121 MATHEMATICS

GENERAL OBJECTIVES

By the end of the course, the learner should be able to:

1. develop a positive attitude towards learning Mathematics;
2. perform mathematical operations and manipulations with confidence, speed and accuracy;
3. think and reason precisely, logically and critically in any given situation;
4. develop investigative skills in Mathematics;
5. identify, concretise, symbolise and use Mathematical relationships in everyday life;
6. comprehend, analyse, synthesise, evaluate and make generalizations so as to solve Mathematical problems;
7. collect, organise, represent, analyse, interprete data and make conclusions and predictions from its results;
8. apply mathematical knowledge and skills to familiar and unfamiliar situations;
9. appreciate the role, value and use of Mathematics in society;
10. develop a willingness to work collaboratively;
11. acquire knowledge and skills for further education and training;
12. communicate mathematical ideas.

1.1.0 SYMBOLS

1.1.1 SI Units will be used throughout this syllabus. Besides the usual operational symbols +, -, x, ÷, the combined ± will be used

1.1.2 Rational symbols

=	is equal to.
≠	is not equal to.
>	is greater than.
≥	is greater than or equal to.
<	is less than.
≤	is less than or equal to.
a:b	ratio of a to b.
∝	varies as.
≡	is congruent to or identical to.
≈	approximately equal to.
⇔	is equivalent
⇒	implies
∴	therefore

2.1.0 NUMBERS

2.1.1 NATURAL NUMBERS

i) Specific Objectives

The learner should be able to:

(a) identify, read and write natural numbers in symbols and words;
(b) round off numbers to the nearest tens, hundreds, thousands, millions and billions;
(c) classify natural numbers as even, odd or prime;
(d) solve word problems involving natural numbers.

ii) Content

(a) Place values of numbers
(b) Rounding off numbers to the nearest tens, hundreds, thousands, millions and billions
(c) Odd numbers
(d) Even numbers
(e) Prime numbers
(f) Word problems involving natural numbers.

2.1.2 FACTORS

(i) Specific Objectives

The learner should be able to:

(a) express composite numbers in factor form;
(b) express composite numbers as product of prime factors;
(c) express factors in power form.

(ii) Content

(a) Factors of composite numbers
(b) Prime factors
(c) Factors in power form

2.1.3 DIVISIBILITY TESTS

(i) Specific Objectives

The learner should be able to test the divisibility of numbers by 2, 3, 4, 5, 6, 8, 9, 10 and 11.

(ii) Content

Divisibility test of numbers by 2, 3, 4, 5, 6, 8, 9, 10 and 11

2.1.4 GREATEST COMMON DIVISOR (GCD)/HIGHEST COMMON FACTOR (HCF)

(i) Specific Objectives

The learner should be able to:

(a) find the GCD/HCF of a set of numbers;
(b) apply GCD to real life situations.

(ii) Content

(a) GCD of a set of numbers
(b) Application of GCD/HCF to real life situations

2.1.5 LEAST COMMON MULTIPLE (LCM)

(i) Specific Objectives

The learner should be able to:
(a) list multiples of numbers;
(b) find the LCM of a set of numbers;
(c) apply knowledge of LCM in real life situations.

(ii) Content

(a) Multiples of a number
(b) LCM of a set of numbers
(c) Application of LCM in real life situations.

2.1.6 INTEGERS

(i) Specific Objectives

The learner should be able to:
(a) define integers;
(b) identify integers on a number line;
(c) perform the four basic operations on integers using the number line;
(d) work out combined operations on integers in the correct order;
(e) apply knowledge of integers to real life situations.

(ii) content

(a) Integers
(b) The number line
(c) Operation on integers
(d) Order of operations
(e) Application to real life situations

2.1.7 FRACTIONS

(i) Specific Objectives

The learner should be able to:
(a) identify proper and improper fractions and mixed numbers;
(b) convert mixed numbers to improper fractions and vice versa;
(c) compare fractions;
(d) perform the four basic operations on fractions;
(e) carry out combined operations on fractions in the correct order;
(f) apply the knowledge of fractions to real life situations.

(ii) Content

(a) Fractions
(b) Proper, improper fractions and mixed numbers
(c) Conversion of improper fractions to mixed numbers and vice versa
(d) Comparing fractions
(e) Operations on fractions
(f) Order of operations on fractions
(g) Word problems involving fractions in real life situations.

2.1.8 DECIMALS

(i) Specific Objectives

The learner should be able to:

(a) convert fractions into decimals and vice versa;
(b) identify recurring decimals;
(c) convert recurring decimals into fractions;
(d) round off a decimal number to the required number of decimal places;
(e) write numbers in standard form;
(f) perform the four basic operations on decimals;
(g) carry our operations in the correct order;
(h) apply the knowledge of decimals to real life situations.

(ii) Content

(a) Fractions and decimals
(b) Recurring decimals
(c) Recurring decimals and fractions
(d) Decimal places
(e) Standard form
(f) Operations on decimals
(g) Order of operations
(h) Real life problems involving decimals.

2.1.9 SQUARES AND SQUARE ROOTS

(i) Specific Objectives

The learner should be able to:

(a) find squares of numbers by multiplication;
(b) find squares from tables;
(c) find square root by factor method;
(d) find square root from tables.

(ii) **Content**

(a) Squares by multiplication
(b) Squares from tables
(c) Square roots by factorization
(d) Square roots from tables.

2.1.10 CUBES AND CUBE ROOTS

(i) Specific Objectives

The learner should be able to:

(a) find the cube of a number by multiplication;
(b) find the cube root of a number by factor method;
(c) find cubes of numbers from mathematical tables;
(d) evaluate expressions involving cubes and cube roots;
(e) apply the knowledge of cubes and cube roots in real life situations.

(ii) Content

(a) Cubes of numbers by multiplication
(b) Cubes from tables
(c) Cube roots of numbers by factor method

(d) Evaluation of cube and cube root expressions
(e) Application of cubes and cube roots to real life situations.

2.1.11 RECIPROCALS

(i) Specific Objectives

The learner should be able to:
(a) find reciprocals of numbers by division;
(b) find reciprocals of numbers from tables;
(c) use reciprocals of numbers in computation.

(ii) Content

(a) Reciprocals of numbers by division
(b) Reciprocals of numbers from tables
(c) Computation using reciprocals.

2.1.12 RATES, RATIOS, PERCENTAGES AND PROPORTION

(i) Specific Objectives

The learner should be able to:
(a) define rates;
(b) solve problems involving rates;
(c) define ratio;
(d) compare two or more quantities using ratios;
(e) change quantities in a given ratio;
(f) compare two or more ratios;
(g) represent and interpret proportional parts;
(h) recognise direct and inverse proportions;
(i) solve problems involving direct and inverse proportions;
(j) convert fractions and decimals to percentages and vice-versa;
(k) calculate percentage change in a given quantity;
(l) apply rates, ratios, percentages to real life situations and proportion.

(ii) Content

(a) Rates
(b) Solving problems involving rates
(c) Ratio
(d) Comparing quantities using ratio
(e) Increase and decrease in a given ratio
(f) Comparing ratios
(g) Proportion: direct and inverse
(h) Solve problems on direct and inverse proportions
(i) Fractions and decimals as percentages
(j) Percentage increase and decrease
(k) Application of rates, ratios, percentages and proportion to real life situations.

2.1.13 COMPOUND PROPORTIONS AND RATES OF WORK

(i) Specific Objectives

By the end of the topic the learner should be able to:

(a) solve problems involving compound proportions using unitary and ratio methods;
(b) apply ratios and proportions to real life situations;
(c) solve problems involving rates of work.

(ii) Content

(a) Proportional parts
(b) Compound proportions
(c) Ratios and rates of work
(d) Proportions applied to mixtures.

2.1.14 LINEAR MOTION

(i) Specific Objectives

By the end of the topic the learner should be able to:
(a) define displacement, speed, velocity and acceleration;
(b) distinguish between (i) distance and displacement, (ii) speed and velocity;
(c) determine velocity and acceleration;
(d) plot and draw graphs of linear motion (distance and velocity time graphs);
(e) interpret graphs of linear motion;
(f) define relative speed;
(g) solve problems involving relative speed.

(ii) **Content**

(a) Displacement, velocity, speed and acceleration
(b) Determining velocity and acceleration
(c) Relative speed
(d) Distance – time graph
(e) Velocity time graph
(f) Interpretation of graphs of linear motion
(g) Solving problems involving relative speed.

2.1.15 INDICES AND LOGARITHMS

(i) Specific Objectives

By the end of the topic the learner should be able to:
(a) define indices (powers);
(b) state the laws of indices;
(c) apply the laws of indices in calculations;
(d) relate the powers of 10 to common logarithms;
(e) use the tables of common logarithms and anti-logarithms in computation.

(ii) Content

(a) Indices (powers) and base
(b) Laws of indices (including positive integers, negative integers and fractional indices)
(c) Powers of 10 and common logarithms
(d) Common logarithms: i) characteristics and ii) mantissa
(e) Logarithm tables

(f) Application of common logarithms in multiplication, division , powers and roots.

2.1.6 FURTHER LOGARITHMS

(i) Specific Objectives

The learner should be able to:

(a) derive logarithmic relation from index form and vice versa;
(b) state the laws of logarithms;
(c) use logarithmic laws to simplify logarithmic expressions and solve logarithmic equations;
(d) apply laws of logarithms for further computations.

(ii) Content

(a) Logarithmic notation (eg. $a^n=b$, $\log a^b=n$)
(b) The laws of logarithms: $\log (AB) = \log A + \log B$, $\log(A \div B) = \log A - \log B$ and $\text{Log } A^n = n \times \log A$.
(c) Simplifications of logarithmic expressions
(d) Solution of logarithmic equations
(e) Further computation using logarithmic laws.

2.1.17 APPROXIMATIONS AND ERRORS

(i) Specific Objectives

The learner should be able to:

(a) Perform various computations using a calculator;
(b) make reasonable approximations and estimations of quantities in computations and measurements;
(c) express values to a given number of significant figures;
(d) define absolute, relative, percentage, round-off and truncation errors;
(e) determine possible errors made from computations;
(f) find maximum and minimum errors from operations.

(ii) Content

(a) Computing using calculators
(b) Estimations and approximations
(c) Significant figures
(d) Absolute, relative, percentage, round-off (including significant figures) and truncation errors
(e) Propagation of errors from simple calculations
(f) Maximum and minimum errors.

2.2.0 MEASUREMENT (1)

2.2.1 LENGTH

(i) Specific Objectives

The learner should be able to:

(a) state the units of measuring length;
(b) convert units of length from one form to another;
(c) express numbers to required number of significant figures;

(d) find the perimeter of a plane figure and circumference of a circle.

(ii) Content

(a) Units of length (mm, cm, m, km)
(b) Conversion of units of length from one form to another
(c) Significant figures
(d) Perimeter
(e) Circumference (include length of arcs).

2.2.2 AREA

(i) Specific Objectives

The learner should be able to:
(a) state units of area;
(b) convert units of area from one form to another;
(c) calculate the area of a regular plane figure including circles;
(d) estimate the area of irregular plane figures by counting squares;
(e) calculate the surface area of cubes, cuboids and cylinders.

(ii) Content

(a) Units of area (cm^2, m^2, km^2, Ares, ha)
(b) Conversion of units of area
(c) Area of regular plane figures
(d) Area of irregular plane shapes
(e) Surface area of cubes, cuboids and cylinders.

2.2.3 PYTHAGORAS THEOREM

(i) Specific Objectives

The learner should be able to:
(a) derive Pythagoras Theorem;
(b) solve problems using Pythagoras Theorem;
(c) apply Pythagoras Theorem to real life situations.

(ii) Content

(a) Pythagoras Theorem
(b) Solution of problems using Pythagoras Theorem
(c) Application to real life situations.

2.2.4 VOLUME AND CAPACITY

(i) Specific Objectives

The learner should be able to:
(a) state units of volume;
(b) convert units of volume from one form to another;
(c) calculate volume of cubes, cuboids and cylinders;
(d) state units of capacity;
(e) convert units of capacity from one form to another;
(f) relate volume to capacity;

(g) solve problems involving volume and capacity.

(ii) Content

(a) Units of volume
(b) Conversion of units of volume
(c) Volume of cubes, cuboids and cylinders
(d) Units of capacity
(e) Conversion of units of capacity
(f) Relationship between volume and capacity
(g) Solving problems involving volume and capacity.

2.2.5 MASS, DENSITY AND WEIGHT

(i) Specific Objectives

The learner should be able to:
(a) define mass;
(b) state units of mass;
(c) convert units of mass from one form to another;
(d) define weight;
(e) state units of weight;
(f) distinguish mass and weight;
(g) relate volume, mass and density.

(ii) Content

(a) Mass and units of mass
(b) Weight and units of weight
(c) Density
(d) Problem solving involving real life experiences on mass, volume, density and weight.

2.2.6 TIME

(i) Specific Objectives

The learner should be able to:
(a) convert units of time from one form to another;
(b) relate the 12 hour and 24 hour clock systems;
(c) read and interpret travel time-tables;
(d) solve problems involving travel time tables.

(ii) Content

(a) Units of time
(b) 12 hour and 24 hour clock systems
(c) travel time-tables
(d) problems involving travel time tables.

2.3.0 MEASUREMENT (2)

2.3.1 AREA OF A TRIANGLE

(i) Specific Objectives

The learner should be able to:

(a) Derive the formula; Area = ½ ab sin C;
(b) Solve problems involving area of triangles using the formula Area = ½ ab sin C;
(c) Solve problems on area of a triangle using the formula area = $\sqrt{s(s-a)(s-b)(s-c)}$;

(ii) Content

(a) Area of triangle A = ½ ab sin C
(b) Area of a triangle A = $\sqrt{s(s-a)(s-b)(s-c)}$
(c) Application of the above formulae in solving problems involving real life situations.

2.3.2 AREA OF QUADRILATERALS AND OTHER POLYGONS

(i) Specific Objectives

The learner should be able to:

(a) find the area of a quadrilateral;
(b) find the area of other polygons (regular and irregular).

(ii) Content

(a) Area of quadrilaterals
(b) Area of other polygons (regular and irregular).

2.3.3 AREA OF PART OF A CIRCLE

(i) Specific Objectives

The learner should be able to:

(a) find the area of a sector;
(b) find the area of a segment;
(c) find the area of a common region between two circles.

(ii) Content

(a) Area of a sector
(b) Area of a segment
(c) Area of common regions between circles.

2.3.4 SURFACE AREA OF SOLIDS

(i) Specific Objectives

The learner should be able to:

(a) find the surface area of a prism;
(b) find the surface area of a pyramid;
(c) find the surface area of a cone;
(d) find the surface area of a frustum;
(e) find the surface area of a sphere and a hemisphere.

(ii) Content

Surface area of prisms, pyramids, cones, frustums and spheres.

2.3.5 VOLUME OF SOLIDS

(i)Specific Objectives

The learner should be able to:

(a) find the volume of a prism;
(b) find the volume of a pyramid;
(c) find the volume of a cone;
(d) find the volume of a frustum;
(e) find the volume of a sphere and a hemisphere.

(ii) Content

Volumes of prisms, pyramids, cones, frustums and spheres.

2.4. 0 ALGEBRA

2.4.1 ALGEBRAIC EXPRESSIONS

(i) Specific Objectives

The learner should be able to:

(a) use letters to represent numbers;
(b) write statements in algebraic form;
(c) simplify algebraic expressions;
(d) factorise an algebraic expressions by grouping;
(e) remove brackets from algebraic expressions;
(f) evaluate algebraic expressions by substituting numerical values;
(g) apply algebra in real life situations.

(ii) Content

(a) Letters for numbers
(b) Algebraic fractions
(c) Simplification of algebraic expressions
(d) Factorisation by grouping
(e) Removal of brackets
(f) Substitution and evaluation
(g) Problem solving in real life situations.

2.4.2 EQUATION OF STRAIGHT LINES

(i) Specific Objectives

The learner should be able to:

(a) define gradient of a straight line;
(b) determine the gradient of a straight line through known points;
(c) determine the equation of a straight line using gradient and one known point;
(d) express a straight line equation in the form $y = mx + c$;
(e) interpret the equation $y = mx + c$;
(f) find the x- and y- intercepts from an equation of a line;
(g) draw the graph of a straight line using gradient and x- and y- intercepts;
(h) state the relationship of gradients of perpendicular lines;
(i) state the relationship of gradients of parallel lines;

(j) apply the relationship of gradients of perpendicular and parallel lines to get equations of straight lines.

(ii) Content

(a) Gradient of a straight line
(b) Equation of a straight line
(c) The equation of a straight line of the form $y = mx + c$
(d) The x and y intercepts of a line
(e) The graph of a straight line
(f) Perpendicular lines and their gradients
(g) Parallel lines and their gradients
(h) Equations of parallel and perpendicular lines.

2.4.3 LINEAR EQUATIONS

(i) Specific Objectives

The learner should be able to:
(a) solve linear equations in one unknown;
(b) solve simultaneous linear equations by substitution and elimination;
(c) Linear equations in one and two unknown.

(ii) Content

(a) Linear equations in one unknown
(b) Simultaneous linear equations
(c) Linear equations in one and two unknowns from given real life situations.

2.4.4 QUADRATIC EXPRESSIONS AND EQUATIONS (1)

(i) Specific Objectives

The learner should be able to:
(a) expand algebraic expressions that form quadratic equations;
(b) derive the three quadratic identities;
(c) identify and use the three quadratic identities;
(d) factorise quadratic expressions including the identities;
(e) solve quadratic equations by factorization;
(f) form and solve quadratic equations.

(ii) Content

(a) Expansion of algebraic expressions to form quadratic expressions of the form $aX^2+b\,X+c$, where a, b and c are constants
(b) The three quadratic identities:

$(a+b)^2 = a^2 + 2ab+b^2$
$(a-b)^2 = a^2 - 2ab+ b^2$
$(a-b)\ (a+b) = a^2-b^2$

(c) Using the three quadratic identities
(d) Factorisation of quadratic expressions

(e) Solve quadratic equations by factorization
(f) Form and solve quadratic equations.

2.4.5 QUADRATIC EXPRESSIONS AND EQUATIONS (2)

(i) Specific Objectives

The learner should be able to:
(a) factorise quadratic expressions;
(b) identify perfect squares;
(c) complete the square;
(d) solving quadratic equations by completing the square;
(e) derive the quadratic formula;
(f) solve quadratic equations using the formula;
(g) form and solve quadratic equations from roots and given situations;
(h) make tables of values from a quadratic relation;
(i) draw the graph of a quadratic relation;
(j) solve quadratic equations using graphs;
(k) solve simultaneous equations (one linear and one quadratic) analytically and graphically;
(l) apply the knowledge of quadratic equations to real life situations.

(ii) Content

(a) Factorisation of quadratic expressions
(b) Perfect squares
(c) Completion of the squares
(d) Solution of quadratic equations by completing the square
(e) Quadratic formula $x = \frac{-b \pm \sqrt{(b-4ac)}}{2a}$
(f) Solution of quadratic equations using the formula.
(g) Formation of quadratic equations and solving them
(h) Tables of values for a given quadratic relation
(i) Graphs of quadratic equations
(j) Simultaneous equation – one linear and one quadratic
(k) Application of quadratic equation to real life situation.

2.4.6 LINEAR INEQUALITIES (1)

(i) Specific Objectives

The learner should be able to:
(a) identify and use inequality symbols;
(b) illustrate inequalities on the number line;
(c) solve linear inequalities in one unknown;
(d) represent the linear inequalities graphically;
(e) solve the linear inequalities in two unknowns graphically;
(f) form simple linear inequalities from inequality graphs.

(ii) Content

(a) Inequalities on a number line

(b) Simple and compound inequality statements
e.g. $_{\chi} > a$ and $\chi \angle b \Rightarrow a \angle \chi \angle b$
(c) Linear inequality in one unknown
(d) Graphical representation of linear inequalities
(e) Graphical solutions of simultaneous linear inequalities
(f) Simple linear inequalities from inequality graphs.

2.5.0 LINEAR PROGRAMMING

2.5.1 LINEAR INEQUALITIES (2)

(i) Specific Objectives

The learner should be able to:
(a) form linear inequalities based on real life situations;
(b) represent the linear inequalities on a graph;
(c) solve and interpret the optimum solution of the linear inequalities;
(d) apply linear programming to real life situations.

(ii) Content

(a) Formation of linear inequalities
(b) Analytical solutions of linear inequalities
(c) Solutions of linear inequalities by graphs
(d) Optimisation (include objective function)
(e) Application of quadratic equations to real life situations.

2.6.0 SURDS

(i) Specific Objectives

The learner should be able to:
(a) define rational and irrational numbers;
(b) simplify expressions with surds;
(c) rationalise denominators with surds.

(ii) Content

(a) Rational and irrational numbers
(b) Simplification of surds
(c) Rationalisation of denominators.

2.7.0 SEQUENCES AND SERIES

(i) Specific Objectives

The learner should be able to:
(a) identify simple number patterns;
(b) define a sequence;
(c) identify the pattern for a given set of numbers and deduce the general rule;
(d) determine a term in a sequence;
(e) recognise arithmetic and geometric sequences;

(f) define a series;
(g) recognise arithmetic and geometric series (Progression);
(h) derive the formula for partial sum of an arithmetic and geometric series (Progression);
(i) apply A.P and G.P to solve problems in real life situations.

(ii) Content

(a) Simple number patterns
(b) Sequences
(c) Arithmetic sequence
(d) Geometric sequence
(e) Determining a term in a sequence
(f) Arithmetic progression (A.P)
(g) Geometric progression (G.P)
(h) Sum of an A.P
(i) Sum of a G.P (exclude sum to infinity)
(j) Application of A.P and G.P to real life situations.

2.8.0 BINOMIAL EXPANSIONS

(i) Specific Objectives

The learner should be able to:

(a) expand binomial expressions up to the power of four by multiplication;
(b) building up – Pascal's Triangle up to the eleventh row;
(c) use Pascal's triangle to determine the coefficient of terms in a binomial expansions up to the power of 10;
(d) apply binomial expansion in numerical cases.

(ii) Content

(a) Binomial expansion up to power four
(b) Pascal's triangle
(c) Coefficient of terms in binomial expansion
(d) Computation using binomial expansion
(e) Evaluation of numerical cases using binomial expansion.

2.9.0 FORMULAE AND VARIATIONS

(i) Specific Objectives

The learner should be able to:

(a) rewrite a given formula by changing the subject;
(b) define direct, inverse, partial and joint variations;
(c) determine constants of proportionality;
(d) form and solve equations involving variations;
(e) draw graphs to illustrate direct and inverse proportions;
(f) use variations to solve everyday life problems.

(ii) Content

(a) Change of the subject
(b) Direct, inverse, partial and joint variations

(c) Constant of proportionality
(d) Graphs of direct and inverse proportion
(e) Equations on variation from real life situations.

2.10.0 GEOMETRY

2.10.1 ANGLES AND PLANE FIGURES

(i) Specific Objectives

The learner should be able to:

(a) name and identify types of angles;
(b) solve problems involving angles on a straight line;
(c) solve problems involving angles at a point;
(d) solve problems involving angles on a transversal cutting parallel lines;
(e) state angle properties of polygons;
(f) solve problems involving angle properties of polygons;
(g) apply the knowledge of angle properties to real life situations.

(ii) Content

(a) types of angles
(b) angles on a straight line
(c) angles at a point
(d) angles on a transversal (corresponding, alternate and allied angles)
(e) angle properties of polygons
(f) application to real life situations.

2.10.2 GEOMETRICAL CONSTRUCTIONS

(i) Specific Objectives

The learner should be able to:

(a) use a ruler and compasses only to:

i) construct a perpendicular bisector of a line;
ii) construct an angle bisector;
iii) construct a perpendicular to a line from a given point;
iv) construct a perpendicular to a line through a given point on the line;
v) construct angles whose values are multiples of $7\frac{1}{2}^{o}$;
vi) construct parallel lines;
vii) divide a line proportionally;

(b) use a ruler and a set square to construct parallel lines, divide a line proportionally, and to construct perpendicular lines;
(c) construct a regular polygon using ruler and compasses only, and ruler, compasses and protractor;
(d) construct irregular polygons using a ruler, compasses and protractor.

(ii) Content

(a) Construction of lines and angles using a ruler and compasses only

(b) Construction of perpendicular and parallel lines using a ruler and a set square only
(c) Proportional division of a line
(d) Construction of regular polygons (upto a hexagon)
(e) Construction of irregular polygons (upto a hexagon).

2.10.3 LOCI

(i) Specific Objectives

The learner should be able to:
(a) define Locus;
(b) describe common types of Loci;
(c) construct;
    i) loci involving inequalities;
    ii) loci involving chords;
    iii) loci involving points under given conditions;
    iv) intersecting loci.

(ii) Content

(a) common types of Loci
(b) perpendicular bisector loci
(c) locus of a point at a given distance from a fixed point
(d) angle bisector loci
(e) other loci under given condition including intersecting loci
(f) loci involving inequalities
(g) loci involving chords (constant angle loci).

2.10.4 SCALE DRAWING

(i) Specific Objectives

The learner should be able to:
(a) interpret a given scale;
(b) choose and use an appropriate scale;
(c) draw suitable sketches from given information;
(d) state the bearing of one point from another;
(e) locate a point using bearing and distance;
(f) determine angles of elevation and depression;
(g) solve problems involving bearings elevations and scale drawing;
(h) apply scale drawing in simple surveying.

(ii) Content

(a) Types of scales
(b) Choice of scales
(c) Sketching from given information and scale drawing
(d) Bearings
(e) Bearings, distance and locating points
(f) Angles of elevation and depression
(g) Problems involving bearings, scale drawing, angles of elevation and depression
(h) Simple surveying techniques.

2.10. 5 COMMON SOLIDS

(i) Specific Objectives

The learner should be able to:

(a) identify and sketch common solids;
(b) sketch and accurately draw nets of solids;
(c) make models of solids from nets;
(d) calculate surface area of solids from nets;
(e) find distances between two points on a solid.

(ii) Content

(a) Common solids, eg cubes, cuboids, pyramids, prisms, cones, spheres, cylinders etc.
(b) Sketches of solids
(c) Nets of solids
(d) Models of solids from nets
(e) Surface area of solids
(f) Distance between two points on the surface of solid.

2.10.6 THREE DIMENSIONAL GEOMETRY

(i) Specific Objectives

The learner should be able to:

(a) state the geometric properties of common solids;
(b) identify projection of a line onto a plane;
(c) identify skew lines;
(d) calculate the length between two points in three dimensional geometry;
(e) identify and calculate the angle between
    (i) two lines;
    (ii) a line and a plane;
    (ii) two planes.

(ii) Content

(a) Geometrical properties of common solids
(b) Skew lines and projection of a line onto a plane
(c) Length of a line in 3-dimensional geometry
(d) The angle between
    i) a line and a line
    ii) a line a plane
    iii) a plane and a plane
    iv) angles between skewlines.

2.10.7 ANGLE PROPERTIES OF A CIRCLE

(i) Specific Objectives

The learner should be able to:

(a) identify an arc, chord and segment;
(b) relate and compute angle subtended by an arc at the circumference;
(c) relate and compute angle subtended by an arc at the centre and at the circumference;

(d) state the angle in the semi-circle;
(e) state the angle properties of a cyclic quadrilateral;
(f) find and compute angles of a cyclic quadrilateral.

(i) Content

(a) Arc, chord and segment
(b) Angle subtended by the same arc at the circumference
(c) Relationship between angle subtended at the centre and angle subtended on the circumference by the same arc
(d) Angle in a semi-circle
(e) Angle properties of a cyclic quadrilateral
(f) Finding angles of a cyclic quadrilateral.

2.10.8 CIRCLES: CHORDS AND TANGENTS

(i) Specific Objectives

The learner should be able to:
(a) calculate length of an arc and a chord;
(b) calculate lengths of tangents and intersecting chords;
(c) state and use properties of chords and tangents;
(d) construct tangent to a circle;
(e) construct direct and transverse common tangents to two circles;
(f) relate angles in alternate segment;
(g) construct circumscribed, inscribed and escribed circles;
(h) locate centroid and orthocentre of a triangle;
(i) apply knowledge of circles, tangents and chords to real life situations.

(ii) Content

(a) Arcs, chords and tangents
(b) Lengths of tangents and intersecting chords
(c) Properties of chords and tangents
(d) Construction of tangents to a circle
(e) Direct and transverse common tangents to two circles
(f) Angles in alternate segment
(g) Circumscribed, inscribed and escribed circles
(h) Centroid and orthocentre
(i) Application of knowledge of tangents and chords to real life situations.

2.11.0 GRAPHS

2.11.1 CO-ORDINATES AND GRAPHS

(i) Specific Objectives

The learner should be able to:
(a) draw and label the complete cartesian plane;
(b) locate and plot points on the cartesian plane;
(c) choose and use appropriate scale for a given data;
(d) make a table of values for a given linear relation;
(e) use values to draw a linear graph;

(f) solve simultaneous linear equations graphically;
(g) draw, read and interprete graphs.

(ii) Content

(a) Cartesian plane
(b) Cartesian co-ordinate
(c) Points on the cartesian plane
(d) Choice of appropriate scale
(e) Table of values for a given linear relation
(f) Linear graphs
(g) Graphical solutions of simultaneous linear equations
(h) Interpretation of graphs.

2.11.2 GRAPHICAL METHODS

(i) Specific Objectives

The learner should be able to:

(a) makes a table of values from given relations;
(b) use the table of values to draw the graphs of the relations;
(c) determine and interpret instantaneous rates of change from a graph;
(d) interpret information from graphs;
(e) draw and interpret graphs from empirical data;
(f) solve cubic equations graphically;
(g) draw the line of best fit;
(h) identify the equation of a circle;
(i) find the equation of a circle given the centre and the radius;
(j) determine the centre and radius of a circle and draw the circle on a cartesian plane.

(ii) Content

(a) Tables and graphs of given relations
(b) Graphs of cubic equations
(c) Graphical solutions of cubic equations
(d) Average rate of change
(e) Instantaneous rate of change
(f) \empirical data and their graphs
(g) the line of best fit
(h) equation of a circle
(i) finding of the equation of a circle
(j) determining of the centre and radius of a circle.

2.12.0 TRIGONOMETRY

2.12.1 TRIGONOMETRY (1)

(i) Specific Objectives

The learner should be able to:

(a) define tangent, sine and cosine ratios from a right angled triangle;
(b) read and use tables of trigonometric ratios;

(c) use sine, cosine and tangent in calculating lengths and angles;
(d) establish and use the relationship of sine and cosine of complimentary angles;
(e) relate the three trigonometric ratios;
(f) determine the trigonometric ratios of special angles 30^o, 45^o, 60^o and 90^o without using tables;
(g) read and use tables of logarithms of sine, cosine and tangent;
(h) apply the knowledge of trigonometry to real life situations.

(ii) Content

(a) Tangent, sine and cosine of angles
(b) Trigonometric tables
(c) Angles and sides of a right angled triangle
(d) Sine and cosine of complimentary angles
(e) Relationship between tangent, sine and cosine
(f) Trigonometric ratios of special angles 30^o, 45^o, 60^o and 90^o
(g) Logarithms of sines, cosines and tangents
(h) Application of trigonometry to real life situations.

2.12.2 TRIGONOMETRY (2)

(i) Specific Objectives

The learner should be able to:
(a) define and draw the unit circle;
(b) use the unit circle to find trigonometric ratios in terms of co-ordinates of points for $0 \leq \theta \leq 360^o$;
(c) find trigonometric ratios of negative angles;
(d) find trigonometric ratios of angles greater than 360^o using the unit circle;
(e) use mathematical tables and calculators to find trigonometric ratios of angles in the range $0 \leq \theta \leq 360^o$;
(f) define radian measure;
(g) draw graphs of trigonometric functions; y = sin x, y = cos x and y = tan x using degrees and radians;
(h) derive the sine rule;
(i) derive the cosine rule;
(j) apply the sine and cosine rule to solve triangles (sides, angles and area);
(k) apply the knowledge of sine and cosine rules in real life situations.

(ii) Content

(a) The unit circles
(b) Trigonometric rations from the unit circle
(c) Trigonometric ratios of angles greater than 360^o and negative angles
(d) Use of trigonometric tables and calculations
(e) Radian measure
(f) Simple trigonometric graphs
(g) Derivation of sine and cosine rule
(h) Solution of triangles
(i) Application of sine and cosine rule to real situation.

2.12.3 TRIGONOMETRY (3)

(i) Specific Objectives

The learner should be able to:

(a) recall and define trigonometric ratios;
(b) derive trigonometric identity $\sin^2 x+\cos^2 x = 1$;
(c) draw graphs of trigonometric functions;
(d) solve simple trigonometric equations analytically and graphically;
(e) deduce from the graph amplitude, period, wavelength and phase angles.

(ii) Content

(a) Trigonometric ratios
(b) Deriving the relation $\sin^2 x+\cos^2 x =1$
(c) Graphs of trigonometric functions of the form
$y = \sin x$ $y = \cos x$, $y = \tan x$
$y = a \sin x$, $y = a \cos x$,
$y = a \tan x$ $y = a \sin bx$,
$y = a \cos bx$ $y = a \tan bx$
$y = a \sin(bx \pm \theta)$
$y = a \cos(bx \pm \theta)$
$y = a \tan(bx \pm \theta)$
(d) simple trigonometric equation
(e) amplitude, period, wavelength and phase angle of trigonometric functions.

2.13.0 COMMERCIAL ARITHMETIC

2.13.1 COMMERCIAL ARITHMETRIC (1)

(i) Specific Objectives

The learner should be able to:

(a) state the currencies of different countries;
(b) convert currency from one form into another given the exchange rates;
(c) calculate profit and loss;
(d) express profit and loss as percentages;
(e) calculate discount and commission;
(f) express discount and commission as percentage.

(ii) Content

(a) Currency
(b) Current currency exchange rates
(c) Currency conversion
(d) Profit and loss
(e) Percentage profit and loss
(f) Discounts and commissions
(g) Percentage discounts and commissions.

2.13.2 COMMERCIAL ARITHMETIC (2)

(i) Specific Objectives

The learner should be able to:

(a) define principal, rate and time in relation to interest;
(b) calculate simple interest using simple interest formula;
(c) calculate compound interest using step by step method;
(d) derive the compound interest formula;
(e) apply the compound interest formula for calculating interest;
(f) define appreciation and depreciation;
(g) use compound interest formula to calculate appreciation and depreciation;
(h) calculate hire purchase;
(i) calculate income tax given the income tax bands.

(ii) Content

(a) Principal rate and time
(b) Simple interest
(c) Compound interest using step by step method
(d) Derivation of compound interest formula
(e) Calculations using the compound interest formula
(f) Appreciation and depreciation
(g) Calculation of appreciation and depreciation using the compound interest formula
(h) Hire purchase
(i) Income tax.

2.14.0 STATISTICS AND PROBABILITY

2.14.1 STATISTICS (1)

(i) Specific Objectives

The learner should be able to:
(a) define statistics;
(b) collect and organise data;
(c) draw a frequency distribution table;
(d) group data into reasonable classes;
(e) calculate measures of central tendency;
(f) represent data in form of linegraphs, bargraphs, pie-charts, pictogram, histogram and frequency polygons;
(g) interpret data from real life situations.

(ii) Content

(a) Definition of statistics
(b) Collection and organization of data
(c) Frequency distribution tables (for grouped and ungrouped data)
(d) Grouping data
(e) Mean, mode and median for ungrouped and grouped data
(f) Representation of data: Line graph, , Bar graph, Pie chart, Pictogram, Histogram, Frequency polygon, Interpretation of data..

2.14.2 STATISTICS (2)

(i) Specific Objectives

The learner should be able to:

(a) state the measures of central tendency;
(b) calculate the mean using the assumed mean method;
(c) make cumulative frequency table;
(d) estimate the median and the quartiles by
  (i) calculation and
  (ii) using ogive;
(e) define and calculate the measures of dispersion: range, quartiles, interquartile range, quartile deviation, variance and standard deviation
(f) interpret measures of dispersion.

(ii) Content

(a) Mean from assumed mean;
(b) Cumulative frequency table
(c) Ogive
(d) Meadian
(e) Quartiles
(f) Range
(g) Interquartile range
(h) Quartile deviation
(i) Variance
(j) Standard deviation

2.14.3 PROBABILITY

(i) Specific Objectives

The learner should be able to:

(a) define probability;
(b) determine probability from experiments and real life situations;
(c) construct a probability space;
(d) determine theoretical probability;
(e) differentiate between discrete and continuous probability;
(f) differentiate mutually exclusive and independent events;
(g) state and apply laws of probability;
(h) use a tree diagram to determine probabilities.

(ii) Content

(a) Probability
(b) Experimental probability
(c) Range of probability measure $0 \leq P(x) \leq 1$
(d) Probability space
(e) Theoretical probability
(f) Discrete and continuous probability (simple cases only)
(g) Combined events (mutually exclusive and independent events)
(h) Laws of probability

(i) The tree diagrams.

2.15.0 VECTORS

2.15.1 VECTORS (1)

(i) Specific Objectives

The learner should be able to:

(a) define vector and scalar;
(b) use vector notation;
(c) represent vectors both single and combined geometrically;
(d) identify equivalent vectors;
(e) add vectors;
(f) multiply vectors by scalars;
(g) define position vector and column vector;
(h) find magnitude of a vector;
(i) find mid-point of a vector;
(j) define translation as a transformation.

(ii) Content

(a) Vector and scalar quantities
(b) Vector notation
(c) Representation of vectors
(d) Equivalent vectors
(e) Addition of vectors
(f) Multiplication of a vector by a scalar
(g) Column vectors
(h) Position vectors
(i) Magnitude of a vector
(j) Midpoint of a vector
(k) Translation vector.

2.5.2 VECTORS (2)

(i) Specific Objectives

The learner should be able to:

(a) locate a point in two and three dimension co-ordinate systems;
(b) represent vectors as column and position vectors in three dimensions;
(c) distinguish between column and position vectors;
(d) represent vectors in terms of **i, j**, and **k;**
(e) calculate the magnitude of a vector in three dimensions;
(f) use the vector method in dividing a line proportionately;
(g) use vector method to show parallelism;
(h) use vector method to show collinearity;
(i) state and use the ratio theorem;
(j) apply vector methods in geometry.

(ii) Content

(a) Coordinates in two and three dimensions

(b) Column and position vectors in three dimensions
(c) Column vectors in terms of unit vectors **i, j,** and **k**
(d) Magnitude of a vector
(e) Parallel vectors
(f) Collinearity
(g) Proportional division of a line
(h) Ratio theorem
(i) Vector methods in geometry.

2.16.0 TRANSFORMATION

2.16.1 REFLECTION AND CONGRUENCE

(i) Specific Objectives

The learner should be able to:
(a) state the properties of reflection as a transformation
(b) use the properties of reflection in construction and identification of images and objects
(c) make geometrical deductions using reflection
(d) apply reflection in the cartesian plane
(e) distinguish between direct and opposite congruence
(f) identify congruent triangles.

(ii) Content

(a) lines and planes of symmetry
(b) mirror lines and construction of objects and images
(c) reflection as a transformation
(d) reflection in the cartesian plane
(e) direct and opposite congruency
(f) congruency tests (SSS, SAS, AAS, ASA and RHS).

2.16.2 ROTATION

(i) Specific Objectives

The learner should be able to:
(a) state properties of rotation as a transformation;
(b) determine centre and angle of rotation;
(c) apply properties of rotation in the cartesian plane;
(d) identify point of rotational symmetry;
(e) state order of rotational symmetry of plane figure;
(f) identify axis of rotational symmetry of solids;
(g) state order of rotational symmetry of solids;
(h) deduce congruence from rotation.

(ii) Content

(a) Properties of rotation
(b) Centre and angle of rotation
(c) Rotation in the cartesian plane

(d) Rotational symmetry of plane figures and solids (point axis and order)
(e) Congruence and rotation.

2.16.3 SIMILARITY AND ENLARGEMENT

(i) Specific Objectives

The learner should be able to:
(a) identify similar figures;
(b) construct similar figures;
(c) state properties of enlargement as a transformation;
(d) apply the properties of enlargement to construct objects and images;
(e) apply enlargement in cartesian planes;
(f) state the relationship between linear, area and volume scale factor;
(g) apply the scale factors to real life situations.

(ii) Content

(a) Similar figures and their properties
(b) Construction of similar figures
(c) Properties of enlargement
(d) Construction of objects and images under enlargement
(e) Enlargement in the Cartesian plane
(f) Linear, area and volume scale factors
(g) Real life situations.

2.17.0 MATRICES

2.17.1 MATRICES

(i) Specific Objectives

The learner should be able to:
(a) define a matrix;
(b) state the order of a matrix;
(c) define a square matrix;
(d) determine compatibility in addition and multiplication of matrices;
(e) add matrices;
(f) multiply matrices;
(g) identify matrices;
(h) find determinant of a 2 x 2 matrix;
(i) find the inverse of a 2 x 2 matrix;
(j) use matrices to solve simultaneous equations.

(ii) Content

(a) Matrix
(b) Order of a matrix
(c) Square matrix
(d) Compatibility in addition and multiplication of matrices
(e) Multiplication of a matrix by a scalar
(f) Matrix multiplication
(g) Identify matrix

(h) Determinant of a 2 x 2 matrix
(i) Inverse of a 2 x 2 matrix
(j) Singular matrix
(k) Solutions of simultaneous equations in two unknowns.

2.17.2 MATRICES AND TRANSFORMATIONS

(i) Specific Objectives

The learner should be able to:

(a) relate image and object under a given transformation on the cartesian plane;
(b) determine the matrix of a transformation;
(c) perform successive transformations;
(d) determine and identify a single matrix for successive transformation;
(e) relate identity matrix and transformation;
(f) determine the inverse of a transformation;
(g) establish and use the relationship between area scale factor and determinant of a matrix;
(h) determine shear and stretch transformations;
(i) define and distinguish isometric and non-isometric transformation;
(j) apply transformation to real life situations.

(ii) Content

(a) transformation on the Cartesian plane
(b) identification of transformation matrix
(c) successive transformations
(d) single matrix of transformation for successive transformations
(e) identity matrix and transformation
(f) inverse of a transformations
(g) area scale factor and determinant of a matrix
(h) shear and stretch (include their matrices)
(i) isometric and non-isometric transformations
(j) application of transformation to real life situations.

2.18.0 NAVIGATION

2.18.1 LONGITUDE AND LATITUDES

(i) Specific Objectives

The learner should be able to:

(a) define the great and small circles in relation to a sphere (including the earth);
(b) establish the relationship between the radii of small and great circles;
(c) locate a place on the earth's surface in terms of latitude and longitude;
(d) calculate the distance between two points along the great circles and small circles (longitude and latitude) in nautical miles (nm) an kilometers (km);
(e) calculate time in relation to longitudes;
(f) calculate speed in knots and kilometres per hour.

(ii) Content

(a) Latitude and longitude (great and small circles)
(b) The Equator and Greenwich Meridian
(c) Radii of small and great circles
(d) Position of a place on the surface of the earth
(e) Distance between two points along the small and great circles in nautical miles and kilometres
(f) Distance in nautical miles and kilometres along a circle of latitude
(g) Time and longitude
(h) Speed in knots and Kilometres per hour.

2.19.0 AREA APPROXIMATION

(i) Specific Objectives

The learner should be able to:

(a) approximate the area of irregular shapes by counting techniques;
(b) derive the trapezium rule;
(c) apply trapezium rule to approximate areas of irregular shapes;
(d) apply trapezium rule to estimate areas under curves;
(e) derive the mid-ordinate rule;
(f) apply mid-ordinate rule to approximate area under curves.

(ii) Content

(a) Area by counting techniques
(b) Trapezium rule
(c) Area using trapezium rule
(d) Mid-ordinate
(e) Area by the mid-ordinate rule.

2.20 0 ELEMENTARY CALCULUS

2.20.1 DIFFERENTIATION

(i) Specific Objectives

The learner should be able to:

(a) find average rates of change and instantaneous rates of change;
(b) find the gradient of a curve at a point using tangent;
(c) relate the delta notation to rates of change;
(d) find the gradient function of a function of the form $y = x^n$ (n is a positive integer);
(e) define derivative of a function, derived function of a polynomial and differentiation;
(f) determine the derivative of a polynomial;
(g) find equations of tangents and normals to the curves;
(h) sketch a curve;
(i) apply differentiation in calculating distance, velocity and acceleration;
(j) apply differentiation in finding maxima and minima of a function.

(ii) **Content**

(a) Average and instantaneous rates of change
(b) Gradient of a curve at a point
(c) Gradient of $y= x^n$ (where n is a positive integer)
(d) Delta notation (Δ) or δ
(e) Derivative of a polynomial
(f) Equations of tangents and normals to the curve
(g) Stationery points
(h) Curve sketching
(i) Application of differentiation in calculation of distance, velocity and acceleration
(j) Maxima and minima.

2.20.2 INTEGRATION

(i) Specific Objectives

The learner should be able to:

(a) carry out the process of differentiation;
(b) interpret integration as a reverse process of differentiation;
(c) relate integration notation to sum of areas of trapezia under a curve;
(d) integrate a polynomial;
(e) apply integration in finding the area under a curve;
(f) apply integration in kinematics.

(ii) Content

(a) Differentiation
(b) Reverse differentiation
(c) Integration notation and sum of areas of trapezia
(d) Indefinite and definite integrals
(e) Area under a curve by integration
(f) Application in kinematics.