The New Senior Secondary Curriculum for Sierra Leone

Subject syllabus for Further Mathematics
Subject stream: Mathematics and Numeracy

This subject syllabus is based on the National Curriculum Framework for Senior Secondary Education. It was prepared by national curriculum specialists and subject experts.

Senior Secondary School Curriculum

Curriculum elements for Further Mathematics – a core subject

Subject Description

The mathematics program will equip students with the basic competencies that would help their prospects of employment and enable them to use mathematics to solve real-life problems. Mathematics is invaluable due to its widespread application in every sphere of life, in the fields of science, technology, agriculture, economics and other social activities. This subject seeks to train students with competencies that will build on the teaching and learning of mathematics at Junior Secondary Level. The program focuses on having every student as its target.
It aims at educating all students to be mathematically literate and more capable in utilizing the available resources and opportunities to improve quality at work, their welfare, and prosperity.

General Learning Outcomes (Broad Goals)

To develop in all students the capabilities and skills to:

- Use Mathematics as a language to analyse and communicate information and ideas
- Use computational and analytic skills for practical use
- Identify mathematical concepts in their fields of study
- Identify mathematics as a tool and as a discipline
- Cooperative/work together with other students to carry out activities and projects in mathematics and consequently acquire the values of cooperation, tolerance and diligence

Subject Content Outline by Broad Themes & Specific Topics

Sets

- Describe set and the various types.
- Apply the algebra of sets.
- Solve two and three set problems (including use of Venn diagrams)

Surds

- Four operations on surds ($+, -, \times$ & $\div$)
- Rationalise the denominator (including binomial denominators)

Relations and Functions

- Relations, Mappings and Functions
- Function Notation.

- Types of functions
- Representing functions.
- Inverse Functions and Composite Functions
- Graphs and roots of Functions

Polynomial Functions

- General Characteristics
- Linear function
- Quadratic Function
- Cubic Functions
- Rational Functions
- Partial fraction
- Exponential function
- Logarithmic Function

The Binomial Theorem

- Binomials expansion by Binomial theorem.
- Binomial expansion by Pascal's triangle

Sequences and Series

Finite and Infinite <u>sequences</u>

- Recurrence sequence
- Arithmetic sequence and Geometric sequence

Finite and infinite <u>series</u>

- Arithmetic series and Geometric series
- Sum of Arithmetic sequences and Geometric sequences

Co-ordinate Geometry

- Loci
- Straight Lines
- Circles
- Parabolas

Trigonometry

- Trigonometric Ratios and Rules
- Compound Angles

- Multiple Angles
- Trigonometric Functions

Calculus
Limits
Introduction to Derivatives
Differentiation

- Methods of Differentiation
- Implicit Differentiation
- Derivative of Trig Functions

Applications of Differentiation
Integration

- The general solution of (Indefinite integral and Definite integral)

Techniques of integration

- Integration of Trigonometric Functions.
- Integration by substitution
- Integration of Logarithmic functions
- Integration of exponential functions.

Applications of Integration

- Area under curves
- Numerical integration (Trapezoidal Rule)

Vectors
Vectors and scalars

- Properties of vectors (representing vectors, equal vectors, null or zero vector)
- The magnitude and direction of a vector
- Algebra of vectors
- Triangle law of vector addition

Statics
Resultant and resolving forces into components

- Equilibrium of coplanar forces
- Types of forces (weight, tension and trust)
- Friction and coefficient of friction

Kinematics of a particle

Dynamics

- Rotational motion of rigid bodies (moment of inertia of a particle and rigid body)
- Newton’s laws of motion
- Motion of two connected particles (problems involving pulleys)
- Momentum and impulse (principle of conservation of momentum)
- Sum of moments
- Equilibrium of a lamina under parallel forces (non-uniform rods)

Matrices

- Operations on matrices
- Finding the determinant and inverse of a matrix (limited to 2 x 2 matrices)
- Application of matrices (Cramer’s rule) to solve simultaneous linear equations in two variables

Linear Transformations

- The concept of linear transformation
- Images of points under given linear transformation
- Determine the matrices of linear transformation
- The inverse of linear transformation
- Composition of linear transformation

Statistics

- Data Representation
- Data Analysis
- Correlation

Probability

- Introductory concepts
- Permutation and Combination
- Binomial Probability Distribution.

Structure of the Syllabus Over the Three Year Senior Secondary Cycle

	SSS 1	SSS 2	SSS 3
Term 1	**Sets** Describe set and the various types. Apply the algebra of sets. Solve two and three set problems (including use of Venn diagrams **Surds** Four operations on surds $(+, -, \times \ \& \div)$ Rationalise the denominator (including binomial denominators)	**The Binomial Theorem** Binomials expansion by Binomial theorem. Binomial expansion by Pascal's triangle **Sequences and Series** Finite and Infinite sequences • Recurrence sequence • Arithmetic sequence and Geometric sequence Finite and infinite series • Arithmetic series and Geometric series • Sum of Arithmetic sequences and Geometric sequences	**Vectors** Vectors and scalars Properties of vectors (representing vectors, equal vectors, null or zero vector) The magnitude and direction of a vector Algebra of vectors Triangle law of vector addition **Statics** Resultant and resolving forces into components Equilibrium of coplanar forces Types of forces (weight, tension and trust) Friction and coefficient of friction **Kinematics of a particle** **Dynamics** moment of inertia of a particle and rigid body Newton's laws of motion Motion of two connected particles Momentum and impulse Sum of moments Equilibrium of a lamina under parallel forces
Term 2	**Relations and Functions** Relations, Mappings and Functions Function Notation. Types of functions Representing functions. Inverse Functions and Composite Functions Graphs and roots of Functions	**Co-ordinate Geometry** • Loci • Straight Lines • Circles • Parabolas **Trigonometry** • Trigonometric Ratios and Rules • Compound Angles	**Matrices** Operations on matrices Finding the determinant and inverse of a matrix (limited to 2 x 2 matrices) Application of matrices (Cramer's rule) to solve simultaneous linear equations in two variables

		• Multiple angles • Trigonometric functions	**Linear Transformations** The concept of linear transformation Images of points under given linear transformation Determine the matrices of linear transformation The inverse of linear transformation Composition of linear transformation
Term 3	**Polynomial Functions** • General Characteristics • Linear function • Quadratic Function • Cubic Functions • Rational Functions • Partial fraction • Exponential function • Logarithmic Function	**Calculus** • Differentiation • Applications of Differentiation • Integration • Applications of Integration	**Statistics** • Data Representation • Data Analysis • Correlation **Probability** • Introductory concepts • Permutation and Combination • Binomial Probability Distribution

Teaching Syllabus

Development of Curriculum & Syllabuses for Senior Secondary Education in Sierra Leone

Topic/Theme/Unit	Expected learning outcomes	Recommended teaching methods	Suggested resources	Assessment of learning outcomes
		YEAR 1/TERM 1		
Sets Understanding and applying the algebra of sets. Solving two- and three-set problems	**Students should be able to:** • Describe set and the various types. • Apply the algebra of sets. • Solve two and three set problems (including use of Venn diagrams)	Introduce set as very important concept in mathematics in everyday life collection. Discuss with the students the definition of set as a well-defined collection of objects of the same kind. Explain the various types of sets Universal set, empty set, subset. Teacher to Describe *set notation, members/elements by* • Listing its members T = (2,3,4,5,7,11) • Given word description of its members A = (prime numbers less than 12). • Using a set-builder notation B = $(x: 1 < x \ < 12)$ $where\ x\ is\ a\ prime\ numbers$ Explain the various types of sets	Diagram of various set type on vanguard Illustrated Venn diagram on vanguard	Ask student short answer questions Eg. Name any 3 types of set. Write two sets and ask students to illustrate union, intersect and complement of set. Write a three sets word problem on the board and asked the students to calculate i). One only…….. ii) Both………… iii) All the three……..

		Teacher to explain the illustrated Venn diagram on the vanguard Discuss operation of sets ∪…..Union ∩….. Intersection !...... Complement Disjoint sets Solve two and three set problems (including use of Venn diagrams)		
Surds Performing the four operations on surds. Rationalising the denominator	**Students should be able to:** • Perform the four operations on surds $(+,-,\times\ \&\ \div)$ • Rationalise the denominator (including binomial denominators)	Review the concept of perfect squares Discuss with the students how a multiple number is simplify into two factors Eg. $\sqrt{500}=\sqrt{100\ \times 5}$ $= \sqrt{100} \times \sqrt{5}$ $= 10\sqrt{5}$ Solve problems with the students involving addition, subtraction, multiplication and division of surds Demonstrate to the students how to Rationalise denominators	Table of perfect square roots. $\sqrt{4} = 2$ $\sqrt{9} = 3$ $\sqrt{16} = 4$ $\sqrt{25} = 5$ . . . etc	Class exercises Eg. Simplify $\sqrt{225}$, $\sqrt{243}$ Etc. Evaluate and leave your answer in $a\sqrt{b}$ a). $\sqrt{50} + \sqrt{18}$ b). $\sqrt{847} - \sqrt{175}$ Rationalize the denominator

YEAR 1/TERM 2				
Relations and Functions Describing Relations, Mappings and Functions Using Function Notation. Specifying the different types of functions Representing functions. Inverse Functions and Composite Functions Graphs and roots of Functions	**Students should be able to:** • Describe Relations, Mappings and Functions • Apply Function Notation, (domain, range, dependent and independent variables) • Identify the different types of functions (one to one, one - many & many to one etc.) • Represent functions using tables, Algebraically, Graphically • Evaluate Inverse and Composite Functions • Draw Graphs of Functions and determine the Roots of Functions	Introduce the concept of relation as an association that exits between two sets of objects the domain and co-domain. Further explain that relation can be shown by means of order pairs Discuss with the students that the set of all possible images of the domain is called range. **Note!** A relation may exist between two sets but not all the elements of the domain may be associated with elements of the co-domain. Types of relation One –to-one, many- to- one, many –to- many. Describe Mapping as a relation in which each member in the domain maps onto only one member in the co-domain I.e one to one and many to one relation are mappings. Discuss with the students how to identify functions from these characteristics.	Illustrated cases of relation, mapping and functions on vanguard • Graph board • Graph paper • Blackboard ruler • Foot rule • Markers • Colored chalks • Pencils Diagram of the various types of functions • One to one • One to many • Many to one Showing the Domain and the image (Range)	Ask students to draw the various types of functions 1 2 3 2 5 8 Eg. Find the images of the elements of the domain [-2,-1 0, 1, 2] define by the function f : x→ $\frac{3x-1}{x-3}$ Eg. Draw the graph of the function f(x) = 2x + 1 in the interval $-2 \leq x \leq 4$ **Inverse Function** Given the function i). f (x) = 3x − 2, find its inverse. ii). Given f(x) = 2x + 3, find $f^{-1}(x)$. iii). Find the inverse of the following function g(x) = (x + 4)/ (2x -5) **Composite Function** i). Given the functions f (x) = x^2 + 6 and g (x) = 2x – 1, find (f ∘ g) (x). ii). Given the functions

		a). Each element in A must be matched with an element in B b). Some elements in B may not be matched with any element in A c). Two or more elements in A may be matched with the same element in B d). An element in A cannot be matched with two different elements in B. Discuss with the students the domain and range of the given function. Illustrate Graphs of functions using the graph board. If f is a function with domain D, then the graph of 'f' is the set of all points P(x, f(x)) in the plane. That is the graph of '*f*' is the graph of y = f(x). Solve problems with the students involving function of a function ie (fog)(x) = f(g(x)) and inverse function Restrict to simple algebraic functions only. Draw graphs of Functions and determine the Roots of Functions using the graph board		g (x) = 2x – 1 and f (x) = x^2 + 6, find (g ∘ f) (x). iii). Find (g ∘ f) (x) given that, f (x) = 2x + 3 and g (x) = – x^2 + 5

YEAR 1/TERM 3				
Polynomial Functions 1 General Characteristics of functions	**Students should be able to:** • Recognise equations of polynomial functions of degree ≤ 4 • Simplify the algebra of polynomial functions • State and apply the Remainder theorem and the Factor theorem	write the remainder and factor theorem and demonstrate how to apply them in simplifying polynomial **Remainder Theorem** if a polynomial $f(x)$ is divided by $x-k, the\ remainder\ is$ $r=f(k)$ Eg. Use the remainder theorem to evaluate the function at x = -2 $f(x)=3x^3+8x^2+5x-7$ **Factor Theorem** A polynomial $f(x)$has a factor$(x-k)$ if and only if $f(k)=0$ Eg. Show that $(x-2)and(x+3)$ are factors of $f(x)=2x^4+7x^3-4x^2-27x-18$	Textbooks Chart showing polynomial functions of degree ≤ 4 a). Linear function b). Quadratic function c). Cubic function	i). The remainder after $2x^2-5x-1$ is divided by x−3 ii). the remainder after $2x^2-5x-1$ is divided by x−5 iii). Use the Factor Theorem to find the zeros of $\boldsymbol{f(x)=x^3+4x^2-4x-16}$ given that (x-2) is a factor of a polynomial. iv. use the factor theorem to find the zeros of $\boldsymbol{f(x)=x^3-6x^2-x+30}$. Given that (x+2) is a factor of a polynomial.
Polynomial Functions 11 Linear Functions	**Students should be able to:** • identify linear function represented by a straight-line graph • Sketch graphs of linear equations • Derive equations of linear equations using slope-intercept, slope point, two points • Find equations of parallel and	Discuss linear function as a graph $f(x)=ax+b$ is a line with slope $m=a$ and y- intercept at $(0,b)$. Teacher Use the graph board, Blackboard ruler, Colored chalks and allow students to work on graph paper to demonstrate how to sketch linear graph Help the students Derive equations of linear equations	Graph board Graph paper Blackboard ruler Foot rule Markers Colored chalks Pencils Graph board	Plot the points and find the slope of the lie that passes through the pair of points i). $(-3,-)\ and\ (1,6)$ ii). $(2,4)and\ (4,-4)$ Use the point on the line and the slope of the line to determine the general equation of the line. 1. Point (2,1) and slope m =1 2. Point (-5,4) and slope m =2

	perpendicular lines to a given line • Solve simultaneous linear equations graphically or algebraically • sketch and solve linear inequalities • Apply linear inequalities to Linear Programming	using **a) slope-intercept** $m = \frac{y_2 - y_1}{x_2 - x_1}$ **b) point - slope** $y - y_1 = m(x - x_1)$ **c) two points** $D(x, y)$ and $R(x, y)$ **Parallel line** $\leftrightarrow m_1 = m_2$ **Perpendicular line** $m_1 m_2 = -1$ Where $m_1 m_2$ are gradients of the two lines? Teacher Use the graph board, Blackboard ruler, Colored chalks and allow students to work on graph paper to demonstrate how to sketch simultaneous linear equations graphically and algebraically (including methods of elimination and substitution Explain symbols involve in Sketching and solving linear inequalities $(<, >, \leq, \& \geq)$ Linear Inequalities e.g. 2x + 5y ≤ 1, x + 3y ≥ 3 Apply linear inequalities to Linear Programming *(optimisation, objective function, constraints and feasible solution)* Solve practical problems to maximize profit.	Graph paper Blackboard ruler Foot rule Markers Colored chalks Pencils	Determine whether the lines L_1 and L_2 are parallel or perpendicular i). L_1(0,-1),(5,9) $L_2(0,3), (4,1)$ .L_1(3,6),(-6,0) $L_2(0, -1), (5, \frac{7}{3})$ **Simultaneous Linear** Solve the following pair of simultaneous linear equations: 2x + 3y = 8 3x + 2y = 7 Using elimination, substitution and graphical methods. **Inequalities** Solve the inequalities: 1. 2 (x – 4) ≥ 3x – 5 2. 7x + 11 > 2x + 5 3. 2(x + 3) < x + 1 4. – 5 ≤ 2x – 7 ≤ 1

Quadratic Functions	**Students should be able to:**
	• Recognise quadratic functions represented by a parabola
	• Sketch graphs of quadratic functions using turning points, intercepts and axis of symmetry
	• Determine the nature of the roots of a quadratic equation Use the discriminant
	• Solve quadratic equations by
	  ○ Graphical method
	  ○ Factorizing method
	  ○ Completing the square
	  ○ Quadratic formula
	• Derive quadratic equations given sufficient information
	• Solve simultaneous equations for one linear, one quadratic
	• Extend concepts to sketching and solving quadratic inequalities
		Teacher to define quadratic function. Let a, b, and c be real numbers with $a \neq 0$. The function $f(x) = ax^2 + bx + c$
		
		Use the graph board, blackboard ruler to illustrate quadratic graph turning points, intercepts and axis of symmetry.
		
		Solve problem on quadratic equation by
		a) Graphical method
		b) Factorizing method
		c) Completing the square
		d) Quadratic formula
		$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
		
		Demonstrate the Roots of quadratic equations – equal roots ($b^2 - 4ac = 0$), real and unequal roots ($b^2 - 4ac > 0$), imaginary roots ($b^2 - 4ac < 0$); sum and product of roots of a quadratic equation
		e.g. if the roots of the equation $3x^2 + 5x + 2 = 0$ are α and β, form the equation whose roots are $\frac{1}{\alpha}$ and $\frac{1}{\beta}$.
		
		Solving quadratic inequalities
				Solve the quadratic equation by completing the square
				
				I. $x^2 + 4x + 1 = 0$
				
				Solve the quadratic equation by formula method
				
				$-4x^2 + x + 3 = 0$.
				
				Solve the quadratic equation by graphical method.
				
				i. $-4x^2 + x + 3 = 0$.

Cubic Functions	**Students should be able to:** • Recognise cubic functions as functions of degree 3 • Draw graphs of cubic functions for a given range • Factorise and solve cubic equations	Discuss cubic functions as functions of degree 3 e.g. f: x → $ax^3 + bx^2 + cx + d$. teacher should support students to Draw graphs of cubic functions for a given range. Explain how to Factorize cubic expressions and solution of cubic equations. Factorization of $a^3 \pm b^3$		**Cubic Function** Determine the roots of the cubic equation $2x^3 + 3x^2 – 11x – 6 = 0$ Find the roots of the cubic equation $x^3 − 6x^2 + 11x – 6 = 0$ Solve the cubic equation $x^3 – 23x^2 + 142x – 120$ Find the roots of $x^3 + 5x^2 + 2x – 8 = 0$ graphically.
Polynomial Functions 111 Rational Functions	**Students should be able to:** • Recognize rational function as a quotient of two polynomial functions • Apply the four operations on rational functions	Teacher to explain to the students that rational function can be written in the form $$f(x) = \frac{N(x)}{D(x)}$$ Where N(x) and D(x) are polynomials and D(x) is not zero. Solve problems as work examples with the students involving rational functions Eg. Find the domain of the function $$f(x) = \frac{4(x+1)}{x(x-4)}$$	Charts of laws of indices Chart of laws of logarithms Graph board Graph paper Blackboard ruler Foot rule Markers Colored chalks Pencils	1). If $f: x \to \frac{1}{2+x}$,find the range if the domain is the set $[x: 1 \leq x \leq 5]$ 2). Simplify the following rational functions $\frac{1}{x-2} + \frac{3}{x+1}$ $\frac{4}{x+2} - \frac{3}{x+3}$ $\frac{2x}{x^2-1} \div \frac{x^2-2x}{x^2-2x+1}$
Partial Fractions	**Students should be able to:** • Decompose rational functions into partial fractions: a) Linear factors in the denominator	Decompose into partial fraction $$f(x) = \frac{N(x)}{D(x)}$$ Eg. Write the partial fraction decomposition of		Resolve $\frac{11-3x}{x^2+2x-3}$ into partial fractions. Resolve $\frac{x^2-1}{x^2-3x+2}$ into partial fractions.

	b) Repeated linear factors in the denominator c) Quadratic factors in the denominator	$f(x) = \frac{x+7}{x^2 - x - 6}$		
Exponential and Logarithmic Functions	**Students should be able to:** • Apply the laws of indices • Solve equations involving indices • Apply the laws of logarithms • Solve equations involving logarithm and change of base • Draw and interpret graphs of exponential relations	Discuss with the students relation between exponential and indices. i.e Exponential function $\boldsymbol{f}$ with base $\boldsymbol{a}$ is denoted by $f(x) = a^x$ Where a $>$ 0, a $\neq 1$ and x is any real number. *Note to the students that in many application the most convenient choice for a base is the irrational number $e = 2.718281828$ Discuss the definition of logarithms function with base a. Ie for $x > 0\ and 0 < a \neq 1$ $y = log_a x\ if\ and\ only\ if\ x = a^y$ Hence $f(x) = log_a x$ is the logarithms function with base a. Eg. Simplify $log_5 5^x$ Solve problems with students involving exponential (indices) and logarithm equations Eg. Solve $2(3^{2x-5}) - 4 = 11$ Solve $log_3(5x-1) = log_3(x+7)$		Without using mathematical table simplify the following 1). $\left(\frac{16}{81}\right)^{-\frac{3}{4}}$ ii). $16^{-\frac{3}{2}}$ Find the value of x in the following i). $3^{x^{2-1}} = 9^4$ ii) $3^{2x} - 4(3^x) + 3 = 0$ Simplify the following i). $log_5 10 + log_5 12$ ii) $log_3 24 + log_3 15 - log_3 10$ Solve the following equation $log_{10}(5x+6) = log_{10}(5x-6)$ ii). $log_{10}(x^2 1) - 2log_{10} x = 1$

		Demonstrate the properties of logarithms. $log_a(UV) = log_a U + log_a V$ $log_a\left(\frac{U}{V}\right) = log_a U - log_a V$ $log_a U^n = nlog_a U$ *Note to the students that there is a natural logarithmic function defined by $f(x) = log_a x = \ln x \quad x > 0$		

		YEAR 2/TERM 1		
The Binomial Theorem Use of the binomial theorem for positive integral index only. Proof of the theorem **<u>not required</u>**	**Students should be able to:** • Expand powers of binomials using the binomial theorem. • Generate co-efficient of binomial expansion by Pascal's triangle.	Discuss the binomial theorem with the students which state that for $(x+y)^0 = 1$ $(x+y)^1 = x+y$ $(x+y)^2 = x^2 + 2xy + y^2$ $For\ any\ (x+y)^n$ $(x+y)^n = x^n + nx^{n-1}y + \cdots + C_r^n x^{n-r} y^r + \cdots$ Illustrate the Pascal's triangle to generate coefficient of binomial expansion $(x+y)^n$ where n = 0,1,2,3,4… Demonstrate with the students work examples on binomial expansion using both methods.	Chart of Pascal's triangle	Use the binomial series to determine the expansion of $(2\mathrm{a} - 3\mathrm{b})^5$ Use the binomial series to determine the expansion of $(2+x)^7$ Use Pascal's triangle to expand$(2-y)^7$ Expand $(2a-3b)^5$ using Pascal's triangle Determine, using Pascal's triangle method, the expansion of $(2p-3q)^5$

		Eg. a). Write the binomial expansion for the expression $(x+1)^3$ b). Find the binomial coefficient $(x+1)^4$		
Sequences and Series	**Students should be able to:** • Differentiate between finite and infinite sequences • Describe the properties of Recurrence sequences, Arithmetic sequences, Geometric sequences • Differentiating between finite and infinite series • Describe the properties of Recurrence series, Arithmetic series, Geometric series • Calculate sum of Arithmetic sequences and Geometric sequences	Teacher to explain finite and infinite sequences. Illustrate how to find terms of a sequence $a_1, a_2, a_3, a_4, \dots a_n$ Discuss the properties of sequences. **a). Recurrence sequences** Generating the terms of a recurrence series and finding an explicit formula for the sequence e.g. 0.9999 = $\frac{9}{10} + \frac{9}{10^2} + \frac{9}{10^3} + \frac{9}{10^4} + \cdots$ **b). Arithmetic sequences** A sequence whose consecutive term have a **Common Difference** $a_n = dn + c$ Un = U1 + (n-1)d **c). Geometric sequences** A sequence whose consecutive terms have a **Common Ratio.** $a_n = a_1 r^{n-1}$ Solve problems involving finite and infinite sequence.		Class excises **AP** example, the sum of the first seven terms of the series 1, 4, 7, 10, 13,.. Determine the number of the term whose value is 22 in the series $2\frac{1}{2}$, 4, $5\frac{1}{2}$,7,... Find the sum of the first 12 terms of the series 5, 9, 13, 17, ... **GP** example, find the sum of the first eight terms of the GP 1, 2, 4, 8, 16, ... Find the sum to infinity of the series 3, 1, $1\frac{1}{3}$, ... Find the tenth term of the series 5, 10, 20,40, ...

		Demonstrate the step by step method of calculating sum of Arithmetic sequences and Geometric sequences • Sum of Arithmetic series (AP) $S_n = \frac{n}{2}(a_1 + a_n)$ $S_n = \frac{n}{2}$ [2a + (n – 1)d] • Sum of Geometric series (GP) $S_n = \sum_{n=1}^{n} a_1 r^{n-1} = a_1\left(\frac{1-r^n}{1-r}\right)$ when r<1 $S_n = \frac{a_1(r^n-1)}{(r-1)}$ when r>1		
		YEAR 2/TERM 2		
Co-ordinate Geometry Loci Equation to a locus.	**Students should be able to:** • Describe locus of a point • Sketch the locus of points satisfying given conditions State the Locus theorem and how it can be used in real life situations or activities. Determine the locus	Sketch the locus of points satisfying given conditions i). The equation of a curve is the relation that holds true between the coordinates of every point on the curve, and no point that doesn't lie on the curve. ii). To find the equation to a locus, we start by converting the given conditions to mathematical equations.		**Example 1** Find the locus of the point moving on a plane which is at a fixed distance **5** units from 'a' the **X** axis. **Example 2** Find the locus of a point which is at a fixed distance **4** from the origin **Example 3**

	of points that will satisfy more than one condition.	**Locus Theorems** **Locus Theorem 1**: The locus of points at a fixed distance, d, from point P is a circle with the given point P as its center and d as its radius. **Locus Theorem 2**: The locus of points at a fixed distance, d, from a line, l, is a pair of parallel lines d distance from l and on either side of l. **Locus Theorem 3:** The locus of points equidistant from two points is the perpendicular bisector of the line segment determined by the two points. **Locus Theorem 4:** The locus of points equidistant from two parallel lines **Locus Theorem 5:** The locus of points equidistant from two intersecting lines **Equation to a locus** "The equation of a curve is the relation which exists between the coordinates of all points on the curve, and		Find the locus of a point such that it is equidistant from two fixed points, **A(1, 1)** and **B(2, 4)**

		which does not hold for any point not on the curve". Finding out the equation to a locus means finding out the relation that holds true between the **x** and **y** coordinates of *all* points on the locus.		
Co-ordinate Geometry The Cartesian coordinate system of a plane. **Straight Lines** Equation of a line segment Equations of parallel and perpendicular lines	**Students should be able to:** • Plot a point on a plane • Define a straight line as a locus of points described by the equation *y* = *mx* + *c* • Find the distance between two points and the gradient of a line joining two points mid-point of a line segment (mid-point formula) • Divide a line segment in a given ratio (externally and internally) • Equation of a straight line • Equations of parallel and perpendicular lines • Perpendicular distance from a line	Describe the Cartesian coordinate system (x-and – y-axes). Demonstrate on a graph board to plot points. Explain the meaning of the variables on the straight line $y = mx + c$ Solve problems on the distance between two given points $(x_1, y_2) and\ (x_2, y_2)$ using the formula d =$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ solve the gradient of the two points $(x_1, y_2) and\ (x_2, y_2)$ using gradient = $\frac{y_2 - y_1}{x_2 - x_1}$ solve a problem on division of line segment in the ratio $m{:}\,n$ at the points $(x_1, y_2) and\ (x_2, y_2)$ use the relation $\left(\frac{mx_2+nx_1}{m+n}, \frac{my_2+ny_1}{m+n}\right)$		Organize students in pairs or groups. Ask simple multiple choice question. Give simple class work. Example. $A(3,4)\ and\ B(5,9)$ are two point on a straight. Compute: a) the distance b) the slope c) mid-point Example. $A(3,4)\ and\ B(5,9)$ are two point on a straight. Compute the equation of the line, Conduct quizzes and examinations.

	• Acute angle between two intersecting lines	solve problems on acute angle between lines		
Co-ordinate Geometry **The Circles** The equation of a circle with a given centre and radius $(x-a)^2+(y-b)^2=r^2$ where (a,b) is the centre and r the radius. Equation of circle through the ends of a diameter Equation of a tangent and normal to a circle	**Students should be able to:** • Define a circle as a locus of points that are a fixed distance from a given point (centre) • Solve problems on center and radius given the equation of a circle; equations of tangent and normal to a circle	Describe a circle and state the general equation of a circle. Teacher solve problems on finding the radius $r=\sqrt{g^2+f^2-c}$ and the center $(-g,-f)$ from the general equation $x^2+y^2+2gx+2fy+c=0$ Solve problems on tangents and normal to a curve		Arrange pupils in groups and give them tasks to do. **Example.** 1). Find the center and radius of the circle $x^2+y^2-3x+4y=8$. 2). Sketch the circle whose general equation is $2x^2+2y^2-3x+16y=8$. 3). Find the equation of the tangent to the circle$x^2+y^2-2x+4y-1=0$. Conduct quizzes and tests
Conics Section – Parabola Standard equation of a parabola The equation of a parabola given the coordinates of the focus and equation of the directrix	**Students should be able to:** • Define a parabola as a locus of points equidistant from a fixed point (focus) and a fixed line (directrix) • Find the equation of a parabola • Sketch a parabola given turning points, intercepts and axis of symmetry • Find the equations of tangent and normal to a parabola	Explain the meaning of a parabola and discusses the shape of the curve when different conditions are given conditions Teacher demonstrates how to sketch a parabola on a graph board Solve problems on tangents and normal to a parabola		Ask simple question about parabolas and record their responses on the board. Organize in groups and give tasks to do in class. Example 1. Find the standard form of the equation of the parabola with vertex $(2,3)$ and focus $(1,2)$. Example 2. Find the equation of the tangent line to the parabola $y=x^2$ at the point $(1,-1)$

	• the axis of symmetry			
Introduction to trigonometry Trigonometric ratios from the right triangle and corresponding reciprocals Trigonometric ratios of known values $(0^0, 30^0, 45^0, , etc)$ Basic relationships and trigonometric identities Convert degrees to radians and vice versa The quadrants and the sign of the trigonometric ratios Applications of trigonometry (solution of a triangle, elevation and depression) simple cases only.	**Students should be able to:** • Find sine, cosine and tangent of angles 0º≤ Ɵ ≤360º in general and 0º, 30º, 45º, 60º and 90º in particular • Use the basic trigonometric ratios and reciprocals to prove given trigonometric identities • Evaluate the sine, cosine and tangent of negative angles • Convert degrees into radians and vice versa • Apply trigonometric ratios and rules to real-life situations	Use the right triangle to derive the three basic trigonometric ratios and their corresponding reciprocals Explain the use of the right triangle to give the relationships between the trigonometric ratios. $\tan x = \frac{\sin x}{\cos x}$, $\sin x = \cos(90 - x)$ $\sec x = \frac{1}{\cos x}$etc. Explain the use of the quadrants for the sign of each trigonometric ratio. Solve simple problems on elevation and depression.		Ask students to name the basic trigonometric ratios. Arrange in groups and give the simple task to do whilst you move around helping struggling students. Example. Evaluate $\cos 225^0$, $\sin 300^0$ Example. Convert 330^0 into radian Convert 4π into degrees
Trigonometric equations and graphs Solving trigonometric equations Trigonometric graphs	**Students should be able to:** • Use trigonometric identities to solve equations. • Draw graphs of sine, cosine and tangent ratios in degrees and	Explain and solve trigonometric equations Draw graphs of the three basic trigonometric ratios and explain their nature and use the graphs to solve trigonometric equations		Give class work. Ask a pupil to come to the board and solve a given exercise. Example. Solve the equation $2\sin x - 3\cos x = 1$ for $0 \leq x \leq 180$ Example. Sole the equation $\sin 2x = \cos 5x$

	radians and recognize their periodic nature over an extended domain • Use graphs to solve trigonometric functions up to quadratics, within a specified domain • Calculate the maximum and minimum points of given trigonometric functions			Example draw the graph of $y = \sin x$ for $0 \leq x \leq 2\pi$

YEAR 2/TERM 3				
Limits Definition of Limit of a function Limit properties 1. Limits of constant 2. Limits of the function x^k 3. Limits of the function x 4. Limits of the function $\dot{k}x$ 5. Limits of the function $f(x).g(x)$ 6. Limits of rational functions 7. Limits involving infinity	**Students should be able:** • Define the concept of limits of a function. • Apply the limit property to evaluate given functions i). If $\lim_{x\to a} f(x) = k$ where k is a constant, then $\lim_{x\to a} k = k$ ii). $\lim_{x\to a} x^k = a^k$ iii). $\lim_{x\to a} x = a$ iv). $\lim_{x\to a} kx = ka$ v). $\lim_{x\to a} f(x).g(x) = \lim_{x\to a} f(x).\lim_{x\to a} g(x) = f(a).g(a)$	Teacher to explain the concept of limits Discuss with the students the properties or theorem of limits with given examples Example: Find $\lim_{x\to 2}(x+3)(x^2-5)$ Solve problems with the students involving application of limit properties	White board	Evaluate 1. $\lim_{x\to 2} x^3 = 2^3$ 2. $\lim_{x\to 2} x = 2$ 3. $\lim_{x\to 5} 3x = 3(5)$ 4. $\lim_{x\to 2}(x^2 - 4x + 2)$ 5. $\lim_{x\to 2}\left\{\frac{x^2-7x+10}{x^2-4}\right\}$ 6. $\lim_{x\to\infty}\left\{\frac{5x^2-1)}{2x^2+1}\right\}$

	vi). $f(x) = \frac{g(x)}{h(x)}$, then $\lim_{x \to a} f(x) = \frac{\lim_{x \to a} g(x)}{\lim_{x \to a} h(x)} = \frac{g(a)}{h(a)}$ vii). $\lim_{n \to \infty} f(x)$.			
Introduction to Derivatives Find the derivative of simple functions.	**Students should be able to:** • Define the derivative of a function • Find the derivative of simple function.	Ask questions about the meaning of a straight line between two points(x_1, y_1) and (x_2, y_2) Record various responses from pupils on the board. Gradient=$\frac{increase\ y}{increase\ x} = \frac{y_2 - y_1}{x_2 - x_1}$ Teacher explains that small increments were added to both x and y then $\frac{\Delta y}{\Delta x} = \frac{f(x+\Delta x) - f(x)}{\Delta x}$. Write the notations of differentiation $\frac{dy}{dx}$ or $f^1(x)$ all denoting first differentials Solve problems with the students involving derivative of a function.	Electronics graph board Graph boards Rulers Graph papers	Give class work. Eg. Differentiate from first principles the function $y = x^2$. Ask pupils to explain how they arrive at the answer
Methods of Differentiation Differentiate a function using first principle. Common functions Product rule of differentiation	**Students should be able to:** • Use the idea of limits to differentiate a function from first principles. • Differentiate common functions	Teacher explains the method of finding derivative of function by first principles. Teacher discuss with students how to differentiate common functions such as : $y = c, y = x^n$, etc	White board, textbooks	Group pupils and give them class activities on the concepts taught. Eg. Use the quotient rule to find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for $y = \frac{2x}{x+5}$.

Quotient rule differentiation Chain rule (also known as function of a function) Successive differentiation (higher derivatives)	• Differentiate a product using product rule. • Eg. If $y = uv$ • $then\ \frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$ • Eg. If y = $\frac{u}{v}$ $then\ \frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$ • Differentiate a function of a function. $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$ • Differentiate a function successively. Eg. $\frac{d^2y}{dx^2}$	Teacher can further discuss with pupils through questioning the meanings of product and quotient of numbers. Apply the product and quotient rule to Differentiate functions Eg. If $y = (2x - 2)(2x^3)$ (Product rule) Eg. If y= $\frac{(2x-2)}{(2x^3)}$ (Quotient rule) Solve problems on Differentiating function of a function. Teacher to introduce higher or successive differentiation.		
Implicit Differentiation How to differentiate function of another function	**Student should be able to:** • Use the chain rule to differentiate implicitly • Find the slope of a curve at a given point. • Apply the concept of implicit differentiation to find the equation of	Explain the meaning of implicit functions. Eg $x^2 - 3xy^2 - y = 6$ Explain to pupils how to differentiate implicitly Solve problems on implicit Differentiating as work examples		Group pupils in pairs and ask them to solve some problems Eg. Find $\frac{dy}{dx}$ for the function$2x^2 - 3xy = 7$.

	a tangent to a curve at a given point.			
Derivative of Trig Functions How to determine the derivative of a trigonometric function with a given function. Differentiation of natural log functions and exponential functions	**Student should be able to:** • Compute the differentials of trigonometric functions • Apply the techniques of differentiation to calculate the differentials of trigonometric functions • Differentiate composite trigonometric functions. • Differentiate logarithmic functions. Such as $y = \log_e(2x - 5)$	Discuss with pupils the three basic trigonometric ratios $(\sin x\,.\cos x\ \ and\ \ \tan x)$ with their corresponding reciprocals $(\csc x\,.\sec x\ \ and\ \ \cot x)$ using the right-triangle. Solve problems on Differentiating trigonometric ratios applying the techniques of differentiation. Solve problems on Differentiating logarithmic and exponential functions applying the techniques of differentiation.		Ask pupils to list the trigonometric ratios. Record their responses on the board. Ask pupils to find the differential coefficient of $y = \sin x$. Ask one or two pupils to try and solve it on the board.
Applications of differentiation Increasing and decreasing functions Rates of change, Velocity and acceleration, Turning points (maximum and minimum) Points of inflexion Tangents and normal Practical problems	**Students should be able to:** • Describe an increasing and decreasing function. • Apply differentiation to Determine I. rates of change II. velocity and acceleration III. (maximum and minimum)	Teacher to discuss with the students meaning of rate of change, Velocity and acceleration, Turning points (maximum and minimum). Explain that at a turning point $\frac{dy}{dx} = 0$. Solve problems as work examples on some application of differentiation.		Ask pupils to explain velocity and acceleration. Give pupils some class work for them to try. Find the maxima and minima points of the function$y = (2x - 1)(4 - x)^2$.

	IV. Tangents and normal Practical problems			
Integration Process of Integration The general solution of An Indefinite integral and a Definite integral	**Students should be able to:** • Define integration as the reverse of differentiation • Determine the integrals of the form x^n and ax^n. Where n is a fractional, zero, or positive or negative integer. $\int x^n\,dx = \frac{x^{n+1}}{n+1} + c$ (indefinite integral) $[x]_a^b = (b) - (a)$ (definite integral)	Explain to pupils the meaning of integration and he notation for integration as $\int$ Solve problems on indefinite integrals $\int x^n\,dx = \frac{x^{n+1}}{n+1} + c$. C is the arbitrary constant also known as the constant of integration. Explain the concept of definite integral$[x]_a^b = (b) - (a)$. Solve some mathematical problems on the definite and indefinite integrals.		Ask pupils to give the difference between differentiation and integration Give pupils (groups) exercises to try in class. Eg. integrate x^2 Eg find $\int_1^2 (3x-4)\,dx$
Techniques of integration Introduction to integration of Trigonometric Functions. Integration by substitution Integration of Logarithmic functions Integration of exponential functions.	**Student should be able to:** • Integrate simple trigonometric functions$\int \sin x\,dx$. • Integrate functions by substitution method • Integrate logarithmic functions ($\int \ln x\,dx$) • Integrate exponential functions ($\int e^x\,dx$)	Ask pupils to state the basic trigonometric ratios. Explain and guide pupils to integrate trigonometric functions. Discuss with pupils the process of substitution in integration. Explain how to integrate logarithmic and exponential functions.		Integrate $\sin x$ and $\cos x$. Eg. Find $\int \frac{1}{2x}\,dx$.
Some applications of integration Area under curves	Students should be able to:	Discuss the concept of definite integral to find the area $\left(\int_a^b f(x)\,dx \text{ or } \int_a^b y\,dx\right)$		Give class work to pupils whilst you walk around supervising.

Numerical integration	• Apply integration to calculate areas under curves • Apply the trapezoidal rule to evaluate the area under a curve	and the volume of a solid obtained by rotating the area bounded by the curve $\left(V = \pi \int_a^b (f(x))^2\, dx\right)$ Explain the use of trapezium rule. Solve problems on the applications.		Eg. Find the area bounded by the curve $y = 4x^2$, the x-axis and the ordinates x=0 and x=1
YEAR 3/TERM 1				
Vectors Vectors and scalars Properties of vectors (representing vectors, equal vectors, null or zero vector) The magnitude and direction of a vector Algebra of vectors Triangle law of vector addition	**Students should be able to:** • Describe vector and scalar quantities • Write the notations for a vector and represent a vector on the rectangular Cartesian co-ordinate system. • Compute the magnitude and direction a vector • Apply the algebra of vectors including:(addition, subtraction and scalar multiplication of vectors) • Use the geometric applications of vectors on the triangle, the parallelogram and other polygons using the laws of	Explain vectors and scalars quantities with given examples to each Demonstrate the representation of vectors on a Cartesian plane using the graph Discusses the various ways of notating a vector. Eg $\overrightarrow{AB}$ (directed line segment joining two points from A to B) or as components of a point that is $\binom{x}{y}$. Bold type letter is another way of notating a vector. Calculate the magnitude as $\lvert\overrightarrow{AB}\rvert = \sqrt{X^2 + Y^2}$ and the direction as $\theta = \tan^{-1}\left(\frac{Y}{X}\right)$ Discuss the geometric approach to solve vector		Ask students to give examples of vector and scalar quantities. Record all responses on the board Ask them to represent a vector on the board Give them group work. Example. A girl walks xkm due east then zkm north-east. Calculate the total distance she has walked and her displacement from her starting point when $x = 3\ and\ z = 4$

	addition and subtraction of vectors	problems using the triangle law of vector addition.		
Kinematics of a particle Motion in a straight line with constant acceleration Vertical motion under gravity Speed- time graphs	**Students should be able to:** • Define kinematics and other related terminologies and state their unit of measurement. • Derive the equations of linear motion with uniform acceleration • Solve problems on acceleration due to gravity • Solve uniform accelerated motion problems graphically	Explain terminologies on uniform motion ***(displacement, velocity, acceleration, distance, speed)*** Apply the definitions of the terminologies to derive the equations of uniformly accelerated motion. That is $a = \frac{v-u}{t}$ $v^2 = u^2 + 2as.$ $s = \left(\frac{u+v}{2}\right)t.$ $s = ut + \frac{1}{2}at^2.$ Solve problems on uniform motion graphically Apply the concept of uniformly accelerated motion to solve problems on vertical motion.		Ask students to define speed, velocity, distance, displacement and acceleration. Record their answers on the board. Group them and give work to do in class. Example. A particle is moving in a straight line with uniform acceleration. If it travels 120m while increasing speed from $5ms^{-1}$ to $25ms^{-1}$ find its acceleration. Conduct quizzes and tests
Statics Resultant and Resolving forces into components Equilibrium of coplanar forces	**Students should be able to:** • Explain the meaning of statics • Resolve forces and calculate the resultant force	Discuss the meaning of statics. Explain the resultant of forces and help students to resolve a force into components forces and compute the resultant force.		Organize them in group and give them class exercises Example. A force F acts on a particle at an angle of θ to the horizontal. Find the horizontal and vertical

Types of forces (weight, tension and trust) Friction and coefficient of friction	• Solve problems on the equilibrium of coplanar forces • Explain friction and resolve a contact force into normal and frictional components	$R = \sqrt{X^2 + Y^2}$, where X = horizontal component Y = vertical component Explain coplanar forces and solve some problems Discuss friction and demonstrate the resolution of the normal and friction components Use the relation $F = \mu R$ to solve friction related problems		components of F when F = 20N and $\theta = 20^0$. Ask students to explain the types of forces.
Dynamics Rotational motion of rigid bodies (moment of inertia of a particle and rigid body) Newton's laws of motion Motion of two connected particles (problems involving pulleys) Momentum and impulse (principle of conservation of momentum)	**Students should be able to:** • Define a rigid body • State and explain Newton's laws of motion • Solve problems using Newton's laws of motion • Explain the meanings of momentum and impulse and how they are related • Solve problems on conservation of linear momentum	Define and explain rigid body Explain that moment of inertia of rigid body = sum of moments of inertia all the particles present in the body, ie $I = m_1 r^2{}_1 + m_2 r^2{}_2 + + \cdots$.. $\rightarrow I = \sum mr^2$. Discuss Newton's laws of motion with practical examples Establish the relationship between impulse and momentum. That is impulse = change momentum, $I = m(v - u)$ Explain the principle of conservation of momentum.		Ask students to state and explain the laws of motion Organize students in groups and administer task to do. Example. Find the resultant force which will produce an acceleration of $5ms^{-2}$ for a particle of 6kg. Example A car of mass 800kg decelerates from 20ms^{-1} to 5ms^{-1}. Find the loss of momentum.

		That is Total momentum before impact = total momentum after impact or $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$		
Moments Sum of moments Equilibrium of a lamina under parallel forces (non-uniform rods)	**Students should be able to:** Explain moments of a force Solve problems on uniform and non-uniform rods	Explain moment of force. Describe non-uniform and uniform rods. Solve problems		Students are organized in groups and given tasks to do. Example. A uniform rod AB of length 5m and mass 6kg is pivoted at C where AC =1.5m. Calculate the mass of the particle which must be attached at A to maintain equilibrium with the rod horizontal.
YEAR 3/TERM 2				
Matrices Operations on matrices Finding the determinant and inverse of a matrix (limited to 2 x 2 matrices) Application of matrices (Cramer's rule) to solve simultaneous linear equations in two variables	**Students should be able to:** • Define matrix, the order of matrix (ie. $2 \times 2, 2 \times 3\ etc$) and recognize the types of matrices • Explain the operations (addition, subtraction and multiplication of matrices up to 3X3 order) and solve problems	Define matrix and explain the order of a matrix Discuss and illustrate the operations on matrices. That is addition, subtraction and multiplication two matrices. Solve problems on determinants and the inverse of a two by two matrix. Eg. If $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, then		Ask pupils to explain different orders of matrices. Organize students in groups and give the class exercises to solve.

	Explain the determinant and its solution Solve problems on the inverse of a 2x2 matrix.	$A^{-1} = \frac{1}{ad-bc}\begin{pmatrix} d & -b \\ c & a \end{pmatrix}$		
Linear Transformations The concept of linear transformation Images of points under given linear transformation Determine the matrices of linear transformation The inverse of linear transformation Composition of linear transformation	**Student should be able to:** • Define transformation and explain image and object • Fine the images of points and objects under linear transformation • Find the matrix and inverse matrix of a linear transformation. • Find composition of linear transformations. Such as $H = FoG = FG = F(G)$ (means take transformation G and then apply transformation F to it in that order} • Recognize the identity transformations • Find the equation of the image of a line under a given linear transformation	With cited examples ask students about the common meaning of transformation Explain with illustrations in finding the inverse of a linear transformation Solve problems on the use of identity transformations. Examples: $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ reflection on the x-axis $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ reflection on the y-axis $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ reflection in the line y = x		Find A representing the linear transformation that maps(x_1, x_2) *onto* $(2x_1 - 5x_2, 3x_1 + 4x_2)$. Find the inverse transformation. Show the details $y_1 = 0.5x_1 - 0.5x_2$ $y_2 = 1.5x_1 - 2.5x_2$

YEAR 3/TERM 3				
Statistics – Data Representation Grouped Data	**Students should be able to:** • Define statistical terms • Represent statistical data using Frequency distribution tables, Histograms, Cumulative frequency curve	Review the concept of ungrouped data. Introduce the topic by defining statistics as way of collecting, ordering, analyzing and interpreting data for proper decision making. Explain some statistical terms: *Discrete data, continuous data, frequency, frequency distribution table, class interval* Discuss how data are represented by: a). Frequency distribution tables b). Histograms c). Cumulative frequency illustrate an example on the graph board how to construct histogram and the ogive curve	Graph board Graph paper Blackboard ruler Foot rule Markers Colored chalks Pencils	Write a short essay on the origin and development of the science of Statistics. (b) Discuss the utility of Statistics to the state, the economist, the industrialist… in a planned economy. Example Draw histogram for the following frequency distribution. Variable : 10—20, 20—30 ,30—40, 40—50, 50—60 ,60—70, 70—80 Frequency : 12 30 35 65 45 25 18 respectively
Statistics – Data Analysis Measures of Central Tendency (Grouped Data)	**Students should be able to:** • Calculate mean, mode, median, quartiles, and percentiles • Estimate mode and modal class for	Explain to the students meaning of mode, mean, median, quartiles, and percentiles Discuss with the students terminologies and columns used as formula to calculate	Electronic Graph board Graph paper Blackboard ruler Foot rule Markers Colored chalks Pencils	Give students class exercises on measures of central tendencies for grouped and ungrouped data. Example:

Measures of Dispersion (Grouped Data)	grouped data from a histogram • Estimate median and mean from grouped data a histogram • Calculate mean and standard deviation, variance, range, inter-quartile range	**Mode for grouped data** $Mode = L + \left[\frac{\Delta_1}{\Delta_1 + \Delta_2}\right] C$ **Median for grouped data** $Median = L + \left[\frac{\frac{1}{2}N - (\sum f)L}{f_{median}}\right] C$ **Mean for grouped data** $\bar{x} = \frac{\sum fx}{\sum f}$ Demonstrate how to estimate mode, median and mean for grouped data using histogram. Solve work examples using the various formulae above. Demonstrate how to Calculate mean and standard deviation, variance, range, inter-quartile range.		Construct a grouped frequency table and use the table to calculate the mean median and mode for the data below. 10, 20, 22, 67, 45, 43, 20, 14, 34, 54, 76, 43, 32, 21, 22, 12, 23, 34, 54, 67, 77, 56, 66, 54, 43, 76, 66, 54, 34, 32, 23, 43, 23, 25, 32, 12, 21, 23, 35, 34
Statistics – Correlation and Regression	**Students should be able to:** • Define correlation • Describe forms of correlation • Draw scatter diagrams • Calculate correlation coefficient by Spearman's rank	Explain correlation as means of determine the relationship between two variables. Further discuss with the students that the two variables are independent Demonstrate using the chart to describe the forms of correlation.	Chart showing types of correlation. Chart -- Line of best fit.2 Chart – illustrating scatter diagram Electronic Graph board Graph paper Blackboard ruler Foot rule	Compute the Spearman rank correlation. <table><tr><td>History</td><td>Algebra</td></tr><tr><td>35</td><td>30</td></tr><tr><td>23</td><td>33</td></tr><tr><td>47</td><td>45</td></tr><tr><td>17</td><td>23</td></tr><tr><td>10</td><td>8</td></tr><tr><td>43</td><td>49</td></tr><tr><td>9</td><td>12</td></tr><tr><td>6</td><td>4</td></tr><tr><td>28</td><td>31</td></tr></table>

	method • Draw the line and finding the equation of best fit ***(Regression)***	***(positive correlation, negative correlation and no correlation)*** Illustrate scatter diagram on a graph board with pair values of two variables. Solve problem with the students to calculate the correlation coefficient using spearman's rank method. *Use data without ties. $\boldsymbol{r = 1 - \frac{6\sum d^2}{n(n^2-1)}}$ $-1 \leq r \leq 1$ Explain the concept of regression line and the equation line of best fit.	Markers Colored chalks Pencils	
Probability – Introductory concepts	**Students should be able to:** • Define probability and related terminologies *(Sample space, Outcome, Observation, Events, relative frequency, occurrence, not occurrence and experiment)* • Describe probability events: Equally likely events, Mutually exclusive	Introduce probability as concept of chance and occurrence of event. Discuss the related terminologies with cited examples. ***Sample space, Outcome, Observation, Events, relative frequency, occurrence, not occurrence and experiment.*** Describe probability events **a). Equally likely events**	Fair coin Fair dice Colored balls Playing cards Colored marbles	Random experiments, sample spaces, and events A ball is drawn at random from a box containing 6 red balls, 4 white balls, and 5 blue balls. Determine the probability that it is (a) red, (b) white, (c) blue, (d) not red, (e) red or white. **independent events** A fair die is tossed twice. Find the probability of getting a 4, 5, or 6 on the first toss and a 1, 2, 3, or 4 on the second toss.

	events, Independent events • Calculate probability value of experiment (coin flip and dice toss) • Apply addition rule or product rule of probability • Identify conditional probability • Draw objects with and without replacement • Construct the tree diagram	$P(E) = \frac{n(E)}{n(S)}$ For $0 \leq p(E) \leq 1$ **b). Mutually exclusive events** If A and B are mutually exclusive then. $P(A \cup B) = P(A) + P(B)$ **c). Independent events** If A and B are mutually exclusive then. $P(A\ and\ B) = P(A) \times P(B)$ Calculate probability value of various events (coin flip and dice toss etc). Apply addition rule or product rule of probability Draw objects with and without replacement Discuss conditional probability and help students to Construct the tree diagram.		One bag contains 4 white balls and 2 black balls; another contains 3 white balls and 5 black balls. If one ball is drawn from each bag, find the probability that (a) both are white, (b) both are black, (c) one is white and one is black.
Probability – Permutations and Combinations	**Students should be able to:** • Define permutation and combinations • Count outcome of events using permutation (order of choices considered)	Introduce the fundamental counting principle Explain the factorial notation (ie. $n!$ Read as $n\ factorial$) Discuss what permutation and combinations are:	Chart illustrating permutation and combinations formula	Arrange students in groups and give tasks to do. Example: Evaluate the value of 7! Find the permutation and combination if n = 12 and r = 2.

	• Count outcome of events using combination (order of choices not considered)	**Permutation** as order of choices considered $P_r^n = \frac{n!}{(n-r)!}$ $= n(n-1)(n-2)(n-3) \ \ldots.(n-r+1)$ **Combinations** order of choices not considered. $C_r^n = \frac{n!}{(n-r)!r!}$ Solve problem on permutation and combination.		In how many ways of 4 girls and 7 boys, can be chosen out of 10 girls and 12 boys to make the team? How many words can be formed by 3 vowels and 6 consonants taken from 5 vowels and 10 consonants? Suppose 30 people are in a room. What is the probability that there is at least one shared birthday among these 30 people?
Probability – Binomial Distribution	**Students should be able to:** • Identify binomial distribution • State the conditions of binomial distribution • Find the probability of a binomial distribution using the binomial formula	Teacher to recap the concept of combination. Describe what binomial distribution as any situation having only two possible mutually exclusive outcomes. ***Eg success and failure… boy or girl.*** Explain that the binomial distribution probability function can be expressing as: $\boldsymbol{P(X = x) = C_r^n \, p^x q^{n-x}}$ If p is the probability that the event will happen and the probability of not happen is $q = 1 - p$		A coin is tossed 10 times. What is the probability of getting exactly 6 heads? 80% of people who purchase pet insurance are women. If 9 pet insurance owners are randomly selected. Find the probability that exactly 6 are women. 60% of people who purchase sports cars are men. If 10 sports car owners are randomly selected. Find the probability that exactly 7 are men.

		Demonstrate by solving practical problems on finding the probability of binomial distribution.		

Resources

- Vanguard
- Graph Board
- Graph paper
- Blackboard ruler
- Foot rule
- Pencil
- Permanent Markers
- Graphing software/laptop
- Coin
- Dice
- Playing Cards
- Coloured Marbles
- Coloured Counters
- A3 Plain paper