10.		
6	2		12. Use the subsidiary angle method to express $a \cos \theta + b \sin \theta$ in the form $r \cos(\theta \pm \alpha)$ or $r \sin(\theta \pm \alpha)$ 13. Use 12 to (a) solve $a \cos \theta + b \sin \theta = c$ (b) find max/min of $a \cos \theta + b \sin \theta$		
6	2		14. Find the general solution of equations of the form: (a) $\sin k\theta = s$, (b) $\cos k\theta = c$, (c) $\tan k\theta = t$, and (d) $a \cos \theta + b \sin \theta = c$, for $a, b, c, k, s, t, \in \mathbb{R}$; 15. Find the solutions of the equations in 14 above for a given range	Use Geogebra to verify solutions of trig equations	

READING LIST:

Pure Mathematics Unit 1 by D. Bahall

