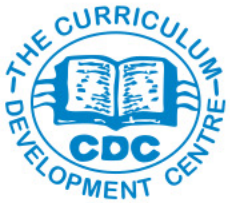
Republic of Zambia

Ministry of General Education

Science, Technology, Engineering and Mathematics (STEM) for Secondary Education

General STEM Mathematics
Grade 10 - 12

Transitional Syllabus



Prepared and Published by Curriculum Development Centre
P.O. Box 50092
Lusaka - Zambia

The National Anthem of Zambia

Stand and sing of Zambia, Proud and free,
Land of work and joy in Unity,
Victors in the struggle for the rights,
We've won freedom's fight.
All one, Strong and Free.

Africa is our own motherland,
Fashion'd with and blessed by God's good hand,
Let us all her people join as one,
Brothers under the sun,
All one, Strong and Free.

One land and one nation is our cry,
Dignity and peace neath Zambia's sky
Like our noble eagle in its flight,
Zambia, praise to thee.

All one, Strong and Free.

CHORUS
Praise be to God,
Praise be, praise be, praise be,
Bless our great nation,
Zambia, Zambia, Zambia
Free men we stand
Under the flag of our land
Zambia, praise to thee!
All one, Strong and Free

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Vision of the Country

A prosperous middle-income Nation by 2030

Vision of Education

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

Mission of Education

To guide the provision of education for all Zambians so that they are able to pursue knowledge and skills, manifest excellence in performance and moral uprightness, defend democratic ideals, and accept and value other persons on the basis of their personal worth and dignity, irrespective of gender, religion, ethnic origin, or any other discriminatory characteristic

Goals of Education

1. Producing a learner capable of:
    a. Being animated by a personally held set of civic, moral and spiritual values;
    b. Developing an analytical, innovative, creative and constructive mind;
    c. Appreciating the relationship between scientific thought, action and technology on the one hand, and sustenance of the quality of life on the other;
    d. Demonstrating free expression of one's own ideas and exercising tolerance for other people's views;
    e. Cherishing and safeguarding individual liberties and human rights;
    f. Appreciating Zambia's ethnic cultures, customs and traditions, and upholding national pride, sovereignty, peace, freedom and independence;
    g. Participating in the preservation of the ecosystems in one's immediate and distant environments;
    h. Maintaining and observing discipline and hard work as the cornerstones of personal and national development
2. Increasing access to education and life skills training
3. Building capacity for the provision of quality education
4. Creating conditions for effective coordination of policies, plans and programmes
5. Rationalizing resource mobilization and utilization.

Foreword

In an effort to promote human capital development proficient in contributing to national development, the Government of the Republic of Zambia is implementing STEM Education as one cardinal way, amongst others, of nurturing the much-needed talent and energy of the learners. STEM Education requires critical understanding and interpretation of the curriculum by teachers to enable them plan and deliver lessons that will engage learners and provoke creativity, innovativeness and critical thinking as envisaged in the Seventh National Development Plan (7NDP) roadmap. This syllabus seeks to provide education that would bring about discipline of mind and good character through acquisition of right competences by learners to be able to contribute to national development. This calls for competence among teachers and requires learning beyond the classroom; migration from conception to products, perception to reality and formalities to requirements. Therefore, the publication of this STEM Education Syllabus cannot be understated.

I thank the Minister of General Education for the tireless effort in providing informed direction on STEM Education implementation. I also thank Director Standards & Curriculum and Director National Science Centre for the technical support rendered in developing this STEM Syllabus. Sincere thanks go to all the other departments and institutions too numerous to mention for providing leadership in supporting STEM Education. Further appreciation goes to the Curriculum Development Centre (CDC) and National Science Centre teams who developed this syllabus as the bed rock of the future of STEM Education in Zambia.

Dr. Jobbicks Kalumba
Permanent Secretary - Technical Services
Ministry of General Education

Acknowledgement

The contribution of STEM Education to national development cannot be over emphasized. Zambia has two dimensional frontiers it can ride on with the STEM agenda; one being that of varied worth of natural resources and the other being land-linked position. Our country is endowed with various resources which need to be well nurtured and also used to benefit its citizens sustainably. The learners at all levels of education require ***development of skills and values***. These skills and values are required in order to be productive and ultimately contribute to socio-economic development of the country. The implementation of STEM Education requires sharing the same sense of mission by all stakeholders. To this effect, many individuals, institutions and organizations were consulted to gather their views on the existing syllabus and to accord them an opportunity to make suggestions for this STEM Education syllabus.

This STEM Education Syllabus has been aligned with a view to develop Critical, Creative and Analytical Thinkers (CCAT). To do so, the integration of STEM disciplines is highly encouraged as the acquisition of knowledge skills and values through the learning outcomes are expected to be attained by the use of constructivist learning models in which learners take Centre stage while teachers assume the facilitator role. It is therefore, expected that through this STEM Education Syllabus, desirable scientific, ICT literacy and research skills essential in the global economy will be enhanced in learners.

The Ministry of General Education wishes to express heartfelt gratitude to all those who participated in this endeavour for their valuable contributions, which resulted in the development of this syllabus. Therefore, there is need for all stakeholders to work together and see to it that STEM Education strategies are well implemented to yield desirable outcomes. With the implementation of this STEM Education syllabus underway emerging issues may arise and hence, various ideas on STEM Education will continue to be developed and shared for effective implementation. The Ministry of General Education will therefore, endeavour to make available the implementation models as they emerge to keep abreast with STEM Education.

I sincerely thank the Directorate of National Science Centre and the Examinations Council of Zambia for their technical and steadfast support rendered. Further gratitude goes to Provincial Education Officers, District Education Board Secretaries, School Administrators together with staff and other institutions too numerous to mention, for their continued support.

Cecilia N.M Sakala (Mrs.)
Director-Standard and Curriculum
Ministry of General Education

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

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

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

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

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

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Aims
The aims of teaching Mathematics will thus be to act as a subject through which learners would ultimately either specialize explicitly in the field of study with the view to take up related careers or to develop actual products, services and improvements in everyday life for socio-economic gains using practical investigations through research, development and commercialization.

The Mathematics syllabus, in fulfilling the educational purposes, will aim more specifically on the following:

1. To provide essential practical knowledge and skills, through a worthwhile educational experience for all learners, whether or not they go on to study Mathematics beyond this level
2. To enable learners, acquire sufficient knowledge and competences on essential Mathematics concepts and principles to:
    a. become confident citizens in a technological world, able to take or develop an informed interest in matters of scientific importance
    b. Recognize the usefulness, and limitations, of scientific method and to appreciate its applicability in other disciplines and in everyday life;
    c. Be suitably prepared for studies beyond Senior Secondary School level in Mathematics;
3. Stimulate learners, create and sustain their interest in the learning of Mathematics.
4. To enable learners to appreciate that
    a. Mathematics is subject to social, economic, technological, ethical and cultural influences and limitations.
    b. The applications of science may be both beneficial and detrimental to the individual, the community and the environment.
5. Promote an awareness that:
    a. Mathematical theories and methods have developed, and continue to do so as a result of co-operative activities of groups and individuals;
    b. The study and practice of Mathematics is subject to social economic, technological, ethnical and cultural influences and limitations;

Objectives of the Mathematics Syllabus

The objectives of teaching Mathematics are to mould a learner who is:

1. A critical, creative and analytical thinker
2. A problem solver and relates thinking with real world situations
3. A responsible citizen
4. ICT literate

Expected Outcomes

The expected outcomes of this syllabus are learners who are:

1. Critical, Creative and Analytical Thinkers (CCAT)
2. Problem-solver
3. Responsible citizen
4. Able to relate thinking with real world situations in technological sense

General Structure of the Syllabus

The syllabus consists of topics and subtopics that have been made arranged in a logical order but this is not intended to suggest a teaching order. It is hoped teachers will develop a considerable flexibility in planning their lesson presentations.

Each of the topics is described under the headings of "Content", "specific outcomes" knowledge and skills. The column headed "skills" is intended to guide with the type of practical skills to be acquired while value must show the importance of learning the topic in relation to the individual, community, nation and everyday application.

It is envisaged that a constructivist approach will be adopted and that learners will spend adequate time on individual experimental work.
The following are the underlying principles for the revised Senior Secondary School Mathematics syllabus:

1. Equity
2. Orderly and logical progression
3. Varied teaching methodology with subjective learning as the keystone
4. Integration of knowledge, skills and values

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

Suggested Teaching Methodology
This Syllabus for Senior Secondary Schools aims at enabling learners acquire Mathematical knowledge, values and skills for the further study of the subject higher level as well as apply it in their daily lives. It is for this reason that teachers should focus on encouraging communication of Mathematical ideas among learners, emphasize problem solving and application to real life situations besides cultivating interest in the subjects.

The mathematical concepts and principles presented in this syllabus aim to encourage learners to think logically and critically and make connections between topics and with other subjects. To achieve this, teachers should put emphasis on teaching the subject in a manner where learners communicate their mathematical ideas as well as misconceptions. This approach will enhance learners' understanding and appreciation of Mathematical concepts and ideas as they construct their own knowledge. Teachers will also need to refocus their teaching approaches and continuously sharpen their Pedagogical Skills in line with contemporary approaches in the teaching of the subject.

Further, since Mathematics is a discipline with hierarchical concepts and skills, teachers should present it in a systematic manner. In the design of the syllabus, effort has been made to sequence the topics across the entire course of study. Successful interpretation and implementation of this syllabus however requires flexibility on the part of teachers in order for them to arrange the content in an easy to understand progression so as to improve Mathematics education in the country.

Therefore, to nurture the much-desired learner as prescribed in the policy document, the following methods among others are recommended:

a. **Problem-Solving Approach (PSA)** – The process starts with problem finding and problem shaping, where the problem is discovered and simplified. The next step is to generate possible solutions and evaluate them.
b. **Project Method** – This is a teaching method that requires the learners to present in concrete form the results of information gathered about a concept, principle or innovation.
c. **Discovery Method** – The ultimate goal of this approach is that learners learn how to learn rather than what to learn. For developing their higher – order thinking skills. This approach refers to an inductive method of guiding learners to discuss and use ideas already acquired as a means of discovering new ideas.
d. **Cooperative Learning** – This is a method in which learners work in small groups to learn. It encourages them to work together towards common goals. It fosters positive intergroup attitudes in the classroom and it eliminates competition among learners.
e. **Discussion Methods** – Are a variety of forums for open-ended, collaborative exchange of ideas among a teacher and learners or among learners for the purpose of furthering learners thinking, learning, problem solving, understanding, or literary appreciation. Participants present multiple points of view, respond to the ideas of others and reflect on their own ideas in an effort to build their knowledge, understanding or interpretation of the matter at hand.
f. **Heuristic Method** – is a pure discovery method of learning Mathematics/Science independent of the teacher. Thus, no help or guidance is provided by the teacher in this method. The teacher sets a problem for the learners and then stands aside while they discover the solution, etc.

The success in Mathematics can be achieved by maximum participation by learners. This subject seeks to develop and enhance **C**ritical, **C**reative, and **A**nalytical **T**hinking (CCAT) skills in learners. To do so the constructivist learning theories are encouraged which focus the learning process in the following manner.

1. Present Problem [**Teacher**] (*Situation/*Key question)
2. Hypothesize [**Learners**]
3. Design Solutions [**Learners**]
4. Present their Solutions **[Learners]**
5. Confirmation of Solutions **[Learners & Teacher]**
6. Further Problem/s **[Teacher and Learners]**

It is advisable that these methods be integrated wherever possible. Additionally, teachers will be required to employ ICT methodologies in their preparations and delivery of lessons so as to help keep learners motivated and engaged in the lesson process. Integrating technology into the classroom is a great way to empower learners to stay connected in this technological era and access virtual reality on concepts which may be difficult to carry out physically.

In order for this approach to be effective the teacher and learners have roles to undertake during the teaching and learning process.

Role of a Teacher

In this model teachers will take the role of a **facilitator.** They should incorporate various learning strategies which include:

1. Inquiry Discovery: Learners interact with the environment through exploration and manipulation.
2. Problem Based Learning: learning by analyzing relevant facts through problem solving.
3. Problem Solving: Learning by solving an open-ended trigger problem.
4. Masterly Learning: Evidence based learning in which great time is spent on depth of content
5. Research Approach: Learners assume the role of researchers and go through all the stages of the research process.
6. 5 Es Approach: Learning through engagement, exploration, explanations, elaboration and evaluating
7. Subjective Learning: Learning which involves space for learners to present their own ideas, conceptions and misconceptions.
8. Experiential Learning: Learning through hands-on experiments.
9. Field Work: Learning outside the classroom where learners can explore, discover and experience Mathematics in everyday life.
10. Model Building: Learners designing and constructing a representation of a concept or an object.
11. Projects: Learners finding out about a phenomenon over a period of time.

To further emphasize the learning of Mathematics using constructivism, teachers are encouraged not only to familiarize themse lves with the scope and sequence of the subject to establish connections of concepts but also incorporate various learning strategies that encourage collaboration such as think pair and share, peeragogy, and heutagogy to meet the learning styles of learners.

Role of a Learner

The role of learners in this constructivist approach will be to take centre stage in the learning process. For learners to be in charge of their own learning individual peeragogy, heutagogy as well as think pair share should be among the learning styles.

Assessment

The types of assessment in this syllabus will be formative and summative. In both types of assessment, the process and product will be given attention with emphasis on skill acquisition.

In order to provide timely and efficient feedback on the effectiveness of the teaching and learning activities in sch ools, assessment will form an on-going and integral part of the teaching and learning process in Mathematics, from the first day a learner enrols at a school. Through the school-based assessment and the final examination, learning will be assessed holistically and from multiple angles. This will necessitate meaningful interventions to be undertaken, other than waiting for the final examination at the end of the learning process, in which if a learner fails there will be no timely responsive intervention. Conducted effectively and consistently, assessment will provide indicators of achievement and attainment of learning outcomes to help ascertain and monitor learning progress.

Both formative and summative assessment will be used to reveal how much content the learners will have learnt throughout the learning process.

Summative Assessment

In Mathematics, summative assessment will be administered by the Examinations Council of Zambia (ECZ). Summative assessment i n Mathematics shall be at the end of three years and shall be 35% of the total aggregate marks. This will be theory examination.

Formative Assessment

Formative assessment will comprise the school-based assessment (SBCA). The School Based Continuous Assessment is 65% of the aggregate scores and will include; tests, assignments, practicals, research, and workbook management.

The scheme of assessment consists of school-based assessment and summative assessment as outlined below:

1. Assignments 30%
2. Practical's 20%
3. Tests 10%
4. Workbook 5%

Apart from the above stated, Research is part of Formative assessment and will have an aggregate score of 100 %.

Assignments

Assignment are tasks assigned by teachers to STEM learners for completion outside regular class time on content already done or yet to be done. Learners will be required to do one assignment per Term at this level. There will be no assignment in Term 3 of Grade 12. The total number of assignments will be 8 at senior level. Each assignment will carry 10% marks except for the research-based major assignment which will carry 20% of the 65% allocated for assignments. At the end of grade 12 level the aggregate will be found by dividing the total marks obtained by the number of assignments given as outlined in the assignment score guide.

Grade Level	Type	Assignments				Weight	Aggregate Score	Weight	Overall Score
		Term 1	Term 2	Term 3	Yearly				
10	Major		1		1	20%	$\frac{Score\ obtained}{Total\ score} \times 20\%$	30%	Major assignment % score + Minor assignment % score
	Minor	1		1	2	10%	$\frac{Sum\ percentage\ score}{Number\ of\ assignments}$		
11	Minor	1	1	1	3				
12	Minor	1	1		2				

Practicals

Practicals are assessment tasks which involve learners working in groups or individually as they observe and manipulate objects to build up understanding of concepts through collection, processing and interpreting data. Practical Work will carry 20 % of the 65 % marks allocated for Continuous Assessment. At the end of the level the aggregate will be found by dividing the total practical scores by the number of practicals undertaken as outlined in the practical score guide.

Grade Level	Practicals			Weight	Aggregate Score
	Term 1	Term 2	Term 3		
10	Score of all practicals	Score of all practicals	Score of all practicals	20%	$\frac{sum\ percentage\ \ practical\ scores}{number\ of\ practicals}$ or $\frac{sum\ \ of\ practical\ \ scores}{total\ number\ of\ practical\ scores} \times 20\%$
11	Score of all practicals	Score of all practicals	Score of all practicals		
12	Score of all practicals	Score of all practicals	Score of all practicals		

Tests

Tests are written tasks with a specified time allocation intended to measure a learner's knowledge and skills. Learners are required to write these tests on hardcopy or softcopy. Some electronic tests will be required to be answered and submitted in real time. The tests will carry 10 % of the 65 % weight allocated for continuous assessment. Learners are required to undertake two tests per term (1 mid and 1 end). There will be no tests in Term 3 of Grade 12. The total number of tests will be 16. Each test will carry 10 % marks. The aggregate test scores will be found by dividing the total test scores by the number of tests as shown test score guide below:

Grade Level	Term 1		Term 2		Term 3		Total	Level Total	Weight	Aggregate Score for Test Assessment
10	Mid Term	End Term	Mid term	End Term	Mid Term	End Term	6	16	10%	$\frac{sum\ percentage\ score}{total\ number\ of\ tests}$ or $\frac{sum\ test\ scores}{total\ number\ of\ scores} \times 10\%$
11	Mid Term	End Term	Mid term	End Term	Mid term	End Term	6			
12	Mid Term	End Term	Mid term	End Term	No Tests		4			

Research

Research is a sandwich intermediate process in which the theories in STEM Education are transited into evidence-based products closer to prototype status as the learners go through the learning process. Learners will be required to write a research report, defend the research and make a product. The weighting for research is as shown in the following research score guide.

Component	Weight	Total	Aggregate Component Score	Total Score
Research Report	30%	100%	$\frac{Total\ report\ score}{30} \times 30\%$	Total Score = Sum of Report % score + Defence % score + Product % score
Defence (Power Point Presentation)	30%		$\frac{Total\ defence\ score}{30} \times 30\%$	
Research Product	40%		$\frac{Total\ product\ score}{40} \times 40\%$	

Workbook

A Workbook is a learner repository platform in either soft or hard copy format in which learners are expected to have a record of practical assignments, tests, daily reflections and research activities. Learners workbooks will be assessed once at the end of each term and each workbook's assessment will carry 5%. Therefore, at Senior Secondary level, work book assessment will be 9 times. The total aggregate score for workbook assessment at Senior Secondary level will be 5% and this will be obtained by dividing the total workbook scores by 9 terms as shown in the following workbook score guide.

Grade Level	Workbook Assessment			At Each Grade Level	Total workbook assessments	Weight	Total aggregate for Workbook assessment
10	End Term 1	End Term 2	End Term 3	3	9	5%	$\frac{sum\ \ percentage\ workbook\ score}{number\ of\ workbook\ assessments}$ or $\frac{sum\ of\ workbook\ scores}{total\ number\ of\ workbook\ assessments} \times 5\ \%$
11	End Term 1	End Term 2	End Term 3	3			
12	End Term 1	End Term 2	End Term 3	3			

Summary of Assessment

Type of assessment	Scheme of Assessment	Item Description	Marks Allocation (%)	Total marks Allocated %)
Examinations Council of Zambia	Theory	Summative Assessment	35	35%
School Based	Assignment	Continuous Assessment (Major and Minor)	30	65%
	Practical's	Continuous Assessment	20	
	Tests	Continuous Assessment	10	
	Work book	Continuous Assessment	5	
	Research	Research Report	30	100%
		Research Defence	30	
		Research Product	40	

Scientific Skills

Through learning Mathematics, learners will interact with their environment, both in-door (classroom, and laboratories) and outside the classrooms (the general environment, industry and any similar knowledge-rich sites). Learners will be engaged in hands-on, minds-on activities leading to acquisition of a variety of rich experiences as well as a wide range of abilities in performing given tasks and with precision. Thus, the emphasis in teaching and learning Mathematics will focus on the acquisition of ***scientific skills***. In so doing, the basics will be a must, therefore if a concept has a dimension of an experiment or investigation; such a task will have to be performed by the learners as fulfilment of the competency aspirations.

The following skills will be useful to help guide and actualize the demands of the specific outcomes in the syllabus in order to mirror the appropriate learner abilities in performing practical tasks throughout the learning process in Mathematics:

Category	Skills	Description of skill
1. Acquisitive Acquisitive Skills are the ability to possess and accumulate intrinsic potential for eagerness to input information through sensory channels and proprioception in both passive and active ways in order to process it for making decisions about a situation or concept.	(i) Listening	Ability to accurately receive and interpret messages in the communication process
	(ii) Observing	Ability to use five senses to derive characteristics of objects, events, attitudes and phenomena
	(iii) Searching	Ability to know where to find information - the key texts in your area, the journals, primary sources, etc., and how to get hold of them. Ability to know what information is needed – understanding topic and knowing the key concepts you should research. Knowing how to search the sources - using keywords etc. Ability to record your searches, so that you have an 'audit trail'
	(iv) Inquiring	Ability to ask questions, and then research, interpret, share, and reflect on answers Ability to apply and use higher order thinking *skills* like analysis and synthesis *Ability to develop* curiosity, critical thinking, and independent thinking
	(v) Investigating	Ability to develop active listening, questioning. interviewing, funnelling, summarizing and note-taking
	(vi) Gathering data	Ability to effectively collect and curate data for research purposes
	(vii) Researching	Ability to search for, locate, extract, organise, evaluate and use or present information that is relevant to a particular topic

Category	Skills	Description of skill
	(viii) Defining operationally	Ability to state how to measure a variable in an experiment
	(ix) Formulating hypotheses	Ability to state the expected outcomes of an experiment
2. Organisational Organisational Skills are the capacity to manage and stay focused on different tasks by using time, energy, mental strength and physical space effectively through forming structures within which order of doing tasks is clear and co-ordinated to achieve the desired outcomes	(i) Recording	Ability to select and keep useful information, usually focused for a specific purpose
	(ii) Comparing	Ability to find similarities between or among objects, ideas, entities, concepts, events, or other subjects in order to organize both new and known information
	(iii) Contrasting	Ability to find differences between or among objects, ideas, entities, concepts, events, or other subjects in order to organize both new and known information
	(iv) Classifying	Ability to sort, group and arrange events, ideas, concepts and entities based on similarities and differences
	(v) Organizing	Ability to create structure and order as well as to efficiently manage time, workload and resources in order to improve productivity and lower stress level
	(vi) Outlining	Ability to list the general features of a research/experiment/event/story in order to shape research/experiment/event/story as intended
	(vii) Reviewing	Ability to learn from experience in order to get more from the work, allowing for flexibility and paying attention to detail
	(viii) Evaluating	Ability to assess the credibility of the claims, and to assess the quality of the reasoning of the arguments or explanations
	(ix) Analysing	*Ability* to collect and *analyze* information, problem-solve, and make decisions Ability to develop a logical and rational approach to tackling new ideas, sorting information, and discovering creative solutions
	(x) Predicting	Ability to state the outcome of a future event based on a pattern of evidence
	(xi) Inferring	Ability to explain observations and data
	(xii) Interpreting data	Ability to organise, conclude from data and make sense of data

Category	Skills	Description of skill
3. Creative Creative Skills are the ability to perceive and think in an imaginative approach about physical occurrences to enable one to find hidden patterns and make connections among apparently discrete concepts in order to generate novel or unorthodox solutions and come up with something new to address the present and future challenges.	(i) Planning ahead	Ability to develop strategies to accomplish goals Ability to anticipate what is needed to know, to have, and to do, in order to achieve set goals
	(ii) Designing	Ability to think creatively and visualise new ideas, relationships, applications, systems and products in order to develop solutions
	(iii) Inventing	Ability to get new materials or processes by disassembling items in order to manufacture discoverable devices Ability or process of creating or making up something or figuring out a way to do something
	(iv) Synthesizing	Ability to combine parts of a whole in new and different ways by thinking flexibly, determining alternatives, and finding new ways to accomplish a given task
	(v) Formulating models	Ability to create a mental or physical model of a process or event
	(vi) Sketching specimen and science apparatus	Ability to develop visual recall, rendering, and novel visualization of specimen and science apparatus
4. Manipulative Manipulative Skills are the ability to physically interact with the materials or procedures to help in understanding of the underlying principles which might also involve some alterations in order to enhance the performance of equipment and functionality of processes	(i) Using, handling and maintaining instruments	Ability to use, handle and maintain instruments and apparatus appropriately and carefully
	(ii) Demonstrating	Ability to give a practical exhibition and explanation of (how a machine, skill, or craft works or is performed). Ability to clearly show the existence or truth of (something) by giving proof or evidence
	(iii) Experimenting	Ability to test by following procedures to produce verifiable results
	(iv) Constructing	Ability to build or make something or form an idea (scientific) or theory by bringing together various conceptual elements
	(v) Calibrating	Ability to correlate readings of (an instrument) with those of a standard in order to check the instrument's accuracy and to adjust (experimental results) to take external factors into account or to allow comparison with other data

Category	Skills	Description of skill
	(vi) Measuring and using numbers	Ability to use standard and non-standard measures to describe dimensions
	(vii) Controlling variables	Ability to identify variables, keep variables constant and manipulate variables
	(viii) Handling specimen and chemicals correctly and carefully	Ability to handle and maintain specimen and chemicals appropriately and carefully
5. Communicative Communicative Skills are the ability to effectively inquire and engage others, to obtain or disseminate vital information, coherently and clearly through the use of mutually understood symbols, signs and semiotic rules in order to make sense of what is intended.	(i) Questioning	Ability to ask appropriate and relevant questions in order to obtain information, clarify a point, test knowledge or encourage further thought
	(ii) Discussing	Ability to state an opinion confidently and ask for others' opinions Ability to argue constructively, offer suggestions and express uncertainty
	(iii) Explaining	Ability to present the subject matter in a simplified form and making it acquirable Ability to use verbal and non-verbal cues at appropriate times in a discussion to show understanding by describing logically' how', 'why' and 'when' concept
	(iv) Reporting	Ability to provide status information, detailed descriptions of the tasks or communication to show presence
	(v) Writing	Ability to put feelings and ideas on paper, to organize knowledge and beliefs into convincing arguments, and to convey meaning through well-constructed text
	(vi) Criticizing	Ability to judge the merits and faults of something Ability to provide constructive arguments for improvement, and being able to withstand the pressure of unfair or dispiriting criticisms while motivating oneself to work harder and better instead of giving up
	(vii) Graphing	Ability to read, construct, analyse and interpret graphs and graphical information in order to visually communicate information
	(viii) Teaching	Ability to use appropriate pedagogy and didactics in order to facilitate learning and communication
	(ix) Communicating	Ability to use words or symbols to describe an action, object or event

Grade 10 General STEM (GS) Mathematics	
General Outcomes:	**Key Competences:**
1. Demonstrate theoretical understanding of Approximations and Estimations, Matrices, Polynomial Equations & Inequations, Business Finances, Coordinate Geometry, Functions 2. Apply the theoretical understanding of Approximations and Estimations, Matrices, Polynomial Equations & Inequations, Business Finances, Coordinate Geometry, Functions 3. Design and develop products based on Approximations and Estimations, Matrices, Polynomial Equations & Inequations, Business Finances, Coordinate Geometry, Functions	Demonstrate Scientific skills such as: • Acquisitive • Organizational • Creative • Manipulative • Communicative

Grade 10 General STEM (GS) Mathematics Syllabus

Topic	**Value**: *Life is all about approximation as all measurements are never exact. Therefore, measuring instruments are made and used for the purpose of being precise and accurate in order to minimize errors and get closer to the true value. In an effort to achieve precision and accuracy, approximation and estimation are applied in many aspects such as measurement of time, weight, distance, size, height, area, space, and many others. Learning precision and accuracy will enable learners acquire precision skills which will help them design and construct infrastructure with accurate measurement. This will eventually install confidence in the users of the infrastructure.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
10.1 Precision and Accuracy	10.1.1 Understanding Precision and Accuracy	10.1.1.1 Demonstrate theoretical understanding of Precision and Accuracy	Theoretical understanding of Precision and Accuracy concepts such as: • Laws of Indices and surds (including negative and fractional indices) • Limits of accuracy • Relative and absolute errors	Acquisitive Organizational Communicative
		10.1.1.2 Apply theoretical understanding of Precision and accuracy	Application theoretical understanding Precision and Accuracy of concepts based on: • Laws of Indices and surds (including negative and fractional indices) • Limits of accuracy • Relative and absolute errors	Organizational Manipulative Communicative
		10.1.1.3 Design products based on theoretical understanding of Precision and accuracy	Product development such as designs of: • Precision instruments • Parts of machines (e.g. bolts and nuts, blades, gears, bearings, needle and many more)	Organizational Manipulative Creative Communicative

Topic	**Value**: *Matrices are used to display information in an array of numbers or symbols. In everyday life, matrices are applied in the fields of engineering, medicine, physics, sports to simplify information and help solve problems involving multiple variables. In the study of Matrices, learners will acquire arithmetic knowledge which will be used to do scientific studies and research in various fields. Understanding of matrices would make learners to design and develop different products such as Dot matrix display, design structure matrices and many others.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
10.2 Matrices	**10.2.1 Working with Matrices**	10.2.1.1 Demonstrate theoretical understanding of Matrices	Theoretical understanding of Matrix concepts such as: • Order of matrix, Transpose of a matrix, Equal matrix • Operations on Matrices (add, subtract, multiply & explore division of Matrices) • Multiplication of matrices • Determinant & Inverse of a 2 x 2 and 3 x 3 matrices. • Symmetric and skew symmetric Matrices • Minors and cofactors • Eigenvalues and eigenvectors • Linear equations up to three variables	Acquisitive Organizational Communicative
		10.2.1.2 Apply theoretical understanding of Matrices	Application of theoretical understanding of matrix concepts based on: • Order of matrix, Transpose of a matrix, Equal matrix • Operations on Matrices (add, subtract, multiply & explore division of Matrices) • Multiplication of matrices • Determinant & Inverse of a 2 x 2 and 3 x 3 matrices. • Symmetric and skew symmetric Matrices • Minors and cofactors • Eigenvalues and eigenvectors • Linear equations up to three variables Finding area of a triangle	Organizational Manipulative Communicative
		10.2.1.3 Design products based on theoretical understanding of Matrices	Product development such as; • Dot matrix display • Design structure matrix used as knowledge capture method for product configuration	Organizational Manipulative Creative Communicative

Topic	**Value**: *Polynomial equations and inequations can be thought of as a generalization of particular arithmetic operations. It is vital for Science, Technology, Engineering and Mathematics as it is used to prepare learners for statistics and calculus which are needed for their research work. Studying Polynomial equations and inequations helps the learners to think logically, breakdown situations into parts in order to analyse them for easier manipulations. Polynomial equations and inequations are also used to make financial decisions. For instance, to select a health care plan for a family using two-variable equations to find the break-even point for each option.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
10.3 Polynomial Equations & Inequations	10.3.1 Exploring polynomial equations & inequations	10.3.1.1 Demonstrate theoretical understanding of polynomial equations & inequations	Theoretical understanding of polynomial equations & inequations such as: • Simplification, Expansion, Factorisation of algebraic expressions • Addition, subtraction, multiplication & division of algebraic expressions (including algebraic fractions) • Formulation of formulae & equations using letters & numbers • Systems of equations • Factors of polynomials up to 4^{th} degree • Remainder and factor theorems • Polynomial equations up to 4^{th} degree • Partial fractions	Acquisitive Organizational Communicative
		10.3.1.2 Apply theoretical understanding of polynomial equations & inequations	Application of theoretical understanding of polynomial equations & inequations based on: • Simplification, Expansion, Factorisation of algebraic expressions • Addition, subtraction, multiplication & division of algebraic expressions (including algebraic fractions) • Formulation of formulae & equations using letters & numbers • Systems of equations • Factors of polynomials up to 4^{th} degree • Remainder and factor theorems • Polynomial equations up to 4^{th} degree	Organizational Manipulative Communicative

Topic	**Value**: *Matrices are used to display information in an array of numbers or symbols. In everyday life, matrices are applied in the fields of engineering, medicine, physics, sports to simplify information and help solve problems involving multiple variables. In the study of Matrices, learners will acquire arithmetic knowledge which will be used to do scientific studies and research in various fields. Understanding of matrices would make learners to design and develop different products such as Dot matrix display, design structure matrices and many others.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
		10.3.1.3 Design products based on theoretical understanding of polynomial equations & inequations	• Partial fractions Product development of designs based on polynomials such as: • Roller coaster • Bridges • Road network	Organizational Manipulative Creative Communicative

Topic	**Value**: *Business Finance deals with money matters, thus it is used in many areas of our daily activities such as personal and small business finance earnings, shares, dividends, and investment bonds among others. It is necessary for learners to have mathematical knowledge of finance and business to understand effective marketing tactics and make better business decisions. learners will develop entrepreneurial skills and competences to interpret business transactions, design plans and establish formidable business ventures.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**

10.4 Business Finance	10.4.1 Personal and Small Business Finance	10.4.1.1 Demonstrate theoretical understanding of Personal and Small Scale-Business Finance	Theoretical understanding of Personal and Small-Scale Business Finance such as:
			• Personal and small business finance earnings
			  ○ Shares
			  ○ Dividends
			  ○ Investment bonds
				Acquisitive
				Organizational
				Communicative

		10.4.1.2 Apply theoretical understanding of Personal and Small-Scale Business Finance	Application of theoretical understanding of Personal and Small-Scale Business Finance based on:
			• Personal and small business finance earnings
			  ○ Shares
			  ○ Dividends
			  ○ Investment bonds
				Organizational
				Manipulative
				Communicative

		10.4.1.3 Design products based on theoretical understanding of Personal and Small Business Finance	Product development such as: • Viable business proposal • Creation of small business entities • Creation of business transaction apps	Organizational Manipulative Creative Communicative

Topic	**Value**: *Coordinate Geometry gives a precise location of a particular position in space in terms of latitudes and longitudes or a point on the plane described using an ordered pair of numbers. Its uses are spread in fields like trigonometry, calculus, Global Positioning System (GPS), and dimensional geometry. Understanding Coordinate Geometry will help the learners to determine and locate the exact positions. Learners will also develop skills required for map reading and be able to design drawings such as site plans and construction plans which may result in economic, security, service provision, tracking, land planning, among others.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
10.5 Coordinate Geometry	10.5.1 Introductory Coordinate Geometry	10.5.1.1 Demonstrate theoretical understanding of Coordinate Geometry	Theoretical understanding of Coordinate Geometry such as: • Distance between two points joined by a straight line (e.g. Pythagoras Theorem applied) • Mid-point of two points • Equations and gradients of straight lines, parallel lines & perpendicular lines • Area of rectilinear figures	Acquisitive Organizational Communicative
		10.5.1.2 Apply theoretical understanding of Coordinate Geometry	Application theoretical understanding of Coordinate Geometry based on: • Distance between two points joined by a straight line (e.g. Pythagoras Theorem applied) • Mid-point of two points • Equations and gradients of straight lines, parallel lines & perpendicular lines • Area of rectilinear figures	Organizational Manipulative Communicative
		10.5.1.3 Design products based on theoretical understanding of Coordinate Geometry	Development of designs and products such as: • Site plans • Construction plans • e-tracker • Land plan App	Organizational Manipulative Creative Communicative

Topic	**Value**: *The existence of anything in nature is dependent on something, and such type of relationship determines the organisational order. This type of relational existence is in the form of a function. A function could be generally said to be a relation between a set of inputs and a set of permissible outputs, provided that each input is related to exactly one output. Learners need to realize that functions are all around us and we continually make sense about dependencies between quantities in nature and society. Functions are also important tools in construction of scientific and mathematical models such as programming, computers, phones, human, plants, animals and industry, and in maintaining the eco-system.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
10.6 Functions	10.6.1 Exploring different Functions	10.6.1.1 Demonstrate theoretical understanding of different Functions	Theoretical understanding of different Functions such as: • Notation and inverse of a function • Graphs of functions (linear, quadratic & cubic) • Composite functions • Quadratic functions and equations • Linear, quadratic and cubic inequalities • Graphs from the maximum or minimum value of $\|x\|$	Acquisitive Organizational Communicative
		10.6.1.2 Apply theoretical understanding of different Functions	Application theoretical understanding of different Functions based on: • Notation and inverse of a function • Graphs of functions (linear, quadratic & cubic) • Composite functions • Quadratic functions and equations • Linear, quadratic and cubic inequalities • Graphs from the maximum or minimum value of $\|x\|$	Organizational Manipulative Communicative
		10.6.1.3 Design products based on theoretical understanding of Functions	Product development such as: • Mathematical models (e.g. farming inputs against the yield)	Organizational Manipulative Creative Communicative

Grade 11 General STEM (GS) Mathematics	
General Outcomes	**Key Competences**
1. Demonstrate theoretical understanding of Circle Theorem and measure, Loci, Series, Permutations and Combinations, Exponents, Logarithmic & Trigonometric Functions, Mathematical Modelling 2. Apply the theoretical understanding of Circle Theorem and measure, Loci, Series, Permutations and Combinations, Exponents, Logarithmic & Trigonometric Functions, Mathematical Modelling 3. Design and develop products based on Circle Theorem and measure, Loci, Series, Permutations and Combinations, Exponents, Logarithmic & Trigonometric Functions, Mathematical Modelling	Demonstrate Scientific skills such as: • Acquisitive • Organizational • Creative • Manipulative • Communicative

Topic	**Value**: *Circles are abundant in our daily life in regards to man-made objects, in modern architecture, in the house and out on the street. Circle theorem and measure helps the learner understand the concepts such as arc and cord length, angles and area related to circles. Learners need to know the relation between radians and degrees and apply the appropriate one contextually. Understanding this topic would help learners develop skills to design patterns and products that involve circles.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
11.1 The Circle and Measure	11.1.1 Properties of a circle and measure	11.1.1.1 Demonstrate theoretical understanding of properties of a circle and measure	Theoretical understanding of properties of a circle and circular measure such as: • Properties of a circle • Radian measure • Converting radians to degrees and vice-versa • Arc length, chord length, segment, diameter and radius • Sector of a circle • Determine surface areas and volume of solids (including cone, rectangular and triangular pyramids and frustums) • Areas and volumes of similar solids	Acquisitive Organizational Communicative
		11.1.1.2 Apply theoretical understanding of properties of a circle and measure	Application of theoretical understanding of angle properties of a circle and circular measure of based on: • Properties of a circle • Radian measure • Converting radians to degrees and vice-versa • Arc length, chord length, segment, diameter and radius • Sector of a circle • Determine surface areas and volume of solids (including cone, rectangular and triangular pyramids and frustums) • Areas and volumes of similar solids	Communicative Organizational Manipulative Communicative
		11.1.1.3 Design products based on theoretical understanding of properties of a circle and measure	Product development such as; • Patterns and designs involving circles • Decorations, land plots, Town plans • 2-D and 3-D shapes • Monument designs	Organizational Manipulative Creative

Topic	**Value**: *Locus, being a set of points with the same property, can be used to accurately construct lines and shapes. Building better streets and cities, use of the sun and shadows to measure how far away the objects are, all rely on the concept of construction and loci. Studying Loci would yield improved information acquisition and better decision-making. It would also help learners develop skills for designing products such as house plans, partitioning of plot of land, and a variety of real-life products including furniture, decorations and origamis.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
11.2 Loci	11.2.1 Exploring Construction and Loci	11.2.1.1 Demonstrate theoretical understanding of Construction and Loci	Theoretical understanding of Construction and Loci concepts in: • 2-D • 3-D	Acquisitive Organizational Communicative
		11.2.1.2 Apply theoretical understanding of Construction and Loci	Application theoretical understanding of Construction and Loci based on: • 2-D (including line and angle bisectors) • 3-D	Organizational Manipulative Communicative
		11.2.1.3 Design products based on theoretical understanding of Construction and Loci	Product development such as; • House plans • Partitioning of plot of land • House furniture • Decorative tiles	Organizational Manipulative Creative Communicative

Topic	**Value**: *In mathematics, a series involves the operation of adding infinitely many quantities, one after the other, to a given starting quantity. Geometric series are used to predict population growths, while, Arithmetic series are used in adding quantities in succession, maintaining a common difference. Binomial series, on the other hand, compare the behaviour of a pair of quantities given certain conditions. Understanding of Series will enable learners make mathematically accurate predictions on the occurrence of events. Learners would eventually be able to develop distribution models to compute the probability of observing a specified event if the process was repeated a number of times.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
11.3 Series	11.3.1 Binomial Theorem, Arithmetic and Geometric Progressions	11.3.1.1 Demonstrate theoretical understanding of Binomial Theorem, Arithmetic and Geometric Progressions	Theoretical understanding of Series concepts based on: • Binomial Expansion and Theorem • Arithmetic and Geometric progressions • Condition for convergence of a GP and the formula for the sum to infinity of a convergent GP	Acquisitive Organizational Communicative
		11.3.1.2 Apply theoretical understanding of Binomial Theorem, Arithmetic and Geometric Progressions	Application of theoretical understanding of Series concepts based on: • Binomial Expansion and Theorem • Arithmetic and Geometric progressions • Condition for convergence of a GP and the formula for the sum to infinity of a convergent GP	Organizational Manipulative Communicative
		11.3.1.3 Design products based on theoretical understanding of Binomial Theorem, Arithmetic and Geometric Progressions	Product development such as: • Architectural Designs • Distribution Models • Flow Charts • Games and Apps	Organizational Manipulative Creative Communicative

Topic	**Value**: *Permutations and combinations are the various ways in which objects from a set may be selected, generally without replacement, to form subsets. This selection of subsets is called a permutation when the order of selection is a factor, a combination when order is not a factor. The understanding of combinations and permutations will help learners develop skills and abilities to determine possible selections and arrangements in any given event. They will also be able to discover the importance of order in events as it is a fundamental principle in this concept. The knowledge of Permutations and Combinations will enable learners develop products such as secure encryption keys and games.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
11.4 Permutations and Combinations	11.4.1 Fundamentals of Permutations and Combinations	11.4.1.1 Demonstrate theoretical understanding of Permutations and Combinations	Theoretical understanding of Permutations and Combinations such as: • Fundamental counting principles • Factorials • Repetition and no repetition Permutations • Repetition and no repetition Combinations	Acquisitive Organizational Communicative
		11.4.1.2 Apply theoretical understanding of Permutations and Combinations	Application of theoretical understanding of Permutations and Combinations concepts such as: • Fundamental counting principles • Factorials • Repetition and no repetition Permutations • Repetition and no repetition Combinations	Organizational Manipulative Communicative
		11.4.1.3 Design products based on theoretical understanding of Permutations and Combinations	Product development such as: • Games and Apps • Flow charts • Permutations and Combinations calculator	Acquisitive Manipulative Creative Communicative

Topic	**Value**: *Exponential, logarithmic and trigonometric functions are important in life as they are used in many aspects such as bacteria growth, compound interest and radioactive decay. Studying these functions will enable learners acquire skills to design and develop mathematical models to predict phenomena such as population growth, carbon dating, determine investments or any other event.* *Architect use trigonometry to calculate structural load, roof slopes, ground surfaces and many other aspects including sun shading and light angles. Knowledge of Exponents, Logarithms and Trigonometric functions by the learners can be used for plotting graphs, manipulate and solve equations.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
11.5 Exponential Logarithmic and Trigonometric Functions	**11.5.1** Exploring Exponential, Logarithmic and Trigonometric Functions	11.5.1.1 Demonstrate theoretical understanding of Exponential, Logarithmic and Trigonometric Function	Theoretical understanding of Exponential, Logarithmic and Trigonometric Functions such as: • Exponential equations • Graphs of exponential functions • Logarithmic functions • Graphs of logarithmic functions • Rules for logarithms • Conversion to linear form, Six trigonometric functions • Special angles (30^0, 45^0 and 60^0) • Compound and multiple angles • Trigonometric equations • Trigonometric identities • Bearings	Acquisitive Organizational Communicative
		11.5.1.2 Apply theoretical understanding of Exponential, Logarithmic and Trigonometric Functions	Application of concepts on theoretical understanding of Exponential, Logarithmic and Trigonometric Functions: • Exponential equations • Graphs of exponential functions • Logarithmic functions • Graphs of logarithmic functions • Rules for logarithms • Conversion to linear form, Six trigonometric functions • Special angles (30^0, 45^0 and 60^0)	Acquisitive Organizational Communicative

<table>
<tr><td rowspan="4">Topic</td><td colspan="3">Value: Exponential, logarithmic and trigonometric functions are important in life as they are used in many aspects such as bacteria growth, compound interest and radioactive decay. Studying these functions will enable learners acquire skills to design and develop mathematical models to predict phenomena such as population growth, carbon dating, determine investments or any other event.

Architect use trigonometry to calculate structural load, roof slopes, ground surfaces and many other aspects including sun shading and light angles. Knowledge of Exponents, Logarithms and Trigonometric functions by the learners can be used for plotting graphs, manipulate and solve equations.</td></tr>
<tr><td rowspan="3">Sub-topic</td><td rowspan="2">Learning Outcomes</td><td colspan="2">Content</td></tr>
<tr><td>Knowledge</td><td>Skills</td></tr>
<tr><td></td><td>• Compound and multiple angles
• Trigonometric equations
• Trigonometric identities
• Bearings</td><td></td></tr>
<tr><td>11.5.1.3
Design products based on theoretical understanding of Exponential, Logarithmic and Trigonometric Functions</td><td>Product development such as;
• Mathematical models
• Population growth e-tracker
• The logarithmic spiral designs</td><td>Organizational
Manipulative
Creative
Communicative</td></tr>
</table>

Topic	**Value**: *Mathematical modelling refers to the art of applying mathematics to a real-life problem with a view to clearly understanding the problem. It deals with the process of using mathematical structures such as graphs, equations, diagrams and scatterplots to represent real world situations. Quantitative results from mathematical models can easily be compared with observational data to identify a model's strengths and weaknesses. Studying modelling will enable learners develop skills and competences to translate real-life problems into mathematical models, and hence, assist in policy decision making, optimising economic growth and save lives. Learners will develop mathematical models of situations and revise their models to more closely predict real world phenomena.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
11.6 Mathematical Modelling	11.6.1 Investigate Various mathematical formulae	11.6.1.1 Demonstrate theoretical understanding of Mathematical Modelling	Theoretical understanding of Mathematical Modelling such as: • Types of modelling • Steps of the modelling process • Choice of good fit model(s)	Acquisitive Organizational Communicative
		11.6.1.2 Apply theoretical understanding of Mathematical Modelling	Application of theoretical understanding of Mathematical Modelling concepts on: • Types of modelling • Steps of the modelling process • Choice of good fit model(s)	Organizational Manipulative Communicative
		11.6.1.3 Design products based on theoretical understanding of Mathematical Modelling	Product development such as; • Models • Model Apps	Organizational Manipulative Creative Communicative

Grade 12 General STEM (GS) Mathematics	
General Outcomes	**Key Competences**
1. Demonstrate theoretical understanding of Introduction to Calculus, Linear Programming, Earth Geometry, Vectors, Geometric Transformations, Probability and Statistics 2. Apply the theoretical understanding of Introduction to Calculus, Linear Programming, Earth Geometry, Vectors, Geometric Transformations, Probability and Statistics 3. Design and develop products based on Introduction to Calculus, Linear Programming, Earth Geometry, Vectors, Geometric Transformations, Probability and Statistics	Demonstrate Scientific skills such as: • Acquisitive • Organizational • Creative • Manipulative • Communicative

Grade 12 General STEM Mathematics Syllabus Content

Topic	**Value**: *Calculus is used in most everyday aspects such as in infrastructure construction, public health systems, meteorology, business and many others. It is also used to interpret and explain certain natural phenomena in the universe. The knowledge of calculus will help learners develop skills of determining rates of change, area of regions and volumes of solids of revolution. Learners will also be able to create mathematical models in order to come up with an optimal solution.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
12.1 Introduction to Calculus	12.1.1 Differentiation and Integration	12.1.1.1 Demonstrate theoretical understanding of Differentiation and Integration	Theoretical understanding of Calculus concepts such as: • Gradient of a straight line, Gradient of a curve • Differentiation and integration • Maxima and minima • Velocity, acceleration, rate of change, area of a region • Volume formed when curve is rotated through 360^0 (for both x and y axes) • Area bounded by curves of polynomials • Integrating polynomials with fractional powers • Differentiating exponential and trigonometric functions • The definite integral, Solid of revolution • Integrating terms of integer powers and their sum • Targets, normal and stationary points	Acquisitive Organizational Manipulative Communicative
		12.1.1.2 Apply theoretical understanding of Differentiation and Integration	Application of theoretical understanding of Calculus concepts based on: • Gradient of a straight line, Gradient of a curve • Differentiation and integration • Maxima and minima • Velocity, acceleration, rate of change, area of a region • Volume formed when curve is rotated through 360^0 (for both x and y axes) • Area bounded by curves of polynomials • Integrating polynomials with fractional powers • Differentiating exponential and trigonometric functions • The definite integral, Solid of revolution	Organizational Creative Manipulative Communicative

<table>
<tr><td rowspan="4">Topic</td><td colspan="3">Value: Calculus is used in most everyday aspects such as in infrastructure construction, public health systems, meteorology, business and many others. It is also used to interpret and explain certain natural phenomena in the universe. The knowledge of calculus will help learners develop skills of determining rates of change, area of regions and volumes of solids of revolution. Learners will also be able to create mathematical models in order to come up with an optimal solution.</td></tr>
<tr><td rowspan="3">Sub-topic</td><td rowspan="2">Learning Outcomes</td><td colspan="2">Content</td></tr>
<tr><td>Knowledge</td><td>Skills</td></tr>
<tr><td></td><td>• Integrating terms of integer powers and their sum
• Targets, normal and stationary points</td><td></td></tr>
<tr><td>12.1.1.3
Design products based on theoretical understanding of Differentiation and Integration</td><td>Design and product development such as:
• Architectural designs and models
• Artistic models
• Computer models
• Robotics
• Apps</td><td>Organizational
Creative
Manipulative
Communicative</td></tr>
</table>

Topic	**Value**: *Linear programming helps in attaining the optimum use of productive resources. It also indicates how a decision-maker can employ productive factors effectively by selecting and distributing the resources. Linear programming techniques improve the quality of decisions. Studying linear programming allows learners and to develop skills for determining the most economical solution to a problem within all of its limitations or constraints. Understanding Linear Programming will lead to formulation of tools for optimizing production in areas such as forestry, business planning, food processing and agriculture. It will also help learners to forecast and predict future results.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
12.2 Linear Programming	12.2.1 Exploring Linear Programming	12.2.1.1 Demonstrate theoretical understanding of Linear Programming	Theoretical understanding of Linear Programming such as: • Inequalities in two variables • Mathematical models • Graphing inequalities • Boundaries of regions • Search line method • Cost lines and profit lines • Maximising and minimising	Acquisitive Organizational Communicative
		12.2.1.2 Apply theoretical understanding of Linear Programming	Application of theoretical understanding of Linear Programming concepts on: • Inequalities in two variables • Mathematical models • Graphing inequalities • Boundaries of regions • Search line method • Cost lines and profit lines • Maximising and minimising	Acquisitive Organizational Communicative
		12.2.1.3 Design products based on theoretical understanding of Linear Programming	Design and product development such as; • Business models • Transaction Apps • Flow charts	Organizational Creative Manipulative Communicative

Topic	**Value**: *Earth Geometry helps measure distances and angles between any two places on the surface of the earth. Understanding Earth Geometry will enable learners gain knowledge of how to locate different places on planet earth. Learners will also be able to comprehend how longitudes of different places influence the time zones as well as develop skills required for map reading. They will be able to produce models to determine distances and times between various places on the earth.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
12.3 Earth Geometry	12.3.1 Exploring Earth Geometry	12.3.1.1 Demonstrate theoretical understanding of Earth Geometry	Theoretical understanding of Earth Geometry such as: • Small and great circles • Latitudes and Longitudes • Distance along latitudes and longitudes • Speed in Knots and time • Length ,chord , arc and sector • Angular distance • Line of axis of the Earth • Circumference of the earth • Standard units of distances in degrees and miles	Acquisitive Organizational Communicative
		12.3.1.2 Apply theoretical understanding of Earth Geometry	Application of theoretical understanding of Earth Geometry concepts on: • Small and great circles • Latitudes and Longitudes • Distance along latitudes and longitudes • Speed in Knots and time • Length, chord, arc and sector • Angular distance • Line of axis of the Earth • Circumference of the earth • Standard units of distances in degrees and miles	Organizational Manipulative Communicative
		12.3.1.3 Design products based on theoretical understanding of Earth Geometry	Design and product development such as; • Computer Apps (e.g. GeoGebra) • Drones and GPS equipment • Robotics	Organizational Manipulative Creative Communicative

Topic	**Value**: *Many quantities used in Physics are vectors. They are physical phenomena which carry a direction, such as velocity, weight, force, displacement and acceleration. Vectors have many real-life applications, including situations involving war planning, space navigation and artwork. Understanding vectors will help learners both in solving problems in Mathematics, Physics and in other fields. Learners will acquire skills to develop a product to measure wind direction and speed or any other that can measure a vector quantity.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
12.4 Vectors	12.4.1 Vectors in two Dimensions	12.4.1.1 Demonstrate theoretical understanding of Vectors in two Dimensions	Theoretical understanding of Vectors in two dimensions such as: • Vector notation and description • Add and subtract vectors • Position vectors • Unit vectors • Scalar and dot products • Product of vector and scalar • Angles between two vectors • Vector equation of a straight line	Acquisitive Organizational Communicative
		12.4.1.2 Apply theoretical understanding of Vectors in two Dimensions	Application of theoretical understanding of Vectors in two dimensions concepts on: • Vector notation and description • Add and subtract vectors • Position vectors • Unit vectors • Scalar and dot products • Product of vector and scalar • Angles between two vectors • Vector equation of a straight line	Organizational Manipulative Communicative
		12.4.1.3 Design products based on theoretical understanding of Vectors in two dimensions	Design and product development such as: • Missile launchers • Satellite launchers • Game tactical analysis • Video sports games	Organizational Creative Manipulative Creative

Topic	**Value**: *Life, being dynamic, involves processes of changing. Therefore, concepts of transformations are diverse such as development of a caterpillar morphing into a butterfly. In Mathematics transformation involves manipulation of position, size or shape of a polygon or any other two-dimensional object on a plane or co-ordinate system. It describes how 2-D figures move around the plane. Knowledge of Geometric Transformations will enable learners to acquire skills to help them manipulate figures in the plane. Learners will be able to produce items such as scaled house plans, machinery parts, levers, and many others.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**

12.5 Geometric Transformations	12.5.1 Rigid and non-Rigid Transformations	12.5.1.1 Demonstrate theoretical understanding of Geometric Transformations	Theoretical understanding of Geometric Transformations such as:
			• Concept of transformation
			• Rigid
			  ○ Translation, Reflection, Rotation
			• Non-rigid
			  ○ Enlargement, Stretch and Shear
			• Matrices representing these transformations
			• Area, scale factors of non-rigid transformations
				Acquisitive
				Organizational
				Manipulative
				Communicative

		12.5.1.2 Apply theoretical understanding of Geometric Transformations	Application of theoretical understanding of Geometric Transformations concepts on:
			• Concept of transformation
			• Rigid
			  ○ Translation, Reflection, Rotation
			• Non-rigid
			  ○ Enlargement, Stretch and Shear
			• Matrices representing these transformations
			• Area, scale factors of non-rigid transformations
				Organizational
				Manipulative
				Communicative

<table>
<tr><td rowspan="3">Topic</td><td colspan="3">Value: Life, being dynamic, involves processes of changing. Therefore, concepts of transformations are diverse such as development of a caterpillar morphing into a butterfly. In Mathematics transformation involves manipulation of position, size or shape of a polygon or any other two-dimensional object on a plane or co-ordinate system. It describes how 2-D figures move around the plane. Knowledge of Geometric Transformations will enable learners to acquire skills to help them manipulate figures in the plane. Learners will be able to produce items such as scaled house plans, machinery parts, levers, and many others.</td></tr>
<tr><td rowspan="2">Sub-topic</td><td rowspan="2">Learning Outcomes</td><td colspan="2">Content</td></tr>
<tr><td>Knowledge</td><td>Skills</td></tr>
<tr><td></td><td>12.5.1.3
Design products based on theoretical understanding of Geometric Transformations</td><td>Design and product development such as;
• Factory machine parts
• Robotic
• Roller-coaster
• Architectural designs
• Decorative geometric designs</td><td>Organizational
Creative
Manipulative
Communicative</td></tr>
</table>

Topic	**Value**: *Probability and statistics are concerned with the laws governing random events, including the collection, analysis, interpretation, and display of numerical data. The importance of probability in statistics is that it can be used to predict results of an experiment under assumption. Learners need the knowledge of Probability and statistics to develop skills and abilities to effectively conduct research. They will also be able to determine probabilities of events, model random data, interpret the results and make decisions accordingly in a variety of real-life situations they are likely to meet.*			
	Sub-topic	**Learning Outcomes**	**Content**	
			Knowledge	**Skills**
12.6 Probability and Statistics	12.6.1 Application of Probability and Statistics	12.6.1.1 Demonstrate theoretical understanding of Probability and Statistics	Theoretical understanding of Probability and Statistics such as: • Experimental probability • Theoretical probability • Laws of probability • Tree diagrams and grid • Statistical charts • Measures of central tendency and dispersion • Statistical graphs	Acquisitive Organizational Communicative
		12.6.1.2 Apply theoretical understanding of Probability and Statistics	Application of theoretical understanding of Probability and Statistics concepts on: • Experimental probability • Theoretical probability • Laws of probability • Tree diagrams and grid • Statistical charts • Measures of central tendency and dispersion • Statistical graphs	Organizational Manipulative Communicative
		12.6.1.3 Design products based on theoretical understanding of Probability and Statistics	Design and product development such as; • Research reports • Statistical Apps • Gambling machines • Playing cards • Weather forecast equipment	Organizational Creative Manipulative Communicative

Scope and Sequence of Topics and Sub Topics

Grade 10		Grade 11		Grade 12	
Topic	Sub Topic	Topic	Sub Topic	**Topic**	Sub Topic
10.1 Precision and accuracy	10.1.1 Understanding Precision and accuracy	**11.1 The Circle and Measure**	11.1.1 Properties of a circle and circular measure	**12.1 Introduction to Calculus**	12.1.1 Differentiation and Integration
10.2 Matrices	10.2.1 Working with Matrices	**11.2 Loci**	11.2.1 Exploring Construction and Loci	**12.2 Linear Programming**	12.2.1 Exploring Linear Programming
10.3 Polynomial Equations & Inequations	10.3.1 Exploring polynomial equations & inequations	**11.3 Series**	11.3.1 Binomial Theorem, Arithmetic and Geometric Progressions	**12.3 Earth Geometry**	12.3.1 Exploring Earth Geometry
10.4 Business Finance	10.4.1 Personal and Small Business Finance	**11.4 Permutations and Combinations**	11.4.1 Fundamentals of Permutations and Combinations	**12.4 Vectors**	12.4.1 Vectors in two Dimensions
10.5 Introductory Coordinate Geometry	10.5.1 Exploring Coordinate Geometry	**11.5 Exponential, Logarithmic & Trigonometric Functions**	11.5.1 Exploring Exponential, Logarithmic and Trigonometric Functions	**12.5 Geometric Transformations**	12.5.1 Rigid and non-Rigid Transformations
10.6 Functions	10.6.1 Exploring Different Functions	**11.6 Mathematical Modelling**	11.6.1 Investigate Various mathematical formulae	**12.6 Probability and Statistics**	12.6.1 Application of Probability and Statistics

Time and Period Allocation

This syllabus will require at least 6 hours (Ten - 40 minutes periods) per week to complete [2 periods /day x 5]