ZIMBABWE

MINISTRY OF PRIMARY AND SECONDARY EDUCATION

CURRICULUM DEVELOPMENT AND TECHNICAL SERVICES

ADDITIONAL MATHEMATICS

SECONDARY SCHOOL LEVEL

FORMS 3 - 6

2015-2022

TEACHER'S GUIDE

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1.0 ORGANISATION OF THE TEACHERS` GUIDE

This teachers' guide was designed taking into cognisance the need to guide you teachers in developing and employing teaching methods in Additional Mathematics. The guide draws from the Additional Mathematics syllabus. It also clarifies aspects contained in the syllabus. This guide assists the teacher to explore teaching strategies that help the learner to acquire necessary skills and competencies. As a teacher you should be able to go beyond this guide by reading relevant material.

This Teachers' Guide is divided into two parts:

Part A -Critical Documents
- Curriculum Framework
- National syllabus
- School syllabus
- Scheme of work
- Lesson plan
- Progress records
- Learner Profile
- Attendance Register

Part B - Curriculum Delivery
- Content
- Objectives
- Methodology
- Teaching-learning materials
- Assessment and Evaluation
- Class Management
- Scope of the Guide

2.0 PART A: CRITICAL DOCUMENTS

Introduction

The critical documents assist you the teacher in handling the Additional Mathematics learning area. As a teacher you need to have the following critical documents in order to deliver the curriculum effectively. You should have the following:

- Curriculum Framework
- National Syllabus
- School syllabus
- Schemes of Work/Scheme Cum Plan
- Lesson Plans
- Learner Profile
- Records
- Register of Attendance

Rationale

The aim is to enable teachers to apply suitable teaching methods that allow learners to explore mathematical and scientific concepts as they are central to most facets of everyday life and enterprise skills. The learning area plays a pivotal role in Science, Technology, Engineering and Mathematics (STEM). The teachers` guide promotes problem solving, innovativeness, confidence, self-actualisation and classroom based research.

It is therefore important as a teacher to expose learners to mathematical and scientific knowledge. This enables learners to manipulate objects and interact with their environment.

Objectives

It is hoped that after going through this part, you will be able to:

- gain an insight into the philosophy of education underpinning the curriculum
- manage your class effectively
- mobilise the teaching and learning resources
- prepare engaging and appropriate teaching aids
- track the learner's progress during the learning process

UNIT 1

Curriculum for Primary and Secondary Education (2015-2022)

Introduction

This is a policy document that outlines underpinning principles, national philosophy, learning areas, the description and expectations of Ministry of Primary and Secondary Education (MOPSE) at policy level. It prescribes what the government expects you to deliver as you go about your duties. The Zimbabwe Curriculum framework sets out the common aims and objectives of the education system and the specific features of different education levels, thereby providing the basis for transparent relationships between schools, parents, and local communities. It also provides guidance to schools and education administrators in the organization, management and evaluation of the effectiveness of the school activities. Schools are encouraged to actively engage, as learning organisations, in providing diversified opportunities for all learners to develop the knowledge, key skills and attitudes defined in this framework. This framework is intended to be the main reference document informing the development of syllabuses, revision of syllabuses, development and use of learning resources and the creation of guidelines for in-service teacher training and support. This Curriculum Framework sets out what learners are expected to know, understand, value and be able to do as a result of their learning experiences in schools and non-formal education settings from Early Childhood Development (ECD) to secondary level. Its fundamental purpose is to provide a structure around which schools can build educational programmes that ensure learners achieve desired outcomes. This framework identifies learning areas for all learners. It is intended to guide schools and teachers, stakeholders and parents over the curriculum process in a rapidly changing environment.

Objectives of the Curriculum:

The Curriculum was developed to:
- promote and cherish the Zimbabwean identity
- Prepare learners for life and work in a largely agro-based economy and an increasingly globalised and competitive environment.
- foster life-long learning in line with the opportunities and challenges of the knowledge society
- Prepare learners for participatory citizenship, peace and sustainable development
- Prepare and orient learners for participation, leadership and voluntary service

Key Elements

The Curriculum of Zimbabwe is made up of the following key elements:
- Background
- Principles and values guiding the curriculum
- Goals of the curriculum
- Learning areas
- Teaching and learning methods
- Assessment and learning
- Strategies for curriculum implementation
- The future

UNIT 2

SYLLABUS INTERPRETATION

Introduction

Syllabus interpretation is the process of making sense out of the syllabus. Interpretation is about finding meaning. It is the process of unpacking the syllabus, analysing it and synthesising it.

Objectives

As a teacher you therefore need to be familiar with the two syllabuses, that is the national syllabus and the school syllabus. This will assist you in your lesson delivery.

Types of School syllabuses

2.1 National Syllabus

It is a policy document that outlines and specifies the learning area philosophy, aims and objectives, Learning/teaching concepts and content, suggested methodology and assessment criteria at every form level. As a teacher you should always have it and use it to guide you in your day to day teaching and learning activities.

Aims: general direction in which you should be guiding your learners (long term)
Objectives: learner behavior after treatment
Assessment objectives: examination oriented (what is to be tested)
Content: topics or aspects to be covered
Methodology: teaching approaches to achieve desired learning outcomes
       Learner-centred approaches allow learners to practice skills learnt
Examination format: how learners will be assessed

2.2 School Syllabus

This must be drawn from the National Syllabus by reorganising content taking into account local factors. It is a breakdown of the national/official syllabus to suit the contextual environment into which the school is located but without changing the content of the national syllabus. This document is drafted at school level by the teachers.
Influenced by:
- Level of learner performance (knowledge they already have)
- Facilities and funds available
- Time allocation in the official syllabus
- Local conditions that affect the choice and sequencing of topics
- Supply of textbooks and other teaching materials
- Education technology
- Community influences

Structure of School Syllabus

- Aims: broad indication of what the learners should learn
- Objectives: learner behavior at the end of the teaching-learning experience
  (competencies)
- Topics/Activities (Content)
- Methodology (Learner – Centred)
- Instructional Or Teaching Materials
- Assessment/Evaluation

UNIT 3

SCHEMES OF WORK/ SCHEMECUM PLANS

SCHEME OF WORK (WEEKLY BREAKDOWN)

By the end of this unit, you should be able to:
- describe the essential components of a scheme plan
- develop a scheme plan
- explain the advantages of writing down your plan
- Realise the merits of planning your lessons well in advance

Definition:

This is a document that you as a teacher should draw from the national and school syllabus. You should outline the objectives, activities, content, and methodologies. A scheme of work is therefore a plan of action, which should enable you to organize teaching activities ahead of time. It is a summarized forecast of work, which you consider adequate and appropriate for the class to cover within a given period from those topics, which are already set in the syllabus.

COMPONENTS

The components of a scheme of work include the following aspects:
- **Level of learners:** state the level (grade/form) of learners you are scheming for.
- **Learning Area:** indicate the learning area you are scheming for
- **Week ending:** the date should be clearly indicated
- **Topic/Key concepts/Skills:** topics should follow the order, which they are supposed to be taught, from simple to complex.

Objectives: each lesson should have objectives, which pinpoint the anticipated learning behaviour of the learners. The objectives must be stated in a manner that there is a measurable aspect manifested at the end of the lesson for example, learners should be able to conduct fire drills.

FORM 3 SCHEMES OF WORK

Learning area: Additional Mathematics form 3
Aims
- acquire mathematical skills to solve problems related to industry and technology
- further develop mathematical concepts and skills for higher studies
- use mathematical skills in the context of more advanced techniques such as research
- apply additional mathematics concepts and techniques in other learning areas
- develop an appreciation of the role of mathematics in personal, community and national development (Unhu/Ubuntu/Vumunhu)
- use I.C.T tools effectively to solve mathematical problems
- apply additional mathematical skills and knowledge in relevant life situations
- enhance confidence, critical thinking, innovativeness, creativity and problem solving skills for sustainable development

WEEK ENDING	TOPIC/ CONTENT	OBJECTIVES	COMPETENCIES/ SKILLS/ KNOWLEDGE	MEDIA	S.O.M/ REFERENCES	METHODS/ ACTIVITIES	EVALUATION
16/12/16	INDICES	By the end of the lesson learners should be able to: ● define an index ● use the laws of indices in algebraic application ● solve equations involv ing indices	● critical thinking ● analytical thinking ● problem solving	● ICT tools(over-head pro-jector and laptop to display laws of indices) ● Work cards	● Additional Mathematics) National Syllabus page 13 ● Additional Mathematics Pu-pils Book 3 page 61-63	● Explaining the term index ● Discussing the laws of indices ● Demonstrat-ing the use of indices ● Solving equations involving indi-ces in groups	Should show strength and weak-nesses of method-ology, and whether objectives were achieved. Map the way forward. This forms the basis for remedial work

SCHEME–CUM PLAN: PURE MATHEMATICS

LEVEL FORM 3

Aim: Develop an ability to apply Pure Mathematics in life and other subjects, particularly Science and Technology.

Week ending	Topic/ Content	Objectives	Methodology and Activities	Competencies (skills, knowledge and attitudes)	References/ Source of material	Media/ Resources	Evaluation
16/12/16	INDICES Lesson 1 Definition Laws of indices	by the end of the lesson learners should be able to: ● define an index ● use the laws of indices to simplify algebraic expressions	Introduction -Learners state examples of indices as asked by the teacher **Step 1 :Brainstorming** -on the laws of indices **Step 2 Demonstration** -learners demonstrate simplification of indices following examples done by the teacher **Step 3 Individual work** -learners write exercise on simplifying indices **conclusion** -summarising main points	● critical thinking ● analytical thinking ● problem solving	● Pure Mathematics) National Syllabus page 5 ● Pure Mathematics Pupils Book 3 page 61-63	● ICT tools(overhead projector and laptop to display laws of indices) ● Print media	

Week ending	Topic/ Content	Objectives	Methodology and Activities	Competencies (skills, knowledge and attitudes)	References/ Source of material	Media/ Resources	Evaluation
16/12/16	Lesson 2 Equations	● solve equations involving indices	**Introduction** Recapping of the concepts of the previous lesson **Step 1 :Discussion** -class discussion on the laws of indices **Step 2: Group work** -on solving equations **Step 3 : Demonstration** Learners demonstrate solving equations **Step 4 : individual work** learnerswrite exercise on solving equations **conclusion** -revising selected questions	● critical thinking ● analytical thinking ● problem solving	● Pure Mathematics) National Syllabus page 5 ● Pure Mathematics Pupils Book 3 page 64	● ICT tools (overhead projector and laptop to display laws of indices ● Work cards	

UNIT 4

LESSON PLANS

Definition

This is a detailed daily plan of what you intend to deliver during the lesson. This is to be used in the event of you having drawn a scheme of work rather than a scheme cum plan.
Components of a lesson plan

A lesson plan is made up of the following components:
- Date
- form
- Time
- Learning area
- Topic/content
- Sub-topic
- SOM
- Teaching and learning aids
- Number of learners
- Assumed knowledge
- Lesson objectives
- Lesson steps
- Evaluation

Example of a lesson plan

The following is an example of a lesson plan drawn from the scheme of work above.
Detailed Lesson Plan

Date :   15 December 2016
Form :   3
Time: 11.30 -12.00
Learning Area   Additional Mathematics forms 3-4
Topic/Content: Indices
Sub-Topic: Laws of Indices
S.O.M: Additional Mathematics forms 3-4
                            National   Syllabus page 13
Equipment: ICT tools (overhead projector and laptop),
                            work cards
Number of learners: 45
Assumed Knowledge: Learners are able to state examples of Indices

Lesson Objectives
By the end of the lesson, learners should be able to:
- state the laws of indices
- use laws of indices to simplify algebraic expressions
- solve equations involving indices

INTRODUCTION: Learners state examples of indices
Stage 1: Learners discuss the laws of indices
Stage 2: Learners,demonstrate how to simplify algebraic expressions.
Stage 3: Learners solve equations involving indices in groups.

Stage 4: individual written workon solving indices equations

Conclusion: learners and the teacher summarises the lesson by highlighting main points

LESSON EVALUATION:

Strength: ....
....
....
....

Weaknesses: ....
....
....
....

Way forward: ....
....
....
....

UNIT 5

RECORD KEEPING

Records are critical documents about the teaching – learning process, which you must keep as a teacher

They include:
- Syllabuses (National and School)
- Staff and pupil details
- Examination documents
- Mark lists
- Stock control registers

OBJECTIVES

By the end of this unit, you should be able to:
- identify the various records you are expected to keep
- prepare accurate records
- Interpret information from records to promote learning
- Maintain and keep records safely
- Appreciate the need to update records regularly

TYPES OF RECORDS
- Official syllabuses
- School syllabuses
- Records of staff details
- Records of learner details
- Supervision records
- Files, circulars, handouts, past exam papers
- Minutes of meetings
- Inventory of resource materials
- Stock control registers
- Learner Profiles
- Attendance Register

CONCLUSION

Effective teaching and learning requires you to have all the critical documents and to use them as required. You need to scheme, plan and prepare for your lessons well in advance. Furthermore, you need to familiarize yourself with the Ministry Of Primary and Secondary Education's Curriculum Framework.

3.0 PART B: CURRICULUM DELIVERY

Introduction

This section comprises of the content, Objectives, Methodology, Teaching-learning materials, Class management and Evaluation

RATIONALE

In its socio-economic transformation agenda, Zimbabwe has embarked on an Industrialisation development process, where high mathematical skills are a prerequisite. 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.

The Additional Mathematics forms 3-4 sand 5-6 syllabi enables learners to develop skills in:

- Problem solving
- Critical thinking
- Decision making
- Leadership
- Self-management
- Communication
- Technology and innovation
- Enterprise

CROSS CUTTING THEMES

In order to foster competence development for further studies, life and work, the teaching and learning of Additional Mathematics for forms 3 - 4 and forms 5-6 should integrate the following cross cutting themes:

- 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

3.1 OBJECTIVES

By the end of this unit, you should be able to:
- select appropriate teaching methods for your lessons
- use a variety of learner-centred approaches
- plan and organise study tours
- help pupils carry-out projects or experiments

3.2 CONTENT

The guide covers the following aspects:
- Syllabus interpretation
- Content
- Methodology
- Teaching-learning materials
- Class management
- Record keeping
- Evaluation

3.3 METHODOLOGY

- As a teacher it is important for you to use problem-solving and learner-centred approaches:
- You are the facilitator
- The learner is the doer

OBJECTIVES

By the end of this unit, you should be able to:
- select appropriate teaching methods for your lessons
- use a variety of learner-centred approaches
- plan and organise study tours
- help pupils carry-out projects or experiments

Teaching methods can be grouped under three main categories:
a) Cognitive development methods
b) Affective development methods
c) Psychomotor development methods

a) Cognitive development methods
These are mainly:
- Discussion Method
- Questioning/Socratic Method
- Team Teaching Method
- Talk Chalk/Recitation Method
- Field Trip/Educational tours Method
- Team Teaching Method
- Question and Answer

b) Affective development methods
- Modelling Method
- Simulation Method
- Dramatic Method

- Simulation Games
- Role-Playing Method
- Gallery walk
- Observation
- Lecture

c) Psychomotor development methods

These are more learner activity based and heuristic
- Inquiry Method
- Interactive e-learning
- Discovery Method
- Process Approach Method
- Demonstration Method
- Laboratory/Experimentation Method
- Programmed Learning Method
- Dalton Plan/Assignment Method
- Project Method, case studies
- Microteaching Method
- Mastery Learning
- Song and dance
- Your subject matter should determine the most suitable teaching method/methods to use.
- The instructional objectives to be achieved by the end of the lesson also determine the choice of teaching methods.
- You must be very familiar with the teaching methods you want to use and be convinced they are the most appropriate for that lesson.
- You must consider the age, interest, level of development of the learners and ensure that all learners will benefit from the method you have chosen.
- You must consider time in relation to the methods chosen.
- You should consider the environment and the size of the class in settling for methods to employ.

3.4 INSTRUCTIONAL (TEACHING-LEARNING) AIDS

- help learners to learn better and faster
- capture learners` interest
- create virtual reality

OBJECTIVES

By the end of this unit, you should be able to:
- select appropriate instructional aids
- make good quality aids from available resources
- use instructional aids effectively
- Design meaningful and effective instructional aids

TYPES OF INSTRUCTIONAL-LEARNING AIDS:

The following are some of the learning aids you can use as a teacher:
- charts,
- chalkboard,
- whiteboard,

- computers,
- slides,
- films,
- videos,
- flannel
- graph,
- textbooks

3.5 ASSESSMENT AND EVALUATION

- Measuring the success of teaching in terms of teacher and learner performance
- Provides feedback on the acquisition of knowledge, skills and attitudes by learners

OBJECTIVES

By the end of this unit, you should be able to:
- evaluate both your work and that of the learners
- identify the essential evaluation methods that you can use
- prepare marking schemes for the various activities or projects

METHODS OF EVALUATION

- Tests and exercises
- Projects
- Examinations
- Assignments

3.6 CLASS MANAGEMENT

Process of planning, organising, leading and controlling class activities to facilitate learning

OBJECTIVES

By the end of this unit, you should be able to:
- create an effective learning environment
- motivate the learners
- maintain discipline
- supervise class activities

ORGANISATIONAL SKILLS FOR EFFECTIVE LEARNING

Classroom organisation which covers:
- physical environment
- emotional environment
- grouping the learners
- class control and discipline
- supervision

PHYSICAL ENVIRONMENT

- Classroom to be clean, tidy and airy
- Safety considerations when arranging furniture
- Teaching aids to be visible to learners

EMOTIONAL ENVIRONMENT

- Be firm, warm and pleasant
- Set the right tone
- Tell learners what behaviour you expect

GROUPING

- Learners may be grouped according to needs, abilities, problems but not sex
- Promote sharing of ideas among learners

CLASS CONTROL AND DISCIPLINE

- Know the schools policy on discipline
- Be firm and fair
- Punishment should be corrective
- Acknowledge good behavior
- Make use of prefects and class monitors
- Create an atmosphere of trust and honesty
- Aim for intrinsic discipline

MOTIVATION

- Make learners feel important
- Recognise and reward excellence
- Be a role model in terms of your demeanour

SUPERVISION

- Check learners` work in order to guide and correct them
- Areas that require supervision include practical work, written work, discussions, group work and field trips

UNIT 6: SCOPE OF THE GUIDE

SYLLABUS TOPICS

It is important for you as an Additional Mathematics teacher to know the topics that are covered and how they are listed according to levels as shall be revealed below. You should also be able to state the objectives, methods, teaching and learning materials, records and evaluation techniques for each topic.

Additional Mathematics forms 3-4 learning area has 13 broad topics as stipulated below.
The following topics will be covered from Form 3 - 4

Pure Mathematics

- Indices and irrational numbers
- Polynomials
- Algebraic Identities, equations and inequalities
- Sequences and Series
- Coordinate geometry in two dimensions
- Functions
- Quadratic functions
- Logarithmic and Exponential functions
- Trigonometrical functions
- Differentiation
- Integration

Probability and Statistics

- Probability
- Data collection and Presentation
- Measures of central tendency and dispersion
- Discrete and continuous probability distributions
- Normal distribution
- Sampling Methods
- Estimation

Mechanics

- Kinematics of motion in a straight line
- Forces and equilibrium
- Newton's Laws of motion
- Energy, Work and Power

NB: For learning areas under forms 5-6 see pages 30-33 of this guide

TOPIC

DATA COLLECTION AND PRESENTATION

Objectives (learner – behaviour)
By the end of the unit learners should be able to:
- define statistical key terms
- statistics,
- data
- frequency
- tally system,
- population and
- samples
- state the source of data
- classify data
- state the types of data in Statistics
- distinguish between primary and secondary data
- outline methods of collecting data
- organise data in appropriate tables
- summarise data in appropriate forms

Sub topics
STATISTICAL KEY TERMS
- Statistics data
- Frequency
- Tally system
- Population
- Samples
- **SOURCES AND TYPES OF DATA**
- Sources
- Classification
- Types
- merits and demerits of sources of data
- **DATA COLLECTION**
- Data collection methods
- Forms of data presentation

ACTIVITIES
- Discussing statistical terms
- Discussing the sources, classes and types of data
- Classifying data
- Distinguishing forms of data
- Collecting data
- Organising and summarising data through appropriate tables

METHODOLOGY (learner - centredness)
- Project based learning
- Educational tours
- E-learning
- Collections
- Demonstrations
- Resource person(s)

TEACHING-LEARNING AIDS
- ICT Tools
- Data collection instruments
- Local environment
- Audio and Visual Materials
- Educational tours

Evaluation

Should show strength and weaknesses of methodology, and whether objectives were achieved. Map the way forward. This forms the basis for remedial work.

TOPIC 2

ENERGY, WORK AND POWER

Objectives (learner – behaviour)

By the end of the unit learners should be able to:
- explain the concepts of gravitational, elastic and kinetic potential energy
- solve problems using the principle of energy conservation
- describe the concept of work done by force
- calculate work done by constant force when its point of application undergoes a displacement
- define power
- calculate power
- Solve problems involving energy and power.

SUB TOPICS
- Energy
  - gravitational potential
  - elastic potential
  - kinetic
- Work
- Power
- Principle of energy conservation

ACTIVITIES
- Discussing concepts of gravitational, elastic and kinetic potential
- Conducting experiments to demonstrate conservation of energy such as falling objects.
- Calculating power
- Solving problems involving energy ,work and power
- Representing life phenomena using mathematical models involving energy, work and power and exploring their applications in life

METHODOLOGY (learner - centredness)
Project based learning
- Educational tours
- E-learning
- Group work
- Demonstrations
- Resource person(s)
- Research and presentations

TEACHING AND LEARNING AIDS
- ICT tools
- Local environment
- Talking books
- Braille materials
- Relevant text

Evaluation

Should show strength and weaknesses of methodology, and whether objectives were achieved. Map the way forward. This forms the basis for remedial work

Topics to be covered

Form 3	FORM 4	FORM 5	Form 6
Indices and irrational numbers	Discrete and continuous probability distribution	Rational fractions	Particle dynamics
Polynomials	Normal distributions	Summation of series	elasticity
Identities, equations and inequalities	Sampling methods	Hyperbolic functions	Energy, work and power
Sequences and Series	Estimation	Matrices and linear spaces	Circular motion (vertical and horizontal motion)
Coordinate geometry in two dimensions	Kinematics of motion in a straight line	Groups	Simple harmonic motion
Functions	Forces and equilibrium	Mathematical induction	Probability
Quadratic Functions	Newton's laws of motion	Polar coordinates	Random variables
Logarithmic and Exponential functions	Motion of a projectile	Vector geometry	Distributions
Trigonometrical functions	Momentum	Differentiation and integration	Sampling and estimation
Differentiation	Energy, work and power	Differential equations	Statistical inference
Integration			Bivariate data

CONCLUSION

This guide is not there to kill your innovativeness but just assist you as you embark teaching this new learning area. Any contributions that will improve our Teachers' Guide are welcomed. Just forward those contributions to Curriculum Development and Technical Services. If there are any teachers who are interest in writing these teachers' guides please just let us know so that we can make the necessary arrangements.

ANNEXURE   1
SYLLABUS SCOPE AND SEQUENCE

FORM 3-4 SCOPE AND SEQUENCE
PURE MATHEMATICS

TOPIC	FORM 3	FORM 4
Indices and irrational numbers	**Indices:** - Rules and notations - Algebraic application - Exponential equations **Irrational numbers:** - Surds - Operations	
Polynomials	**Polynomials:** - Definition - Operations **Factor theorem** - Factorisation **Remainder theorem**	
Identities, equations and inequalities	**Identities:** - Definition - unknown coefficient **Equations:** - Linear - Simultaneous - Quadratic **Inequalities:** - Linear - Quadratic	
Sequences and Series	**Sequences:** - Notation **Behaviour of a sequence** - Periodic - Oscillatory - Convergent - Divergent **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	

TOPIC	FORM 3	FORM 4
Functions	**Functions:** - Definitions - Domain - Range - One to one mapping - Inverse functions - Composite functions **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 **Exponential equations** **Logarithmic 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 **Stationary Points** - Maximum - Minimum **Application:** - Tangent and normal - Rates of change	
Integration	**Integration:** - Notation - Integration of simple functions **Application** - Area under the curve	

PROPABILITY AND STATISTICS

TOPIC	FORM 3	FORM 4

SETS AND NOTATION		**Set Language and notation**
		- Trial
		- Sample spaces
		- Outcome/events
		- Venn diagrams
		  Approaches to probability
		  Experimental
		  Objective
		  Classic
		  Subjective
		  Conditional probability
		  Addition and Product Rules
		- independent events
		- mutually exclusive events
		- Outcome tables
		- tree diagrams
		Conditional probability

Data collection and Presentation		Key Statistical terms - Statistics data - Frequency - Tally system - Population - Samples **Data** - Sources - Classification - Types - Merits and demerits of sources of data **Data collection methods** **Forms of data presentation**
Measures of central tendency and dispersion		The mean, median and mode (for grouped and ungrouped data) **Measures of dispersion** - Variance - Standard deviation - Coefficient of variation - Range - Interquartile range

TOPIC	FORM 3	FORM 4
Discrete and continuous probability distributions		**Discrete random variables** Probability distribution of a discrete variable Mean and variance of a discrete random variable Binomial probability distribution Continuous random variables Probability distribution of a continuous variable Mean and variance of a continuous random variable
Normal distribution		Properties of a normal distribution curve The standard normal variable(z) Probabilities Using standard normal tables (including reverse to find when z when ϕ(z) is known 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) Non- Probability sampling techniques
Estimation		**Point estimation** - Mean and Variance **Interval estimation** - Confidence interval (for mean of the population mean of a normal distribution with known variance and large sample size).

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

TOPIC	FORM 3	FORM 4
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** **Applications**
Energy, Work and Power		**Energy** **Work** **Power** **Principle of energy conservation**

FORM 5-6 SCOPE AND SEQUENCE

TOPICS	FORM 5	FORM 6
RATIONALFUNCTIONS	Partial Fractions Oblique Asymptotes Graphs	
SUMMATION OF SERIES	Standard results ($\sum r, \sum r^2, \sum r^3$) Method of differences Sum to infinity	
HYPERBOLIC FUNCTIONS	Six hyperbolic functions Identities Inverse notation	
MATRICES AND LINEAR SPACES	Linear equations Spaces and subspaces	
GROUPS	Properties Order of elements Simple subgroups LaGrange's theorem Structure of finite groups Isomorphism	
MATHEMATICAL INDUCTION	Proof by induction Conjecture	
POLAR COORDINATES	Cartesian and polar coordinates Polar coordinates curves Area of a sector	

TOPIC	FORM 3	FORM 4
VECTOR GEOMETRY	Triple scalar product Cross product Equations of lines and planes	
DIFFERENTIATION AND INTEGRATION	Higher order differentiation Concavity Reduction formulae Arc lengths Surface areas of revolution Differentiation and Integration of inverse trigonometric functions and hyperbolic functions	
DIFFERENTIAL EQUATIONS	First order differential equations Second order differential equations Complementary function General and Particular integrals Substitution Particular solution	

MECHANICS

TOPICS	FORM 5	FORM 6
PARTICLE DYNAMICS		Kinematics of motion Newton's laws of motion Motion of a projectile
ELASTICITY		Properties of elastic strings and springs Work done in stretching a string Elastic potential energy Mechanical energy Conservation of mechanical energy
ENERGY, WORK AND POWER		Energy Gravitational potential Elastic potential Kinetic Work Power Principle of energy conservation

TOPIC	FORM 3	FORM 4
CIRCULAR MOTION (Vertical and Horizontal)		Angular speed and velocity Horizontal and vertical circular motion Acceleration of a particle moving on a circle Motion in a circle with constant speed Centripetal force Relation between angular and linear speed Conical pendulum Banked tracks
SIMPLE HARMONIC MOTION		Basic equation of simple harmonic motion Properties of simple harmonic motion

STATISTICS

TOPIC	FORM 5	FORM 6
PROBABILITY		Events Independent Mutually exclusive Exhaustive Combined Conditional probability Tree diagrams Outcome tables Venn diagrams Permutations and combinations
RANDOM VARIABLES (discrete and continuous)		Probability distributions Expectation Variance Probability density functions (pdf) and cumulative distribution functions (cdf) Mean, median, mode, standard deviation and percentiles
DISTRIBUTIONS		Binomial distribution Poisson distribution Normal distribution Standard normal tables Continuity correction Linear combinations of normal and Poisson distributions

TOPIC	FORM 3	FORM 4
SAMPLING AND ESTIMATION		Probability sampling techniques Non-probability sampling techniques Estimation of population parameters Central limit theorem Confidence intervals
STATISTICAL INFERENCE		Null hypothesis Alternative hypothesis Test statistics Significance level Hypothesis test (1-tail and 2-tail) Type 1 and type 2 errors z- tests t – tests chi-squaredtests
BIVARIATE DATA		Scatter diagrams Regression lines Least squares Pearson`s Product moment correlation (r) Coefficient of determination (r2)