ZIMBABWE

MINISTRY OF PRIMARY AND SECONDARY EDUCATION

ADDITIONAL MATHEMATICS SYLLABUS

FORMS 3 - 4

2015 - 2022

ACKNOWLEDGEMENTS

CONTENTS

1.0. PREAMBLE

1.1. Introduction

In developing the Additional Mathematics syllabus, cognisance was taken of the need to broaden the form 1 – 4 Mathematics and accommodate students with high ability in the learning area and as well provide a solid base for further studies in mathematics and other career developments. The intention is to provide wider opportunities for mathematically gifted learners who wish to pursue highly skilled, scientifically and technologically based competences required for the National human capital development needs in the 21st century.

1.2. Rationale

In its socio-economic transformation agenda, Zimbabwe has embarked on an Industrialisation development process, where high mathematical skills are a pre-requisite. It is therefore, important to provide a sound grounding for development and improvement of the learner's intellectual competencies in logical reasoning, spatial visualisation, analytical and abstract thinking. This will form the basis for creative thinkers, innovators and inventors.   Additional Mathematics optimises the potential of the mathematically gifted learners through exposure to more challenging practical life problems that require practical solutions. The thrust is to provide wider opportunities for the mathematically gifted learners who desire to undertake technologically and industrially related careers such as actuarial sciences, architecture, engineering and other scientific research activities. Sound knowledge of mathematics enables learners to develop skills such as accuracy, research and analytical competencies essential for life and sustainable development.

1.3. Summary of Content

The Form 3 - 4 Additional Mathematics syllabus will cover the theoretical concepts and their application. This two-year secondary course consists of pure mathematics, mechanics, probability and statistics.

1.4 Assumptions

The syllabus assumes that the learner

- has a talent in mathematics
- has strong algebraic and geometric thinking
- can easily master the form 1– 4 Mathematics Syllabus concepts

1.5. Cross Cutting Themes

The following are some of the cross cutting themes in Additional Mathematics: -

• Business and financial literacy
- Disaster and risk management
- Communication and team building
- Problem solving of environmental issues
- Inclusivity
- Enterprise skills
- Cultural Diversity
- ICT
- HIV & AIDS EDUCATION

2.0 PRESENTATION OF SYLLABUS

The additional mathematics syllabus is a single document covering forms 3 - 4
It contains the preamble, aims, objectives, syllabus topics, scope and sequence, competency matrix and assessment procedures. The syllabus also suggests a list of resources to be used during learning and teaching process.

3.0 AIMS

The syllabus will enable learners to:

3.1   acquire mathematical skills to solve problems related to industry and technology

3.2   further develop mathematical concepts and skills for higher studies

3.3   use mathematical skills in the context of more advanced techniques such as research

3.4   apply additional mathematics concepts and techniques in other learning areas

3.5   develop an appreciation of the role of mathematics in personal, community and national development (Unhu/Ubuntu/Vumunhu)

3.6   use I.C.T tools effectively to solve mathematical problems

3.7   apply additional mathematical skills and knowledge in relevant life situations

3.8   enhance confidence, critical thinking, innovativeness, creativity and problem solving skills

for sustainable development.

4.0 OBJECTIVES

The learners should be able to:

4.1   apply relevant mathematical symbols, definitions, terms and use them appropriately in problem solving

4.2   use appropriate skills and techniques that are necessary for further studies

4.3   formulate problems into mathematical terms

4.4   identify the appropriate mathematical procedure for a given situation

4.5   use appropriate techniques to solve selected world problems in an ethical manner

4.6   use appropriate estimation procedures to acceptable degree of accuracy

4.7   present data through appropriate representations

4.8   draw inferences through correct manipulation of data

4.9   use I.C.T tools responsibly in problem solving

4.10   interpret mathematical data for use in relevant situations

5.0 METHODOLOGY

It is recommended that teachers use teaching techniques in which mathematics is seen as a process which arouse an interest and confidence in tackling problems both in familiar and unfamiliar contexts. The teaching and learning of mathematics must be learner centred and practically oriented. Multi-sensory approach should also be applied during teaching and learning of mathematics. The following are some of the suggested methods:

• Guided discovery
• Collaborative learning
• Project based learning
• Group work
• Interactive e-learning
• Problem solving
• Simulation
• Visual tactile
• Educational tours

5.1 Time Allocation

Four periods of 40 minutes each per week should be allocated for the adequate coverage of the syllabus

6.0 TOPICS

The following topics will be covered from Form 3 to 4

6.1 Pure Mathematics

6.1.1   Indices and irrational numbers
6.1.2   Polynomials
6.1.3   Algebraic Identities, equations and inequalities
6.1.4   Sequences and Series
6.1.5   Coordinate geometry in two dimensions
6.1.6   Functions
6.1.7   Quadratic functions
6.1.8   Logarithmic and Exponential functions
6.1.9   Trigonometrical functions
6.1.10   Differentiation
6.1.11   Integration

6.2. Probability and Statistics

6.2.1   Probability
6.2.2   Data collection and Presentation
6.2.3   Measures of central tendency and dispersion
6.2.4   Discrete and continuous probability distributions
6.2.5   Normal distribution
6.2.6   Sampling Methods
6.2.7   Estimation

6.3 Mechanics

6.3.1   Kinematics of motion in a straight line
6.3.2   Forces and equilibrium
6.3.3   Newton's Laws of motion
6.3.4   Energy, Work and Power

7.0 SCOPE AND SEQUENCE

7.1   PURE MATHEMATICS

TOPIC	FORM 3	FORM 4
Indices and irrational numbers	• Indices: - Rational indices - Rules and notations - Algebraic application - Exponential equations • Irrational numbers: - Surds - Operations	
Polynomials	• Polynomials: - Definition - Operations • Factor theorem - Factorisation • Remainder theorem	
Algebraic identities, Equations and Inequalities	• Identities: - Definition - unknown coefficient • Equations: - Linear - Simultaneous - Quadratic • Inequalities: - Linear - Quadratic	
Sequences and Series	• Sequences: - Notation - Behaviour of a sequence • Series: - Notation - Arithmetic progression - Geometric progression	
Coordinate geometry in two dimensions	• Coordinate Geometry: - Distance between two points - Gradient - Equation of a straight line - Parallel and perpendicular lines	

7.1   PURE MATHEMATICS

TOPIC	FORM 3	FORM 4
Functions	• Functions: - Definitions - Domain - Range - One to one mapping - Inverse functions - Composite function • Graphs: - Graphical illustration	
Quadratic Functions	• Quadratic expression • Quadratic equation • Quadratic function • Maximum / minimum value • Nature of roots	
Logarithmic and Exponential functions	• Logarithms: - Definition - Laws - Sketch graphs - Sketch inverse • Logarithmic equations • Exponential equations	
Trigonometrical functions	• Trigonometry: - Ratios - Simple identities - Simple Equations • Trigonometric Functions	
Differentiation	• Differentiation: - Gradient of a curve - Derivative notation - Rules of derivatives - Derivative of simple functions • Stationery Points - Maximum - Minimum • Application - Tangent and normal - Rates of change	

7.1   PURE MATHEMATICS

TOPIC	FORM 3	FORM 4
Integration	• Integration • Reverse process of differentia-tion • Notation • Integration of simple functions • Application - Area under the curve	

7.1   PROBABILITY AND STATISTICS

TOPIC	FORM 3	FORM 4

Probability		• Set Language and notation
		- Trial
		- Samples spaces
		- Outcomes/events
		- Venn diagrams
		• Approaches to probability
		- Objective probability
		  - Experimental
		  - Classic
		  - Subjective probability
		• Addition and product Rules
		  - Independent events
		  -Mutually exclusive events
		  - Outcome Tables
		  - Tree Diagram
		Conditional probability

Data collection and Presentation		• Key Statistical terms
		• Statistics data
		• Frequency
		• Tally system
		• Population
		• Samples
		• Data
		  - Sources
		  - Classification
		  - Types
		  - Merits and demerit
		• Data collection methods
		  • Forms of data presentation

7.2   PROBABILITY AND STATISTICS

TOPIC	FORM 3	FORM 4
Measures of central tendency and dispersion		• The mean, median and mode • Measures of dispersion - Variance - Standard deviation - Coefficient of variation - Range Interquartile range
Discrete and continuous probability distributions		• Discrete random variables - Probability distribution of a discrete variable - Binomial probability distribution • Continuous random variables - Probability distribution of a continuous variable • Mean and variance of a random variable
Normal distribution		• Properties of normal distribution curve • The standard normal variable, Z • Probabilities • Using standard normal tables (including reverse to find Z when is known $\square$ (z) Finding σ or μ or both
Sampling Methods		• Sampling techniques - Random and non-random sampling • Central limit theorem • Distribution of sample mean (when population of X is normal)
Estimation		• Point estimation - Mean and variance • Interval estimation - Confidence interval (for mean of the population and mean of a normal population with known variance and arge sample

7.3 MECHANICS

TOPIC	FORM 3	FORM 4
Kinematics of motion in a straight line		• Distance and speed - x – t graphs - Gradient as Velocity • Vector and scalar quantity • Velocity and acceleration - v – t graphs - Gradient as acceleration • Equations of motion
Forces and Equilibrium		• Force - Types of forces - Representation of force by vectors - Resultants and components - Composition and Resolutions - Equilibrium of a particle - Friction
Newton's Laws of motion		• Newton's laws of motion • Application
Energy, Work and Power		• Energy • Work • Power • Principle of energy conservation

8.0   COMPETENCY MATRIX: FORM 3

TOPIC 1: INDICES AND IRRATIONAL NUMBERS

SUB TOPIC	LEARNING OBJEC-TIVES	CONTENT (Attitudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Indices	• define an index • use the laws of indices in algebraic application • solve equations involving indices	• Indices: - indices - Rules and notations - Algebraic application • Exponential equations	• Discussing indices • Applying the rules of indices in algebraic expression • Finding values of unknown in problems involving indices	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts
Irrational Numbers	• Simplify given surds • Carryout basic operations involving surds	• Irrational numbers: - Surds • Operations - addition - subtraction	• Reducing surds to simplest form • Performing operations involving surds	• ICT tools • Brail materials • Talking books or software • Relevant texts

TOPIC 2: POLINOMIALS

SUB TOPIC	LEARNING OBJECTIVES Learner should be able to:	CONTENT (Attitudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Polynomials	• define a polynomial • carryout basic operations involving polynomials	• Polynomials: - Definition - Operations	• Discussing polynomials • Performing basic operations with polynomials of order not more than three	• ICT tools • Brailel materials and equipment • Talking books or software • Relevant texts
Remainder Theorem	• state the remainder theorem • find the remainder of a polynomial when divisible by a given factor	• Remainder theorem	• Using the remainder theorem in identifying factor and remainder • Using the remainder theorem to solve problems involving polynomials	• ICT tools • Braille material and equipment • Talking books or software • Relevant texts
Factor Theorem	• Factorise given polynomials	• Factor theorem - factorisation	• Identifying factors for given polynomials	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

TOPIC 3: ALGEBRAIC IDENTITIES, EQUATIONS AND INEQUALITIES

SUB TOPIC	LEARNING OBJECTIVES Learner should be able to:	CONTENT (Attitudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Identities	• distinguish identities from equations • determine unknown coefficients using identities	• Identities: - Definition - unknown coefficient	• Comparing given polynomial expressions • Comparing coefficients of identical expressions	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts
Equations (up to order 3)	• solve given equations • solve a pair of simultaneous equations with at least one linear and at most one quadratic	• Equations: - Linear - Simultaneous - Quadratic - cubic	• solving equations (up to order 3) • Solving simultaneous equations with at least one linear and at most one quadratic	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts
Inequalities	• Solve given inequalities	• Inequalities - Linear - Quadratic	• Solving problems involving inequalities	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts

TOPIC 4: SEQUENCE AND SERIES

SUB TOPIC	LEARNING OBJECTIVES Learner should be able to:	CONTENT (Attitudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Sequence	• define a sequence • identify the elements of a sequence • identify the behaviour of sequences	• Sequences - notation • Behaviour of sequences - Periodic - Oscillatory - Convergent - divergent	• Discussing and identifying sequences • Observing and discussing the behavioural nature of given sequences	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts

TOPIC 4: SEQUENCE AND SERIES

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to:	CONTENT (Attitudes, Knowldeg and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Series	• define sigma notation • use the sigma notation to solve problems involving series • recognise arithmetic and geometric progressions • find the nth term and sum of the first n terms of an AP and GP • find sum to infinity of a geometric progression • solve problems involving series	• Series - Notation • Arithmetic progression (AP) • Geometric progression (GP)	• Finding sum of sequential terms using the sigma notation ($\sum$) • Using the AP or GP to find the nth term and sum of the n terms • Using the formula to find sum to infinity • Representing life phenomena using mathematical models involving series and exploring their applications in life	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts

TOPIC 5: COORDINATE GEOMETRY IN TWO DIMENSIONS

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to:	CONTENT (Attitudes, Knowldeg and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Coordinate Geometry in two Dimensions	• calculate the distance between two given points • calculate gradient between two points • find the equation of a straight line • find the equation of a normal to the given straight line	• Distance between two points • Gradient • Equation of a straight line • Parallel and perpendicular lines • Equation of a normal	• Calculating gradient between two points in a straight line • Discussing and deducing the relationship between gradients of parallel and perpendicular lines • Finding equations of parallel or perpendicular lines using the above relationships	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts

TOPIC 6: FUNCTIONS

SUB TOPIC	LEARNING OBJEC-TIVES Learners should be able to:	CONTENT (Atti-tudes, Knowldeg and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
FUNCTIONS	• define a function • find the domain and range • distinguish a function from given relations • recognise a one to one mapping • find inverse and composite functions • represent functions graphically	• Definitions • Domain • Range • One to one mapping • Inverse functions • Composite function • Graphical illustration	• Discussing and deducing the concept of a function. • Identifying domains and ranges of functions • Deducing an inverse function • Sketching graphs using function properties such as one to one function	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts

TOPIC 7: QUADRATIC FUNCTIONS

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to:	CONTENT (Atti-tudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIV-ITIES	SUGGESTED RE-SOURCES
Quadratic Functions	• state the quadratic expression • solve quadratic equations • recognise a quadratic function as a two to one mapping • find its maximum /minimum using the graph or completion of a square • use the discriminant to determine the nature of the roots of the quadratic equation	• Quadratic expression • Quadratic equation • Quadratic function • Maximum / minimum value • Nature of roots	• Discussing and identifying quadratic relations as a function • Sketching the graphs to identify the maximum and minimum values • Solving problems involving quadratic equations • Using the algebraic approach such as the coefficient of the quadratic variable to determine the nature of the turning point and line of symmetry	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts

TOPIC 8: LOGARITHMIC FUNCTIONS

SUB TOPIC	LEARNING OBJECTIVES Learners should be able to:	CONTENT (Attitudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Logarithmic and Exponential Functions	• define a logarithmic function • use laws of logarithms to solve logarithmic and exponential equations • express logarithms as exponential functions and vice versa • sketch logarithmic graph and its inverse • solve the logarithmic and exponential equations	• Logarithms: - Definition - Laws - Sketch graphs and their inverse • Logarithmic equations • Exponential equations	• Discussing logarithmic function • Discussing the laws of logarithms • Solving Logarithmic and exponential equations • Using logarithmic properties to sketch graphs	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts

TOPIC 9: TRIGONOMETRY

SUB TOPIC	LEARNING OBJECTIVES Learners should be able to:	CONTENT (Attitudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Trigonometry	• state the three basic trigonometric ratios • deduce the other three trigonometric ratios • identify trigonometric relations as functions • sketch graphs of trigonometric functions • prove simple trigonometric identities • solve trigonometric equations using some identities	• Trigonometry: - Ratios - Simple identities - Simple equations • Trigonometric Functions	• Discussing the three basic trigonometric ratios • Using quadrants of a circle to deduce trigonometric ratios • Sketching graphs trigonometric functions • Using simple identities to solve trigonometric equations	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

TOPIC 10:   DIFFERENTIATION

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to	CONTENT (Atti-tudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIV-ITIES	SUGGESTED RE-SOURCES
Differentiation	• find the gradient of a straight line • approximate the gradient of a tangent on the curve at the point of contact using gradients of sequence of chords (from first principles) • recognize appro-priate notation for the derivation process of given functions • differentiate using quotient and product rules • apply differen-tiation to find gradients and equations of a normal and tangent to the curve • use differentiation to identify statio-nery points and their nature • apply differentia-tion to determine rates of change and approxima-tions	• Differentiation: - Gradient of a curve - Derivative notation - Rules of derivatives - Derivative of simple functions • Stationery Points - Maximum - Minimum • Application: - Tangent and normal Rates of change	• Discussing and deducing the gradient of curve at a point • Using operating rules to derive given functions such as ax^n, $\ln x$, $\sin x$, $\cos x$, $\tan x$, $1/x$, e^x • Using appropriate notation such as $f'(x)$, $dy/(dx,)$ $(d^2 y)/(dx^2)$ for the derivation process of given functions • Determining the nature of the stationery points using change of sign or second derivative test • Applying differenti-ation to determine rates of change	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts

TOPIC 11:   INTEGRATION

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to:	CONTENT (Atti-tudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIV-ITIES	SUGGESTED RE-SOURCES
Integration	• recognize integration as the reverse process of differentiation • integrate basic functions • apply integration to find area and volume under a curve	• Reverse process of differentiation • Notation • Integration of simple functions such as xn (including the case where n= -1), cosx, sinx,e^x • Application - Area under the curve	• Discussing the relationship between differentiation and integration • Integrating sim-ple functions which includes the following (ax+b)n, eax+b, sin (ax+b) (Integration is restricted to linear substitution) • Finding volumes and area under the curve using integra-tion	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

FORM FOUR (4)

9.0   COMPETENCY MATRIX: FORM 4

PROBABILITY AND STATISTICS

TOPIC 1: PROBABILITY

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to:	CONTENT (Atti-tudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIV-ITIES	SUGGESTED RE-SOURCES
Sets and Notation	• define probabil-ity, trial, sample space, outcome and events • illustrate different sample spaces • relate sets to events • illustrate two or more events using Venn diagrams	• Trial • Sample space • Outcomes and events • Venn diagrams	• Discussing probability terms • Carrying out experiments to illustrate proba-bility space and outcome • Discussing Venn diagrams • Demonstrating events on Venn diagrams	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts
Approaches to Probability	• describe the basic approaches to probability	• Objective proba-bility - Experimental - Classical • Subjective proba-bility	• Discussing the various types of probabilities	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts
Addition amd Prod-uct Rules	• apply addition rule for mutually exclusive events • apply the product rule for indepen-dent events • calculate probability using tree diagrams and outcome tables	• Mutually exclusive events • Independent events • Outcome tables • Tree diagrams • Addition rule • Product rule	• Discussing the concepts of mutually events and Independent events • Calculating probabilities using outcome tables and/ or tree diagrams	• ICT tools • Brail materials and equipment • Talking books or software
Conditional Proba-bility	• define conditional probability • solve probability problems involv-ing conditional probabilities	• Conditional probability • Diagrams	• Discussing conditional probability • Solving problems on conditional probabilities	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts

TOPIC 2: DATA COLLECTION AND PRESENTATION

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to	CONTENT (Atti-tudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIV-ITIES	SUGGESTED RE-SOURCES
Statistical Key Terms	• define statistical key terms - statistics, - data - frequency - tally system, - population and - samples	• Definition of statistical key terms such as: - Statistics data - Frequency - Tally system - Population samples	• Discussing statistical terms using illustarions and appropriate examples	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts
Sources and types of data	• state the source of data • classify data • state the types of data in Statistics • distinguish between primary and secondary data	• Data - Sources - Classification - Types - merits and demerits	• Discussing the sources, classes and types of data • Classifying data • Distinguishing forms of data	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts
Data Collection	• outline methods of collecting data • organise data in appropriate tables • summarise data in appropriate forms	• Data collection methods • Forms of data presentation	• Collecting data • Organising and summarising data through appropriate tables and graphs	• ICT tools • Brail materials and equipment • Talking books or software

TOPIC 3. MEASURES OF CENTRAL TENDENCY AND DISPERSION

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to	CONTENT (Atti-tudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIV-ITIES	SUGGESTED RE-SOURCES
The Measures of Dentral Tendency	• calculate mean, mode and median	• Mean • Mode • Median (grouped and ungrouped data)	• Discussing the relationship between mean, mode and median • Calculating mean, mode and median of a distribution	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

TOPIC 3. MEASURES OF CENTRAL TENDENCY AND DISPERSION

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to	CONTENT (Attitudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Measures of Dispersion	• define measures of dispersion • calculate measures of dispersion • explain the importance of measures of dispersion	• Variance • Standard deviation • Range • Interquartile range • Coefficient of Variation	• Calculating measures of dispersion • Discussing the use of measures of dispersion	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

TOPIC4 : DISCRETE AND CONTINOUS PROBABILITY DISTRIBUTIONS

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to:	CONTENT (Attitudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Discrete random variables	• define discrete random variable and its probability distribution • use probability distribution table to find - E(x) - Var (x) - unknown values in the probability distribution table • state characteristics of a Binomial model • use the Binomial probability density function to calculate probabilities • calculate mean and variance of the Binomial distribution	- Discrete random variables - Probability distribution of a discrete variable - Binomial probability distribution - E(x), Var(x) - Binomial distribution - Mean and variance of binomial distribution	• Discussing application areas of the discrete random variables • Calculating E [x], Var [x] and unknown values in the probability distribution table • Discussing the characteristics of a Binomial distribution • Calculating probabilities using the Binomial probability density function • Calculating mean and variance of the distribution • Representing life phenomena using mathematical models involving series and exploring their applications in life	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

TOPIC4 : DISCRETE AND CONTINOUS PROBABILITY DISTRIBUTIONS

SUB TOPIC	LEARNING OBJECTIVES Learners should be able to:	CONTENT (Attitudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Continuous random variables	• define continuous random variable and its probability density function • Find the mean and variance • calculate probabilities using the probability density function	• Continuous random variable • probability density function (pdf) • Mean and variance of a continuous random variable	• Discussing application of the continuous random variables • Finding E(x) and Var (x) of continuous random variables • Using probability density function to calculate the probabilities	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

TOPIC 5: NORMAL DISTRIBUTION

SUB TOPIC	LEARNING OBJECTIVES Learners should be able to:	CONTENT (Attitudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Normal Distribution	• explain the characteristics of normal distribution curve • use the standard normal variable to find the probabilities • use standard normal tables (including finding z when Φ (z) is known) • Find mean and variance	• The normal distribution curve • Probability • Mean and variance	• Standardising variables • Using standard normal tables • Calculating probabilities • Finding mean and variance	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

TOPIC 6: SAMPLING

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to:	CONTENT (Atti-tudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIV-ITIES	SUGGESTED RE-SOURCES
Sampling	• explain the basic sampling methods • choose samples using randomness and non-ran-domness • apply the sam-pling methods to identify represen-tative samples • use (without proof) the Central Limit Theorem	• Sampling tech-niques • Random and non-random sampling • Expectation and sample mean • Central Lmit Theorem • Distribution of sample mean, $\bar{x}$ (when population of X is normal)	• Distinguishing between the use of sample and population • Choosing sam-ples to represent a population • Solving problems involving the use of Central Limit Theorem	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

TOPIC 7: ESTIMATION

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to:	CONTENT (Atti-tudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIV-ITIES	SUGGESTED RE-SOURCES
Estimation	• recognise the importance of estimation • calculate unbi-ased estimators of population mean and variance. • use point and interval estimators to a given margin of error/signifi-cance level of 5% or 1 %	• Point estimation - Mean and variance • Interval estimation - Confidence interval for mean of the population mean of a normal population with known variance and large sample	• Discussing concept of estimation and its application • Calculating unbiased estimators of population mean and variance • Calculating standard error of the mean • Calculating confi-dence interval	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts

10.0 COMPETENCY MATRIX: FORM 4

FORM FOUR (4)
MECHANICS

TOPIC 1: KINEMATICS OF MOTION IN A STRAIGHT LINE

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to:	CONTENT (Atti-tudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIV-ITIES	SUGGESTED RE-SOURCES
Kinematics of Motion in a Straight Line	• define a vector and a scalar quantity • sketch (x-t) and (v-t) graphs • find gradient of (x-t) and (v-t) graphs • distinguish between velocity and acceler-ation • use the equations of motion to solve kine-matics problems	• Vector and scalar quantity • Distance and speed - x – t graphs - Gradient as Velocity • Velocity and accel-eration - v – t graphs - Gradient as accel-eration • Equations of motion	• Discussing the concept of change of the subject of the formulae • Discussing the relationship between gradient, velocity and acceleration • Sketching (x-t) and (v-t) graphs • Finding distance, velocity and acceler-ation from graphs • Solving equations of motion	• ICT tools • Brail materials and equipment • Talking books or software • Relevant texts

TOPIC 2: FORCES AND EQUILIBRIUM

SUB TOPIC	LEARNING OB-JECTIVES Learners should be able to:	CONTENT (Atti-tudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIV-ITIES	SUGGESTED RE-SOURCES
Forces and Equilib-rium	• define force • identify the forces acting in a given situation • represent forces by vectors • find resultants and components of vectors	• Types of forces • Representation of force by vectors • Resultants and components • Composition and Resolutions • Equilibrium of a particle • Friction	• Sketching and labelling of forces on a plane • Identifying forces acting on a body in equilibrium	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

TOPIC 2: FORCES AND EQUILIBRIUM

SUB TOPIC	LEARNING OBJECTIVES Learners should be able to:	CONTENT (Attitudes, Knowldege- and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Forces and Equilibrium	• use resultants and components of vectors to formulate equations • represent contact force between two surfaces by two components, the 'normal force' and 'frictional forces' • use the principle that, when a particle is at equilibrium the vector sum of the forces acting is zero • solving problems involving forces and equilibriums		• Calculating resultant forces and or unknown variables • Educational Tours • Representing life phenomena using mathematical models involving series and exploring their applications in life	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

TOPIC 3: NEWTON'S LAWS OF MOTION

SUB TOPIC	LEARNING OBJECTIVES Learners should be able to:	CONTENT (Attitudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Newton's Laws of Motion	• state Newton's laws of motion • apply Newton's laws of motion to the linear motion of a body of constant mass moving under the action of constant forces	• Newton's laws of motion • Application	• Discussing the Newton's laws of motion • Using Newton's laws of motion in problem solving • Interpreting solutions in familiar and unfamiliar contexts	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

TOPIC 4: ENERGY, WORK AND POWER

SUB TOPIC	LEARNING OBJEC-TIVES Learner s should be able to:	CONTENT (Atti-tudes, Knowldege and Skills)	SUGGESTED NOTES AND ACTIV-ITIES	SUGGESTED RE-SOURCES
Energy, work and power	• explain the con-cepts of gravitational potential energy • use the principle of energy conservation to solve problems involving energy • calculate the work done by a constant force when its point of application under-goes a displacement • apply the definition of power as the rate at which work is done	• Energy • Work • Power • Principle of energy conservation	• Discussing the con-cept of total energy, potential and kinetic energy • Demonstrating simple experiments on conservation of energy • Calculating power	• ICT tools • Braille materials and equipment • Talking books or software • Relevant texts

11.0: ASSESSMENTS

11.1 Assessment

The assessment will test candidate's ability to: -
• recall and use manipulative techniques
• interpret and use mathematical data, symbols and terminology
• comprehend numerical, algebraic and spatial concepts and relationships
• recognise the appropriate mathematical procedure for a given situation
• formulate problems into mathematical terms, select and apply appropriate techniques of solutions

11.2 Scheme of Assessment

Forms 3 to 4 Aadditional Mathematics assessment will be based on 30% continuous assessment and 70% summative assessment.

The syllabus' scheme of assessment is grounded in the principle of equalisation of opportunities hence, does not condone direct or indirect discrimination of learners.

Arrangements, accommodations and modifications must be visible in both continuous and summative assessments to enable candidates with special needs to access assessments and receive accurate performance measurement of their abilities. Access arrangements must neither give these candidates an undue advantage over others nor compromise the standards being assessed.

Candidates who are unable to access the assessments of any component or part of component due to disability (transitory or permanent) may be eligible to receive an award based on the assessment they would have taken.

NB For further details on arrangements, accommodations and modifications refer to the assessment procedure booklet.

a) Continuous Assessment
Continuous assessment for Form 3 – 4 will consists of assignments, tests, projects and tasks to measure soft skills

i. Topic Tasks
These are activities that teachers use in their day to day teaching. These should include practical activities, assignments and group work activities.

ii. Written Tests
These are tests set by the teacher to assess the concepts covered during a given period of up to a month. The tests should consist of short structured questions as well as long structured questions.

iii. End of term examinations
These are comprehensive tests of the whole term's or year's work. These can be set at school, district or provincial level.

iv. Project
This should be done from term one to term five.

a. Summary of Continuous Assessment Tasks
From term one to five, candidates are expected to have done the following recorded tasks:
• 1 Topic task per term
• 2 Written tests per term
• 1 End of term test per term
• 1 Project in five terms

Detailed Continuous Assessment Tasks Table

Term	Number of Topic Tasks	Number of Written Tests	Number of End Of Term Tests	Project	Total
1	1	2	1		
2	1	2	1		
3	1	2	1	1	
4	1	2	1		
5	1	2	1		
Weighting	25%	25%	25%	25%	100%
Actual Weight	7.5%	7.5%	7.5%	7.5%	30%

11.3 Specification Grid for Continuous Assessment

Component Skills	Topic Tasks	Written Tests	End of Term	Project
Skill 1 Knowledge Comprehension	50%	50%	50%	20%
Skill 2 Application Analysis	40%	40%	40%	40%
Skill 3 Synthesis Evaluation	10%	10%	10%	40%
Total	100%	100%	100%	100%
Actual weighting	3%	7.5%	15%	4.5%

b) Summative Assessment

The examination will consist of 2 papers: paper 1 and paper 2.

Additional Mathematics paper 1 (Pure Mathematics)

Duration: Two hours thirty minutes (2 ½ hrs)

The paper consists of two sections, Section A and Section B

Section A: Compulsory short answer structured questions, (marked out of 52)

Section B: Long answer structured questions, candidates choose four question from a total of six questions (marked out of 48)

Additional Mathematics paper 2 (Mechanics and Statistics)

Duration: Two hours thirty minutes (2 ½ hrs)

The paper consists of three sections: Section A, Section B and Section C

Answer all questions in Section A and any five from either section B and or Section C

Section A: It will consist of 4 compulsory questions selected from Mechanics and Statistics (marked out of 40)

Section B: It will consist of 7 questions from Mechanics Section of the syllabus where candidates choose at most 5 questions each carrying 12 marks (marked out of 60)

Section C: It will consist of 7 questions from Probability and Statistics Section of the syllabus where candidates choose at most 5 questions each carrying 12 marks (marked out of 60)

The tables below show the information on weighting, types of papers to be offered and the time allowed for each paper.

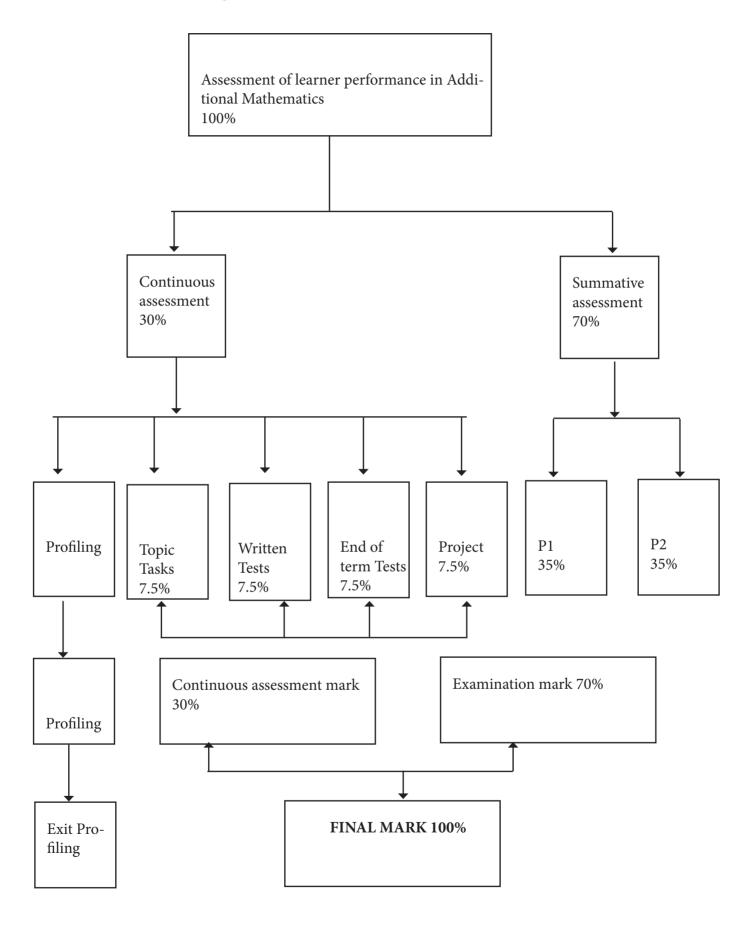|	P1	P2	Total
Weighting	50%	50%	100%
Actual weighting	35%	35%	70%
Type of Paper	**Section A (52 Marks)** 4 compulsory short answers structured questions **Section B (48 Marks)** 4 structured questions	**Section A (40 Marks)** 4 structured questions **Section B (60 Marks)** 5 structured questions **Section C (60 Marks)** 5 structured questions	
Marks	100	100	

Specification Grid for Summative Assessment

	P1	P2	Actual Weighing
Skill 1 Knowledge & Comprehension	50%	40%	31.5%
Skill 2 Application & Analysis	40%	45%	29.75%
Skill 3 Synthesis & Evaluation	10%	15%	8.75%
Total	100%	100%	
Weighting	35%	35%	70%

9.3   ASSESSMENT MODEL

Learners will be assessed using both continuous and summative assessments.