THE REPUBLIC OF UGANDA
Ministry of Education and Sports

ADVANCED SECONDARY CURRICULUM

PRINCIPAL MATHEMATICS SYLLABUS

NCDC
NATIONAL CURRICULUM DEVELOPMENT CENTRE
2025

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National Curriculum Development Centre
P.O. Box 7002,
Kampala- Uganda
www.ncdc.co.ug

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Contents

Foreword

The Ministry of Education and Sports, through the National Curriculum Development Centre (NCDC), aligned the Advanced Level Curriculum with the competency-based Lower Secondary Curriculum (LSC) to ensure a smooth learner transition from lower secondary to advanced level.

The two-year aligned Advanced Secondary Curriculum adopted learner-centered approaches, inquiry-based, and discovery methods. The learning outcomes give the learner hands-on experiences in real-life situations while being cognizant of different learner abilities and learning styles. The syllabus focuses on assessment for learning with emphasis on criterion-referenced assessment. It further provides learners with the opportunity to enhance the 21st-century skills and values that were acquired at the lower secondary level.

This Mathematics syllabus is fundamental in providing tools for analysing and interpreting data in all fields of life. It is also essential for logical reasoning and making informed decisions. It promotes acquisition of Higher-Order Thinking Skills (HOTS) such as inquiry, creativity and innovation, decision-making, critical thinking and problem-solving. It calls for the use of learner-centred pedagogies with hands-on experience by the learners in real life situations, while acknowledging different learner abilities and learning styles.

As the Minister responsible for Education, I endorse this syllabus as the official document for teaching and learning Mathematics at the Advanced Level of secondary education in Uganda.

Hon. Janet Kataaha Museveni

First Lady and Minister of Education & Sports

Acknowledgement

The National Curriculum Development Centre (NCDC) is indebted to the Government of Uganda for financing the alignment of the Advanced Level Curriculum to Lower Secondary Education in Uganda.

Our gratitude goes to the Ministry of Education and Sports for overseeing the adaptation of the curriculum, the Curriculum Task Force of the Ministry of Education and Sports for the oversight role and making timely decisions whenever necessary, and members of the public who made helpful contributions towards shaping this curriculum.

NCDC is also grateful to Members of Parliament, schools, universities, and other tertiary institutions, the writing panels, and professional bodies, for their input in the design and development of the Adapted A level curriculum. To all those who worked behind the scenes to finalise the adaptation process of this teaching syllabus, your efforts are invaluable.

NCDC takes responsibility for any shortcomings that might be identified in this publication and welcomes suggestions for effectively addressing the inadequacies. Such comments and suggestions may be communicated to NCDC through P. O Box 7002, Kampala, or Email: admin@ncdc.go.ug or on the Website: www.ncdc.go.ug

Dr Grace K. Baguma
Director
National Curriculum Development Centre

1.0 INTRODUCTION

The Advanced Secondary Curriculum has been aligned with the Lower Secondary competency-based model for ease of progression of learners from the Lower to Advanced Secondary Level. The alignment is a result of the analysis of the Advanced Level Curriculum published in 2013, to determine whether the content is:

i) appropriate,
ii) high pitched or overloaded,
iii) covered at lower secondary,
iv) obsolete, or
v) repeated in different topics and redundant.

The results from the curriculum analysis revealed that there were overlaps of concepts with what was covered at the Lower Secondary, as well as concepts within different topics of the same subject. In addition, a number of syllabuses had content that is no longer necessary for today's contemporary society and the 21st century.

1.1 Changes in the Curriculum

The alignment of the A-Level Curriculum to that of the Lower Secondary led to changes in the pedagogies of learning from a knowledge- and objective-based, to an integrated and learner-centred competency-based approach. The adapted syllabus, therefore, is a result of rationalising, integrating, and merging content with overlaps and similar skills, dropping topics that had been studied at Lower Secondary, or are no longer critical and relevant for the current learning needs, while upgrading those that were of low competencies to match with the advanced level. The programme planner details the learning progression derived from the learning outcomes. The detailed syllabus section unfolds the learning experiences with corresponding assessment strategies.

This Mathematics syllabus is part of the Advanced Secondary Curriculum. The teacher is encouraged to read the whole syllabus before planning your teaching programme, since many topics have been merged, upgraded, or removed. While aligning this syllabus, efforts were made to ensure a smooth progression of concepts from the Lower Secondary Level, adapting topics and content with familiar features that are of value to the learner and society. In addition, the process of developing this syllabus document removed what was considered obsolete, high pitched as well as content overlaps and overloads.

1.2 Classroom-Based Assessment

This syllabus requires classroom learning to be experiential, through the suggested learning activities for the acquisition of the learning outcomes. This is the gist of a learner-centred and activity-based approach to learning, which emphasises the acquisition of required competencies. Formative assessment in Mathematics will focus on the acquisition of knowledge and skills, through performance of the learning activities.

The learning activities sprout from the learning outcomes, which are evidenced by acquiring and demonstrating the application of the desired skills, to show that learning has taken place. The sample assessment strategies have been provided to guide the teacher on classroom-based assessment. The teacher can develop more assessment strategies based on the same principles of observation, conversation, and product, for the acquisition of the desired knowledge, skills, values, and attitudes. (See detailed syllabus)

1.3 Learners with Special Educational Needs

The Advanced Secondary Curriculum is designed to empower all learners, including those with Special Educational Needs (SEN), to reach their full potential and contribute meaningfully to the nation. By incorporating inclusive strategies, the curriculum ensures equitable access to high-quality learning opportunities while maintaining high academic standards. It emphasises creating an inclusive learning environment that supports the diverse needs of learners with SEN, enabling them to succeed alongside their peers.

1.4 Generic Skills

Generic skills are embedded within all subjects and are essential for learning and workforce readiness. These skills enable learners to engage with the entire curriculum effectively and prepare them for lifelong learning. These skills equip learners with the ability to adapt to change and navigate life's challenges in the 21st century.

The key generic skills include:

1

Critical thinking and problem-solving

i) Planning and carrying out investigations
ii) Sorting and analysing information
iii) Identifying problems and proposing solutions
iv) Predicting outcomes and making reasoned decisions
v) Evaluating different solutions

2

Co-operation and Self-Directed Learning

i) Working effectively in diverse teams
ii) Interacting effectively with others
iii) Taking responsibility for own learning
iv) Working independently with persistence
v) Managing goals and time

3

Creativity and Innovation

i) Using imaginations to explore possibilities
ii) Working with others to generate ideas
iii) Suggesting and developing new solutions
iv) Experimenting with innovative alternatives
v) Looking for patterns and making generalisation

4

Communication

i) Listening attentively and with comprehension
ii) Talking confidently and explaining ideas/opinions clearly
iii) Reading accurately and fluently
iv) Writing and presenting information coherently
v) Using a range of media to communicate ideas

5

Mathematical Computation

i) Using numbers and measurements accurately
ii) Interpreting and interrogating mathematical data
iii) Using mathematics to justify and support decisions

6

Information and Communication Technology (ICT) Proficiency

i) Using technology to create, manipulate and process information
ii) Using technology to collaborate, communicate and refine work

7

Diversity and Multicultural Skills

i) Appreciate cultural diversity
ii) Respectfully responding to people of all cultures
iii) Respecting positive cultural practices
iv) Appreciating ethnicity as a cradle for creativity and innovation

1.5 Cross-cutting Issues

These are issues which young people need to learn about, and are not confined to a particular subject but are studied across subjects. They help learners to develop an understanding of the connections between the subjects and the complexities of life as a whole. They include:

i) Environmental awareness
ii) Health awareness
iii) Life skills
iv) Mixed abilities and involvement
v) Socio-economic challenges
vi) Citizenship and patriotism

Cross-cutting issues are concern to all humankind irrespective of their areas of speciality. They are infused in the different learning outcomes of the different subjects.

1.6 Values

The curriculum is based on a clear set of values. These values underpin the whole curriculum and the work of schools. Learners need to base themselves on these values as citizens of Uganda. These values are derived from the Uganda National Ethics and Values Policy of 2013. They are:

i) Respect for humanity and environment
ii) Honesty; uphold and defend the truth at all times
iii) Justice and fairness in dealing with others
iv) Hard work for self-reliance
v) Integrity; moral uprightness and sound character
vi) Creativity and innovativeness
vii) Social responsibility
viii) Social harmony
ix) National unity
x) National consciousness and patriotism

Values are not taught directly in lessons, nor are they assessed by pen and paper. However, they are incorporated in some learning outcomes and are developed as a learner progresses.

1.7 ICT integration

The integration of ICTs into teaching and learning is strongly encouraged in this A-level adapted curriculum. ICT enhances the implementation of competency-based learning by fostering learner engagement, creativity, and lifelong learning. Teachers are encouraged to use technology to create interactive content, such as digital simulations and videos, to illustrate abstract or complex concepts effectively. Integrating ICT not only enhances the learning experience but also equips learners with essential digital skills for the 21st century.

ICT teachers should endeavour to assist other subject teachers in making the ICT integration process a reality. The table below shows a sample of suggested ICT tools that may be applied to given tasks.

Sample Task in the Syllabus	Suggested ICT Tool
Fieldwork	Use of cameras to take photos and record videos
Locate places on a map	Use digital maps such as Google Maps or an equivalent application.
Presentation in class	Use presentation applications or online presentation tools like Canva
Search for keywords and meanings	Use an online dictionary or search online
Make drawing/graphics	Use drawing tools like Draw.io or publishing software/Word processor
Roleplay, narrations	Use audio and video recordings
Demonstrations	Use audio/video recordings, models, simulations, or virtual labs
Analyse and present data	Use spreadsheet software or any other analytics tools
Group discussions	Mind mapping software
Search for extra reading materials	Download files from the Internet from academic Databases
Writing equations and formulae	Use equation editors like MathType
Carry out academic search/research	Use the Internet, AI models, and other academic applications like “Encarta”, “Britannica”, etc.
Collaborate with others across the world	Form learning networks with blogs, social media, emails, and videoconferencing tools like Zoom, MS Teams, Webex, Google Meet or any other networking application.

1.8 Projects

Projects and project-based learning are integral to the teaching and learning of Principal Mathematics in the 21st century. Learners will be required to undertake a mathematical project as part of this subject, enabling them to apply mathematical concepts to solve real-life problems and engage in inquiry-based learning. This approach promotes critical thinking, analytical skills, and the application of mathematical tools to investigate and address challenges in their local environment.

Teachers are encouraged to guide learners in choosing projects that are relevant to their immediate context and linked to practical applications, such as optimising resource use, analysing data trends, and modelling real-world phenomena. Through these projects, learners will conduct personal research under the teacher's guidance, develop mathematical models, analyse data, and present findings in a coherent, well-structured report that effectively communicates their process and solutions.

This initiative supports the development of core competencies such as problem-solving, creativity, collaboration, and effective communication, which are essential for academic growth and future careers in mathematics and related fields.

1.9 The Aims of Secondary Education

The aims of secondary education in Uganda are to:

i) instill and promote national unity, understanding of the social and civic responsibilities, strong love and care for others and respect for public property, as well as appreciation of international relations and beneficial international co-operation,

ii) promote appreciation and understanding of the cultural heritage of Uganda including its languages,

iii) impart and promote a sense of self discipline, ethical and spiritual values, personal and collective responsibility and initiative,

iv) enable individuals to acquire and develop knowledge and understanding of emerging needs of society and the economy,

v) provide up-to date and comprehensive knowledge in theoretical and practical aspects of innovative production, modern management methods in the field of commerce and industry and their application in the context of socio-economic development of Uganda,

vi) enable individuals to develop basic scientific, technological, technical, agricultural and commercial skills required for self-employment,

vii) enable individuals to develop personal skills of problem-solving, information gathering and interpretation, independent reading and writing, self-improvement through learning and development of social, physical and leadership skills such as are obtained through games, sports, societies and clubs,

viii) lay the foundation for further education,

ix) Enable individuals to apply the acquired skills in solving problems of their community, and to develop a strong sense of constructive and beneficial belonging to that community,

x) instill positive attitudes towards productive work and strong respect for the dignity of labour and those who engage in productive labour activities,

xi) develop a positive attitude towards learning as a lifelong process.

1.10 Aims of the Advanced Secondary Curriculum

i) To adopt a competency-based learning approach.
ii) To develop holistic education for personal and national development based on clear shared values.
iii) To develop key skills which are essential to work and to life, and to promote life-long learning.
iv) To adopt an integrated approach to learning that develops the ability of learners to apply learning.
v) To improve assessment by incorporating school-based assessment into the End of Cycle Assessment.
vi) To emphasise learners' participation through engagement with the community.
vii) To prepare learners for further education.

1.11 The Rationale for teaching Mathematics at Advanced Level

The Advanced Level Mathematics syllabus aims at:

i) developing the learner's ability to use mathematical tools to analyse and interpret data in various fields, enabling logical reasoning and informed decision-making,

ii) fostering critical thinking and problem-solving skills by applying mathematical concepts and techniques to real-life situations and professional contexts,

iii) equipping learners with the skills to model, analyse, and solve practical problems using mathematical approaches, fostering appreciation for the role of mathematics in personal, academic, and societal development,

iv) guiding learners to present mathematical reasoning, computations, and solutions in a coherent, structured, and precise manner to communicate ideas effectively.

1.12 Subject Overview

The areas of study have been re-organised within the syllabus to come up with the adapted version. The subject areas of study are Data analysis, Effective Mathematical Communication and Developing models in various fields.

This Advanced Level Mathematics syllabus enables the learner to:

i) analyse data and mathematical equations thereby developing critical thinking skills for decision making,
ii) interpret and present data in various forms for logical and effective mathematical communication and lifelong learning,
iii) formulate and apply mathematical models in real-world situations such as industry, business, health, insurance, finance and others to solve personal and community problems.

1.13 Time Allocation

The learners shall be engaged for eight (8) periods each of 40 minutes per week, from Senior Five to Senior Six.

1.14 Suggested Approaches to Teaching Mathematics

The suggested approaches enhance learning and empower teachers to support learners so that they acquire the planned competencies. This necessitates teachers to work alongside learners to guide, support and supervise them as they progress through the research process. These approaches include:

i) **Inquiry-based learning:** Learners investigate through research directed by their interest, to solve problems through a series of questions and scenarios. This enhances their critical thinking, communication and research skills.
ii) **Experiential learning:** Learners actively participate in hands-on experiences during research and learn through reflecting upon their work. This leads to the development of reflective skills.
iii) **Problem and project-based learning**: Learners find solutions to problems through their experience in research and projects. This leads to the development of critical thinking, social and research skills.
iv) **Case-based learning**: Learners refer to real-world scenarios to discuss and analyse them. This enables them to develop critical thinking, analytical and research skills.
v) **Discovery learning**: Learners construct their own knowledge through active participation, exploration and inquiry. This encourages them to critically think, ask questions and hypothesise through research.

Note: The suggested teaching and learning strategies in this syllabus are not exhaustive. The teachers are encouraged to devise other teaching strategies to enable the learners to achieve the learning outcomes and develop competences prescribed in this syllabus.

1.15 Programme Planner

Class/Term	Topic	Sub-topics	Periods
Senior Five Term 1	1. Numerical concepts	1.1 Indices 1.2 Logarithms 1.3 Surds	10
	2. Equations and inequalities	2.1 Linear and simultaneous equations 2.2 Quadratic equations 2.3 Quadratic inequalities 2.4 Polynomials	26
	3. Coordinate geometry 1	3.1 Straight lines	12
	4. Partial fractions	4.1 Linear factor 4.2 Quadratic factor 4.3 Repeated factor 4.4 Improper fraction	08
	5. Trigonometry	5.1 Trigonometrical ratios 5.2 Clockwise and anti-clockwise angles 5.3 Graphs of $\sin\theta$, $\cos\theta$, $\tan\theta$ 5.4 Compound angle formulae and derived identities 5.5 Solution of triangles	25
	6. Descriptive statistics	6.1 Measures of dispersion 6.2 Measures of relative positions	15
			Total Periods = 96
Senior Five Term 2	7. Correlation and scatter diagrams	7.1 Scatter diagram 7.2 Correlation	08
	8. Dynamics 1	8.1 Resultant and components of forces 8.2 Friction 8.3 Connected particles	20
	9. Probability theory	9.1 Probability theorems 9.2 Applications of probability in real life	16

	10. Differentiation 1	10.1 Gradient of a curve 10.2 Gradient functions 10.3 Composite functions 10.4 Implicit functions 10.5 Products and quotients of functions 10.6 Applications of differentiation1 (Nature of turning points, curve sketching, small changes, rates of change and velocity and acceleration)	20
	11. Integration 1	11.1 Indefinite integral 11.2 Definite integral 11.3 Applications of integration (Area enclosed in stated boundaries and volume of solids of revolution) 11.4 Mean value of a function	22
	12. Permutations and combinations	12.1 Permutations and combinations	10
			Total Periods = 96
Senior Five Term 3	13. Series	13.1 Arithmetic Progression (A.P) 13.2 Geometric Progression (G.P) 13.3 Proof by induction 13.4 Binomial expansion	20
	14. Random variables	14.1 Discrete random variables 14.2 Continuous random variables	30
	15. Probability distributions	15.1 Binomial distribution 15.2 Uniform rectangular distribution. 15.3 Normal distribution 15.4 Normal approximation to the binomial distribution for $n>20$	30
	16. Error analysis	16.1 Errors 16.2 Propagation of errors using simple interval arithmetic method 16.3 Errors in functions	16
			Total Periods = 96

Senior Six Term 1	17. Vectors	17.1 Vectors in three dimensions 17.2 Lines in two and three dimensions 17.3 Planes	22
	18. Differentiation 2	18.1 Trigonometric functions 18.2 Exponential, logarithmic and inverse trigonometric functions 18.3 Maclaurin's theory 18.4 Further curve sketching	40
	19. Integration 2	19.1 Function and its derivative (change of variables) 19.2 Exponential and logarithmic functions 19.3 Trigonometric functions (Even and odd powers of $\sin\theta$, $\cos\theta$, etc, Factor formulae, Inverse trigonometric functions and t- substitution) 19.4 Partial fractions 19.5 Integration by parts	34
			Total Periods = 96
Senior Six Term 2	20. Dynamics 2	20.1 Resultant velocity 20.2 Relative motion 20.3 Projectiles	28
	21. Trapezium rule	21.1 Estimating an Integral 21.2 Percentage error	06
	22. Sampling distribution	22.1 Distribution of sampling mean 22.2 Point estimation 22.3 Interval estimation	12
	23. Iterative methods	23.1 Interpolation and extrapolation 23.2 Location of roots 23.3 Newton Raphson method 23.4 Further linear interpolation	22
	24. Coordinate geometry 2	24.1 Locus 24.2 The circle 24.3 Parabola 24.4 Ellipse	28
			Total Periods = 96

Senior Six Term 3	25. Complex numbers	25.1 Imaginary numbers 25.2 Algebra of complex numbers 25.3 Argand diagram and polar form 25.4 Locus 25.5 De Moivre' s theorem	28
	26. Differential equations	26.1 Differential equations 26.2 Solving first order differential equations 26.3 Application of differential equations	26
	27. Flow charts	27.1 Algorithms and presenting them on flow charts 27.2 Performing dry runs	16
			Total Periods = 70

1.16 Note to users:

Each topic has a competency, which is a broad statement that brings out what the learner is expected to do at the end of the topic. The competency is broken down into learning outcomes, for which suggested learning activities and sample assessment strategies are developed as represented in the three columns below.

Learning outcomes	**Suggested learning activities**	**Sample assessment strategy**
A statement of the knowledge, understanding, skills, generic skills, values, and attitudes expected to be learned by the end of the topic. Hence each learning outcome is coded with some of these as **k, u, s, gs and v/a** for emphasis to the teacher on what to consider during the lesson.	The sort of hands and minds on engagements, which enable the learner to achieve the learning outcome including the generic skills and values. They are designed to enable learners to Discover, Explain, Apply and Analyse (**DEAA**) as they participate in knowledge construction.	Opportunities for assessment within the learning process that is, during and after the lesson.

The learning activities and assessment strategies in the syllabus are "suggested" and "samples" respectively and not exhaustive. The teacher is encouraged to develop more learning activities and assessment strategies that are based on the learning outcomes. In addition, teacher is free to customise the suggested learning activities to make them suitable for their respective learning environments and for learners with Special Educational Needs (SEN).

2.0 DETAILED SYLLABUS

Senior Five Term 1

TOPIC 1: Numerical Concepts

Duration: 10 Periods

Competency: The learner analyses contextual use of indices, logarithms and surds through mathematical computations for precision, developing analytical skills and making informed decisions to communicate effectively.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) apply the laws of indices and logarithms to solve real life exponentiation problems. (k, s, u, v/a, gs)	a) Through group discussions, learners review powers as indices, laws of indices and simplifying expressions. b) In pairs, learners discuss the relationship between logarithms and indices, logarithmic notation and laws of logarithms. c) Through group discussions, learners explore how to apply laws of indices and logarithms to solve equations involving indices and logarithms. d) By use of internet or other sources, learners demonstrate the applications of the concepts of indices and logarithms in real life scenarios involving exponential growth, decay, or scientific calculations.	a) Observe learners as they discuss indices and relate them to logarithms, noting learners' ability to; i) interact effectively with others, ii) work effectively in diverse teams. iii) exhibit justice and fairness in dealing with others. b) Converse with learners and judge their ability to convert index notation into logarithmic notation; solve index and logarithmic equations. c) Assess learners' written work for correctness on use of laws of indices and logarithms in solving equations involving exponential growth and decay.

b) use properties of surds to solve real-world situations that require precise calculations and accurate results. (k, s, u, v/a, gs)	a) In group discussions, learners review rational and irrational numbers, simplify and rationalise surds. b) In group discussions, learners solve equations involving surds. c) By use of internet or other sources, learners search for and demonstrate the applications of surds in fields such as engineering, art and architecture that require high precision and accuracy.	a) Observe learners as they discuss rational and irrational numbers noting their ability to; i) use numbers and measurements accurately, ii) use mathematics to justify and support decisions iii) show justice and fairness in dealing with others. b) Converse with the learners as they simplify and solve equations involving surds and their applications. Evaluate learners' understanding of the concepts. c) Assess learners' written work for correctness of: i) solutions to equations involving surds. ii) calculations on applications of surds.

TOPIC 2: Equations and Inequalities

Duration: 26 Periods

Competency: The learner investigates equations and inequalities to acquire mathematical computational and analytical skills applicable in the real world.

Learning Outcomes The learner should be able to:	Suggested Learning Activities	Sample Assessment Strategies
a) interpret the solutions of quadratic equations in various real life contexts involving optimisation. (k, u, s, v/a, gs)	a) In group discussions, learners review different methods of solving quadratic equations using: Factorisation, completing the square and quadratic formula. b) In groups, learners discuss how to express roots as a sum and a product using coefficients of a quadratic equation, and formulate quadratic equations using new roots. c) Through think- pair and share, learners solve simultaneous equations that have; linear and non - linear terms, logarithms and equations reducing to quadratics. d) Through think- pair and share, learners apply the method of completing squares to: i) determine maximum and minimum values, e.g. maximum profits, minimum costs ii) represent the information graphically, iii) verify the nature of roots of quadratic equations using the discriminant.	a) Observe learners as they solve quadratic equations, noting learners' ability to; i) predict outcomes and make reasoned decisions, ii) evaluate different solutions, iii) exhibit honesty; uphold and defend the truth at all times. b) In a conversation, evaluate learners' ability to explain how to solve simultaneous equations that have; linear and non – linear terms, logarithms and equations reducing to quadratics and techniques of solving quadratic equations with emphasis on completing squares, to sketch quadratic curves, determining their maximum and minimum values and verify the nature of roots using the discriminant. c) Assess learners' written work focusing on formulation of quadratic equations using sum and product of roots and correct use of methods of solving quadratic equations.

b) apply solutions of linear simultaneous equations in three variables to solve real-world problems involving multiple constraints. (k, u, s, v/a, gs)	a) In group discussions, learners review: linear equations in one variable linear simultaneous equations in two variables using methods such as substitution, elimination and matrix operations. b) In groups, learners discuss how to solve linear simultaneous equations in three variables (in areas such as motion, economics) using elimination, substitution, row reduction and Echelon form.	a) Observe learners as they discuss linear simultaneous equations in three variables; focusing on the learners' ability to: i) interpret and interrogate mathematical data, ii) use mathematics to justify and support decisions, iii) demonstrate social harmony. b) In a conversation, prompt learners to explain different methods of solving simultaneous equations in two and three unknowns. Evaluate their solutions through probing questions, use feedback sessions to further deepen their understanding of solving equations. c) Assess learners' product in form of written work focusing on correctness of methods of solving linear simultaneous equations in three variables using elimination, substitution, row reduction and Echelon form.

c) a pply quadratic inequalities to determine feasible solution sets in real-world scenarios. (k, u, s, v/a, gs)	a) In group discussions, learners review linear inequalities on a number line and graphs of inequalities. b) Through think- pair and share, learners solve quadratic inequalities (such as determining profit ranges and resource allocation) using graphical methods and algebraic techniques. c) In pairs, learners use the internet and other sources to discuss applications of quadratic inequalities	a) Observe learners as they discuss quadratic inequalities; note learners' ability to: i) work independently with persistence, ii) take responsibility for own learning. iii) demonstrate hard work and self-reliance. b) Converse with the learners to explain graphical methods and algebraic techniques of solving quadratic inequalities. Check whether they are appropriately applying correct methods of solving quadratic inequalities. c) Assess learners' product in form of written work focusing on the level of understanding of algebraic and graphical techniques to solve inequalities and their applications in real life.
d) manipulate polynomial equations and expressions for solving problems in various contexts such as engineering, economics, and physics. (k, s, u, v/a, gs)	a) In group discussions, learners formulate polynomials to identify the degree of a polynomial. b) Through think- pair and share, learners: i) perform long division of polynomials, ii) factorise polynomials, iii) solve equations of the form $f(x) = 0$ where f(x) is a polynomial of degree three and above. c) In group discussions, learners deduce the remainder theorem to find the remainder when the divisor is linear or quadratic. d) Through think- pair and share, learners determine the remainder when the polynomial is not known.	a) Observe learners as they formulate, solve polynomials and determine remainders of polynomials noting whether they are able to; i) use mathematics to justify and support decisions, ii) interpret and interrogate mathematical data, iii) exhibit justice and fairness in dealing with others. b) In the conversation, prompt learners to explain how to solve polynomials , compute the remainder of a polynomial when the divisor is linear or quadratic, when the polynomial is not known, and when the polynomial has repeated roots. Evaluate learners' understanding of the concepts.

	e) In groups, learners find the quotient and remainder of a polynomial with repeated roots. f) In group discussions, learners deduce the factor theorem.	c) Examine learners' written solutions for correctness of formulation of polynomials, long division of polynomials, factorisation of polynomials, determination of the remainder and solving of equations of the form $f(x) = 0$ where f(x) is a polynomial of degree three and above.

TOPIC 3: Coordinate Geometry 1

Duration: 12 Periods

Competency: The learner analyses linear relationships to solve geometric problems and interpret spatial relationships in real-life situations.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) examine basic coordinate geometry concepts for solving problems related to lines, shapes, and their positions in the plane. (k, s, u, v/a, gs)	a) In group discussions, learners review: Cartesian equations of lines, gradients of straight lines intercepts, midpoint of a line, distance between two points, and point of intersection of a pair of lines. b) Through think- pair and share, learners use the concept of the mid-point to determine subdivisions of a line and locate coordinates of any point on that line. c) In groups, learners discuss: i) the angle between a line and the x-axis, relating it to the gradient of the line, ii) the angle between	a) Observe learners as they discuss how to solve geometrical problems, focusing on learners' ability to; i) take responsibility for their own learning, ii) work effectively in diverse teams, iii) demonstrate creativity and innovativeness. b) Converse with learners as they do peer presentations, prompting them to explain relationships between coordinate geometric components focusing on understanding of concepts. c) Assess learners' written work and check for the correctness of concepts on: i) intercepts, ii) mid-point of a line, iii) sub-divisions of a line, iv) the angle between a line and the x −axis, v) the angle between lines, vi) the distance between two

	two lines, iii) the relationship between gradients of parallel lines, iv) the relationship between the gradients of perpendicular lines. d) In groups, learners brainstorm how to find the shortest distance between a point and a line.	points, vii) the shortest distance between a point and a line, viii) parallel lines and perpendicular lines and ix) intersection of lines.
b) apply concepts of basic coordinate geometry to solve and interpret geometric problems in real-life situations. (k, s, u, v/a, gs)	a) In groups, learners demonstrate a variety of real-world geometric problems and use ICT related aids or other resources to create a visual presentation of their findings.	a) Observe learners as they discuss how to apply concepts of geometry of lines to solve real-world problems paying attention to learners' ability to: i) use mathematics to justify and support decisions, ii) use technology to create, manipulate and process information, iii) exhibit creativity and innovativeness. b) Converse with learners and judge their ability to use ICT related aids to demonstrate geometry concepts and their applications in real life. c) Assess learners' written exercises and ICT presentations to check for correctness of geometric concepts.

TOPIC 4: Partial Fractions

Duration: 08 Periods

Competency: The learner decomposes rational expressions into partial fractions useful in integral calculus and real-world context.

Learning Outcome The learner should be able to**:**	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) Decompose proper and improper fractions into partial fractions for further learning. (k, s, u, v/a, gs)	a) In groups, learners discuss how to express the sum of simple fractions as a single fraction. b) In group discussions, learners, express: i) proper algebraic fractions as a sum of simple fractions, ii) improper algebraic fractions as a quotient and proper algebraic fraction.	a) Observe learners as they express algebraic expressions into partial fractions, focusing on learners' ability to: i) write and present coherently, ii) talk confidently and explain ideas/opinions clearly, iii) exhibit creativity and innovativeness. b) Converse and probe learners to explain clearly the different types of algebraic fractions and how to break down proper and improper fractions into partial fractions. Evaluate learners' ability to explain the concepts clearly. c) Assess learners' written work, noting correctness as they decompose proper and improper algebraic fractions into partial fractions.

TOPIC 5: Trigonometry

Duration: 25 Periods

Competency: The learner applies trigonometric functions, identities, and equations to solve problems in mathematics and real-life application in navigation, construction, aviation and other fields.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) analyse the sides and angles of a right-angled triangle to deduce trigonometric ratios and derive trigonometric identities to solve real-world problems. (k, s, u, v/a, gs)	a) Through guided discovery, learners: i) review trigonometrical ratios from a right-angled triangle, sine, cosine, tangent of an angle of any magnitude using the quadrants of a unit circle and drawing of graphs of trigonometrical functions, ii) use the trigonometric ratios of sine, cosine, and tangent to determine their corresponding reciprocals, iii) determine trigonometric ratios of 30^o, 45^o and 60^o, iv) use Pythagoras theorem to derive $Sin^2\theta + Cos^2\theta = 1$, and simplify trigonometrical identities; prove identities, solve trigonometrical equations and eliminate parameters from pairs of parametric equations.	a) Observe learners in groups as they discuss trigonometric ratios, derive trigonometric identities, and solve trigonometric related problems, noting learners' ability to; i) work with others to generate ideas, ii) interact effectively with others. iii) show justice and fairness in dealing with others. b) Dialogue with learners noting their ability to explain the different approaches used in deriving trigonometric identities and solving trigonometric equations c) Assess learners' written work to check: i) correctness of the graphs drawn, ii) derivations of trigonometric ratios and identities, iii) eliminating parameters from a pair of parametric equations, and iv) solving trigonometrical equations derived from Pythagoras theorem.

b) apply trigonometrical concepts to solve problems related to fields such as navigation, construction, aviation. (k, s, u, v/a, gs)	a) Learners in group discussions, develop the compound angle formulae and use it to deduce the formulae for double angles, half angles, other multi-angles corresponding identities. b) In group discussions, learners solve trigonometric equations: involving inverse trigonometric ratios and using t –formulas. c) In group discussions, learners use the expressions $Rcos(\theta \pm \alpha)$ or $Rsin(\theta \pm \alpha)$ to: i) solve trigonometrical equations of the form $a\cos\theta \pm b\sin\theta + c = 0$, ii) find the maximum and minimum of trigonometrical functions involving $a\cos\theta \pm b\sin\theta + c = 0$ and $\frac{1}{a\cos\theta \pm b\sin\theta + c}$ d) In groups, learners discuss and find out how to: i) derive the cosine, sine and tangent rules, ii) solve triangles using the rules, iii) derive the formulae for angles of a triangle in terms of the sides, iv) derive the formulae for area of a triangle. e) In pairs, learners use the internet or any other sources, to find out and discuss applications of trigonometry in real life.	a) Observe learners as they explore various trigonometrical techniques to solve a variety of trigonometrical equations, noting their ability to: i) evaluate different solutions, ii) identify problems and ways forward. iii) exhibit creativity and innovativeness. b) Converse with learners and judge their ability to explain derivation of the angles and triangles trigonometric properties in solving trigonometric equations and applications of trigonometry in real life scenarios. c) Assess learners' written work to determine the accuracy of: i) derivation of the compound angle formulae and identities, ii) solving trigonometric equations, iii) maximum and minimum of trigonometrical functions, iv) cosine, sine and tangent rules, v) angles of a triangle, vi) area of a triangle. vii) applications of trigonometry, viii) and correctness of the calculations made.

TOPIC 6: Descriptive Statistics

Duration: 15 Periods

Competency: The learner analyses data through collection, presentation, and evaluation of population parameters and sample statistics in order to predict and plan for self and community development.

Learning Outcomes The learner should be able to:	Suggested Learning Activities	Sample Assessment Strategies
a) present statistical data for prediction and further learning. (k, u, v/a, s, gs)	a) Through group discussions, learners review how to organise data with equal class width and represent it graphically (histogram and ogive) and make presentations. b) In groups, learners explore how to present data with un equal class width on the histogram and use it to estimate mode. c) Learners use ICT tools like programmable scientific calculators, smart phones to present real life situations.	a) Observe learners as they review how to organise and present statistical data focusing on their ability to: i) sort and analyse information, ii) evaluate different solutions, iii) demonstrate honesty; uphold and defend the truth at all times. b) Dialogue with learners as they do the activity; ask questions that elicit them to explain how statistical data is organised and presented. c) Assess learners' written work with emphasis on presentation of data while focusing on neatness, scale uniformity and proper use of graphical techniques.

b) analyse data in order to predict phenomena for purposes of decision making and community development. (k, u, v/a, s, gs)	a) In groups, learners review through peer teaching how to determine the average, mode, median, range. b) In groups, learners discover how to determine the mode of unequal class width, variance, standard deviation, and estimate percentiles, deciles, quartiles using the ogive. c) By use of internet or otherwise, learners do research on how statistics is applied in different fields of learning. d) Through discovery, learners use ICT tools like programmable scientific calculators, smart phones to analyse data for prediction of real-world situations.	a) Observe learners as they compute different measures of central tendency, relative position and dispersion. Note how learners: i) exhibit hard work for self-reliance, ii) sort and analyse information, iii) predict outcomes and make reasoned decisions. b) Dialogue with learners as they determine and estimate measures of central location and dispersion, focusing on learners' ability to interpret and interrogate data. c) Assess learners' written work for accuracy of the solutions for statistical measures obtained and correctness of graphs focusing on neatness, scale uniformity and proper use of graphical techniques.

Senior Five Term 2

TOPIC 7: Scatter Diagrams and Correlations

Duration: 08 Periods

Competency: The learner investigates the relationship between two quantitative variables through graphical representation and evaluation of correlation coefficients for decision making and prediction.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) determine the correlation between two variables using scatter plots and correlation coefficients for prediction and decision making. (k, u, v/a, s, gs)	a) In groups, learners through experimentation: i) record and tabulate the values of any two variables, ii) plot the data on graph paper, draw the line of best fit and comment on the relationship between the two variables, b) In groups, learners discuss how to rank the data and compute Spearman's and Kendall's rank correlation coefficients of a set of data and make presentations.	a) Observe learners while they explore various methods of interpreting coefficients noting learners 'ability to: i) use mathematics in justifying and supporting decisions, ii) evaluate different solutions, iii) show honesty; uphold the truth and defend the truth at all times. b) Converse with learners and assess their ability to critically analyse the plotted points and explain the relationship between the two sets of data as well as how to compute the correlation coefficients between the two given sets of data. c) Assess learners' written work for correctness of the methodology in computation of the rank correlation coefficients and check for uniformity of scale and correct labeling of the axes on graphs.

b) argue on the relationship between two quantitative variables for prediction and informed decision making. (k, u, v/a, s, gs)	a) Learners, through discussion, comment on the values obtained from correlation coefficients and scatter graphs and make presentations. b) Learners use the internet or other sources to analyse the applications of scatterplots and correlation coefficients.	a) Observe learners as they discuss the relationship between variables focusing on learners' ability to: i) predict outcomes and make reasoned decisions, ii) identify problems and ways forward, iii) exhibit justice and fairness in dealing with others. b) Converse with learners to comment on correlation coefficients using different approaches focusing on learners' ability to listen attentively with comprehension and respect to one another. c) Assess learners' written work for correctness of the comments on the relationship between variables.

TOPIC 8: Dynamics 1

Duration: 20 Periods

Competency: The learner determines the resultant force and analyses the effect of forces on bodies by applying Newton's laws to solve problems in real world phenomena.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) determine the resultants of parallel and non-parallel forces for lifelong learning. (k, u, v/a, s, gs)	a) In groups, through discussion, learners review trigonometrical ratios of *sine, cosine* and *tangent*, and explore the application of ratios in finding the resultant of two or more forces acting at a point and make presentations.	a) Observe learners as they review trigonometrical ratios, focus on learners' ability to: i) exhibit integrity; moral uprightness and sound character, ii) work with others to generate ideas, iii) use mathematics to justify and support decisions. b) Dialogue with learners and prompt them to explain how the components of a force are obtained. Pay attention to the learners' ability to apply trigonometric ratios to resolve components. c) Assess learners' written work for correctness and accuracy of the resolved components and the resultant force obtained.

b) evaluate the resultant of forces in polygons for lifelong learning. (k, u, v/a, s, gs)	a) In groups, learners discuss how to resolve forces in polygons and determine the resultant force.	a) Observe learners as they discuss resultant of forces in polygons. Note their ability to: i) work with others to generate ideas, ii) suggest and develop new solutions, iii) demonstrate social harmony. b) Dialogue with learners and judge their ability to explain how the components of force are obtained and hence the resultant force. c) Assess learners' written work for correctness of resolved components, the resultant force obtained and the accuracy in the computations.
c) investigate the effects of friction on bodies in limiting equilibrium and in motion on horizontal and inclined surfaces for problem- solving in different fields of engineering. (k, u, v/a, s, gs)	a) Through demonstration, learners review friction, equations of motion and Newton's laws. b) In groups learners experiment the application of friction and Newton's laws to bodies in limiting equilibrium and in motion on horizontal and inclined surfaces and make presentations.	a) Observe learners as they review friction, equations of motion and Newton's laws paying attention to learners' ability to: i) work with others to generate ideas, ii) try out innovative alternatives, iii) demonstrate creativity and innovativeness. b) Dialogue with learners and prompt them to apply the knowledge of friction, equations of motion and Newton's laws to bodies on horizontal and inclined rough surfaces; focusing on learners' ability to work independently with persistence. c) Assess learners' work, check for correctness of the force diagrams, the equations obtained and the use of the S.I units.

d) apply Newton's laws of motion to connected bodies to solve problems involving real- world phenomena. (k, u, v/a, s, gs)	a) In groups, learners review Newton's laws and discuss the application of the laws to the pulley systems. b) In groups, learners demonstrate how to apply the Newton's laws to connected bodies on smooth and rough surfaces for horizontal and inclined planes and make presentations. c) In groups, learners use internet, library or any other to demonstrate the application of connected particles in real-life phenomena.	a) Observe learners as they review and apply Newton's laws of motion, paying attention to learners' ability to: i) work effectively in diverse teams, ii) listen attentively and with comprehension, iii) exhibit hard work for self-reliance. b) Dialogue with learners and prompt them to explain how to apply Newton's laws to connected bodies on smooth and rough surfaces for horizontal and inclined planes and demonstrate their application in real-world situations; focusing on their ability to write and present work coherently and life skills development. c) Assess learners' work and check the correctness of force diagrams, relative accelerations in pulley systems and SI units.

TOPIC 9: Probability Theory

Duration: 16 Periods

Competency: The learner evaluates probabilities through applying the probability laws and theorems to predict the occurrence of events in real life.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) determine the chances of occurrence of events in different aspects for prediction and decision making in the real-world situations. (k, u, v/a, s, gs)	a) Learners, through demonstration, review the terms; probability, an event, sample space and probability range. b) In groups, learners discuss how to generate possibility space using the tree diagram, table of outcomes and explore the use permutations and combinations. c) In groups, learners through discussion: i) relate set theory to probability theory and design a contingency table, ii) determine the chance of occurrence of different events in different situations and make presentations.	a) Observe learners as they review the terms used in probability, note learners' ability to: i) use numbers and measurements accurately, ii) interpret and interrogate mathematical data, iii) exhibit respect for humanity and environment. b) Converse and probe learners to explain how to generate sample space using different methods and determine probabilities focusing on learners' ability to explain the possible alternatives. c) Assess learners' written work; check the accuracy and validity of the probabilities obtained, under various methods focusing on learners' ability to identify the best method of solving a problem.

b) apply the probability theorems to predict other occurrences and plan for the future. (k, u, v/a, s, gs)	a) In groups, learners discuss and explore Bayes' theorem to determine probabilities of occurrence of events. b) In groups, learners explore situations that require the application of probability theory in daily life. c) Learners use the library, internet or other sources to brainstorm the applications of probability in real-world.	a) Observe learners as they discuss and explore Bayes' theorem. Focus on learners' ability to: i) predict outcomes and make reasoned decisions, ii) evaluate different solutions, iii) exhibit creativity and innovativeness. b) Converse and prompt learners to explain how to use Bayes' theorem to obtain probabilities and its application in daily life. Evaluate learners' understanding of the concepts. c) Assess learners' written work and check for the accuracy and validity of the probabilities obtained by Bayes' theorem.

TOPIC 10: Differentiation 1

Duration: 20 Periods

Competency: The learner applies differentiation techniques to solve problems in calculus and interpret their significance in real-world contexts.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) explore rates of change and slopes of curves using differentiation for further learning. (k, u, v/a, s, gs)	a) In groups, learners discuss how the gradient of a curve at a point can be derived from gradient of a chord using small increments. b) Learners, through think-pair and share, deduce the gradient of the tangent at a point on the curve. c) In groups, learners through discussions, deduce the formula for differentiation of $ax^n, n \in R$ d) Through guided group discussions, learners differentiate functions and identify the equations of the tangents and normal curves at different points. e) In group discussions, learners differentiate: i) product and quotient functions ii) composite function. iii) parametric functions iv) implicit functions f) In groups, learners explore second derivatives of functions.	a) Observe learners as they explore different techniques of differentiating algebraic functions paying attention to learners' ability to: i) work independently with persistence, ii) work effectively in diverse teams, iii) demonstrate hard work for self-reliance. b) Converse with learners and evaluate their ability to explain the relation of gradient of a curve to gradient of a line, differentiation formula, differentiation of functions and equations of the tangents and normal to curves at a different point. c) Assess learners' written work to determine the correctness of the gradient of the tangent at a point on the curve, equation of tangents and normal to a curve, differentiation formula, and differentiation of functions.

b) interpret the significance of differentiation in calculus and solving real-world problems in fields like Physics, Biology, and Environmental Science. (k, u, v/a, s, gs)	a) In groups, through guided discovery, learners determine the maximum and minimum values of given functions. b) In group discussions, learners investigate the nature of turning points in curve sketching and optimization of resources. c) In group discussions, learners use small changes to approximate roots of numbers, errors in measurements, changes in physical quantities, trigonometric functions etc. d) In group discussions, learners apply differentiation concepts to velocity, displacement and acceleration.	a) Observe learners in group discussion as they apply differentiation, noting learners' ability to: i) evaluate different solutions, ii) identify problems and ways forward, iii) exhibit justice and fairness in dealing with others. b) Converse with learners and prompt them to elaborate on using small changes, the nature of turning points, the different applications of differentiation like curve sketching and kinematics in real life. Focus on learners' ability to explain the concepts. c) Assess learners' written work for correctness of approximations, nature of turning points and the depth of their knowledge in differentiation.

TOPIC 11: Integration 1

Duration: 22 Periods

Competency: The learner applies integration techniques to solve problems involving areas under curves, accumulation of quantities, and other real-world applications.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) relate integration to differentiation to integrate definite, and infinite integrals. (k, u, v/a, s, gs)	a) In groups, learners through guided discovery: i) link integration and differentiation as reverse processes through finding functions which when differentiated return to the original function, ii) associate the limit of summation to the integral sign and evaluate a definite integral using the limits.	a. Observe learners as they relate differentiation to integration and evaluate integrals. Note their ability to: i)identify problems and ways forward, ii) evaluate different solutions, iii) exhibit creativity and innovativeness. b. In conversation, prompt learners to discover the relationship between differentiation and integration, noting their ability to critically discover why integration generates a family of functions to understand the implication of the constant of integration. c. Assess learners' written work for accuracy of the integrals and computations.

b) apply integration concepts in various fields. (k, u, v/a, s, gs)	a) In groups, through induction, learners apply integration to: i) determine the area under curve bounded by the x- axis and y- axis and deduce that area is a scalar quantity, ii) determine areas enclosed between two functions, iii) determine displacement, velocity and acceleration, iv) determine the volume of a solid of revolution about: • x – axis • y - axis v) calculate the mean value of a function.	a) Observe learners in groups as they discuss applications of integration in various fields focusing on the ability to: i) suggest and develop new solutions, ii) work with others to generate ideas, iii) exhibit creativity and innovativeness. b) Converse with learners and examine their understanding of area, volume, displacement, velocity, acceleration and mean value of a function. c) Assess the correctness and accuracy of their computations of area, volume, and mean value of a function.

TOPIC 12: Permutations and Combinations

Duration: 10 Periods

Competency: The learner applies the permutations and combinations concepts to solve mathematical problems and model real-world situations.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) apply the concepts of permutations to solve problems in Mathematics, everyday life and other fields such as computer algorithm design, scheduling, and cryptography. (k, u, v/a, s, gs)	a) In groups, through experimentation, learners arrange sets of different objects in a row to distinguish between different arrangements. b) In group discussions, learners demonstrate how to arrange a number of different objects in turn to derive the relationship between the factorial notation (!) and number of arrangements. c) In groups, through guided discussions, learners perform arrangements of a number of different items to discover that the arrangement of r out of the n objects in a row is given by the formula nPr. d) Learners explore different forms of permutations involving: i) identical objects, ii) with or without repetition, iii) with restrictions, iv) circular arrangements.	a. Observe how well learners arrange the objects, paying attention to their ability to: i) look for patterns and make generalisations, ii) use imaginations to explore possibilities, iii) show creativity and innovativeness. b. Converse with learners and assess how they come up with the arrangement,; state the number of arrangements, derive the relationships between possible arrangements of r objects from n objects. c. Assess learners' written work to check for the correct arrangements involving: i) identical objects, ii) with or without repetition,. iii) With restrictions, circular arrangements. Note how accurate their calculations are.

b) analyse concepts of combinations to solve problems in Mathematics, everyday life and other infields like genetics, optimisation and statistics. (k, u, v/a, s, gs)	a) Through group demonstrations, learners: i) select a set of 2 items from 2, 3 or 4 items to form a group, ii) illustrate how a group of r items can be selected from n items to form a combination, iii) develop the formula nCr used for selecting r objects from n objects to form a group, iv) recognise the difference between permutations and combinations scenarios. b) In groups, learners discuss combinations with restrictions. c) In group discussions, learners apply knowledge of permutations and combinations in various real-world situations like creation of passwords, pin numbers, team selections, planning menus or outfits etc.	a) Observe how well learners select r objects from n objects, paying attention to how learners: i) use imaginations to explore possibilities, ii) try out innovative alternatives, iii) exhibit integrity, moral uprightness and sound character. b) Converse with learners and probe them to explain how they come up with the selections of r objects from *n* objects for different scenarios while judging their presentations. c) Assess learners' written work to check how they perform selections with or without restrictions of various situations,

Senior Five Term 3

TOPIC 13: Series

Duration: 20 Periods

Competency: The learner applies principles and techniques of series and binomial expansions to understand and solve mathematical and scientific problems in the real world.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) analyse Arithmetic Progression principles to solve problems, recognise patterns and their applications in various contexts. (k, u, v/a, s, gs)	a) In groups, learners through discussion: i) review sequences to identify a series, ii) explore how adding a fixed number to previous terms generates an Arithmetic Progression (A.P.), iii) derive the formula for finding the sum of an A.P, iv) derive expressions for the n^{th} - term of an A.P; apply the derivations to solve numerical problems, b) Use case studies, internet or other sources to analyse real life financial scenarios such as investment growth and payment schemes. They examine the patterns and demonstrate the applications of A.Ps in real life situations.	a. Observe learners as they generate, apply A. Ps to solve mathematical problems; note learners' ability to: i) look for patterns and make generalisations, ii) use imaginations to explore possibilities, iii) exhibit hard work and self-reliance. b. Converse and prompt learners to explain how to generate, identify and apply A.Ps. Evaluate learners' understanding of the concepts. c. Assess learners' written work to establish the correctness of: i) the formulas for sum of an A. P. ii) n^{th} - term of an A.P iii) report on applications of A.P.
b) analyse Geometrical Progression principles to solve problems, recognise patterns and their applications in various contexts. (k, u, v/a, s, gs)	a) In groups, learners through discussion: i) generate series with a constant ratio between successive terms (G.P) from sequences, ii) derive expressions for the n^{th} term and the sums of a (G.P); apply the derivations to solve mathematical problems,	a) Observe learners as they generate, apply G.Ps to solve mathematical problems; note learners' ability to: i) interpret and interrogate mathematical data,

	iii) analyse convergence of G.P to generate the sum to infinity of a G.P, iv) use summation notation to determine the sum of any series, b) Learners using Socratic circle, discuss the applications of G.P to real- world problems such as compound interest, spread of disease, cell division, radioactivity decay, c) In groups, learners design different savings or investment plans using information from a guest speaker from business/ financial sector, or internet or other sources. They discuss which plan might be more suitable based on the client's goals and timeline.	ii) use mathematics to justify and support decisions, iii) exhibit honesty; uphold and defend the truth at all times. b) Converse and prompt learners to explain how to generate, identify and apply G.Ps. Evaluate learners' understanding of the concepts. c) Assess learners' written work to establish the correctness of: i) the formulas for sum, ii) n^{th} - term of a G.P, iii) sum to infinity of converging series, iv) expressing series into summation form, v) report on the different savings or investment plans and their suitability.
c) apply the logical steps to establish the truth of a mathematical statement in solving real world problems that require inductive reasoning. (k, u, s, v/a, gs)	a) In groups, learners through experimentation: i) demonstrate simple mathematical statements e.g, the sum of two even numbers is even ii) extend the boundaries of the experiment above and prove that the same statement is still true (say sum of two integers is also even). iii) Under teacher's guidance, learners explore proving that the same statement is true for any set of even numbers using inductive method. b) In groups, learners discuss the validity of other mathematical statements using proof by induction.	a) Observe learners as they evaluate proofs by induction noting their ability to: i) use mathematics to justify and support decisions, ii) interpret and interrogate data, iii) exhibit honesty; uphold and defend the truth at all times. b) Converse with the learners and prompt them to explain the logical steps involved in establishing the truth of a mathematical statement. Focus on the logical flow of their explanations.

	c) Use internet or other sources, learners explore the applications of proof by induction in real life.	c) Assess learners' written work for correct steps and truthiness of the mathematical statements.
d) apply the binomial theorem to solve real-world problems such as stochastic models, etc. (k, u, v/a, s, gs)	a) In group discussions, learners: i) generate Pascal's triangle to expand the forms $(a + b)^n$ for $n = 1,2,3,4.$ ii) generate coefficients of terms in the expansion to deduce the binomial theorem, iii) expand binomial expressions in ascending and descending order. b) In groups, learners apply the binomial theorem to: i) compute a particular term of binomial expansion, ii) compute roots of numerical values, iii) state range of validity of binomial expansion.	a) Observe learners as they expand the forms $(a + b)^n$ to deduce the binomial expansion, use it to compute particular terms of the expansion and evaluate roots of numerical values, noting learners' ability to: i) work with others to generate ideas, ii) look for patterns and make generalisations, iii) exhibit hard work for self-reliance. b) Converse with learners and examine how they explain derivation of binomial theorem and how it is used to expand rational functions and how it can be applied to solve real-world problems. c) Assess the correctness of derivation of binomial theorem and its applications to compute roots and terms of the expansion.

TOPIC 14: Random Variables

Duration: 30 Periods

Competency: The learner models and analyses the outcomes of random phenomena through determining probabilities and expected values for prediction of uncertainties in real life.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) design different sample spaces and corresponding probabilities of random events to support conclusions and decisions. (k, u, v/a, s, gs)	a) In pairs through demonstration, learners perform different experiments with coins, pair of die and record the outcomes. b) In pairs, learners discuss how to compute and tabulate probability distribution corresponding to a given random event and make presentations.	a) Observe learners as they record and tabulate experimental results, putting emphasis on learners' ability to: i) write and present information coherently, ii) use a range of media to communicate ideas, iii) exhibit respect for humanity and environment. b) Converse and engage learners to explain properties of random variables, probability mass/density function notations and definition of a random variable. Prompt learners to come up with random variables using classroom events; focusing on learners' ability to ask engaging questions, seek clarification and how they correspond to their findings. c) Assess learners' sample spaces to determine how well the learner can: i) draw sample spaces outcome of tossing coin(s), dice, pair of dice, ii) develop the probability distributions of random events for the sample spaces above, iii) illustrate properties of random variables.
b) analyse the concept of a probability mass function of a discrete random variable to solve applied	a) In groups, learners through discussion: i) describe a discrete random variable and explain the properties of its probability mass	a) Observe learners as they describe and apply the probability mass functions to solve problems, focusing on their ability to: i) sort and analyse information, ii) identify problems and ways forward, iii) exhibit justice and fairness in dealing with others. b) Converse with learners as they analyse

problems. (k, u, v/a, s, gs)	function, (p. m. f). ii) determine probabilities, measures of central location and dispersion and sketch the p. m. f of a discrete random variable. b) In pairs, learners choose and use appropriate technology effectively in a range of contexts, to produce, plot and investigate the probability of these discrete random variables and their cumulative probabilities.	discrete random variables. Assess their ability to describe the concept of a discrete random variable, its probability distribution, and how to compute parameters and draw graphs. Guide learners to construct arguments to prove and justify results. c) Assess learners' written work for coherence, accuracy of the calculations and proper graphical techniques. Determine whether there is evidence that a learner can: i) articulate discrete random variable characteristics, ii) illustrate a probability distribution for a discrete random variable and its properties, iii) compute probabilities corresponding to a given random variable, iv) calculate the mean and the variance of a discrete random variable, v) interpret the mean and the variance of a discrete random variable, vi) solve problems involving mean and variance of probability distributions, vii) calculate the mode, median, CDF (F(X)) and probability distribution table of a discrete random variable.
c) analyse the concepts of a probability density function of a continuous random variable to solve applied problems. (k, u, v/a, s, gs)	a) In groups, learners through discussion, describe a continuous random variable and explain the properties of its probability density function (p.d.f). b) Through demonstration, learners determine probabilities, measures of central location and dispersion and sketch the p.d.f and cumulative	a) Observe learners as they describe and apply the probability density functions of continuous random variables, noting learners' ability to: i) interpret and interrogate mathematical data, ii) write and present coherently, iii) exhibit hard work for self-reliance. b) Converse with learners as they analyse continuous random variables. Prompt them to determine probabilities, measures of central location and dispersion, sketch the p.d.f and c.d.f of continuous random variables. Focus on learners' computation and graphical skills.

	distribution function of a continuous random variables. c) In pairs, learners use technology and other sources to investigate the application of continuous variables in solving problems in real life.	c) Assess learners' written work for coherence, accuracy of the calculations and proper graphical techniques. Determine whether there is evidence that a learner can: i) articulate continuous random variable characteristics, ii) illustrate a density distribution for a continuous random variable and its properties, iii) compute probabilities corresponding to a given random variable, iv) calculate the mean and the variance of a continuous random variable, v) interpret the mean and the variance of a continuous random variable, vi) solve problems involving mean and variance of probability distributions, vii) calculate the mode, median, CDF (F(X)) and probability distribution table of a continuous random variable, viii) distinguish between a discrete and a continuous random variable.

TOPIC 15: Probability Distributions

Duration: 30 Periods

Competency: The learner demonstrates the ability to analyse and apply binomial, rectangular, and normal distributions to solve real-world problems.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) apply the binomial distribution function to solve relevant probability and statistical problems in real life. (k, u, v/a, s, gs)	a) In pairs, learners through discussion, review combinations and the probability product rule, use them in scenarios with repeated independent events to discover the binomial distribution formula. b) In groups, learners: i) perform a binomial experiment and use it to determine probabilities of success *p*, and failure *q*, for *n* trials, ii) discuss and determine probabilities using binomial formula and the mathematical tables, iii) explore mean, mode and variance of a binomial distribution.	a) Observe learners as they generate scenarios with repeated independent events. Note how learners: i) plan and carry out investigations, ii) sort and analyse information, iii) exhibit respect for humanity and environment. b) Converse with learners and assess how they use the binomial formula and tables to determine probabilities. c) Assess learners' written work. Check on the correctness of: i) probabilities while using tables or calculators, ii) values (mode mean variance).

b) demonstrate properties of the rectangular distribution, using it to solve relevant probability and statistical problems in real life. (k, u, v/a, s, gs)	a) In groups, learners carry out an experiment that generates a rectangular distribution to derive its probability distribution function, p.d.f. b) In groups, learners: i) discuss and determine probabilities in rectangular distribution using real life scenarios, ii) explore the mean, mode and variance of the rectangular distribution.	a. Observe learners as they discuss the properties of the rectangular distribution, and how they use it to obtain probabilities. Focus on their ability to: i) write and present work coherently, ii) work independently with persistence, iii) exhibit hard work and self- reliance. b. Dialogue with learners as they interrogate the meanings of the mean, mode and variance and to ascertain that they understand why it is called a rectangular distribution. Examine learners' ability to explain the concepts. c. Assess learners' written work for coherence and accuracy of their calculations.

c) analyse the normal distribution and its properties through graphical representations to solve relevant probability and statistical problems in real life. (k, u, v/a, s, gs)	a) In groups, learners explore and discuss properties of normal distribution and how it can be standardised to a standard normal, using graphical representations. b) In groups, learners discuss standardisation of random variables and use of normal distribution tables/calculators to determine probabilities c) Learners in groups discuss how to de- standardise the normal variables to determine parameters.	a) Observe learners as they discuss the properties of normal distribution, standardising of variables. Focus on their ability to: i) evaluate different solutions, ii) identify problems and ways forward, iii) demonstrate hard work and self-reliance. b) Dialogue with learners as they analyse normal distribution probe them to explain how to standardise, and de-standardise variables in determining probabilities and parameters using tables or calculator. Evaluate learners' understanding of the concepts. c) Assess learners' written work for correctness of: i) standardised values (z values), ii) values read from tables, iii) probabilities.

d) transform a binomial random variable to a normal using continuity correction. (k, u, v/a, s, gs)	a) In groups, learners through demonstration, perform an experiment tossing a coin 50 times and determine the probabilities of any number of heads or tails obtained. Or they use appropriate ICT tools to visualise the outcomes and compare with the normal distribution. b) In groups, learners discuss conditions for a binomial distribution to be approximated by normal distribution and how to obtain continuous variables (Continuity correction). c) Through Think pair- share, learners determine the expectation and variance.	a) Observe learners as they discuss their observations from the experiment and as they transform a binomial random variable to a normal using continuity correction. Note how learners: i) work with others to generate ideas, ii) look for patterns and make generalisation, iii) exhibit social responsibility. b) Prompt learners to explain their observations, conditions for normal approximation and to determine probabilities and parameters; focusing on mixed abilities as they freely explain concepts. c) Assess learners' work and check on the correctness of: i) continuity correction of values, ii) Z- values, iii) probabilities

e) apply the binomial, rectangular and normal distributions to predict outcomes of random processes in real life. (k, u, s, v/a, gs)	a) In groups, through storytelling and under the facilitator's guidance, learners i) select data problems of interest in various fields, discuss them, and use the internet and other resources to model them, ii) generate questions and use their skills to answer, interpret and explain the relevance of their findings using appropriate ICT tools.	a) Observe learners as they discuss the motivation of their problems of interest, focusing on learners' ability to: i) try out innovative alternatives, ii) suggest and develop new solutions, iii) show national consciousness and patriotism. b) In conversation, ask questions and assess whether the chosen distributions model the problems at hand and the solutions are meaningful in real-life. c) Assess learners' ICT aided presentations and written work, check for appropriateness of the modelling distributions and interpretation of solutions.

TOPIC 16: Error Analysis

Duration: 16 Periods

Competency: The learner analyses errors in mathematical operations and functions to understand the role of precision and accuracy in problem-solving.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Suggested Assessment Strategies**
a) examine the propagation of errors in mathematical operations and functions. (k, u, v/a, s, gs)	a) In pairs, through experimentation and discussions, learners: i) measure lengths, weights, volumes, thicknesses, temperatures, timings etc. using various measurement tools of varying levels of precision and use the measurements to compute and compare sums, differences, products and ratios of similar measurements but from different tools, ii) describe errors, sources of errors, the terms used in error analysis and note cases where errors may arise in mathematical computations and real life. b) In groups, learners through peer-teaching explore how to derive and compute absolute, relative and percentage errors, minimum and maximum values/ limits of accuracy in expressions and make presentations. c) Through guided discovery, learners use their knowledge of differentiation to derive the formulae for error propagation in functions.	a) Observe learners as they discuss propagation of errors in mathematical operations and functions noting their ability to: i) work hard for self-reliance, ii) interact effectively with others, iii) work effectively in diverse teams. b) Converse with learners and prompt them to explain how errors arise in measurement, determine errors in different mathematical operations, determine the minimum and maximum values/ limits of accuracy, and how errors propagate in functions, focusing on learners' ability to adapt and manipulate the knowledge of errors and its relevance in real life. c) Assess learners' written work or ICT aided oral presentations to evaluate the accuracy in describing error terms, types and sources of errors and the appropriate formula for propagation of errors in functions.

b) apply the knowledge of error analysis to improve the level of precision and accuracy in contextual problems. (k, u, v/a, s, gs)	a) In groups, learners use the internet or other resources to: i) discuss other sources of errors other than measurement, ii) identify problems and use the knowledge of errors to discuss the implications of various error measurements (absolute, relative, percentage, minimum value, maximum value) on the solution to their chosen problems and give presentation.	a) Observe learners as they discuss other sources of errors, present the motivation of their choice problem. Pay attention to learners' ability to: i) talk confidently and explain ideas clearly, ii) work effectively in diverse teams, iii) exhibit national consciousness and patriotism. b) Converse with learners and provoke them to explain why various error measures are used to analyse the potential implications of errors in measurement. Prompt them to discuss where else the knowledge of error analysis can be used other than the problem of their choice. Evaluate their explanations. c) Assess learners' written work or oral presentations for correct application of error analysis and the accuracy of their result interpretations.

Senior Six Term 1

TOPIC 17: Vectors

Duration: 22 Periods

Competency: The learner applies vector concepts to model and solve mathematical and physical problems in 2D and 3D spaces.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) perform operations to determine magnitude and direction in 2D and 3D spaces. (k, u, v/a, s, gs)	a) In groups, learners through discussions and experimentations: i) review vector definitions, representation, and vector algebra in 2D e.g., by demonstrating vectors from one seat to another in a row-by-column class sitting arrangement, ii) relate vector definitions, representation, and vector algebra performed in (a) above to 3D by adding a z-component in their earlier experiments e.g., by demonstrating the vector from an item on the floor to an item on the desk or using ICT tools for visualisation in 3D, iii) determine magnitude and direction of a vector to calculate the distance between two points and length of a vector in 3D, iv) compute the product of two vectors: • dot product • cross product and their applications. v) state and apply the ratio theorem.	a) Observe learners as they discuss and demonstrate vector representations in both 2D and 3D. Note learners' ability to: i) interpret and interrogate mathematical data ii) write and present coherently iii) demonstrate creativity and innovativeness. b) Converse with learners and implore them to explain vector positions, vector algebra, distance between two points and length of a vector in both 2D and 3D focusing on their understanding of the similarities between 2D and 3D. c) Assess learners' written work or ICT aided visualisations to check the correctness of vector representations, algebra, distance between two points, length of a vectors, product of vectors and use of the ratio theorem in both 2D and 3D.
b) analyse properties of lines in 2D and	a) In groups, learners discuss how to derive vector, parametric and	a) Observe learners as they analyse line

	3D spaces for real-life applications. (k, u, v/a, s, gs)	Cartesian equations of a line. b) Learners think-pair and share how the dot product is applied to find the angle between two lines. c) In groups, learners discuss how to determine the distance of a point from a line. d) In group discussions, learners determine the point of intersection of lines. e) In groups, learners brainstorm properties of skew lines.	properties. Note whether learners: i) use imagination to explore possibilities, ii) work with others to generate ideas, iii) exhibit hard work and self-reliance. b) Dialogue and probe learners to explain how to determine properties of lines. Evaluate learners' understanding of concepts. c) Assess learners' written work for correctness of calculations involving lines.
c)	analyse properties of planes in 2D and 3D spaces for real- life applications. (k, u, v/a, s, gs)	a) Through group discussions, learners: i) form: • parametric equations of planes, • Cartesian equation of planes, ii) determine: • points of intersection of line and plane, • line of intersection of 2 planes and 3 planes, • point of intersection of 3 planes. iii) determine the angle between: • a line and a plane, • two planes, iv) determine the perpendicular distance of a point from a plane.	a) Observe learners as they present plane properties. Note whether learners are able to: i) sort and analyse information, ii) use imagination to explore possibilities, iii) exhibit creativity and innovativeness. b) Converse and prompt learners to explain the properties of planes. Evaluate learners' understanding of the concepts. c) Assess learners' written work for correctness of calculations involving planes.

TOPIC 18: Differentiation 2

Duration: 40 Periods

Competency: The learner applies differentiation techniques to non-algebraic functions, Maclaurin's series and irrational curves to analyse real-world phenomena in various fields.

Learning Outcomes The learner should be able to:	Suggested Learning Activities	Sample Assessment Strategies
a) apply trigonometric derivatives to solve mathematical problems applicable in fields such as engineering and Physics. (k, u, v/a, s, gs)	a) In group discussions, learners review trigonometric functions, the concept of limits and derivatives to determine derivatives of trigonometric functions from first principles. b) In pairs, learners apply various differentiation techniques to determine derivatives of trigonometric functions. c) In group discussions, learners employ differentiation techniques to deduce derivatives of inverse trigonometric functions with particular emphasis on inverse of $\sin x$, $\cos x$, $\tan x$	a) Observe learners as they present their findings on differentiating trigonometric and inverse trigonometric functions. Note whether learners are able to: i) sort and analyse information, ii) evaluate different solutions, iii) exhibit hard work and self-reliance. b) Converse with learners and ask questions that provoke them to relate differentiation of trigonometric ratios from first principles to other differentiation methods. Examine learners' explanations for correctness of the concepts. c) Assess learners' written work keenly looking at correct differentiated expressions of trigonometric functions and applications into real life.
b) apply differentiation rules to exponential and logarithmic functions, recognising their inverse relationship in various contexts. (k, u, v/a, s, gs)	a) In group discussions, learners: i) sketch exponential and logarithmic functions graphs to observe their shape and characteristics, ii) generate the derivative of the exponential function e^x using concepts of limits and derivatives,	a) Observe learners as they work out exponential/ logarithmic derivatives. Note learners' ability to: i) interpret and interrogate mathematical data, ii) use mathematics to justify and support decisions, iii) exhibit hard work for self–reliance.

	iii) deduce the general formula for differentiating exponential functions, iv) relate exponential functions to natural logarithms, v) deduce logarithmic derivatives from exponential derivatives, vi) apply the natural logarithms to differentiate exponential functions, vii) apply the differentiation techniques in various fields like Physics, engineering, economics, etc. to address real-world problems.	b) Dialogue with learners and assess them on the correct and appropriate methods to differentiate exponential and logarithmic functions. c) Assess learners' written work noting the correctness of the exponential and logarithmic methods of differentiation and accuracy of the calculations made.
c) generate Maclaurin's series to approximate functions to solve advanced calculus problems and real-world scenarios, particularly in engineering and Physics. (k, u, v/a, s, gs)	a) Through group discussions, learners generate Maclaurin's polynomial expansion in the form: $f(x) = f(0) + xf'(0) + \frac{x^2}{2!}f''(0) + \ldots\ldots$ by summing up successive derivatives of a given function when $x = 0$. b) In groups through discussions, learners apply Maclaurin's theorem in expansions to: i) approximate functions, ii) truncate series to desired degree.	a) Observe learners as they apply Maclaurin's theorem. Pay attention to learners' ability to: i) work effectively in diverse teams, ii) interact effectively with others, iii) exhibit justice and fairness in dealing with others. b) Dialogue with learners as they derive Maclaurin's series. Prompt them to focus on the accuracy of the terms of the expansion and analyse different outputs. Examine learners' explanations for correct understanding of the concepts. c) Assess learners' written work for correctness of Maclaurin's series and correct application in approximating and simplifying functions, truncating series.

d) develop graphing skills to enhance spatial reasoning and visualisation in solving real-world contexts such as optimisation. (k, u, v/a, s, gs)	a) In group discussions, learners: i) identify key features (intercepts, asymptotes, range, domain) using knowledge of coordinate geometry and algebra, ii) analyse function behaviour (increasing/ decreasing, concavity, and turning points), iii) apply concepts of differentiation, coordinate geometry to accurately sketch curves, iv) use the internet and other sources of information to search for applications of irrational curves.	a) Observe learners as they sketch curves. Note learners' ability to: i) work independently with persistence, ii) interact effectively with others, iii) exhibit hard work and self-reliance. b) Converse with learners and implore them to clarify their arguments objectively and rationally as they sketch the curves. Examine learners' explanations for correct understanding of the concepts. c) Assess learners' sketched curves and written work and other ICT aided presentations for correct graphical and analytical skills.

TOPIC 19: Integration 2

Duration: 34 Periods

Competency: The learner applies appropriate methods of integration to solve real-world problems.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) determine definite and indefinite integrals of different functions using various techniques of integration to solve problems in engineering, economics, etc. (k, u, v/a, s, gs)	a) In groups, learners through discussions: i) integrate functions by recognising a function and its derivative including odd and even powers of trigonometric functions, ii) use change of variables to integrate composite functions,	a) Observe learners as they defend their choices of techniques to integrate various functions. Note their ability to: i) take responsibility for their own learning, ii) manage goals and time, iii) exhibit justice and fairness in dealing with others. b) Converse with learners and probe them to apply different

	iii) integrate exponential and logarithmic functions of forms: • $\int f'(x)e^{f(x)}dx = e^{f(x)} + c$ • $\int \frac{f'(x)}{f(x)}dx = lnf'(x) + c$ iv) Integrate functions of the form: • $\frac{1}{\sqrt{(a^2-b^2x^2)}}$ • $\frac{1}{(a^2+b^2x^2)}$ v) integrate using the t-substitution, vi) integrate partial fractions, vii) integrate by parts.	methods on the same problems to enhance their analysis of the appropriateness of the methods. Pay attention to problems that can be tackled using more than one technique to assess their reasons for their chosen option. c) Assess learners' written work, check for accuracy, coherence and correct evaluation of integrals. Check for correctness for the findings of applications of integration.
b) apply the concepts of integration to solve problems of forces and moments in engineering, economics, population dynamics, statistical modelling using the normal distribution, etc. (k, u, v/a, s, gs)	a) In group discussions learners: i) select problems of interest in various fields, discuss them, and use the internet and other sources to obtain their mathematical representations, ii) use appropriate integration techniques to obtain their solutions and present their solutions and contextual interpretations to the class.	a) Observe learners as they discuss the applications of integration noting their ability to: i) talk confidently and explain ideas/opinions clearly, ii) write and present coherently, iii) demonstrate social harmony. b) In a conversation, establish whether the mathematical representations of the problems were meaningful and whether the problems could be solved using the learned techniques of integration to deepen their understanding of applications of integration in real life. Evaluate learners' understanding of the concepts.

		c) Assess learners' ICT aided presentations and written work. Check for appropriateness of techniques, coherence and correct evaluation of integrals and interpretation of solutions in relation to the problems.

Senior Six Term 2

TOPIC 20: Dynamics 2

Duration: 28 Periods

Competency: The learner analyses motion patterns of objects as observed from different reference points to predict their behaviour and solving kinematic issues.

Learning Outcomes The learner should be able to:	Suggested Learning Activities	Sample Assessment Strategies
a) determine the resultant velocity of bodies in motion for prediction. (k, u, v/a, s, gs)	a) Through discussion, learners review resultant vector and resolution of vectors and apply them in obtaining resultant velocity of moving bodies. b) In groups, learners discuss and explore how to determine the resultant velocity of bodies in space and when crossing a river in different cases and make presentations.	a) Observe learners as they determine the resultant velocity of bodies in motion, check whether they: i) plan and carry out investigations, ii) evaluate different solutions, iii) exhibit creativity and innovativeness. b) Converse and prompt learners as they present findings to explain how they apply vectors to determine resultant velocity, time and distance of a body moving in space and when crossing the river focusing on learners' ability

		to interpret and interrogate mathematical data. c) Assess learners' written work for accuracy and appropriateness of their presentations, Pay attention to the correctness of: i) vector notations, ii) vector diagrams, iii) resultant velocity, iv) S.I units.
b) analyse the relative velocity, displacement, course and time for collision and closest approach to simplify motion related problems. (k, u, v/a, s, gs)	a) Through group discussions, learners explore relative velocity, true velocity and relative displacement of bodies at any time. b) In groups, learners demonstrate how to obtain the position, course and time of collision of two bodies using the vectorial or geometrical approach. c) In groups, learners explore through discussion how to determine the distance, time and course for closest approach. d) Learners use the internet and other sources to explore to case study the application of resultant and relative motion in real world.	a) Observe learners as they explore relative velocity noting their ability to: i) take responsibility for their own learning, ii) work independently with persistence, iii) exhibit social harmony. b) Converse with learners and prompt them to explain how to determine the position, course and time for; collision and closest approach focusing on learners' ability to adapt and manipulate values in complex expressions. c) Assess learners' written work to evaluate their level of understanding of the concepts of collision and closest approach focusing on vector notations, correctness of vector diagrams and the use of SI units.

c) apply the equations of linear motion to solve problems involving projectiles in the real world. (k, u, v/a, s, gs)	a) In groups, learners through guided discovery: i) discuss the terms used in projectiles (range, maximum height, time of flight, maximum range), ii) review the equations of linear motion and resolution of vectors, b) In groups, learners discuss how to use the equations of motion to solve projectiles in the vertical, horizontal and at an angle to the horizontal in relationship to real -world scenarios.	a) Observe learners as they discuss the terms used and review the equations of motion, check whether they: i) work with others to generate ideas, ii) try out innovative alternatives, iii) exhibit hard-work for self-reliance. b) Converse and prompt learners as they present their findings on how the equations of linear motion can be applied to solve problems involving projectile motion in vertical, horizontal and at an angle to the horizontal. Evaluate learners' understanding of the concepts. c) Assess learners' written work to evaluate their level of understanding of the concepts of projectile motion focusing on correct: i) resolution into vertical and horizontal components, ii) interpretation of a projectile, iii) use of SI units.

TOPIC 21: Trapezium Rule

Duration: 06 Periods

Competency: The learner applies the trapezium rule to estimate definite integrals and areas under a curve to solve problems involving numerical integration.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Suggested Assessment Strategies**
a) evaluate definite integrals and areas under curves using the trapezium rule. (k, u, v/a, s, gs)	a) Through discussion, learners: i) sketch smooth curves on a piece of paper dividing it into trapeziums with equal step widths, ii) approximate the area under the curve by calculating the sum of the trapeziums' areas, iii) calculate the sum of the areas of the trapeziums of your shape for varying step widths, iv) observe a general pattern to derive the formula for the trapezium rule and use the rule to estimate definite integrals and areas under curves.	a) Observe learners as they sketch curves and evaluate areas over certain intervals. Focus on learners' ability to: i) take responsibility for own learning, ii) work independently with persistence, iii) exhibit honesty; uphold and defend the truth at all times. b) Converse and implore learners to explain how to clearly approximate the areas under curves through summing up the areas of trapezoidal strips. Focus on learners' ability to pay attention to areas that fall under the x-axis and how learners use them to explain the difference between an integral and the area under a curve. c) Assess learners' presentations and written work on areas under a curve using trapezium rule with different step sizes. Check for coherence, correctness and degree of accuracy of their solutions.

b) generate a comparison between numerical and analytical solutions to integral problems. (k, u, v/a, s, gs)	a) Learners through group discussions, determine and compare the exact area under a given curve with the trapezoidal solutions. Analyse the errors in the trapezium rule in relation to different step sizes and make presentations. b) In pairs, learners use ICT simulations to determine the trapezium rule solutions and errors. c) Learners demonstrate the applications of the numerical integration in solving real-world problems.	a) Observe learners as they determine areas under curves. Note their ability to: i) evaluate different solutions, ii) predict outcomes and make reasoned decisions, iii) exhibit honesty; uphold and defend the truth at all times. b) Converse with learners as they work. Prompt them to explain and analyse the resultant error as a result of applying the trapezoidal rule. Complement the varying solutions and provide support where necessary. Examine their ability to explain the concepts clearly. c) Assess learners' written work on: i) comparison of numerical and exact solutions, ii) effect of size of step width on errors, iii) ICT solutions of trapezium rule. iv) Check for correctness and accuracy of the findings.

TOPIC 22: Sampling Distribution

Duration: 12 Periods

Competency: The learner estimates population parameters by using sample distributions to predict and eliminate variability in research and collection of statistical data.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Suggested Assessment Strategies**
a) determine probabilities involving sample mean for a normal population for prediction and decision making. (k, u, v/a, s, gs)	a) In groups, learners discuss how to standardise the sample mean and use the standardised variable to determine the probabilities and make presentations.	a) Observe learners as they discuss how to standardise the sample mean. Check whether learners: i) exhibit creativity and innovativeness, ii) work effectively in diverse teams, iii) manage goals and time/ b) Dialogue with learners as they use normal distribution tables and calculators. Probe them to explain how to standardise and read table values focusing on the learner's ability to predict outcomes and make reasoned decision. c) Assess learners' written work for coherence and accuracy of: i) values through standardisation ii) the probability values from the mathematical tables or using the calculator.

b) apply confidence intervals and point estimation to solve real-world challenges. (k, u, v/a, s, gs)	a) Learners, through group discussions, differentiate between a population and sample; determine point and interval estimates of population parameters. b) In groups, learners discuss how to compute the confidence intervals for the population mean when the population variance is known or unknown for large sample ($n \geq 30$) and make presentations.	a) Observe learners as they discuss the differences between population and sample and how to compute confidence intervals. Note learners' ability to: i) interpret and interrogate mathematical data, ii) use mathematics to justify and support decisions, iii) exhibit justice and fairness in dealing with others. b) Dialogue with learners and probe them to differentiate between a population and a sample, determine point and interval estimates using confidence intervals to predict the population mean. Focus on learners' ability to correctly read and interpret mathematical tables. c) Assess learners' written work for correct table values, determining and presentation of confidence intervals/limits.

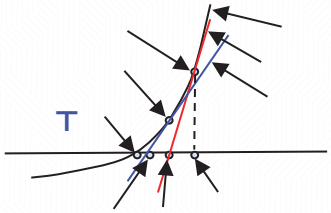
TOPIC 23: Iterative Methods

Duration: 22 Periods

Competency: The learner applies iterative numerical methods to approximate solutions to problems while critically analysing accuracy and limitations of methods used in real life situations

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Suggested Assessment Strategies**
a) estimate the unknown tabular values using the gradient method for prediction and decision making. (k, u, v/a, s, gs)	a) Through discussion, learners review the gradient method and present their findings. b) In groups or as individuals, learners perform an experiment by measuring temperature change of hot water with time, tabulate the results, analyse the data obtained and predict non tabular values that are within or outside the tabulated values.	a. Observe learners as they review gradient method, record and tabulate experimental results using correct scale interpretation of the thermometer, paying attention to learners' ability to: i) interpret and interrogate mathematical data, ii) use mathematics to justify and support decisions, iii) show respect for humanity and environment. b. Converse and prompt learners as they analyse data to explain how to predict non-tabular values within and outside the tabulated values by applying the concept of gradient of a line. Focus on learners' ability to explain the concepts clearly. c. Assess learners' written work for correctness of the gradient method, non-tabulated points, computation, and interpretation of data.

b) Investigate the range within which the roots of the function $f(x)$ lie for decision making. (k, u, v/a, s, gs)	a) In groups, learners discuss, tabulate and plot $[x, f(x)]$ values within a given range. b) In groups, learners through discussion analyse tabulated values and plotted coordinates to: i) determine the range in which the root lies, ii) observe that graphically, correct ranges must have one coordinate below and the other above the x-axis.	a) Observe learners as they determine values of f(x) for a given range in x, noting the learners' ability to: i) work effectively in diverse teams, ii) work independently with persistence, iii) exhibit justice and fairness in dealing with others. b) Converse with learners and prompt them to investigate patterns in the tabulated values and evaluate their ability to explain how to determine the range in which the root lies. c) Assess learners' written work to determine the accuracy of their computations and plotting in identifying the ranges where the root lies ensuring that their results from both procedures tally.
c) approximate the root of a non-linear function using Newton Raphson method and further linear interpolation iterative schemes for decision making. (k, u, v/a, s, gs)	a) In pairs, learners perform an experiment where they: i) draw a smooth curve that crosses the x-axis e.g., $f(x)$, ii) select any point along the x-axis as an initial guess e.g., x_i. iii) draw a tangent line to the curve at the point $(x_i, f(x_i)$. iv) note the point at which the tangent line crosses the x-axis and label it x_{i+1}.	a) Observe learners as they discuss, derive, and apply linear interpolation and Newton Raphson method to determine the root of the function focusing on their ability to: i) interpret and interrogate mathematical data,

Note: Using visuals from ICT tools could make the derivation more interesting as learners play with different initial points/guesses.	v) observe that the tangents keep going closer to the root iteratively.  vi) derive Newton's Raphson method by using the slope of tangent 1 (derivative of the function at x_i) i.e. a. $f'(x_i) = \frac{f(x_i)-0}{x_i - x_{i+1}}$ implying $$x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$$ b) In groups, learners discuss and explore the idea of iteration and tolerance limit (TOL). c) In pairs, learners through peer teaching explore linear interpolation and Newton's Raphson formula and apply them to determine the root of the function $f(x)$ i.e., where $f(x) = 0$. Learners use different rough approximated initial values in order to compare accuracy and computational involvement due to certain initial values. d) In groups, learners discuss the advantages and limitations of Newton Raphson to further linear interpolation methods.	ii) use mathematics to justify and support decisions, iii) exhibit creativity and innovativeness. b) Converse with learners and prompt them to explain how to determine the root of the function using Newton Raphson and linear interpolation iterative schemes. Pay attention to learners' presentations and assess to check for learners that may choose a starting point where f'(x)=0 and the NRM collapses. Assist them to appreciate it as a limitation and choose another point. c) Assess learners' written work and check out for correct: i) derivatives of the function, ii) substitutions in the Newton Raphson iterative formula, iii) error bounds, iv) degree of accuracy of the values obtained,

TOPIC 24: Coordinate Geometry 2

Duration: 28 Periods

Competency: The learner applies algebraic and geometric techniques to analyse spatial relationships applicable in real-world contexts.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) analyse loci to understand geometric relationships in real-world contexts such as navigation, robotics, surveying and microphone placement. (k, u, v/a, s, gs)	a) In group discussions, learners: i) review to construct loci involving points under given conditions and deduce locus of a variable point, ii) determine the equation of the locus of a variable point to predict its behaviour.	a) Observe learners as they determine the loci of a variable point. Note learners' ability to: i) listen attentively and with comprehension, ii) talk confidently and explain ideas/ opinions clearly, iii) show justice and fairness in dealing with others. b) Dialogue with learners and ask questions to elucidate loci of a variable point under different constraints. Evaluate learners, understanding of the concepts. c) Assess learners' written work for accurate construction, correct locus of a variable point and prediction.

b) analyse locus of a circle to solve contextual problems in geometry, motion, engineering, and architecture. (k, u, v/a, s, gs)	a) In pairs, learners use a compass, pencil and paper or any other material to review the centre, radius of a circle with reference to coordinate geometry 1 to determine the equation of a circle b) In pairs, learners use a compass, pencil and paper to determine the tangent to a circle, its relationship to the radius and length of tangent drawn from a point outside the circle. c) In groups, learners use concepts of perpendicular lines or differentiation to determine the tangent to a circle at a point. d) Learners use a compass, pencil and paper to deduce the conditions for external, internal and orthogonal intersection of circles.	a) Observe learners as they determine the characteristics and properties of a circle. Note learners' ability to: i) identify problems and ways forward ii) predict outcomes to make reasoned decisions iii) demonstrate creativity and innovativeness. b) Converse with learners and assess their ability to explain: i) how the equation of a circle is determined, ii) tangent to a circle and relationship to the radius, iii) conditions for external, internal and orthogonal intersection of two circles. c) Assess learners' written work for correctness of the equation of a circle, equation of a tangent to a circle, relationship between tangent and the radius of a circle and conditions for external, internal and orthogonal intersection of two circles.

c) analyse locus of parabola to solve contextual problems in geometry, motion, engineering and architecture. (k, u, v/a, s, gs)	a) In group discussions, learners review concepts of locus of a variable point from a fixed line and fixed point to identify a conic section. b) In group discussions, learners review concepts of quadratic curves in relation to locus of a variable point from a fixed line and fixed point to: i) define and sketch a parabola, ii) identify its vertex and line of symmetry, iii) locate its focus and directrix, iv) determine the equation of the parabola, c) Learners through think-pair and share, apply concepts from geometry, algebra and differentiation to: i) determine the equation of the tangent, normal and chord of a parabola, ii) determine the parametric equations of the parabola. d) In group discussions, learners use the internet and other resources to identify applications of parabola in the real-world like, parabolic mirrors, satellite dishes, etc.	a) Observe learners as they analyse characteristics and properties of a parabola paying attention to learners' ability to: i) interpret and interrogate mathematical data, ii) use mathematics to justify and support decisions, iii) show creativity and innovativeness. b) Converse with learners to examine their understanding of properties and characteristics of a parabola. c) Assess learners' written work and check for correctness of graph work, equation of the parabola, equation of the tangent, normal and chord of a parabola and parametric equations of the parabola.

d) analyse locus of ellipse to solve contextual problems in geometry, motion, engineering and architecture. (k, u, v/a, s, gs)	a) Through group discussions, learners: i) use a compass, pencil and paper to: • sketch and identify an ellipse, • identify the major and minor axis and semis axis and their lengths, • find the eccentricity, foci, and equations of directrices. ii) apply concepts from geometry, algebra and differentiation to: • find the parametric equations of the ellipse, • find the equation of the tangent, normal and chord of an ellipse. iii) use the internet and other resources to identify applications of ellipse in the real- world like, parabolic mirrors, satellite dishes, etc.	a) Observe learners as they analyse characteristics and properties of ellipse. Pay attention to learners' ability to: i) Identify problems and ways forward, ii) evaluate different solutions ideas, iii) exhibit hard-work for self- reliance. b) Converse with learners to examine the understanding of properties and characteristics of the ellipse. c) Assess learners' written work and check for correctness of graph work, equation of the ellipse, equation of the tangent, normal and chord of an ellipse and parametric equations of the ellipse.

Senior Six Term 3

TOPIC 25: Complex Numbers

Duration: 28 Periods

Competency: The learner applies concepts of complex numbers to solve modelling problems across different mathematical and real-world scenarios.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) explain the algebra of complex numbers. (k, s, u, v/a, gs)	a) Through story- telling, learners explore the evolution of the number system; - scenario problems that gave rise to natural numbers, zero, negative numbers, fractions and imaginary numbers to discover the characteristics of complex numbers including powers of ***i***, real and imaginary parts, powers of complex numbers, and roots of negative numbers. b) By induction, learners discuss the concept of the conjugate of a complex number. c) In groups, learners through brainstorming review the concept of collecting like terms during algebraic computations and use the skills to explore operations on complex numbers, e.g., addition, subtraction, multiplication and division. d) In groups, learners use the internet or other sources to solve: i) equations with complex coefficients ii) quadratic equations with complex roots.	a) Observe learners as they explore the algebra of complex numbers. Focus on learners' ability to; i) work with others to generate ideas, ii) suggest and develop new solutions, iii) exhibit hard work for self-reliance. b) Converse with learners and implore them to apply algebraic concepts to simplify and analyse complex numbers. Ascertain learners' understanding that real numbers are complex numbers whose imaginary part is zero. c) Assess learners' written work to determine the accuracy of computations

b) evaluate different forms of complex numbers for application in relevant situations. (k, u, s, v/a, gs)	a) In groups, learners: i) relate complex numbers to the cartesian coordinate system. ii) use the internet or other sources to represent complex numbers on the argand diagram, define modulus and argument of a complex number. b) Through guided discovery, learners represent the locus of a complex equation and inequalities on a complex plane and present to the class using appropriate ICT tools. c) Through induction, learners are guided to express complex numbers in polar forms and apply De Moivre's theorem in determining roots and powers of complex numbers, simplification of trigonometric expressions and solving equations.	a) Observe learners as they relate complex numbers to the cartesian coordinate system, graphically represent complex numbers and convert complex numbers from one form to another. Pay attention to learners' ability to: i) evaluate different solutions ii) sort and analyse information iii) exhibit hard work for self-reliance. b) Converse with learners and ask questions to trigger them to appreciate the relationship between complex numbers and the cartesian coordinate system, use algebraic concepts to determine the loci of complex numbers and apply De Moivre's theorem to simplify expressions and solve equations. Evaluate learners' understanding of the concepts. c) Assess learners' ICT aided oral presentations and written work to check the accuracy and clarity and analysis of their computation and graphical skills.

c) appreciate the application of complex numbers to solve modelling problems across mathematical and real-life scenarios e.g., periodic motions, electrical engineering, etc. (k, u, v/a, s, gs)	a) By use of internet and other sources, learners explore mathematical computations that are made easy by use of complex numbers in AC circuits, electromagnetism, etc. and present to the class.	a) Observe learners as they discuss the applications of complex numbers focusing on their ability to: i) talk confidently and explain ideas/opinions clearly, ii) write and present clearly, iii) exhibit respect for humanity and environment. b) In conversation, evaluate learners' understanding of concepts by asking questions that trigger an imagination of Mathematics without complex numbers in relation to the learners' discovered application of complex numbers. c) Assess learners' presentations to check for the clarity and relevance of their use of complex numbers.

TOPIC 26: Differential Equations

Duration: 26 Periods

Competency: The learner models and solves problems involving rates of change to interpret the solutions for prediction in context for acquisition of analytical skills.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) demonstrate the ability to solve differential equations using various techniques in real life scenarios. (k, u, v/a, s, gs)	a) In groups, learners through discussions review linear equations. b) In groups, learners through guided discovery: i) form differential equations. ii) discuss the relationship between linear equations and differential equations. c) In groups, learners use the internet and other sources to: i) classify first order differential equations as separable, exact, linear, homogenous etc. ii) solve first order differential equations using appropriate techniques such as separation of variables, integration factor, particular substitution.	a) Observe learners as they communicate the similarities and differences between linear equations and differential equations, reason around their classification of differential equations and defend their choice of techniques for solving differential equations. Pay attention to learners' ability to: i) suggest and develop new solutions, ii) work with others to generate ideas, iii) demonstrate creativity and innovativeness. b) Dialogue with learners to ascertain their understanding of differential equations, focusing on their ability to derive, classify, and solve first order differential equations using appropriate techniques. c) Asses learners' ICT aided oral presentations or written work taking keen interest in the use of correct methods and accuracy of the work.

b) generate differential equations to model and analyse real- world situations such as in population growth, price of commodities and temperature variations. (k, u, v/a, s, gs)	a) Learners use internet or other sources to discuss the applications of differential equations to real world scenarios such as predicting population growth/decline, forensic analysis (time of death estimation), drug absorption. b) In groups, through story-telling, learners discuss the applications of differential equations in real world, use the internet and other sources to decide on a problem to research on and later present to the class.	a) Observe learners as they discuss and decide on their problem of interest. Note their urge to seek new knowledge by: i) use of technology to collaborate, communicate and refine work, ii) use mathematics to justify and support decisions, iii) demonstrate justice and fairness in dealing with others. b) Converse with learners as they decide on their problem to make sure the problem can be modelled by differential equations. During presentations, ask questions that evaluate how learners interpret their results in the context of the problem. c) Assess learners' findings focusing on the relevancy and correctness of the applications of differential equations in real life.

TOPIC 27: Flow Charts

Duration: 16 Periods

Competency: The learner develops flowcharts to organise and represent mathematical processes and problem-solving strategies by breaking down complex tasks into simpler, more manageable steps, and applies these skills to tackle emerging challenges.

Learning Outcomes The learner should be able to:	**Suggested Learning Activities**	**Sample Assessment Strategies**
a) design flow charts to represent mathematical processes using dry runs to identify areas of improvement or detect errors and to solve a given mathematical problem. (k, u, v/a, s, gs)	a) In groups, learners: i) discuss and explore what flowcharts are and the roles of different symbols in flowcharts ii) discuss logical steps and represent iterative algorithms in diagrams using shapes and arrows to solve a given mathematical problem iii) perform dry runs and state the purpose of given flowchart to detect and correct errors.	a. Observe learners as they brainstorm iterative algorithms as diagrams. Note their ability to: i) predict outcomes and make reasoned decisions, ii) write and present coherently, iii) exhibit creativity and innovativeness. b. Converse with learners as they work through problems, prompt them to describe how to present multiple tasks on flowcharts and perform dry runs to solve a given mathematical problem. Encourage learners to seek for support where necessary. Note their ability to respond to criticisms and correction. c. Examine learners' work, check for the correctness of: i) the shapes used, ii) the logical flow of the algorithm, iii) table values in the dry run and harmonise the varying solutions.

b) apply flowcharts to represent and solve real world problems in designing computer algorithms, business processes, production lines in industry, etc. (k, u, v/a, s, gs)	a) In groups, learners use the internet and other sources to discuss and explore real-world scenarios where flowcharts are used and present to class.	a) Observe learners as they discuss and analyse various situations that require a flow-chart implementation. Note their ability to: i) exhibit creativity and innovativeness, ii) sort and analyse information iii) predict outcomes and make reasoned decisions b) Converse with learners, and prompt them to describe how they apply flow charts to solve real-world problems in designing computer algorithms, business processes, production lines in industry, focusing on learners' ability to use technology to create, manipulate and process information. c) Assess learners' work and the validity of their presentations in relation to the real-world challenges in technology. **(NB. This is a potential area for project work. A learner can explore the application of moderate computer programming to implement an algorithm)**

3.0 ASSESSMENT

3.1 Assessing Mathematics

The adapted curriculum sets new expectations for learning, with a shift from Objectives to Learning Outcomes that focus mainly on application of knowledge and deeper learning that leads to acquisition of skills. These Learning Outcomes require a different approach to assessment. The Learning Outcomes in the syllabuses are set out in terms of Knowledge, Understanding, Skills, Values, and Attitudes. This is what is referred to by the letters k, u, s, v & a.

It is not possible to assess attitudes in the same way as knowledge, understanding and skills because they are more personal and variable and are long-term aspirations. This does not mean that values and attitudes are not important or cannot be assessed. They too can be assessed but not easily done through tests and examination. Values and attitudes can be assessed over a period of time through observing and having interactions with the learner.

So, this guidance section focuses on knowledge, skills and understanding. Each has its own implications for learning and assessment.

To assess knowledge and its application, understanding and skills, we need to look for different things. Knowledge can be assessed to some extent through written tests, but the assessment of skills, application of what is learnt and deeper understanding requires different approaches. Because of this, the role of the teacher in assessment becomes much more important.

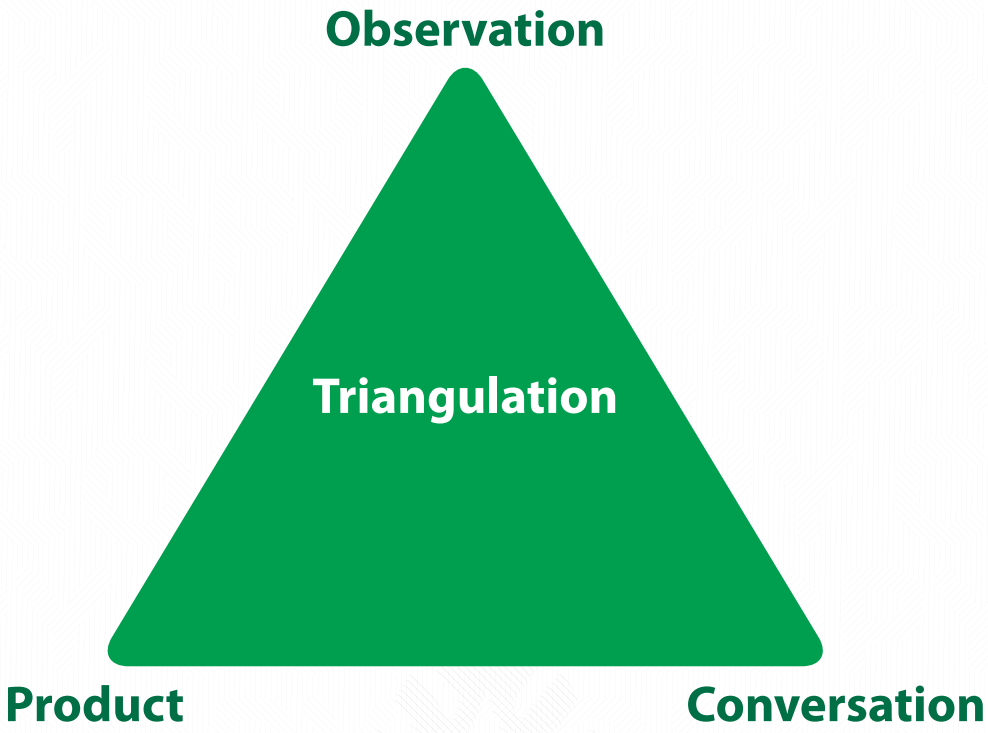
3.2 Formative Assessment

In this aligned curriculum, the teacher's assessment role is not to write tests for learners, but to make professional judgement about learners' learning in the course of the normal teaching and learning process. The professional judgement is about how far the learner achieves the Learning Outcomes that are set out in this syllabus. To make this judgement the teacher needs to look at how well the learners are performing in terms of each Learning Outcome.

The formative assessment opportunities occur in three forms. They can be done through:

a) **Observation**– watching learners working (good for assessing skills, values and attitudes)
b) **Conversation** – asking questions and talking to learners (good for assessing knowledge and understanding)
c) **Product** – appraising the learner's work (writing, report, translation, calculation, presentation, map, diagram, model, drawing, painting, etc.). In this context, a "product" is seen as something physical and permanent that the teacher can keep and look at, not something that the learner says.

When all three are used, the information from any one can be checked against the other two forms of assessment opportunity (e.g. evidence from **observation** can be checked against evidence from **conversation** and **product**). This is often referred to as **triangulation**



3.3 Assessing Generic Skills

The Generic Skills have been built into the syllabuses and are part of the Learning Outcomes. It is therefore not necessary to assess them separately. It is the increasingly complex context of the subject content that provides progression in the Generic Skills, and so they are assessed as part of the subject Learning Outcomes. Assessing generic skills is done with the help of **an observation checklist and scoring rubric**.

3.4 Assessing Values/Attitudes

It is not possible to assess values and attitudes in the same way as knowledge, understanding and skills because they are more personal and variable and are long-term aspirations. This does not mean that attitudes are not important. It means that we must value things that we cannot easily assess through tests and examination. However, values and attitudes can be assessed over a long period of time through observing and interactions.

3.5 Assessment of Project-based Learning

Project-based learning is a teaching method in which learners or participants gain knowledge and skills by engaging for an extended period of time to investigate and respond to an authentic challenge. The task must have a driving question and it involves sustained inquiry.

Project-based learning is assessed using a rubric and an observation checklist.

3.6 Examinations

There will be only one school based summative assessment at the end of the year. There will no longer be examinations or tests set at the beginning and end of every term. Instead, there will be a summing up of on-going teacher assessments made in the context of learning through end of topic scenario-based tasks (Activities of Integration). The learners will also be subjected to the end of cycle assessment for certification.

3.7 Record keeping

In competency-based learning, accurate and comprehensive record keeping is crucial to track learners' progress and achievements. Therefore, the teacher and school **must keep accurate records about learners' achievement.**

Various assessment tools and strategies are employed to capture learners' demonstration of abilities and achievements, including observation checklists, rubrics, and scoring grids. These tools provide a holistic picture of learners' strengths, weaknesses, and areas for improvement.

The collected data and evidence from these assessments are correctly recorded and maintained in learners' files, portfolios and anecdotal notes.

GLOSSARY OF KEY TERMS

Term	Definition
competency-based curriculum	One in which learners develop the ability to apply their learning with confidence in a range of situations.
differentiation	The design or adaptation of learning experiences to suit an individual learner's needs, strengths, preferences, and abilities.
formative assessment	The process of judging the learner's performance, by interpreting the responses to tasks, in order to gauge progress and inform subsequent learning steps.
generic skills	Skills which are deployed in all subjects, and which enhance the learning of those subjects. These skills also equip young people for work and for life.
inclusion	An approach to planning learning experiences which allows each student to feel confident, respected and safe and equipped to learn at his or her full potential.
learning outcome	A statement which specifies what the learner should know, under-stand, or be able to do within a particular aspect of a subject.
process skill	A capability acquired by following the programme of study in a particular learning area; enables the learner to apply the knowledge and understanding of the learning area.
sample assessment activity	An activity which gives a learner the opportunity to show the extent to which s/he has achieved the learning outcomes. This is usually part of the normal teaching and learning process, and not something extra at the end of the topic.
suggested learning activity	An aspect of the normal teaching and learning process that will enable a formative assessment to be made.

CONTACT US:

National Curriculum Development Centre
Plot M838, Kyambogo.
P.O.Box 7002 Kampala, Uganda
+256-393-112-088
www.ncdc.go.ug

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