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MINISTRY OF EDUCATION, SCIENCE, VOCATIONAL TRAINING AND EARLY EDUCATION

O-LEVEL MATHEMATICS SYLLABUS

GRADES 10 – 12

PREPARED AND WRITTEN BY THE CURRICULUM DEVELOPMENT CENTRE
P.O. BOX 50092, LUSAKA – ZAMBIA
2013

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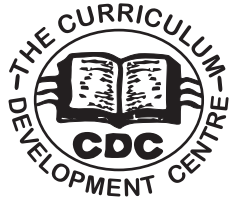

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VISION

Quality, lifelong education for all which is accessible, inclusive and relevant to individual, national and global needs and value systems

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PREFACE

The syllabus was produced as a result of the Curriculum review process carried out by the Ministry of Education, Science, Vocational Training and Early Education under the auspices of the Curriculum Development Centre (CDC). The curriculum reform process started way back in 1999 when the Ministry of Education commissioned five (5) curriculum studies which were conducted by the University of Zambia. These studies were followed by a review of the lower and middle basic and primary teacher education curriculum. In 2005 the upper basic education National survey was conducted and information from learners, parents, teachers, school managers, educational administrators, tertiary institutions traditional leaders civic leaders and various stakeholders in education was collected to help design a relevant curriculum.

The recommendations provided by various stakeholders during the Upper Basic Education National survey of 2005 and National symposium on curriculum held in June 2009 guided the review process.

The review was necessitated by the need to provide an education system that would not only incorporate latest social, economic, technological and political developments but also equip learners with vital knowledge, skills and values that are necessary to contribute to the attainment of Vision 2030.

The syllabus has been reviewed in line with the Outcome Based Education principles which seek to link education to real life experiences that give learners skills to access, criticize, analyze and practically apply knowledge that help them gain life skills. Its competences and general outcomes are the expected outcomes to be attained by the learners through the acquisition of knowledge, skills, techniques and values which are very important for the total development of the individual and the nation as a whole.

Effective implementation of Outcome Based Education requires that the following principles be observed: clarity of focus, Reflective designing, setting high expectations for all learners and appropriate opportunities.

It is my sincere hope that this Outcome Based syllabus will greatly improve the quality of education provided at Grade 8 and 9 levels as defined and recommended in various policy documents including Educating Our Future`1996 and the `Zambia Education Curriculum Framework `2013.

Chishimba Nkosha (Mr.)
Permanent Secretary,
MINISTRY OF EDUCATION, SCIENCE, VOCATIONAL TRAINING AND EARLY EDUCATION

ACKNOWLEDGEMENT

The syllabus presented here is a result of broad-based consultation involving several stakeholders within and outside the education system.

Many individuals, institutions and organizations were consulted to gather their views on the existing syllabus and to accord them an opportunity to make suggestions for the new syllabus. The Ministry of Education wishes to express heartfelt gratitude to all those who participated for their valuable contributions, which resulted in the development of this syllabus.

The Curriculum Development Centre worked closely with other sister departments and institutions to create this document. We sincerely thank the Directorate of Teacher Education and Specialized Services, the Directorate of Planning and Information, the Directorate of Human Resource and Administration, the Directorate of Open and Distance Education ,the Examinations Council of Zambia, the University of Zambia, schools and other institutions too numerous to mention, for their steadfast support.

We pay special tribute to co-operating partners especially JICA in conjunction with Hiroshima University and UNICEF for rendering financial and technical support in the production of the syllabus.

C.N.M Sakala (Mrs.)
Director-Standard and Curriculum
MINISTRY OF EDUCATION, SCIENCE, VOCATIONAL TRAINING AND EARLY EDUCATION

INTRODUCTION

This syllabus has been prepared and produced against the background of the need to set high standards for mathematics education and actualize the country's vision from ECCDE through to Teacher Education. It is a culmination of reviews of existing materials and policies from a number of countries both in Africa and beyond with progressive mathematics education. It also draws from studies, research and the country's policy documents and aspirations.

The following are the underlying principles for the revised Junior Secondary school mathematics syllabus:

- Equity
- Orderly and logical progression
- Varied teaching methodology with subjective learning as the keystone
- Integration of knowledge, skills and values

These syllabus guidelines have been defined at two levels namely the content and process domains. The content domain is defined according to seven themes namely; **Numbers & Calculations**, **Algebra**, **Geometry**, **Computers**, **Measures**, **Probability & Statistics** and **Relations**. The process domain on the other hand is defined according to three categories of knowledge, skills and values**.** These two domains constitute the general outcomes of the Mathematics course.

RATIONALE

Mathematics is an important subject on the Zambian School curriculum. It is featured as one of the core subjects in all the options for both the academic as well as the practical career pathways.

Mathematics enhances the learners' understanding of the world around and prepares them for further education. It also plays a key role as a tool for learning other subjects and learning areas. The subject fosters the development and improvement of learners' intellectual competence in logical reasoning, spatial visualization, analysis and abstract thought. When learners have acquired enough knowledge in mathematics they develop reasoning, thinking and problem solving skills. Mathematics is also important in science and technology subjects which are vital for the development of the country. It therefore equips the learner to live in the age of Science and technology and enable them contribute to social, economic development of the country.

Mathematics can also be an interesting subject when learners appreciate basic concepts and insights that will equip them to pursue mathematics education at higher levels.

SUGGESTED TEACHING METHODOLOGY

This syllabus encourages a learner-centred approach or pedagogy. This requires learners to learn Mathematics in context of multipart, comprehensive and practical problems. Under such learning situations learners may be put in groups and required to identify what they already know, what they need to know and how and where to access new information that may lead to resolution of the problem.

The Problem-Based Learning (PBL) in mathematics may include the four core area specific outcomes, thinking process, skills and values with the aim of nurturing wise citizens who are responsible in decision-making for sustainable and responsible development.

The role of the teacher may be that of a facilitator of learning who provides appropriate scaffolding of that process by asking probing questions, providing appropriate resources and leading class discussions as well as designing student's assessments. The strategy strives to transform the traditional teacher centred mathematics classroom situation into student centred environment completely where learners are allowed to construct new knowledge through, the specific outcomes learned, thinking processes such as communication, interconnections, reasoning, representations, problem solving and other similar ones: both mathematics and non-mathematical positive as well as universal values.

The teaching of Ordinary Level Mathematics should expose learners to practical applications of mathematics in everyday life. Learners should be exposed to do more of practical work as much as necessary through contextual reference to the local environment.

Use of computer related software for mathematics should be encouraged and the teacher should encourage learners to use available mathematics software.

Learners may be exposed to situation where they can provide assistance and support to their peer in learning groups. The opportunities may help to evaluate their peers and conduct self-assessment that helps them to shoulder responsibility for their learning.

ASSESSMENT

Assessment is an important diagnostic tool in the teaching and learning process used to determine whether teaching and learning have taken place or not. It requires well defined rubrics to facilitate a fair and consistent assessment of learner's work as well as clearly defined performance targets at key stages and during the process of teaching and learning.

Classroom based continuous assessment must form an integral part of the implementation of this syllabus. This is in view of the value that this adds to the modification of instruction delivery thereby contributing to best practices by the teacher. In order to attain this, teachers are urged to employ various techniques of assessment according to the topics and themes at various levels. These methods may include learner observation, projects, tests, portfolios and projects among others.

For terminal assessment, the Examinations Council will provide guidelines on the objectives to be assessed in at specific levels both for selection and certification.

TIME AND PERIOD ALLOCATION

This syllabus will require at least 4 hours 40 minutes (seven-40 minute periods) per week to complete.

GENERAL OUTCOMES

- To build an understanding and appreciation of mathematical concepts and computational skills in order to apply them in everyday life.
- To develop ethical values necessary for accountability in financial matters through interpreting financial information.

GRADE 10

GENERAL OUTCOMES AND KEY COMPETENCES

General Outcomes	Key Competences at grade 10 level
• Provide clear mathematical thinking and expression in the learner • Develop the learners' mathematical knowledge and skills • Enrich the learners' understanding of mathematical concepts in order to facilitate further study of the discipline • Build up an appreciation of mathematical concepts so that the learner can apply these for problem solving in everyday life. • Enable the learner represent, interpret and use data in a variety of forms • Inculcate a desire to develop different career paths in the learners	• Assimilate necessary mathematical concepts for use in everyday life such as environment and other related disciplines. • Think mathematically and accurately in problem solving skills and apply these skills to formulate and solve mathematical and other related problems. • Develop necessary skills needed to apply mathematical concepts and skills in other disciplines. • Produce imaginative and creative work from mathematical concepts and ideas. • Develop abilities and ideas drawn from mathematics to reason logically, communicate mathematically, and learn independently without too much supervision (self-discipline). • Develop positive attitudes towards mathematics and use it in other subjects such as science and technology. • Apply mathematical tools such as information and communication technology in the learning of other subjects. • Use mathematics for enjoyment and pleasure. • Develop understanding of algebra, geometry, measurements and shapes.

TOPIC	SUB-TOPICS	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
10.1 SETS	**10.1.1 Set Operations**	10.1.1.1 Carry out operations on sets. 10.1.1.2 Apply higher operations on sets	• Operations on sets. • Numerical problems involving sets • Applying higher operations on sets (numerical problems involving sets)	• ***Identification*** of operations on sets • ***Comparing*** numerical problems involving sets • ***Computations*** involving sets.	• ***Appreciation*** of set operations. • ***Curiosity*** in computations.
10.2 INDEX NOTATION	**10.2.1 Indices**	10.2.1.1 Apply laws of indices 10.2.1.2 Simplify positive, negative and zero indices 10.2.1.3 Simplify fractional indices 10.2.1.4 Solve equations involving indices	• Laws of indices • Double indices • Multiplicative inverse • Fractions with negative indices • Equations involving indices • Problems involving application of indices	• ***Identification*** of indices with same base. • ***Simplification*** using indices. • ***Application*** of indices to simplify multiplication and division.	• ***Curiosity*** in using indices to solve problems. • ***Appreciation*** of using indices. • ***Logical thinking*** in simplifying using indices.
10.3 ALGEBRA	**10.3.1 Basic Processes**	10.3.1.1 Expand and simplify expressions 10.3.1.2 Factorise algebraic expressions 10.3.1.3 Simplify Algebraic fractions	• Expansion and simplification of expressions • Factorisation by using common factors, grouping terms, factors of quadratic expressions and difference of two square • Addition , subtraction , multiplication and division of algebraic fractions • Lowest common multiple	• ***Simplification*** of expressions • ***Identification*** of common factors, factors of quadratic expressions and difference of two square • ***Computation*** of algebraic fractions applying the four rules.	• ***Orderliness*** in factorisation of algebraic expressions • ***Logical thinking*** in factorising quadratics.

TOPIC	SUB-TOPICS	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
10.4 MATRICES	**10.4.1 Transpose of a matrix** **10.4.2 Multiplication of matrices** **10.4.3 Inverse of a matrix**	10.4.1.1 Find a Transpose of a matrix 10.4.2.1 Multiply matrices (up to 3x3 matrices) 10.4.3.1 Calculate the determinant of a 2 by 2 matrix 10.4.3.2 Find the inverse of a 2 by 2 matrix 10.4.3.3 Solve systems of linear equations in two variables 10.4.3.4 Apply matrices to solve real life problems	• Transpose of a matrix • Multiplying matrices (up to 3x3 matrices) • The null (zero) and identity matrices • Determinant and Inverse of a 2x2 matrix • Singular matrices • Solving systems of linear equation in two variables using matrices • Cramer's Rule • Applying matrices to solve real life problems	• ***Interpretation*** of transpose of a matrix. • ***Comparison*** of matrices. • ***Computation*** of matrices • ***Application*** of matrices in solving linear equations.	• ***Appreciation*** of matrices. • ***Awareness*** of solving linear equations using matrices.
10.5 SIMILARITY AND CONGRUENCY	**10.5.1 Application of Ratio and Proportion** **10.5.2 Areas and Volumes of Similar figures**	10.5.1.1 Calculate the scale on a map 10.5.2.1 Calculate length and area using a given scale and vice versa 10.5.2.2 Calculate areas and volumes of similar figures 10.5.2.3 Apply ratio, proportion, to solve problems on similarity and congruence	• Representative Fraction (Scale) • Calculating length and area using a given scale and vice versa • Calculating areas and volumes of similar figures • Applying ratio, proportion, similarity and congruence in solving real life problems	• ***Computation*** of representative fractions (RFs). • ***Representation*** of measurements on the map. • ***Application*** of ratio, proportion, similarity and congruence in solving real life problems	• ***Judgement*** of virtual and actual distances • ***Accuracy*** in computation

TOPIC	SUB-TOPICS	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
10.6 TRAVEL GRAPHS	**10.6.1 Distance time graphs** **10.6.2 Velocity Time graphs**	10.6.1.1 Compute average speed, distance and time 10.6.2.1 Determine acceleration and retardation/deceleration 10.6.2.2 Draw travel graphs 10.6.2.3 Calculate the distance under a velocity time graph 10.6.2.4 Relate area under the graph to distance travelled	• Scalar and vector quantities • Average speed • Distance/displacement • Acceleration and deceleration/retardation • Drawing travel graphs • Distance/area under a velocity time graph • Concept of similarity • Explaining why the area under the graph represents distance travelled	• ***Identification*** of Scalar and vector quantities • ***Computation*** of average speed, distance and time using travel graphs. • ***Relation*** between areaunder the graph to distance travelled.	• ***Curiosity*** in using travel graphs. • ***Awareness*** of vector and scalar quantities. • ***Appreciation*** of relating area under the graph to distance travelled
10.7 SOCIAL AND COMMERCIAL ARITHMETIC	**10.7.1 Investments**	10.7.1.1 Carry out calculations that involve Shares, dividends and investment Bonds	• Shares, dividends and Investment Bonds	• ***Interpretation*** of Shares, dividends and Investment Bonds. • ***Calculations*** involving Shares, dividends and Investment Bonds.	• ***Appreciation*** of Shares, dividends and Investment Bonds.
10.8 BEARINGS	**10.8.1 Bearings and Scale Drawing**	10.8.1.1 Draw/sketch diagrams to represent position and direction 10.8.1.2 Use bearing and scale drawing in real life	• Scale drawing • Three figure bearings • Solving problems involving bearing and scale drawing from real life problems • Angles • Measuring instruments	• ***Communication*** through diagrams to represent position and direction • ***Computation*** involving bearing and scale drawing. • ***Application*** of bearing and scale drawing from real life problems.	• ***Awareness*** of bearing and scale drawing • ***Appreciation*** of bearings.

TOPIC	SUB-TOPICS	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
10.9 SYMMETRY	**10.9.1 Symmetry of solids**	10.9.1.1 Determine order of rotational symmetry 10.9.1.2 Determine symmetry of solids 10.9.1.3 Determine plane symmetry	• Point, Rotational and Plane Symmetry • Centre of rotation • Order of symmetry in three dimension • Plane and axis of symmetry	• ***Identification*** of symmetry of solids. • ***Determination*** of plane symmetry	• ***Awareness*** of order of symmetry in three dimensions
10.10 COMPUTER AND CALCULATOR	**10.10.1 Functions on a Calculator** **10.10.2 Basic components of a computer** **10.10.3 Algorithms** **10.10.4 Methods of implementing an algorithm**	10.10.1.1 Demonstrate the use of different functions on a calculator 10.10.2.1 Describe components of a computer 10.10.3.1 Describe various methods of implementing an algorithm 10.10.4.1 Outline problem solving stages	• Using different functions on a calculator • Describing Components of a computer (i.e. Input, Process and Output Parts/devices) • Definition of an algorithm • Algorithm (sequence , decision loops) • Methods of implementing an algorithm (flow charts and pseudo codes) • Stages of problem solving (define a problem , analysis method of solution, write a computer program, document the program)	• ***Identification*** of basic components of a computer. • ***Interpretation*** of functions on a calculator • ***Modelling*** of simple algorithms • ***Implementation*** of algorithms in programming. • ***Coding*** simple computer programs.	• ***Logical thinking*** in designing flow charts. • ***Appreciation*** of use of compute and calculator

GRADE 11

GENERAL OUTCOMES AND KEY COMPETENCES

General Outcomes	Key Competences
• Provide clear mathematical **thinking** and expression in the learner • Develop the learners' mathematical **knowledge and skills** • Enrich the learners' **understanding** of mathematical concepts in order to facilitate further study of the discipline • Build up an appreciation of mathematical concepts so that the learner can **apply** these for problem solving in everyday life. • Enable the learner **represent**, interpret and use data in a variety of forms • Inculcate a desire to **develop different career paths** in the learners	• Assimilate necessary mathematical concepts for use in everyday life such as environment and other related disciplines. • Thank mathematically and accurately in problem solving skills and apply these skills to formulate and solve mathematical and other related problems. • Develop necessary skills needed to apply mathematical concepts and skills in other disciplines. • Produce imaginative and creative work from mathematical concepts and ideas. • Develop abilities and ideas drawn from mathematics to reason logically, communicate mathematically, and learn independently without too much supervision (self-discipline). • Development positive attitudes towards mathematics and use it in other subjects such as science and technology. • Apply mathematical tools such as information and communication technology in the learning of other subjects. • Use mathematics for enjoyment and pleasure. • Develop understanding of algebra, geometry, measurements and shapes.

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.1 APPROXIMATIONS	11.1.1 **Relative and absolute error**	11.1.1.1 Work with relative and absolute errors	• Relative error • Limits • Absolute error • Tolerance • Percentage error • Estimation	• ***Interpretation*** of relative and absolute error. • ***Computation*** of absolute and relative error. • ***Comparison*** of measurements.	• ***Accuracy*** in finding relative and absolute error.
11.2 SEQUENCES AND SERIES	11.2.1 **Arithmetic progression** 11.2.2 **Geometric progression**	11.2.1.1 Identify an arithmetic progression (AP) 11.2.1.2 Find the nth term of the AP 11.2.1.3 Find the sum of an AP 11.2.1.4 Find the arithmetic mean 11.2.2.1 Identify a geometric progression (GP) 11.2.2.2 Find the nth term of a GP 11.2.2.3 Find the geometric mean 11.2.2.4 Find the sum of a geometric progression 11.2.2.5 Find the sum to infinity of a Geometric progression	• Arithmetic and Geometrical Progressions. • The nth terms of AP and GP • Sums of APs and GPs • Arithmetic and geometric means • Sum to infinity of a Geometric progression	• ***Identification*** of arithmetic and geometrical Progressions. • ***Ordering*** of Arithmetic and Geometrical Progressions. • ***Computation*** of Arithmetic and Geometrical Progressions.	• ***Accuracy*** in computing progressions. • ***Appreciation*** of the nth term of the progression. • ***Prediction*** of the nth term.
11.3 COORDINATE GEOMETRY	11.3.1 **Length of a straight line between two points** 11.3.2 **The mid point** 11.3.3 **Gradient** 11.3.4 **Equation of a straight line** 11.3.5 **Parallel and perpendicular lines**	11.3.1.1 Calculate the length of a straight line 11.3.2.1 Calculate the mid-point of two points 11.3.3.1 Calculate the gradient of a line segment 11.3.4.1 Find the equation of a straight line 11.3.5.1 Find the gradients of parallel and perpendicular lines 11.3.5.2 Use gradients of parallel and perpendicular lines to find equations	• Length (distance formula) • Mid point • Gradient • Gradient point form • Gradient Intercept form • Double intercept form • Parallel lines • Perpendicular lines	• ***Interpretation***of distance and gradient formula. • ***Calculation*** of gradient of a line segment.	• ***Curiosity*** in using distance and gradient formula. • ***Recognition*** of distance and gradient formula.

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.4 RELATIONS AND FUNCTIONS	11.4.1 Inverse functions 11.4.2 Composite functions 11.4.3 Application	11.4.1.1 Find inverses of one- to-one functions 11.4.2.1 Simplify composite functions 11.4.3.1 Solve problems involving linear functions	• Formula, functional notation, set builder notation • Inverse functions • Composite functions • Problems involving linear functions	• ***Identification*** of inverse of a function. • ***Representation*** of composite functions. • ***Problem solving*** involving linear functions.	• ***Logical thinking*** in solving inverse and composite functions. • ***Appreciation*** of functions.
11.5 QUADRATIC FUNCTIONS	11.5.1 Introduction to Quadratic Functions	11.5.1.1 Explain the quadratic function and its graph 11.5.1.2 Sketch the graph of a quadratic function	• Meaning of quadratic function and its graph • Sketching the graph • Maximum and minimum Roots/zeros	• ***Identification*** of a quadratic function. • ***Interpretation*** of Maximum and minimum of function. • ***Drawing*** of function graphs.	• ***Neatness*** in sketching graphs. • ***Logical thinking*** in determining the turning points. • ***Accuracy*** in finding the roots.
11.6 QUADRATIC EQUATIONS	11.6.1 Introduction to Quadratic equations 11.6.2 Solutions of quadratic equations	11.6.1.1 Explain the meaning of the quadratic equation 11.6.2.1 Solve quadratic equations by graphical method 11.6.2.2 Solve quadratic equations using factorisation method 11.6.2.3 Solve quadratic equations using completing of square method 11.6.2.4 Solve quadratic equations using quadratic formula method 11.6.2.5 Apply quadratic equations to solve real life problems	• Meaning of quadratic equation • Solving quadratic equations by Factorisation, graphical method, completion of squares and quadratic formula • Application of quadratic equations	• ***Identification*** of method of quadratic • ***Computation*** of quadratic equations using various methods.	• ***Logical thinking*** in computing quadratic equations. • ***Accuracy*** in finding quadratic roots.

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.7 VARIATION	11.7.1 Introduction to variation 11.7.2 Direct and Inverse Variation 11.7.3 Joint and Partial Variation 11.7.4 Graphs 11.7.5 Applications	11.7.1.1 Describe variation 11.7.2.1 Distinguish between direct and inverse variation 11.7.3.1 Distinguish between joint and partial variation 11.7.4.1 Draw and Interpret graphs of variation 11.7.5.1 Solve problems involving variations	• Describing variation (Notation and Constant) • Distinguishing between direct and inverse variation • Distinguishing between Joint and Partial variation • Graphs of variation • Solving problems involving variations	• ***Interpretation*** of variation • ***Problem solving*** involving variations • ***Comparison*** between joint and partial variation.	• ***Appreciation*** of variation in • ***Logical thinking*** in calculating
11.8 CIRCLE THEOREMS	11.8.1 Properties of a circle 11.8.2 Angle properties	11.8.1.1 Analyse the parts of a circle 11.8.2.1 Solve problems using angle properties of a circles 11.8.2.2 Solve problems involving tangent properties	• Parts a circle (chord, segment, arc, sector, radius, diameter) • Angle in the same segment • Angle at the centre twice one at the circumference • Angle in a semicircle • Cyclic quadrilateral (opposite sides) • Alternate segments • Tangent properties of a circle • External angle of a cyclic Quadrilateral equal to the opposite interior angle	• ***Identification*** of parts of a circle (chord, segment, arc, sector, radius, diameter) • ***Computation*** involving angle properties of a circle. • ***Interpretation*** of circle theorems.	• ***Curiosity*** I using circle theorems. • ***Appreciation*** of angle property of a circle.

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.9 CONSTRUCTION AND LOCI	**11.9.1 Construction** **11.9.2 Locus** **11.9.3 Loci in two dimensions** **11.9.4 Loci in three dimension**	11.9.1.1 Construct line and angle bisectors 11.9.2.1 Explain the meaning of Locus 11.9.3.1 Describe locus of point in two and three dimensions 11.9.4.1 Construct locus of point in two dimensions	• Line and angle bisectors • Finding the centre of circle • Constructing a tangent from a point to a circle • meaning of Locus • Locus of points in two and three dimensions (equidistant from a Point and two fixed points, from two intersecting line, from a Straight line) • Locus of points which subtends a constant angle • Locus of points such that the area of triangles is constant	• ***Identification*** of loci of points. • ***Construction*** locus of point in two and three dimensions.	• ***Accuracy*** in construction. • ***Neatness*** in constructing lines and points. • ***Appreciation*** of loci.

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.10 TRIGONOMETRY	**11.10.1 Introduction to Trigonometry**	11.10.1.1 Relate right angled triangle to the three trigonometric ratios	• Sine, cosine and tangent ratios on a right angled triangle (Opposite, adjacent and hypotenuse sides) • Three trigonometric ratios in quadrants • Sides and angles of right angled triangles using the three trigonometric ratios • Special angles (60^0, 45^0 and 30^0) • Finding sides and angles of non right angled triangles using the sine and cosine rule. • Calculating area of a non right angled triangle using the sine rule. • Using of Mathematical tables and scientific calculators • Determining signs of the three trigonometric ratios in the quadrants • Graphs of ($y = \sin\theta$, $y = \cos\theta$ and $y = \tan\theta$) • Application of trigonometry(Include three dimensional figures) (Include: Bearings)	• Comparison • **Identification** of trigonometric ratios. • ***Interpretation*** Opposite, adjacent and hypotenuse sides • ***Computation*** of sides and angles of a right angled triangle. • ***Determination*** of the signs of the three trigonometric ratios in respective quadrants • ***Application*** of trigonometry in real life situations.	• ***Appreciation*** of trigonometry ratios. • ***Curiosity*** in using cosine and sine rules. • ***Logical thinking*** in computing trigonometric problems.
	11.10.2 Trigonometric ratios	11.10.2.1 Describe the three trigonometric ratios on a right angled triangle			
		11.10.2.2 Calculate sides and angles of a right angled triangle			
		11.10.2.3 Work with special angles (60^o, 45^o and 30^o)			
	11.10.3 Sine and Cosine rules	11.10.3.1 Find sides and angles of non right angled triangles.			
	11.10.4 Area of a triangle	11.10.4.1 Calculate areas of a non right angled triangle			
		11.10.4.2 Determine the signs of the three trigonometric ratios in the quadrants			
		11.10.4.3 Draw graphs for sine, cosine and tangent curves			
		11.10.4.4 Solve trigonometric equations			
		11.10.4.5 Use trigonometry to solve practical problems			

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.12 MENSURATION	11.12.1 Area 11.12.2 Volume	11.12.1.1 Calculate the area of a sector 11.12.1.2 Calculate surface area of three dimensional figures 11.12.2.1 Calculate volume of prisms 11.12.2 2 Solve problems involving area and volume	• Area of a sector • Surface area of three dimensional figures (pyramid and cone) • Volume of solid s (cone, rectangular and triangular pyramids. Include: frustum) • Solving problems involving area and volume.	• ***Interpretation*** of sector of a circle. • ***Computation*** of the area and volume of figures. • ***Relation*** between area and volume.	• ***Appreciation*** of area and volume of figures. • ***Accuracy***in calculations of volume and area.
11.13 PROBABILITY	11.13.1 Laws of probability 11.13.2 Tree Diagrams and grid	11.13.1.1 Compute probabilities using the laws of probability 11.13.2.1 Calculate probabilities using tree diagrams and grids. 11.13.2.2 Calculate probabilities of mutually exclusive events and compound events 11.13.2.3 Find probabilities of independent events 11.13.2.4 Apply probability to real life problems	• Addition and Multiplication Laws • Calculating probabilities using tree diagrams and grids. • Calculating expected values, Independent and dependent events, mutually exclusive events, conditional events and Compound events. • Continuous sample space.	• ***Computation*** of probabilities using the laws of probability • ***Interpretation*** tree diagrams and grids to calculate probabilities. • Communication • ***Analysis*** of mutually exclusive events, compound and independent events.	• ***Curiosity*** in using laws of probabilities. • ***Logical thinking*** in calculating probabilities.

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.14 STATISTIC	11.14.1 **Cumulative frequency tables**	12.14.1.1 Construct cumulative frequency tables using grouped and ungrouped data 12.14.1.2 Draw cumulative frequency curves 12.14.1.3 Draw relative cumulative curves	• Constructing Cumulative frequency tables • Drawing Cumulative frequency curves (ogive) • Drawing Relative cumulative frequency curves	• ***Drawing*** cumulative tables and frequency curves. • ***Computation*** of measures of dispersion. • ***Interpretation*** of cumulative curves.	• ***Logical thinking*** in computation of measures of dispersion • ***Appreciation*** of cumulative and frequency curves.
	11.14.2 **Measures of dispersion**	12.14.2.1 Calculate the range, inter quartile range, and semi inter quartile range 12.14.2.2 Calculate the percentiles 12.14.2.3 Calculate variance and standard deviation for ungrouped and grouped data	• Calculating the range, inter quartile range, semi inter quartile range and Percentiles • Calculating variance and standard deviation for ungrouped and grouped data		

GRADE 12

GENERAL OUTCOMES AND KEY COMPETENCES

General Outcomes	Key Competences
• Provide clear mathematical **thinking** and expression in the learner • Develop the learners' mathematical **knowledge and skills** • Enrich the learners' **understanding** of mathematical concepts in order to facilitate further study of the discipline • Build up an appreciation of mathematical concepts so that the learner can **apply** these for problem solving in everyday life. • Enable the learner **represent**, interpret and use data in a variety of forms • Inculcate a desire to **develop different career paths** in the learners	• Assimilate necessary mathematical concepts for use in everyday life such as environment and other related disciplines. • Thank mathematically and accurately in problem solving skills and apply these skills to formulate and solve mathematical and other related problems. • Develop necessary skills needed to apply mathematical concepts and skills in other disciplines. • Produce imaginative and creative work from mathematical concepts and ideas. • Develop abilities and ideas drawn from mathematics to reason logically, communicate mathematically, and learn independently without too much supervision (self-discipline). • Development positive attitudes towards mathematics and use it in other subjects such as science and technology. • Apply mathematical tools such as information and communication technology in the learning of other subjects. • Use mathematics for enjoyment and pleasure. • Develop understanding of algebra, geometry, measurements and shapes.

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.1 GRAPHS OF FUNCTIONS	**12.1.1 Cubic functions** **12.1.2 Inverse functions**	12.1.1.1 Draw graphs of cubic functions 12.1.1.2 Use graphs to find solutions 12.1.1.3 Determine gradients of curves 12.1.1.4 Estimate areas under curves 12.1.2.1 Draw graphs of inverse functions 12.1.2.2 Application of graphs of functions	• Drawing Graphs of cubic functions • Finding Zeros of the function, Solutions of graphs • Determining Gradients of curves • Turning points and their nature (Maximum and minimum) • Area under the graph (Counting square, Trapezium) • Drawing Graphs of inverse functions • Exponential graphs • Applying graphs of functions	• ***Identification*** of a cubic function. • ***Interpretation*** of gradients and areas under curves. ***Drawing*** graphs of cubic and inverse functions.	• ***Neatness*** in sketching graphs. • ***Logical thinking*** in determining area under the curve. • ***Accuracy*** in finding the turning points.
12.2 LINEAR PROGRAMMING	**12.2.1 Linear programming**	12.2.1.1 Draw graphs of linear equations and inequations in one and two variables (as a recap) 12.2.1.2 Shade the wanted and unwanted regions 12.2.1.3 Describe the wanted or unwanted regions. 12.2.1.4 Determine maximum and minimum values 12.2.1.5 Use the search line to determine the maximum and minimum values 12.2.1.6 Apply knowledge of linear programming in real life	• Drawing graphs of linear equations and inequations in one and two variables (as a recap) • Shading the wanted and unwanted regions • Describing the wanted or unwanted region • Finding Values in the feasible region • Using the Search line to determine the maximum and minimum values • Applying knowledge of linear programming in real life	• ***Interpretation*** of the wanted or unwanted regions. • ***Shading*** of the unwanted region. • ***Determination*** of maximum and minimum values. • ***Application*** of linear programming in real life situation.	• ***Logical thinking*** in finding the wanted region. • ***Planning*** when using graph paper.

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.3 TRAVEL GRAPHS	12.3.1 Velocity - time graphs (Curves)	12.3.1.1 Calculate the displacement in a velocity - time graph	• Distance/area under the graph in a velocity - time graph	• ***Representation*** of velocity-time graphs. • ***Interpretation*** of displacement in a velocity - time graph.	• ***Curiosity*** in using velocity-time graphs
12.4 VECTORS IN TWO DIMENSIONS	12.4.1 Introduction to vectors 12.4.2 Addition and subtraction 12.4.3 Translations 12.4.4 Scalar multiplication 12.4.5 Collinearity 12.4.6 Vector geometry	12.4.1.1 Describe a vector 12.4.1.2 Represent and denote a vector 12.4.2.1 Add and subtract vectors 12.4.3.1 Apply translations on vectors and find magnitude 12.4.4.1 Multiply vectors by scalars 12.4.5.1 Determine collinearity of points 12.4.6.1 Solve geometrical problems involving vectors	• Describing a vector (direction and magnitude) • Zero and Free vectors • Representing and denoting • Adding and subtracting vectors (triangular and parallelogram laws) • Resultant vectors • Multiplying vectors by scalars • Translation (Position vectors) • Component form • Calculating Magnitude/Modulus of vectors • Collinearity and parallelism • Ratios (Mid - point theorem) • Vector geometry	• ***Representation*** of vector quantities • ***Computation of*** vector related problems • ***Application*** of vector in ***Problem solving***	• ***Appreciation*** of sense of direction • ***Logical thinking*** in solving vector problems. • ***Creativity*** in design

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.5 GEOMETRICAL TRANSFORMATIONS	**12.5.1 Introduction to transformation**	12.5.1.1 Explain the concept of transformation	• Explaining the concept of transformation (Object and Image)	• ***Interpretation*** the concept of transformation	• ***Appreciation*** of transformation***s***
	12.5.2 Translation	12.5.2.1 Use a column vector to translate an object	• Translation (Translation vector, Mediator)	• ***Comparison*** between different forms of transformation.	• ***Logical thinking*** in solving transformations.
	12.5.3 Reflection.	12.5.3.1 Reflect objects by different methods	• Reflection (mirror lines and matrices of reflections)	• ***Computation*** involving transformations.	• ***Creativity*** in designing.
			• Rotations (by construction and matrix methods)		
	12.5.4 Rotation.	12.5.4.1 Rotate objects by different methods	• Rotations (Finding centre, angle and direction)		
	12.5.5 Enlargement	12.5.5.1 Enlarge objects by different methods	• Finding matrix of rotation		
			• Enlargement (by construction and matrix methods)		
	12.5.6 Stretch	12.5.6.1 Stretch objects by different methods	• Finding the centre, scale factor and matrix of enlargement		
			• Stretch (by construction and matrix methods)		
		12.5.6.2 Find area, scale factors of a stretch by determinant method	• Finding the centre, scale factor, invariant line and matrix of stretch		
	12.5.7 Shear	12.5.7.1 Shear objects by different methods	• Shear (by construction and matrix methods)		
			• Finding the shear factor, invariant line and matrix of shear		
	12.5.8 Combined transformations	12.5.8.1 Solve problems involving combined transformations	• Area scale factor		
			• Determinant of a matrix		
			• Inverse transformations		

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.6 EARTH GEOMETRY	**12.6.1 Introduction to Earth Geometry**	12.6.1.1 Explain the concept of Earth Geometry	• Explaining the concept of Earth Geometry and its significance • Southern and Northern hemispheres (South and North Poles)	• ***Application*** of the relationship of earth geometry in real life. • ***Computation*** of distances of latitudes and longitudes. • ***Location*** of points on the globe.	• ***Appreciation*** of the concept of earth geometry. • ***Curiosity*** in exploring earth geometry. • ***Team work*** through cooperative learning
	12.6.2 Small and great circles	12.6.2.1 Distinguish between small and great circles	• Great Circles(the equator and all longitudes)		
	12.6.3 Latitudes and Longitudes	12.6.3.1 Calculate distance along parallels of latitudes and longitude in kilometres and nautical miles	• The Greenwich and Equator • Small Circles(latitudes) • Centre of the earth • Length ,chord , arc and sector • Angular distance • Line of axis of the Earth • Circumference of the earth		
	12.6.4 Distance along latitudes and longitudes	12.6.4.1 Calculate the shortest distance between two points on the surface of the earth	• Standard units of distances in degrees and miles (1^{o} of latitude represents 60 nautical miles/or 110.9 Km) • Conversion of distance in kilometre and nautical mile		
	12.6.5 Speed in Knots and time	12.6.5.1 Calculate speed in knots and time	• Longitude and time • Greenwich Mean Time • Solving problems involving Earth Geometry in real life		

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.7 INTRODUCTION TO CALCULUS	**12.7.1 Differentiation**	12.7.1.1 Explain concept of differentiation 12.7.1.3 Differentiate functions from first principles. 12.7.1.4 Use the formula for differentiation 12.7.1.8 Calculate equations of tangents and normals	• Explaining the concept of differentiation • Differentiating functions from first principles (Limits) • Product rule; chain rule and quotient rule ($y = ax^n; \frac{dy}{dx} = nax^{n-1}$)	• ***Interpretation*** of differentiation and integration • ***Application*** of definite integrals. • ***Estimation*** of area under the curve.	• ***Appreciation*** of calculus. • ***Curiosity*** in differentiating and integrating. • ***Critical thinking*** in using rules for differentiation and integration.
	12.7.2 Integration	12.7.2.1 Explain integration 12.7.2.3 Find Indefinite integrals 12.7.2.2 Evaluate simple definite integrals 12.7.2.3 Find the area under the curve	• Indefinite integrals • Arbitrary constant • Definite integrals • Stationary points • Secant • Tangents • Normal • Explain integration as the reverse of differentiation • Rule of integration ($\left(\frac{dy}{dx} = ax^n; \int ax^n dx = \frac{ax^{n+1}}{n+1} + c\right)$ • Area under the curve		

GRADES 10 - 12 "O" LEVEL MATHEMATICS SEQUENCE

The table below shows the coverage of the syllabus in Mathematics from Grades 10 to 12. It is important for a teacher to refer to this table from time to time to know the knowledge that the learners already have or need to have at various levels of learning of the subject.

DOMAIN	TOPIC	SPECIFIC OUTCOME		
		GRADE 10	GRADE 11	GRADE 12
	Sets	10.1.1.1 Carry out operations on sets. 10.1.1.2 Apply higher operations on sets		
	Algebra	10.3.1.1 Expand and simplify expressions 10.3.1.2 Factorise algebraic expressions 10.3.1.3 Simplify Algebraic fractions		
	Matrices	10.4.1.1 Find a Transpose of a matrix 10.4.2.1 Multiply matrices (up to 3x3 matrices) 10.4.3.1 Calculate the determinant of a 2 by 2 matrix 10.4.3.2 Find the inverse of a 2 by 2 matrix 10.4.3.3 Solve systems of linear equations in two variables 10.4.3.4 Apply matrices to solve real life problems		
	Quadratic Equations		11.6.1.1 Explain the meaning of the quadratic equation 11.6.2.1 Solve quadratic equations by graphical method 11.6.2.2 Solve quadratic equations using factorisation method 11.6.2.3 Solve quadratic equations using completing of square method 11.6.2.4 Solve quadratic equations using quadratic formula method 11.6.2.5 Apply quadratic equations to solve real life problems	

DOMAIN	TOPIC	SPECIFIC OUTCOME		
		GRADE 10	GRADE 11	GRADE 12
	Linear Programming			12.2.1.1 Draw graphs of linear equations and inequations in one and two variables (as a recap) 12.2.1.2 Shade the wanted and unwanted regions 12.2.1.3 Describe the wanted or unwanted regions. 12.2.1.4 Determine maximum and minimum values 12.2.1.5 Use the search line to determine the maximum and minimum values 12.2.1.6 Apply knowledge of linear programming in real life
	Index Notation	10.2.1.1 Apply laws of indices 10.2.1.2 Simplify positive, negative and zero indices 10.2.1.3 Simplify fractional indices 10.2.1.4 Solve equations involving indices		
	Social & Commercial Arithmetic	10.7.1.1 Carry out calculations that involve Shares, dividends and investment Bonds		
Numbers & Calculations	**Sequences & Series**		11.2.1.1 Identify an arithmetic progression (AP) 11.2.1.2 Find the nth term of the AP 11.2.1.3 Find the sum of an AP 11.2.1.4 Find the arithmetic mean 11.2.2.1 Identify a geometric progression (GP) 11.2.2.2 Find the nth term of a GP 11.2.2.3 Find the geometric mean 11.2.2.4 Find the sum of a geometric progression 11.2.2.5 Find the sum to infinity of a Geometric progression	

DOMAIN	TOPIC	SPECIFIC OUTCOME		
		GRADE 10	GRADE 11	GRADE 12
	Similarity & Congruency	10.5.1.1 Calculate the scale on a map 10.5.2.1 Calculate length and area using a given scale and vice versa 10.5.2.2 Calculate areas and volumes of similar figures 10.5.2.3 Apply ratio, proportion, to solve problems on similarity and congruence		
	Bearings	10.8.1.1 Draw/sketch diagrams to represent position and direction 10.8.1.2 Use bearing and scale drawing in real life		
	Symmetry	10.9.1.1 Determine order of rotational symmetry 10.9.1.2 Determine symmetry of solids 10.9.1.3 Determine plane symmetry		
	Coordinate Geometry		11.3.1.1 Calculate the length of a straight line 11.3.2.1 Calculate the mid-point of two points 11.3.3.1 Calculate the gradient of a line segment 11.3.4.1 Find the equation of a straight line 11.3.5.1 Find the gradients of parallel and perpendicular lines 11.3.5.2 Use gradients of parallel and perpendicular lines to find equations	

DOMAIN	TOPIC	SPECIFIC OUTCOME		
		GRADE 10	GRADE 11	GRADE 12
	Circle Theorems		11.8.1.1 Analyse the parts of a circle 11.8.2.1 Solve problems using angle properties of a circles 11.8.2.2 Solve problems involving tangent properties	
	Construction & Loci		11.9.1.1 Construct line and angle bisectors 11.9.2.1 Explain the meaning of Locus 11.9.3.1 Describe locus of point in two and three dimensions 11.9.4.1 Construct locus of point in two dimensions	
	Trigonometry		11.10.1.1 Relate right angled triangle to the three trigonometric ratios 11.10.2.1 Describe the three trigonometric ratios on a right angled triangle 11.10.2.2 Calculate sides and angles of a right angled triangle 11.10.2.3 Work with special angles (60^{o}, 45^{o} and 30^{o}) 11.10.4.1 Find sides and angles of non right angled triangles. 11.10.4.1 Calculate areas of a non right angled triangle 11.10.4.2 Determine the signs of the three trigonometric ratios in the quadrants 11.10.4.3 Draw graphs for sine, cosine and tangent curves 11.10.4.4 Solve trigonometric equations 11.10.4.5 Use trigonometry to solve practical problems	

DOMAIN	TOPIC	SPECIFIC OUTCOME		
		GRADE 10	GRADE 11	GRADE 12
	Vectors in two Dimensions			12.4.1.1 Describe a vector 12.4.1.2 Represent and denote a vector 12.4.2.1 Add and subtract vectors 12.4.3.1 Apply translations on vectors and find magnitude 12.4.4.1 Multiply vectors by scalars 12.4.5.1 Determine collinearity of points 12.4.6.1 Solve geometrical problems involving vectors
	Geometrical Transformations			12.5.1.1 Explain the concept of transformation 12.5.2.1 Use a column vector to translate an object 12.5.3.1 Reflect objects by different methods 12.5.4.1 Rotate objects by different methods 12.5.5.1 Enlarge objects by different methods 12.5.6.1 Stretch objects by different methods 12.5.6.2 Find area, scale factors of a stretch by determinant method 12.5.7.1 Shear objects by different methods 12.5.8.1 Solve problems involving combined transformations

DOMAIN	TOPIC	SPECIFIC OUTCOME		
		GRADE 10	GRADE 11	GRADE 12
	Earth Geometry			12.6.1.1 Explain the concept of Earth Geometry 12.6.2.1 Distinguish between small and great circles 12.6.3.1 Calculate distance along parallels of latitudes and longitude in kilometres and nautical miles 12.6.4.1 Calculate the shortest distance between two points on the surface of the earth 12.6.5.1 Calculate speed in knots and time
Relations	Travel Graphs	10.6.1.1 Compute average speed, distance and time 10.6.2.1 Determine acceleration and retardation/deceleration 10.6.2.2 Draw travel graphs 10.6.2.3 Calculate the distance under a velocity time graph 10.6.2.4 Relate area under the graph to distance travelled		12.3.1.1 Calculate the displacement in a velocity - time graph
	Relations & Functions	11.4.1.1 Find inverses of one- to- one functions 11.4.2.1 Simplify composite functions 11.4.3.1 Solve problems involving linear functions		
	Quadratic Functions	11.5.1.1 Explain the quadratic function and its graph 11.5.1.2 Sketch the graph of a quadratic function		

DOMAIN	TOPIC	SPECIFIC OUTCOME		
		GRADE 10	GRADE 11	GRADE 12
	Variations		11.7.1.1 Describe variation 11.7.2.1 Distinguish between direct and inverse variation 11.7.3.1 Distinguish between joint and partial variation 11.7.4.1 Draw and Interpret graphs of variation 11.7.5.1 Solve problems involving variations	
	Graphs of Functions			12.1.1.1 Draw graphs of cubic functions 12.1.1.2 Use graphs to find solutions 12.1.1.3 Determine gradients of curves 12.1.1.4 Estimate areas under curves 12.1.2.1 Draw graphs of inverse functions 12.1.2.2 Application of graphs of functions
	Introduction to Calculus			12.7.1.1 Explain concept of differentiation 12.7.1.3 Differentiate functions from first principles. 12.7.1.4 Use the formula for differentiation 12.7.1.8 Calculate equations of tangents and normals 12.7.2.1 Explain integration 12.7.2.3 Find Indefinite integrals 12.7.2.2 Evaluate simple definite integrals 12.7.2.3 Find the area under the curve
Computer	Computer & Calculator	10.10.1.1 Demonstrate the use of different functions on a calculator 10.10.2.1 Describe components of a computer 10.10.3.1 Describe various methods of implementing an algorithm 10.10.4.1 Outline problem solving stages		

DOMAIN	TOPIC	SPECIFIC OUTCOME		
		GRADE 10	GRADE 11	GRADE 12
Measures	Approximations		11.1.1.1 Work with relative and absolute errors	
	Mensuration		11.12.1.1 Calculate the area of a sector 11.12.1.2 Calculate surface area of three dimensional figures 11.12.2.1 Calculate volume of prisms 11.12.2 2 Solve problems involving area and volume	
Probability & Statistics	Probability		11.13.1.1 Compute probabilities using the laws of probability 11.13.2.1 Calculate probabilities using tree diagrams and grids. 11.13.2.2 Calculate probabilities of mutually exclusive events and compound events 11.13.2.3 Find probabilities of independent events 11.13.2.4 Apply probability to real life problems	
	Statistics		12.14.1.1 Construct cumulative frequency tables using grouped and ungrouped data 12.14.1.2 Draw cumulative frequency curves 12.14.1.3 Draw relative cumulative curves 12.14.2.1 Calculate the range, inter quartile range, and semi inter quartile range 12.14.2.2 Calculate the percentiles 12.14.2.3 Calculate variance and standard deviation for ungrouped and grouped data	