THE REPUBLIC OF UGANDA

Ministry of Education and Sports

SECONDARY SCHOOL
ABRIDGED CURRICULUM
FOR UGANDA

- GEOGRAPHY
- BIOLOGY
- AGRICULTURE
- CHEMISTRY
- PHYSICS
- MATHEMATICS

SENIOR 6

NCDC

NATIONAL CURRICULUM DEVELOPMENT CENTRE

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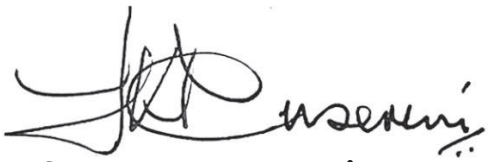
FOREWORD

The COVID-19 pandemic caused a disruption in our education system and made learners miss schooling for almost 18 months of the 2020-2021 schooling period. This has created a need to re-think what and how learners will learn when schools re-open.

The Ministry of Education and Sports through National Curriculum Development Centre (NCDC), has developed this abridged curriculum for Primary and Secondary schools in the country. This curriculum presents a selection of priority learning competences and concepts, along with psychosocial support, which should be the focus of instruction in the 2022 school year in order to achieve learning recovery.

This curriculum is not a departure from the existing curricula for the different classes but rather, a modification of the same with a purpose of recovering the lost learning time with minimum learning loss. It has been packaged for all Primary and Secondary classes with exception of Primary One, Senior One and Senior Five that will use the standard curriculum.

I therefore, recommend this abridged curriculum and ask all stakeholders to support its implementation as a strategic intervention towards the mitigation of the effects of COVID-19 pandemic on our education system. The effective implementation of this curriculum by the implementers will be a great milestone towards the recovery of lost learning time and giving hope and confidence to learners and teachers.



HON. Janet K. Museveni
First Lady and Minister for Education and Sports

ACKNOWLEDGEMENT

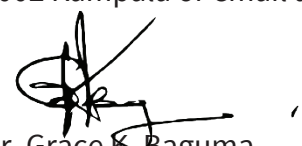
National Curriculum Development Centre (NCDC) would like to express its most sincere appreciation to all those who worked tirelessly towards the development of the abridged curriculum for Primary and Secondary levels of education.

The Centre is indebted to the NCDC Governing Council and the Academic Steering Board whose guidance and input helped to develop quality curriculum materials.

Great thanks go to the Specialists, panel members, the Quality Assurance and Editorial Committees that invested heavily in the conceptualisation, development and quality assurance processes that collectively delivered the materials that we have here. Their efforts, extra energy and professionalism has been unmatched.

This abridged curriculum was developed with support from The Government of the Republic of Uganda, Save the Children, UNESCO, Uganda National Examinations Board (UNEB), Directorate of Education Standards (DES), Universities, National Teachers Colleges (NTCs) and Primary Teachers Colleges (PTCs).

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



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GEOGRAPHY

ABRIDGED GEOGRAPHY SYLLABUS FOR SENIOR SIX

Introduction

The abridged Geography Syllabus for Senior Six has been designed to address the learning gaps that were created as a result of the Covid 19 pandemic. Critical content has been sorted and put together to be taught in a period of one year. The syllabus combines work which was not taught in Senior Five before the lock down and that for Senior Six. In order to avoid repetition of related concepts, learning has been structured around two thematic areas: Physical Geography and Development Geography. It is hoped that the content areas included in this syllabus will enable the learner to acquire the target knowledge, skills and values for the Advanced level of education.

The critical changes are highlighted in the table below.

MATRIX SHOWING CRITICAL CHANGES IN THE SYLLABUS

SN	CRITICAL CHANGES	JUSTIFICATION
	PART 1: PHYSICAL GEOGRAPHY	
1	Left out the topic on Introduction to physical Geography	• Content for the topic can be summarised and inferred from the sections of the paper i.e. what physical geography studies.
2	Merged the topics of the Structure of the earth and tectonism with the origin of continents	• Students cannot understand the drifting and distribution of continents without background knowledge of the internal structure of the earth; especially how radioactive decay and energy transfer in the core and mantle

		affect the sialic layer. • The effects of continental drift are well understood and appreciated by examining tectonic landforms.
3	Topics on Map work and Photograph interpretation are fused into all topics on landform evolution	• These are skills which can be developed and applied in all topics. The student can acquire them better if they are not treated in isolation.
4	Left out the topic of Lakes and their modes of formation.	• The major lakes especially in Uganda and the rest of East Africa are largely covered in the formation of landforms e.g. volcanic lakes and faulted. Content on formation of down warped is the drainage of Uganda.
5	Left out the topic of glaciation	• It is not very significant in the evolution of East Africa's relief and landscape. Learners can hardly relate with the effects of this process.
6	Left out the topic of Mass wasting	• The concepts to be learnt in the topic are largely brought out in the topic of weathering and slope development.
7	Merged the topics of Tectonic landforms in Uganda, Climate of Uganda, Climate change in Uganda, and Vegetation and land use planning in Uganda, with related aspects in East Africa and other parts of the world	• To help the learner to learn from known to unknown and to avoid repetition of related content.

	(where applicable).	
8	Left out the topics of Rivers and River Systems, Soils, and Coastal Geomorphology	• Learners have been exposed to related content at the Lower level. They can build on the existing knowledge to further their understanding of these processes.
9	Fused Fieldwork as a topic in all other topics across the syllabus.	• Fieldwork is a method of learning geography. Learners can acquire the investigative, data handling and reporting skills in this topic by learning other topics through field work.
	PART 2: DEVELOPMENT GEOGRAPHY (STUDIES IN WORLD PROBLEMS AND DEVELOPMENT)	
1	Left out the Topic of Development	• Presumed to have been covered during the time before the lockdown.
2	Left out the subtopics of small holder farming, Extensive cereal farming, and Specialized farming	• Related content was extensively covered at O-level. Learners can only be guided to revise it.
3	Fused the topic of Statistical Representation, Interpretation and Analysis in all other topics across the syllabus.	• These are practical skills which the learner can acquire through practice rather than learn about it ..

4	Left out the topics of Fishing, Rural Settlement, Fuel and Power Production, Transport and Communications, and World Trade and Regional Integration	• To avoid content overload since the time available cannot allow the learner to study these topics
5	Merged topics on human and development geography of Uganda with related studies in other parts of the world	• To help the learner to learn from known to unknown and to avoid repet of related content.

PART 1: PHYSICAL GEOGRAPHY

Topic 1: The Origin of Continents and Ocean basins

Duration: 20 Periods

General Objective

By the end of the topic, the learner should be able to explain the theories of the origin of continents and ocean basins; and relate continental drift to the relief and drainage of Africa and East Africa.

SUBTOPIC	OBJECTIVES The learner should be able to:	CONTENT	SUGGESTED TEACHING ACTIVITIES	ASSESSMENT STRATEGY
Continental Drift	a. Explain continental	• The concept of	• Provide atlas map/wall	• Read learners' reports

and its effects on the Relief and landforms of East Africa	Drift. b. Describe the distribution of the present day continents and ocean basins. c. Evaluate the theories which explain the origin of continents and ocean basins. d. Examine the effects of continental drift on the evolution of	continental drift • Distribution of continents and - ocean basins • Theories of the origin of continents and ocean basins • Effects of continental drift on the evolution of physical features in East Africa (*Faulting, Folding, Crustal warping, Volcanicity and Earth quakes*)	map/textbook map of the world or a video clip on continental drift and use questioning to guide learners to understand the meaning of a continent and ocean basins. • Ask learners to: ○ copy the map in their notebooks ○ cite examples of continents and ocean basins and mark and name these on the sketch map they have drawn. • Observe	about faulting and volcanicity in East Africa and evaluate their ability to sort and communicate information; and to relate each process to the relief and landscape of East Africa. • Task learners to assess the extent to which the theory of continental can be relied upon to explain the formation

	landforms and drainage features in Uganda and the rest of East Africa. e. Use survey maps to analyse the effects of tectonic movements on relief, drainage and human activities. -		learners as they draw the map and ensure that the continents and ocean basins are correctly placed on the sketch map. • Demonstrate the drifting of continents using jig-saw pieces, video clips/simulations or any other method. • Challenge learners to explain what they observe and explain what they understand by continental drift. • Write their contributions on the chalkboard	landforms in East Africa. - -

			and explain further. • In groups, learners discuss and suggest the forces responsible for the drifting of continents. • Groups present their ideas to the whole class and critique each other's work. • Ask probe questions to elicit more responses and to encourage deeper thinking and reasoning. • Provide a world map or maps with evidence of continental drift and through questioning, guide	

			learners to find out the proof that continents have drifted and are still drifting. **Effects of tectonic movements** • Learners brainstorm the influence of continental drift on the formation of relief and landforms citing examples from Uganda and the rest of East Africa(*faulting, Earth quakes, folding, crustal warping, and* volcanicity • *Task learners to research and*	

			make notes about faulting and volcanicity y in Uganda and the rest of East Africa. • Give out topographic survey maps from areas affected by tectonic movements and challenge the learners to: o Identify the effects of those movements on relief and drainage. o Draw cross sections and analyse the influence of tectonic	

			landforms on human activities.	

Topic 2: The Drainage of Uganda

Periods: 6

General Objectives

By the end of the topic, the learner should be able to:

i) Describe the drainage system of Uganda.

ii) Explain the evolution of Uganda's drainage.

SUBTOPIC	OBJECTIVES The learner should be able to:	CONTENT	SUGGESTED TEACHING ACTIVITIES	ASSESSMENT STRATEGY
The Drainage System and its evolution	1. Describe the drainage system of Uganda. 2. Use diagrams and maps to explain the evolution of the	• Drainage system of Uganda • Stream reversal and the evolution of the	• Build on learner's knowledge of rivers and drainage patterns in East Africa which was acquired at O-level. • Use questioning to guide learners to explore the drainage of Uganda and its	1. Give a task for the learners to imagine and write an essay on the kind of vegetation and climate o Uganda would have

	drainage system of Uganda. 3. Explain the processes which led to the formation of major lakes and river systems in Uganda. 4. Explain the benefits and disadvantages of down warped lakes in Uganda.	drainage system of Uganda. • Formation of - major lake type and river systems in Uganda	main components (lakes, rivers, streams and swamps). • Learners use a textbook, wall, atlas or chalkboard map to identify the main drainage features in Uganda and their distribution. They copy the map into their notebooks. • In groups, learners use the same map to: ○ Identify and describe the extent of the main drainage basins in Uganda. ○ Identify the direction of flow of rivers in Uganda. ○ Explain the relationship between the flow of rivers	without the present drainage system. 2. Provide survey maps from Uganda and task the learners to: (i) Identify the drainage patterns displayed by the rivers. (ii) Explain the relationship between relief and drainage in the areas

			and relief. • Using a map of ancient drainage (*before pleicetocene period*) and the map of present drainage, explain the evolution of Uganda's drainage system. • Learners draw the maps in their notebooks. **Down Warping and formation of lakes** • Ask: How much of Uganda is a plateau? What is a plateau? • Using a diagram, explain how the plateau was uplifted in some places and down warped or sagged in other places. • Learners suggest where this has happened most	shown on the maps.

			in Uganda. (L. Victoria and L. Kyoga basin). • Learners copy the diagram and summarise the process of down warping in their notebooks. • Using a map of ancient drainage (*before pleicetocene period*) and the map of present drainage, explain stream reversal and the evolution of Uganda's drainage system. • Learners draw the maps in their notebooks. • In groups, learners discuss the benefits and problems of down warped lake basins and lakes in Uganda. Groups share their ideas in a whole class	

			discussion.	

Topic 3: Rocks of the Earth

Duration: 10 Periods

General Objectives

By the end of the topic, the learner should be able to:

i) Describe the processes of formation of different types of rocks.

ii) Explain the importance of rocks in East Africa.

SUBTOPIC	OBJECTIVES The learner should be able to:	CONTENT	SUGGESTED TEACHING ACTIVITIES	ASSESSMENT STRATEGY
Introduction to Rocks	a. Explain what a rock is. b. Analyse the classification of rocks. c. Explain the rock cycle. d. Describe the processes of rock formation.	• Definition of rocks • Classification of rocks: ○ igneous ○ sedimentary ○ metamorphic • Processes of rock formation • The rock cycle -	• Build on learners existing knowledge of rocks to help them achieve deeper understanding of rocks. • Guide learners to brainstorm on: ○ the meaning of rocks. ○ the types and properties of rocks. • Clarify the learners' contributions and lead them to a common	1. Give a task to assess the knowledge on rock types, their properties and modes of formation. -

			definition and meaning of rocks. • Present samples of rocks of different rock types and ask the learners to describe their characteristics and determine what type each one is. • Present diagrams illustrating rock formation and through discussion, guide the learners to explain the formation of each rock type. • Present a diagram of the rock cycle and ask learners to analyse the relationships it displays. To further understanding, ask: Which type is the primary rock of the earth?	
Influence of Rocks on	a. Discuss the influence of rock	• Influence of rock structure on landscape • Economic	• In groups, learners conduct a field work study of rocks in the	1. Give a task for learner s to

landscape and human activities	structure on landscape. b. Discuss the economic Importance of rocks.	importance of rocks	local area. They analyse the types of rock, their properties, and influence on human activities. Groups present their reports to the whole class. • Summarise group findings, help them to make corrections and guide them to understand how rock structure (composition, colour, hardness, jointing, etc.) influence the formation of landforms. • Present photographs from areas with outcrop rocks and challenge the learners to analyse the relationship between rocks and: o Landscape o Human activities	analyse the influence of rocks on landscape in Uganda. 2. Task the learners to explain the relationship between rocks and human activities in the local area. - -

Topic 4: Weathering and Slope development

Duration: 18 Periods

General Objective

By the end of the topic, the learner should be able to explain the process of weathering and the formation of rocks in humid and arid areas.

SUBTOPIC	OBJECTIVES The learner should be able to:	CONTENT	SUGGESTED TEACHING ACTIVITIES	ASSESSMENT STRATEGY

Introduction to Weathering	a. Explain the meaning of weathering
	b. Describe the types and processes of rock weathering.
	c. Analyse the factors affecting rock weathering.
	d. Explain the relationships
		• Definition of weathering
		• Types and processes of weathering:
		  ○ physical
		  ○ chemical
		  ○ biological
		• Factors affecting weathering
		• Interdependence of chemical and physical weathering
		-
			• Build on the learners' existing knowledge of weathering acquired at O-level. Lead learners outside the class room and ask them to pick samples of hard rock and soil. They examine the samples and describe their characteristics and suggest any relationship between them.
			• Explain that the all soil we see was at
				1. Give a task on the broad types of rock weathering and their interdependence.

	betwe en the weath ering types. -		one time hard rock but, overtime the rock was broken down until it became soil. This is called weathering. • Learners brainstorm the : ○ meaning of weathering. ○ types of weathering. ○ the processes of weathering. ○ factors affecting weathering. • Using the discussion method, clarify the learners' contributions. • Using photograph s, diagrams and simulations, demonstrat e the different types of rock weathering. • Learners	

			read written texts on the processes of weathering under each type and make notes. • List factors influencing the rate and nature/character of rock weathering. Learners work in groups to discuss how each factor can affect weathering. Group ideas feed into a class discussion. • Through questioning, guide learners to explore the relationship and interdependence between physical and chemical weathering.	

Landforms due to Weathering	a. Describe the landforms resulting from weathering. b. Explain the economic importance of weathering.	• Land resulting from weathering: ○ exfoliation domes ○ inselbergs/tors ○ etch plains ○ spheroids ○ Karst features such as: caverns, - Stalactites, stalagmites, pillars, dolines etc. • Economic importance of - weathering	• Present photographs from different environments affected by weathering e.g. inselbergs, limestone/chalk areas and through questioning, challenge the learners to identify the landforms shown and explain how they can be related to weathering. • Using discussion, clarify the learners' contributions. • Using diagrams/ simulations /video clips, demonstrate the formation of landforms	1. Give the learners a task on the effects of weathering on the relief and landforms of East Africa and how these landforms are important to people.

			resulting from weathering. • Challenge learners to conduct a fieldwork study in the local area on the effects of weathering on landscape; and present their reports. • Basing on the field work findings, learners discuss the effects of weathering on human activities.	
Slope development in humid and arid areas	a. Define a slope. b. Identify the types of slopes.	• Definition of a slope • Types of slopes • Theories for slope • development, for example: ○ Morris Davis' teory ○ William	• Lead the learners outside the classroom to observe slopes of different types (if	1. Give a task for learners to assess the extent to which the M.W. Davis'

	c. Explain the theories for slope development. d. Explain the factors influencing slope development.	Penck's theory • Factors influencing slope development such as: ○ rock hardness ○ faulting ○ erosion ○ Location/climate	possible). Through questioning, guide them come up with the meaning of slope. • Challenge the learners to suggest possible classification of slopes. Summarise their contributions on the chalk board. • Using textbook/chalk board diagrams/ video clips, guide the learners to understand the types of slopes. • In groups, learners read texts on theories of slope	theory can explain the development of slopes in Uganda. 2. Assess learners' research reports about theories of slope development. Evaluate their understanding of concepts, and ability to analyse issues and to communicate findings.

			development make summary notes and share in a whole class discussion. • Focus the learners to understand Morris William Davis' theory of peneplanation. • Basing on their fieldwork findings, learners suggest the stage of slope development in the Davisian cycle at which landscape in the local areas is. • Through discussion, guide the learners to explore the factors	

			influencing slope development. • Guide the learners analyse the pros and cons of the Davisian Cycle of erosion and slope development. • Task the learners to conduct library/internet research and make notes on other theories of slope development.	

Topic 5: Mass Wasting

Duration: 6 Periods

General Objectives

By the end of the topic, the learner should be able to:

i) Describe the formation of the resultant features of mass wasting.

ii) Explain the effects of mass wasting on the physical and human environment.

SUBTOPIC	OBJECTIVES The learner should be able to:	CONTENT	SUGGESTED TEACHING ACTIVITIES	ASSESSMENT STRATEGY
Mass Wasting	a. Explain the meaning of mass wasting. b. Locate areas where mass wasting occurs. c. Explain the types and processes of mass wasti	• Types and causes of Mass wasting • Effects of mass wasting on: ○ Landscape ○ Human activities • Control measures for mass wasting	• Conduct a fieldwork study in the local area to enable learners to observe mass wasting. Or Present news paper articles/ photographs/ video clips on landslides in Uganda. Learners analyse the information presented and write summary notes. • Using the brainstorming method, ask the learners to: ○ Explain what mass wasting is. ○ Identify kinds of	1. Give a task for learners to research and write a report about an area in Uganda where mass wasting has recently occurred.

	ng in East Africa. d. Analyse the effects of mass wasting. e. Discuss the measures which can be used to control mass wasting.		areas where mass wasting commonly occurs. ○ Identify types/processes of mass wasting. • Present a textbook/chalkboard/ Atlas/wall map of East Africa and challenge the learners to suggest areas which can experience mass wasting. Probe learners to give reasons for their suggestions. • Learners draw the map in their notebooks and show areas in East Africa where mass wasting occurs. • Basing on the map and news paper articles/photographs/video clips presented, learners work in groups to identify the causes of mass wasting. Groups	They establish its type, causes and effects on landscape, people's lives and property. -

			share their ideas in a whole class discussion.
			• Clarify group ideas and add missing points if any.
			• Through discussion, guide the learners to explore the effects of mass wasting on:
			  ○ Relief and landscape,
			  ○ People's lives and property
			• Using photographs, diagrams, and other illustrations, demonstrate measures which can be taken to control mass wasting.
			• Learners make notes and draw diagrams to illustrate the measures.
			• Ask: Which of those measures would you recommend to be used in Kigezi region/Bugisu?	

			Give reasons.	

Topic 6: Climatology and Meteorology

Duration: 28 Periods

General Objectives

By the end of the topic, the learner should be able to:

i) Describe the measurement and recording of elements of weather.
ii) Explain the factors influencing the elements of weather.
iii) Explain the regional variations of climate in East Africa.

SUBTOPIC	OBJECTIVES The learner should be able to:	CONTENT	SUGGESTED TEACHING ACTIVITIES	ASSESSMENT STRATEGY
Measurement and Recording of Elements of weather	a. Distinguish between weather and climate. b. Outline the elements of - weather and climate. c. Use diagrams to explai	• Temperature • Humidity • Clouds • Precipitation • Solar radiation/ Sunshine • Winds • Atmospheric pressure	• Build on the learners' knowledge of weather and climate acquired at O-level to guide them revise weather and climate. • Lead the class outside and ask learners to describe the weather of the place around the school. Ask: Is the weather now similar to that of yesterday	1. Observe learners as they present their report and assess their understanding of individual elements of weather, their measurement and recording. Also note

	n how weather is measured and recorded. d. Explain factors influencing variations in each element of weather. e. Draw graphs, maps and diagrams to illustrate how elements of weather are recorded. -		or the past 3 days? • Ask learners to identify the things they use to describe weather. These are called the elements of weather. • Ask the learners to describe the pattern of weather of a local area they are familiar with over a period of 2 years. Explain how this pattern can, over a long period of time, be used to describe the climate of the area. • Challenge the learners to explain the difference between weather and climate. • *Individually, learners visit a weather station or carry out library/internet research to investigate the elements of*	how well they can communicate information including use of relevant illustrations such as diagrams, graphs and maps.

			weather, their measurements and recording; and the importance of each to human life. They write and present a report.	
The climate of Uganda and the rest of East Africa	a. Draw maps to show the climatic zones of Uganda and East Africa. b. Describe the characteristics of the different climatic zones of Uganda and the rest of East Africa.	• Climatic zones of Uganda and East Africa • Characteristics of the climatic zones • Factors influencing the climate of Uganda and the rest of East Africa • Influence of climate on human activities	• Build on the learners' knowledge of climate of East Africa acquired at O-level. Using questioning, guide the learners to revise the climate of East Africa. • Present a wall map/atlas map/ chalk board map and challenge the learners to identify the climatic zones of East Africa. • Learners copy the map into their notebooks and make notes about each climatic zone. • Present climatic statistics from the different zones and task the learners to:	1. Task the learners to choose any **one** administrative region of Uganda and : a) Describe its climate and explain the factors affecting the climate. b) Assess the extent to which the activities carrie

	c. Use statistics and graphs to analy climate. d. Explain the factors influencing the climate of East Africa. e. Identify climatic zones from photographs. f. Explain the influence of climate on human activities. -		○ Draw graphs to represent the information, ○ Describe the characteristics of each zone from the graph. • In groups, learners study the map of East Africa and identify the climatic types in Uganda and draw a map to represent these. On the map they include some of the districts/places covered by each climatic zone. • List the factors affecting the climate of East Africa on the chalk board and task the learners to explain how each affects the climate. Summarise their contribution on the chalk board	d out by people living in the region are influenced by climate.

			and clarify on areas which need more explanation. **Influence of climate on human activities** • Present photos from different climatic zones of East Africa showing land use /people's ways of life and challenge the learners to study them and: ○ Identify the climatic zone shown in each, and describe climate. ○ Explain the relationship between climate and people's ways of life in each	

			photo. Summarise the learners' ideas and help them to understand the influence of climate people's ways of life.	
Climate Change in Uganda and the rest of East Africa	a. Explain what climate change is. b. Identify the indicators of climate change. c. Identify areas in Uganda and the rest of East Africa affected by climate change. d. Explain the causes of climate Change. e. Analyse the effects	• Concept of climate change • Indicators of climate change in Uganda • Causes and effects of climate change • Mitigating climate change	• Guide the learners to brainstorm on the definition, indicators, causes and effects of climate change. • Using discussion, clarify their contributions. • Give the learners an individual exercise on the causes and effects of the current climate change in Uganda.	i. Give a task for learners to describe the indicators of climate change in their home district, and explain its causes and how it can be controlled .

	of climate change. f. Explain the measures being g. taken to control the effects of climate change h. Evaluate adaptation measures to climate change. - -			
Ocean currents and their effects on the climate of adjacent lands	a. Explain what ocean currents are. b. Locate the different ocean - current	• Meaning of ocean currents • Location of different ocean currents around the world • Types of ocean	• Present a world map/video clip/simulation showing the positions and flow of ocean currents. Guide the learners to identify the ocean currents and draw a table	1. Task the learners to assess the extent to which desert climate in Africa is due to ocean

	s around the world. c. Identify the types of ocean - currents d. Describe the characteristics of ocean currents. e. Explain the factors influencing ocean currents. f. Analyse the influence of ocean currents on the environment.	currents: ○ cold ○ warm • Characteristics of ocean currents. • Factors influencing ocean currents. • Influence of ocean currents on the environment.	to classify them by their types: Cold and Warm currents. • Ask learners to explain what is meant by ocean currents and how ocean currents differ from winds. • As a whole class, learners suggest the difference between cold and warm ocean currents. • Clarify the difference between the two types of ocean currents and help learners to understand the characteristics of each type. • List the following factors on the chalk board and challenge the learners to explain how they can cause ocean currents: ○ Rotation of the earth ○ Rise and fall of the tides ○ Movement	currents.

			of winds over the sea ○ Difference in temperature and salt content of sea water • Summarise learners' ideas and help them to understand the causes of ocean currents. **Effects of ocean currents** • Use the world map showing world climates, guide the learners to explore the effects of ocean currents on weather and climate. • In groups, learners discuss the effects of ocean currents on human activities such as: Shipping and navigation, marine fisheries, recreation, alternative source of energy etc.	

Topic 7: Vegetation

Duration: 20 Periods

General Objectives

By the end of the topic, the learner should be able to:

i) Identify the different vegetation types in Uganda, East Africa and the rest of the world.

ii) Describe the factors influencing vegetation distribution in Uganda and the rest of East Africa.

iii) Explain the importance of vegetation.

SUBTOPIC	OBJECTIVES The learner should be able to:	CONTENT	SUGGESTED TEACHING ACTIVITIES	ASSESSMENT STRATEGY
Natural Vegetation	a. Locate the different natural vegetation types in East Africa and the rest of the world. b. Draw maps to show the distribution of vegetation in the world, East Africa and Uganda. c. Describe the characteristics of the different natural	• Distribution of natural vegetation in East Africa and the rest of the world • Characteristics of different types of natural vegetation • Factors influencing the distribution of natural vegetation. • Economic importance of natural vegetation	• Lead learners outside the classroom to observe the vegetation of the area around the school. Learners record the types of vegetation, its characteristics, and classify it as natural or human-created. They	1. Task the learners to account for the occurrence of a named vegetation type in East Africa. - They justify the conservation of the named vegetation type.

	- vegetation types. d. Use photographs to identify and describe vegetation types. e. Explain the factors influencing the distribution of natural vegetation. f. Explain the factors for the - deterioration of the natural - Vegetation in Uganda and other parts of the world. g. Describe the measures to control the depletion of natural vegetation. h. Explain the economic - importance of the different - natural vegetation	• Factors for the deterioration of - natural vegetation • Measures to conserve natural vegetation	discuss and come up with factors influencing the distribution of vegetation in the area. • Challenge the learners to explain the meaning of natural vegetation of an area. • Present a wall map/atlas map/textbook map/chalk board map showing natural vegetation. Challenge the learners to identify the vegetation type and describe the distribution. • Learners copy the map into their notebooks, annotate it	

	types.		and create a key. • In groups, learners read a written text about world vegetation types and summarise the characteristics of each type, and factors influencing vegetation distribution. • Groups share their ideas in a whole class discussion. Learners compare their notes with the field work report about vegetation around the school. • Guide the learners to explore the natural vegetation of Uganda and draw a	

			map to show its distribution.
			• Present photographs showing different vegetation types and challenge the learners to:
			  ○ Describe the vegetation and identify what type it is.
			  ○ Explain the relationship between vegetation and people's ways of life.
			• In groups, learners discuss how vegetation provides the basis for land use planning in Uganda.
			• Using whole class	

			discussion, guide the learners to find out the environmental benefits and disadvantages of natural vegetation. **Deterioration of natural vegetation** *Learners carry out library/internet research about the deterioration of natural vegetation in East Africa, its causes, effects and conservation measures.*	

PART 2: DEVELOPMENT GEOGRAPHY (STUDIES IN WORLD PROBLEMS AND DEVELOPMENT)

Topic 8: Development of Agriculture

Duration: 36 Periods

General Objectives

The learner should be able to:

i) Categorise the dominant types of agriculture in the developed and developing countries.
ii) Describe the characteristics of each type of agriculture.
iii) Explain the factors influencing the various agricultural types.
iv) Analyse the contribution, problems and solutions to the problems of each type of agriculture.

SUB TOPIC	OBJECTIVES The learner should be able to:	CONTENT	SUGGESTED TEACHING ACTIVITIES	ASSESSMENT STRATEGY
Large Scale Agriculture	a. Explain what large - scale agriculture is b. Identify the types of large scale agriculture c. Describe the	• Meaning of large scale agriculture • Types of large scale farming and their characteristics: ○ Plantation agriculture ○ Livestock ranching • Factors for the development of large scale	• If possible, guide the learners to conduct a field work study of a plantation farm to investigate and make a report about its characteristics, development,	1. Read learners' reports about sugarcane plantations in South Africa and Livestock Ranching in

	- characteristics of - large scale agriculture d. Explain the factors - favoring the - development of large - scale agriculture e. Explain the - contribution of large - scale agriculture to - development f. Analyze case studies - of large scale - agriculture g. Explain the problems - facing large scale - agriculture and	farming • The role of large scale agriculture in development. • **Case Studies:** ○ Rubber Plantations in Liberia/Sugar cane plantations in Natal Province ○ Livestock ranching in Argentina	benefits to the community and country, and problems. • Or through discussion, ask the learners to mention examples of plantation farms in Uganda. They draw a map of Uganda to locate the examples. • As whole class, learners discuss the characteristics of plantation farms. Summarise their ideas and explain further. • Through discussion, guide the learners to explore the factors favouring development of plantation farms; benefits, disadvantages and	Argentina and evaluate their ability to sort and communicate information; and how well they understand large scale agriculture.

	solutions to these problems.		challenges of plantation farms in Uganda. **Rubber Plantations in Liberia** • Learners use a wall map/atlas/textbook map of Africa to locate Liberia. They use its position to suggest the likely type of climate experienced in Liberia and crops grown; and give reasons. • List these on the chalk board and allow the learners to explore Plantation farming in Liberia. • Present a map of Liberia showing plantation farms and challenge the learners to	

			draw and label it. Explain the organisation, ownership, management and development of plantation farms in Liberia. • In groups, learners discuss factors favouring plantation farming in Liberia. • Provide statistics on rubber production/trade and challenge learners to draw suitable graphs/charts or diagrams to analyse them. • Through questioning, help the learners to find out the contribution and disadvantages of large scale	

			farming in Liberia. • *Task the learners to carry out research on Extensive sugar cane plantations in Natal Province and Livestock ranching in Argentina and make reports.*	
Intensive Commercial Farming	a. Explain the meaning of intensive commercial farming b. Explain the characteristics of intensive commercial farming. c. Draw maps of to locate case study areas of Intensive commercial farming.	• Meaning of - Intensive Commercial farming • Types of Intensive Commercial farming and their characteristics: ○ market gardening /truck - farming ○ factory farming • Main areas of intensive commercial farming: ○ Netherlands ○ Canada ○ Kenya	• Through questioning, guide the learners to identify forms of intensive commercial farming in Uganda. Ask learners to draw a sketch map to locate areas of Intensive commercial farming in Uganda. • Learners describe the characteristics of Intensive farming in Uganda. • Guide learners to come up with and	1. Give a task for the learners to: a) Write detailed notes on: (i) Truck farming. (ii) Factory farming b) Assess the contribution of market gardening to the develop

	d. Use a map of Uganda to locate areas of intensive Commercial farming. e. Analyze factors for - development of intensive commercial farming. f. Evaluate the contribution of - Intensive commercial farming to development. -	• Factors for the - development of Intensive commercial farming • The role of Intensive - commercial - farming in - development	agree on the meaning of intensive commercial farming and focus them to understand *Market gardening* and *Factory farming*. • Summarise learners' ideas on the chalk board and help them to understand the relationship between intensive commercial farming and urbanisation. **Case studies** ○ Netherlands ○ Canada ○ Kenya • Present a chalk board map /textbook map/atlas map of the Netherlands and guide the learner to identify areas	ment of a named developed country.

			of intensive commercial farming. Ask: what kind of areas are they? • Explain the organisation and management of intensive commercial farms. • Guide the learners to discuss factors favouring the development of intensive commercial farming in the Netherlands; and its contribution to development. • Task learners to conduct library/internet research other case studies of Intensive commercial farming and make reports.	
Irrigation Farming	a. Identify the major	• Why Irrigation farming is carried out.	• Build on learners' knowledge of	1. Give a task for learners

	areas of irrigation farming. b. Describe the organization of irrigation farming using specific examples. c. Explain factors leading to irrigation farming. d. Analyse the benefits and problems of irrigation farming. e. Evaluate solutions to the problems of irrigation farming.	• How irrigation is - carried out • The benefits and disadvantages of - Irrigation farming. • Solutions to problems caused by irrigation farming • Case studies of areas of successful irrigation farming: ○ The Central Valley of California ○ Gezira Scheme -	irrigation farming acquired at O-level and guide them to revise some aspects of this method of farming. • In groups, learners discuss and identify major areas of irrigation farming in Africa and elsewhere in the world. • Through questioning, guide the learners to explore the conditions leading to irrigation of farmland in the areas they have identified. • Challenge the learners to identify the methods used to supply water on irrigated farmland. Summarise	to evaluate the contribution of irrigation farming to the development of a named area or country. 2. Task the learners to imagine they are land use planners for their country. They suggest, with reasons, methods they would use to ensure that the semi arid lands in their country produce crops all

			their responses and clarify where necessary. Learners suggest which methods can be used to irrigate the dry lands of Uganda and why. **Case Studies: The Gezira scheme** • Present a map of Sudan with the branches of River Nile and task the learners to identify the position of the Gezira Plains and irrigation Scheme. • Learners draw a map of the Gezira scheme and annotate it to show the water supply facilities. • Present statistics of cotton/crop production on	the year round. They also explain the likely challenges they would face in doing so.

			the Gezira for several years and task the learners to use a suitable statistical drawing to represent and analyse them. • Through discussion, guide learners to explore the benefits and disadvantages of irrigation farming in Sudan. • As a whole class, learners discuss and suggest solutions to the problems of irrigation farming in Sudan. • *Task learners to carry out library /internet research and write a report about irrigation farming in California, USA.*	
	a. Explain the	• Meaning of agricultural	• Ask: Is Uganda carrying out	1. Give a task for

Agricultural Modernisation	meaning of agricultural modernisation. b. Explain the factors that have led to agricultural modernisation. c. Explain the methods used to modernise agriculture in Uganda and other parts of the world. d. Analyse case studies of - Agricultural modernisation. e. Explain the	- modernisation • Factors leading to agricultural - modernisation • Methods used to modernize - agriculture. • Case study of agriculture - modernisation: • The Green Revolution in Asia and Africa • Success and problems of - agriculture modernisation	agricultural modernization? If Yes, identify ways in which Uganda is trying to modernize her agriculture. • Using brainstorming, ask learners to: ○ Explain the concept of agricultural modernisation. ○ Identify factors that have led to agricultural modernization in Uganda and elsewhere in the world. • Using guided discussion, guide learners to explore the methods used	the learners to draw a map of Uganda showing major areas of agricultural modernization. They assess the contribution of agricultural modernisaton to the development of Uganda.

	success and - problems of agricultural - modernisation.		to modernize agriculture in developed and developing countries including Uganda. • Lead the class to analyse the benefits and disadvantages of agricultural modernization in Uganda and other parts of the world. **The Green Revolution** • Lead the learners to brainstorm on the concept of the Green revolution as one of the efforts being used to modernize agriculture. • Give background about the origin and progress of the revolution and - challenge the	

			learners to justify why it was necessary to undertake the revolution • Through discussion, guide the learners to find out the benefits and problems associated with the Green Revolution. • Ask: Why is the Green revolution not very prominent in African countries? Summarise learners' contributions and lead them to agree on the challenges of using science and technology to modernize African agriculture.	

Topic 9: Problems of Food Supply

Duration: 4 Periods

Overview

General Objectives

By the end of the topic, the learner should be able to:

i) Describe the trends in food supply since 1950 in both developed and developing countries.
ii) Examine the relationship between food supply and population trends.
iii) Discuss the causes and effects of food shortage in developing countries.
iv) Explain the measures taken to address the issue of famine and food shortages (Green revolution, World Food Program, Trade).

SUBTOPIC	OBJECTIVES The learner should be able to:	CONTENT	SUGGESTED TEACHING ACTIVITIES	ASSESSMENT STRATEGY
Trends in Food Supply Since 1950	a. Describe the world pattern of food production and supply. b. Examine causes/factors - influencing the levels of food supply in developing	• Pattern of food production in developed and developing countries • Factors influencing levels of food supply in developed and - developing countries: ○ physical ○ human • Dangers of decreasing food supply in developing countries.	• Present statistics of food production and supply for selected years since 1950 and guide the learners to analyse them. Learners describe the	- 1. Give a task the learners to assess the extent to which the endless food shortages in sub-Saharan Africa are a

	countries. c. Discuss the dangers of - decreasing food supply in developing countries.		trends in world food production and supply. • Using questioning, guide the learners to understand the factors influencing the levels of food production and supply. • Lead the class to discuss the dangers of decreasing food supplies in the developing countries.	result of natural factors.
Food Shortage in Developin	a. Locate case studies of countries	• Areas experiencing frequent and severe food shortages e.g.	• Learners study the atlas to identify the parts	

g Countries	experiencing food shortages. b. Explain the causes of the food shortages. c. Explain the solutions to the problems of food shortages. d. Discuss the challenges faced in improving food security in developing countries.	Sub- Saharan Africa, Bangladesh • Causes of food - shortages • Measures taken to control food - Shortages and challenges faced.	of the world with food deficits and draw a map showing those countries. • Guide the learners to understand food shortages in Africa. Basing on the atlas map, ask: In which parts of Africa are the counties affected by famine? • Learners discuss the causes of famine in Africa and measures being taken to address famine. • Using questioni	

			ng, guide the learners to identify and explain the challenges of improving food supply and food security in Africa. • *Learners carry out research about food shortages in other developing countries of the world and present reports.*	

Topic 10: Forestry

Duration: 20 Periods

General Objectives

By the end of the topic, the learner should be able to:

i) Analyse the economic importance of forests.

ii) Explain the problems facing forestry and possible solutions.

SUBTOPIC	OBJECTIVES The learner should be able to:	CONTENT	SUGGESTED TEACHING ACTIVITIES	ASSESSMENT STRATEGY
Forests and Forestry	a. Explain the meaning of forestry. b. Outline the status of the forestry Sector in Uganda. c. Describe the characteristics of the different types of forests in Uganda d. Use statistics, graphs, charts and other	• Meaning of forestry • Status of the forestry sector in Uganda • Factors influencing • the development of forestry • The role of forestry in development • Case studies: Tropical regions e.g. Gabon • Temperat	• Lead the learners to brainstorm on: ○ the meaning of the term forestry. ○ the status of forestry in Uganda. • Provide a chalk board/ wall/ atlas / textbook map showing distribution of forests and challenge the learners to identify the forests of Uganda by types. Learners draw the map. • Build on the learners' knowledge of vegetation and	1. Give a task to draw a map of Uganda showing rain forests and Savanna land forests. Learners explain the differences between the two types of forests and examine their value in terms of

	drawings to analyse aspects related to forestry. e. Explain factors influencing the distribution of the forest resources of Uganda. f. Explain the factors - favouring the development - of forestry in Uganda. g. Analyse the contribution, problems, and solutions to the problems facing the forestry industry.	e regions e.g. Scandinavian countries	through questioning, guide them to describe the characteristics of each type of forest. • As whole class, learners discuss the factors influencing the distribution of the forest resources in Uganda. • In groups, learners discuss the importance of the forest resources in Uganda. Group ideas feed into a whole class discussion. • Clarify their contributions and guide them to focus on the environmental and economic role of forests. • Present statistics on forestry in Uganda and challenge the learners to draw suitable graphs or charts to analyse them	the natural environment

			• Explain the problems and solutions to the problems of forestry in Uganda; including deforestation.	
Harvesting Forests in other parts of the world	a. Locate the major areas of case studies on forestry. b. Describe the characteristics of the different types of forests in Uganda and other countries. c. Explain the factors - favouring the development - of forestry in the case study areas. d. Analyse the contribution, problems, and solutions	• Forestry in the Tropical regions e.g. Gabon • Forestry in Temperate regions e.g. Scandinavian countries	• Learners use the atlas/wall map of Africa to locate Gabon. They suggest the type of climate and vegetation in the area where Gabon is located. • Present a map of Gabon showing areas of forestry and ask the learners to draw it. Guide the learners to understand the distribution and characteristics of forests. • Learners read texts about the development of forestry in Gabon and summarise the main aspects. • Through discussion, guide the	1. Present statistics on trade / production of forest products in either the tropical region or temperate region and ask questions about them. 2. Learners discuss the role of forestry in development of the region.

	to the problems facing the forestry industry in case study areas. - -		learners to explore the factors favouring the development the forest industry in the tropical region, its contribution to development and challenges. • *Challenge the learners to carry out research and write reports about forestry in the temperate world: Canada/Scandinavia.*	

Topic 11: Mining

Duration: 20 Periods

General Objectives

By the end of the topic, the learner should be able to:

i) Explain the factors influencing the exploitation of minerals.
ii) Assess the contribution of mining to development.
iii) Analyse the problems facing the mining industry and solutions to those problems.

SUBTOPIC	OBJECTIVES The learner should be able to:	CONTENT	SUGGESTED TEACHING ACTIVITIES	ASSESSMENT STRATEGY

Minerals and Mineral Extraction	a. Identify the major types of minerals.
	b. Outline the status of the mining sector in Uganda and selected countries.
	c. Describe the distrib
		• Major types of minerals.
		  ○ Metals
		  ○ Non-metals
		  ○ Fossil fuel minerals
		• Distribution of major minerals in the world
		• Factors influencing mining
		• Mining methods
		• Case studies of major mining regions of the world:
		  ○ The Rand of South Africa
		  ○ Nigeria (oil and natural
			• If possible, guide the learners to visit a local mining site and investigate the mineral mined, methods used, and effects of mining.
			• Or build on the learners' knowledge of mining acquired at O-level and using questioning, guide them to:
			  ○ identify the major types of minerals
			  ○ identify	

	ution of mineral resources in Uganda and selected countries in the world. d. Discuss the factors influencing mining. e. Describe the mining methods. f. Assess the contribution of mining to the development of Uganda and selected countries.	gas) ○ The Copper Belt of Zambia and D.R.C. ○ The Great Lakes region of - N. America • Importance, problems and possible solutions to the problems facing mining in each region /country.	and describe the methods used in mining. • Learners use the atlas/textbook to identify the major minerals in Uganda and map them. • Present photos showing mining areas in Uganda and challenge the learners to identify the methods being used to extract the minerals. Learners make notes to summarise their findings. • Learners discuss the factors favouring the development of mining in Uganda and use examples to illustrate each factor. • Present statistics on mineral	

	g. Use case studies to analyse the importance, problems and solutions to the problems of mining. h. Use statistics, graphs, charts and other drawings to analyse aspects related to mining.		production/exports by Uganda and challenge the learners to use a suitable statistical diagram to analyse them. • Task the learners to carry out library/internet research about the contributions of mining to the development of Uganda. Learners share their reports in a whole class discussion. Clarify the key issues in the reports. • Using the discussion method, explain the factors limiting mineral exploitation in Uganda and the measures being taken to solve the problems. **Mining in other parts of the world**	

			• Guide the learners to explore the development of in two case study areas: one from the developed world and one from Africa. Consider the following: o The Rand of South Africa o Nigeria (oil and natural gas) o The Copper Belt of Zambia and D.R.C. o The Great Lakes region of - N. America • *Challenge the learners to work in groups and carry out research and make reports about other cases studies which they have not looked at as a class.*	

Topic 12: Industrialisation

Duration: 30 Periods

General Objectives

By the end of the topic, the learner should be able to:

i) Classify manufacturing industries according to location, factors, size, types of production.

ii) Analyse factors influencing the location and development of industries.

iii) Discuss the effects of industrialisation on the environment in developed and developing countries.

SUBTOPIC	OBJECTIVES The learner should be able to:	CONTENT	SUGGESTED TEACHING ACTIVITIES	ASSESSMENT STRATEGY
Location and development of Manufacturing **Industries**	a. Describe the types of - manufacturing industries. b. Analyse factors influencing - the location and development of industries. c. Discuss the contribution of - manufacturing	• Types of manufacturing • industries, such as: ○ small scale and large scale industries ○ light and heavy industries	• Through discussion, guide the learners on the classification of manufacturing industries and the kind of places where industries can	1. Give a task for the learners to assess the contribution of domestic mineral resources to the development of manufacturing industrie

	industries to - development of Uganda and selected. d. Assess the effects of - industrialisation on the - environment in Uganda and selected countries. e. Discuss the challenges facing industrial development in developing countries. f. Explain the solutions to the - challenges facing industrial - development in developing - countries. g. Use statistics, graphs, charts and other drawings to analyse aspects related to	○ labour – Intensive and capital – intensive industries ○ raw material-oriented industries • Factors influencing location of - manufacturing industries: • Contribution of manufacturing - industries to socio-economic development: • Effects of industrialisation on the physical environment • Challenges to industrial	develop. • If possible, learners visit a local factory and investigate its type, factors for its location, factors favouring its development, contribution to the local population, effects on the physical environment and the challenges it faces. • Or, ask the learners to identify the major	s in Uganda.

	industrial development.	development in developing countries. • Solutions to the challenges facing industrial development.	industrial areas/centres in Uganda and the types of industries in each. Learners draw a map to show the distribution of industries in Uganda. • Basing on their map, learners discuss the factors influencing the distribution of industries. • Using questioning lead the learners to explore the	

			factors for industrial development in Uganda especially over the past 35 years. • In groups , learners discuss the benefits and problems associated with the development of industries in Uganda. Groups share their ideas in a whole class discussion. • Clarify learners' ideas and	

			focus them to understand the social, economic and environmental effects of industrialisaion. • Present statistics on industrial development in Uganda and challenge the learners to construct a suitable statistical drawing to analyse them. • Explain the challenges to industrial	

			development and measures being taken to promote industrial development in Uganda.	
Major World Industrial Regions	a. Locate on the world map, the major world industrial regions. b. Analyse case studies of major industrial regions.	• Major world industrial regions: ○ Western Europe, e.g. Germany ○ North America e.g. USA ○ Asia e.g. Japan, China ○ Africa e.g. ○ The Republic of South Africa, Egypt	**Case studies of Major world industrial regions** • Using questioning, discussion and library/internet research, guide the learners to explore industrial development in at least 2 of the case study areas below: ○ Western Europe, e.g.	1. Read the learners' research reports on case study areas and evaluate their understanding of the main aspects of industrialisation. Note how well they use examples to illustrate industrial development.

			Germany ○ North America e.g. USA ○ Asia e.g. Japan, China ○ Africa e.g. The Republic of South Africa, Egypt • Emphasise that learners focus on the types of industry in each region/country, factors for industrial development, the role of manufacturing in development, problem	

			s and challenges associated with industrial development, prospects of further industrial development.	

BIOLOGY

Senior Six Biology Abridged Curriculum

Introduction

The Senior Six abridged syllabus has been designed to address the learning gaps that were created as a result of the covid-19 pandemic. The syllabus is a combination of content from the 2013 Advanced level biology curriculum for Senior Five and Senior Six. The critical content has been sorted and put together to be taught in a period of one year. The abridged syllabus contains key concepts in all topics from both classes. In order to compensate for the lost time, concepts that were taught at lower levels (for example feeding relationships and growth curves of living organisms etc.) are left out. Learning outcomes with similar content are merged or transferred to another class. Content that was not relevant to the abridged curriculum is also left out (for example some systems and processes other than those in mammals). It is assumed that "Cell Biology" was covered during the time before the lockdown. It is hoped that the content areas included in this syllabus will enable the learner to acquire the target knowledge, understanding, skills and values for their progression. The teacher's and learners are encouraged to make reference to the Biology home study materials that can be accessed on the center's website www.ncdc.go.ug.

The matrix below shows the key changes that were made in abridging the Senior Six syllabus and their justification.

KEY CHANGES	JUSTIFICATION
All S.5 topics moved to S.6 except cell biology and all S.6 topics are maintained.	These topics had not been covered before students went for lock down except cell biology.
Some objectives from all A 'level topics are left out.	Content/concepts from these objectives is; -Embedded in other objectives. -Already known from lower secondary school. -Not relevant to the abridged curriculum.

Detailed Syllabus

Topic	Sub-topic	Objectives *The learner should be able to*	Content
Chemicals of life (30 Periods)	Acids, bases and salts	• describe properties of acids bases and salts • explain the role of acids, bases and salts in maintaining a stable internal environment for physiological processes.	• Properties of acids, bases and salts • Functions of acids, bases and salts in organisms
		Practical • The learner should be able to identify salts using quantitative and qualitative analysis.	• Test for presence of mineral salts in food samples /extracts (refer to inorganic analysis in Chemistry practical).
	Water	• Relate the water properties to its role in the life of organisms.	• Role / significance of water in the life of organisms in relation to its properties
		(Practical) The learner should be able to: • test for water. • determine water content in tissues by using dry weigh method. • investigate the natural relationship of water and organisms in a habitat (including humans).	• Testing for water • Measuring water content in tissues • Field study on water habitats. (The • natural relationship of water and • organisms)

	Structure of carbohydrates	• describe the structure and components of various carbohydrates. • explain the properties of carbohydrates. • explain the functions of carbohydrates in organisms. • describe the condensation of carbohydrates. • describe the hydrolysis of carbohydrates.	• Structure and components of carbohydrates • Properties of carbohydrates • Importance of carbohydrates: monosaccharide's, disaccharides, polysaccharides • Condensation of carbohydrates • Hydrolysis of carbohydrates
		(Practical) The learner should be able to: • carry out food test for • carbohydrates on food samples / extracts. • demonstrate hydrolysis of non-reducing sugars.	• Testing for carbohydrates • Hydrolysis of non-reducing sugars • to reducing sugars.
	Structure of lipids	• describe the structure and components of lipid molecules. • state properties of lipids. • explain the functions of lipids in organisms. • explain effects of lipids and steroids to organisms • state the importance of cholesterol in organisms.	• components of lipids molecules • Properties of lipids Importance of lipids in organisms • Effects of lipids and steroids to organisms • Importance of cholesterol in organisms

		(Practical) The learner should be able to; • Carry out food tests for lipids on food samples / extracts.	• Tests for lipids
	Structure of proteins	• describe the structure and components of proteins. • describe the properties of proteins. • explain the functions of proteins in organisms. • explain effects of heat / temperature changes on proteins.	• Structure and components of proteins • Properties of proteins • Functions of proteins in organisms: buffer, enzymes/catalytic, hormones, structural, growth, carriers etc. • Effects of heat/temperature on proteins
		(Practical) The learner should be able to: • Carry out food tests for proteins on food samples / extracts.	• Test for proteins
	Vitamins	• state types of vitamins. • state the importance of vitamins in organisms.	• Types of vitamins: water soluble and fat soluble, essential and non-essential • Importance of vitamins in the life of organisms: protection against diseases, formation of

			• Co-enzymes role in blood clotting and component of visual pigment
		(Practical) The learner should be able to: • test for vitamin C. demonstrate effect of over boiling vegetables. • demonstrate the effect of storage on quality of fresh foods.	• Test for vitamin C • Effect of over boiling vegetables • Effects of storage on quality of fresh foods.
	Enzymes	• describe the criteria for naming enzymes. • explain the characteristics /properties of enzymes. • state factors that affect enzyme action. • explain the mechanism of • enzyme action using the lock and key mechanism and induced fit. • explain the role of enzymes in the organism's life.	• Criteria for naming enzymes: Use type of substrate, type of reaction • Characteristics/ Properties of enzymes relating to factors • affecting enzyme activities: Protein in nature, can be denatured, catalytic /change rates of reactions, work in small amounts, specific to reactions they catalyse, catalyse reversible reactions, can be inhibited, affected by temperature, pH, concentration of substrate and some require coenzymes/ cofactors • Factors affecting enzyme action: pH, temperature,

			inhibitors, substrate concentration • The enzyme action: lock and key mechanism, induced fit • Role of enzymes in living organisms including inhibition, competitive/non-competitive, reversible/non reversible
		(Practical) The learner should be able to: • demonstrate properties of enzyme action in specific temperature, pH range, substrate concentration. • identify enzymes in the different parts of the gut based • on their actions on different • food substances. • carry out food tests on gut • Contents.	• Enzyme properties relating to factors (temperature and pH, concentration of substrate) affecting enzymes' activities • Enzymes in the different parts of the gut based on their actions on different food substances • Food tests using the animal gut contents and enzymes.
Cell physiology (12 Periods)	Movement in and out of cells	• describe the processes • osmosis.	• Process of osmosis: including; turgidity, plasmolysis, water • potential, osmotic potential, wall pressure.
		• **(Practical)** • The learner should be able to: • identify habitats with suitable media for organisms' survival.	• Habitats with suitable media for organisms' survival • Use of salt in food preservation • Use of visking

		• demonstrate use of salt in food preservation. • demonstrate use of visking tubing, glass columns, microscope in diffusion and osmosis experiments. • Demonstrate conditions affecting the rate of diffusion. • demonstrate effects of osmosis on the cells/ tissues.	tubing, glass columns and microscope in • diffusion and osmosis • experiments • Conditions affecting the rate • of diffusion • Effect of osmosis in living • cells/tissues
Levels of organization and diversity of life (32 periods)	Diversity of Living Things	• list 3 criteria for classifying organisms. • state the hierarchy of classification according to Carl Linnaeus. • distinguish between scientific and local names.	• 3 Criteria for classifying organisms: morphology, anatomy, physiology • Hierarchy of classification according to Carl Linnaeus (kingdom-phylum/ division - class-order-family-genus-species) • Scientific /binomial nomenclature and local names
		(Practical) The learner should be able to: • identify organisms using observable features. • construct simple biological keys.	• Identification of organisms using • observable features • Construction and use of simple biological keys.
	Viruses	• explain characteristics of viruses.	• Characteristics of viruses
	Kingdom Monera	• describe characteristics of bacteria.	• Characteristics of bacteria: shape, cell

		• differentiate between bacteria and viruses.	wall, reproduction, movement • Differences between bacteria and viruses
		• **(Practical)** • The learner should be able to: • draw, label and state the types of bacteria • demonstrate the role of bacteria in the production of dairy products. • identify common bacterial diseases in plants and animals. • demonstrate methods of preventing the common bacterial diseases.	• Types of bacteria • Role of bacteria in production of dairy products • Common bacterial diseases in plants and animals • Methods of preventing common bacterial diseases.
	Kingdom Protoctista	• State characteristics of Protoctista. • outline the role of protozoa and algae in the environment. • Name common diseases caused by Protozoa.	• Characteristics of Protoctista • Economic importance of protozoa and algae e.g. *Amoeba, Euglena, Entamoeba, Paramecium, Trypanosoma, Plasmodium* • Common diseases caused by protozoa
		(Practical) The learner should be able to: • prepare temporary mount of *Spirogyra* filaments. • draw and label structure of *Spirogyra* as seen under a light microscope. • identify and draw	• Structure of the *Spirogy* • Structure of protozoa

		protozoa from prepared slides.	
	Kingdom Fungi	• State characteristics of fungi. mushroom. • state the economic importance of fungi. • describe the methods of preventing the spread of fungal diseases.	• Characteristics of fungi (feeding, reproduction). • Economic importance of fungi • Methods of preventing the spread of fungal diseases
		(Practical) The learner should be able to: - prepare temporary mount of yeast, *Mucor/Rhizopus*. - draw and label structure of *Rhizopus* or *Mucor,* y east and t he Mushroom.	• Structures of yeast, *Mucor*/*Rhizopus* as seen under the light microscope • Structure of the mushroom.
	Kingdom Plantae	- identify lower plants and higher plants using structural features. - name the plant groups to phyla. - outline the characteristics and structures of the named plant groups.	- Structural features of lower plants and higher plants - Lower plants: Bryophyta and Pteridophyta (Ferns)/Filicinophyta Higher plants: Coniferophyta, Spermatophyta - Characteristics and structures of named plant groups: Bryophyta, Filicinophyta, Coniferophyta, Spermatophyta: gymnosperms and angiosperms to class level
		(Practical) The learner should be able to:	- Structural features of lower

		- Identify distinguishing structural features of plant groups in lower plants. - identify distinguishing structural features of plant groups in higher plants.	plants: Bryophyta, Pteridophytes/ Filicinophyta - Structural features of higher plants: Coniferophyta, Spermatophyta:(gymnosperms, angiosperms)
	Kingdom Animalia	- state characteristics of invertebrates and vertebrates. - state the distinguishing structural features of organisms in different animal phyla.	- Characteristics of invertebrates and vertebrates - Distinguishing structural features of various animal phyla: - arthropoda down to classes. consider class insecta down to order. - chordata down to vertebrate classes.
		(Practical) The learner should be able to: - classify phylum Arthropoda to class level using structural features. - identify structural features of class Insecta down to order level. - state distinguishing structural features of animals other than Arthropoda.	- Structural features of Arthropoda down to class level - Structural features of class Insecta down to order level - Structural features of animals other than arthropods.

Ecology (18 Periods)	Components of the Environment	• state abiotic and biotic factors • explain how Components of the Environment w the components and environmental factors influence the distribution and abundance of organisms in an ecosystem.	- Abiotic components: air, water, Soil Biotic components: living things - Influence of abiotic and biotic components and factors of the environment on distribution and abundance of organisms
		(Practical) The learner should be able to: - collection of data from field studies. - analyse and interpret data or literature on ecological principles.	- Collection of data on ecological components and factors of an ecosystem - Analysis and interpretation of data or literature on ecological principles
	- Concept of Ecosystem - - - - - - - - - - - - - -	• describe an ecosystem. • state the types and properties of an ecosystem. • explain changes in an ecosystem. • describe feeding relations in an ecosystem. • explain energy flow and recycling of nutrients in an ecosystem.	- Ecosystem: definition - Aquatic and terrestrial ecosystems and properties of an ecosystem: feeding relations, cycling of materials, succession, climax, and homeostasis of an ecosystem/balance of nature - Changes in an ecosystem: ecosystem productivity, succession and climax - Feeding relations: food chains, food webs, ecological pyramids - Recycling of nutrients

			and energy flow in ecosystems
	Population and Natural resources	• Explain factors affecting population density. • explain population growth patterns. • explain the terms renewable and non-renewable resources • discuss environmental resistance and "balance of nature".	- Population density dependent factors and density independent factors - Population growth patterns - Natural resources types: renewable and non-renewable, importance, conservation - Environmental resistance: density dependent factors affecting "balance of nature"
	Interdependence	- explain the various interactions of organisms in nature.	- Interactions among organisms and their effects: interspecific and intraspecific relationships between organisms: competition, parasitism, predation, saprophytism, mutualism, commensalism
	Effects of Human Activities on Ecosystem	- explain the effects of human activities on ecological components and factors in a habitat. - discuss natural resource utilisation and sustainable development.	- Effects of human activities on ecosystem components and factors in a habitat: - interruption of biogeochemical cycles,

			natural resources imbalances, population imbalances, soil erosion, soil exhaustion, extinction, pollution, speciation. - Natural resources utilisation and sustainable development
		(Practical) The learner should be able to: - demonstrate conservation practices.	- Natural resource conservation practices: mulching, terracing, crop rotation, afforestation, reforestation, mixed farming, agro forestry, wise use of resources, etc.
Inheritance and Evolution (19 Periods)	Genetics	- explain the concept of inheritance. - define genetics terms. - describe Mendel's investigations on heredity. - explain inheritance of traits using the monohybrid and dihybrid crosses. - explain the two Mendel's laws of inheritance. - discuss the challenges of inheritable disorders.	- Concept of inheritance - Definition of genetics terms e.g. inheritance, gene, allele, chromosome, DNA, trait, etc - Mendel's work on heredity - Monohybrid inheritance and dihybrid inheritance. - Mendel's laws of inheritance: law of independent assortment and law of segregation - Challenges of inheritable disorders
		(Practical) The learner should be able to:	- Monohybrid inheritance dominant and recessive

		- demonstrate monohybrid and dihybrid inheritance. - illustrate a pedigree.	traits: using uniform money coins/ beads/seeds. - Pedigree study: baldness, early greying of hair, haemophilia, eye colour, sickle cell, albinism
	Chromosomes and genes	- The learner should be able to explain the terms: gene interactions, sex linkage, sex determination, sex limitation, lethal genes and polygenes.	- Terms: - gene interactions: definition and examples: linkage, multiple alleles, codominance, incomplete dominance, dominant and recessive traits, epitasis and complementary genes - sex linkage definition, examples and inheritance - sex determination: definition and examples in humans - sex limitation: definition and examples - lethal genes: definition and examples: phenyl ketonuria, neurospora, etc - polygene: definition and Examples.
	Variation	-explain population traits and types of variation. - describe the causes of variation.	- Population traits and types of variations: continuous (quantitative) and discontinuous

		- define mutation. - describe types and causes of - explain the significance of mutations.	(qualitative) - Causes of variation: genetic and environmental factors - Definition of mutation - Types of mutations: gene and chromosomal mutation - Causes of mutation: chance, radiation, chemicals - Significance of mutations
		(Practical) The learner should be able to: - identify variations in organisms. - collect data on variations among themselves.	- Variations among organisms - Data on variations among organisms (e.g. sex, height, tongue rolling).
	Mechanisms of Evolution	- explain Darwin's theory of natural selection. - explain the importance of variation in evolution. - discuss Neo-Darwinism. - explain the causes of present day evolution.	- Darwin's theory of natural selection: observations and deductions - Importance of variation in evolution - Neo- Darwinism (present day theory of evolution) - Causes of present day evolution: competition, changes in the environment, sexual reproduction, mutations, gene recombination, industrialisation, effects of drug / chemical resistance, artificial

			selection, polyploidy
	Evidence of evolution	- discuss evidence of evolution.	- Evolution evidence based on: fossilization, comparative study of anatomy, embryology, cytology, biochemistry, taxonomy, geographical distribution, vestigial structures, analogous structures, homologous structures
	Selection and Speciation	- explain natural selection and artificial selection. - state the roles of natural selection and artificial selection in speciation. - explain extinction.	- Natural selection and artificial selection. - Role of natural selection and artificial selection in speciation. - Extinction: meaning, causes and Effect.
	Circulatory system in animals	- describe types of circulatory systems. - explain the advantages and disadvantages of open and closed systems in animals. - describe the functioning of the mammalian heart. explain the response of the heart to body activities. relate the action of adrenalin and acetylcholine to the innervation of the heart. interpret information on the effects of drugs and variation of temperature on the cardiac frequency. - describe the role of blood components in the transport process. - explain the diseases related	- Types of circulatory systems: open and closed, single and double. - Advantages and disadvantages of open and closed systems in animals. - Functioning of the mammalian heart: cardiac cycle, blood pressure changes, myogenic property, control of the heart beat. - Response of heart to body activities - Action of adrenalin and acetylcholine on the innervation of the heart - Effects of drugs and

		to the circulatory system.	temperature variations on the cardiac frequency - Blood constituents and functions - Common diseases of the blood and heart, including, sickle cell anaemia and coronary artery disease.
		(Practical) The learner should be able to: - identify structural features of blood vessels. - display and draw major structures of the circulatory systems in insects, toads, and mammals. - describe the insects', toads' and mammals' circulatory system in relation to their functions. - describe the structural adaptations of the muscles of the circulatory system of mammals.	- Structure of blood vessels (veins, arteries, capillaries) - Circulatory systems in insects, toads and mammals: gross structure and fine structure - Insects, toads and mammals circulatory systems in relation to functions - Structural adaptation of cardiac muscle and smooth muscle of the circulatory system of mammals.
	Defense against Diseases	describe the mechanism of blood clotting. describe immune responses in humans. describe the effects of the Rhesus factor during pregnancy.	- Mechanism of blood clotting - Immune responses in humans: definition, primary, secondary - Effects of the Rhesus factor during pregnancy
	Vascular System of Flowering	describe the structural and functional adaptations of the vascular tissues to the	- Structure and functional adaptations of vascular tissues in

	Plants	transport process of materials in monocotyledonous and dicotyledonous plants. - explain the mechanism of transporting materials in plants. - describe the evidence for the path of materials in plants. - describe translocation and uptake of water and mineral salts in plants.	monocotyledonous and dicotyledonous plants - Mechanism of transporting materials in plants - Evidence for the path of materials in plants - Uptake of water and mineral salts in plants.
		(Practical) - interpret data related to transport of materials. - identify types and the pattern of distribution of vascular bundles in plant organs. - stain and make temporary mounts of transverse sections (T.S) and longitudinal sections (L.S) o f: stems, roots and T .S o f leaves from herbaceous plant organs. - interpret T.S and L.S of stems, roots and T.S of leaves. - draw and label low power plans to show distribution of tissues in T.S and L.S of stems, roots and T.S of leaves. - make high power labelled drawings of vascular tissues in T.S and L.S of stems, roots and	- Structure and distribution pattern of the vascular tissues in monocotyledonous and dicotyledonous plants - Transverse (T.S) and longitudinal sections (L.S) of: stems, roots and, T.S of leaves of monocotyledonous and herbaceous dicotyledonous plants Labelled diagrams of T.S and L.S of stems, roots and T.S of Leaves.

		T.S of leaves	
Nutrition (27 Periods)	Autotrophic nutrition	describe photosynthesis. - describe the structure of chloroplasts. - describe the absorption and action spectrum of chlorophyll.	Photosynthesis including adaptations of C3, C4 and CAM to different environmental conditions - Structure of chloroplasts - Absorption and action spectrum of chlorophyll
		(Practical) The learner should be able to: - design and carry out experiments to investigate factors affecting the rate of photosynthesis. - carry out experiments to test for starch production in terrestrial plants and oxygen in aquatic plants.	- Experiments to investigate factors affecting photosynthesis: light, carbon dioxide, availability of water, chlorophyll, temperature. - Tests for starch in terrestrial plants and tests for oxygen in aquatic plants.
	Holozoic Nutrition	Explain the role of the nervous and hormonal systems in digestion.	The role of the nervous and hormonal systems in the regulation/ control of digestion
		(Practical) The learner should be able to: - open up the animal and display the digestive system. - examine, draw and label the major parts of the animals' digestive systems. - observe and state structural adaptations of the parts of the digestive system. - identify food substances in	- The digestive system of cockroach, toad/frog, birds, rat/rabbit/cow/goat - Parts of the digestive system - Function and structural adaptations of the digestive system parts. - Food tests on gut

		the different parts of the gut. - Identify enzymes in the different parts of the gut. - identify, draw the different parts that make up the mouth of insects, mammals and toad. - state the functions of mouth parts of insects, mammals and toad. - compare dentition in the animals.	content - Gut extracts actions on different foods - Structure of mouth parts of insects, mammals and toad - Functions of mouth parts of insects, mammals and toad - Dentition in animals
	Mutualism	define mutualism. - describe the role of mutualistic organisms in the nitrogen cycle. - explain the relationships of mutualistic associations in an ecosystem. - discuss the economic importance of mutualistic associations.	Definition of mutualism - Role of mutualistic organisms in the nitrogen cycle - Mutualistic associations between organisms - Economic importance of mutualistic associations
	Parasitism	explain adaptation of disease causing organisms in plants and animals. - explain the effect of host-parasite relations.	Adaptations of disease causing organisms in plants and animals - Interrelationship between parasites and hosts of the following: intestinal worms, a tick and one plant parasite

Gaseous Exchange (19 Periods)	Gaseous Exchange in plants	explain the mechanism of opening and closure of a stoma. - explain conditions affecting the functioning of stomata. - explain how stomata, lenticels and breathing roots are adapted to their function. - relate the differences between the structure of aquatic and aerial leaves to a habitat.	Mechanism of opening and closure of stoma - Conditions affecting functioning of stomata - Structural adaptation and function of the stomata, lenticels and breathing roots - Structural adaptation of aquatic and aerial leaves to a habitat
		(Practical) The learner should be able to: - identify, draw and label stomata. - examine principles related to control of gaseous exchange in plants. - determine surface area to volume ratio in large and small objects.	- Structures of stomata - Principles related to control of gaseous exchange in plants - Surface area to volume ratio in large and small pieces of plant organs.
	Gaseous Exchange in Animals	explain the efficiency of gaseous exchange surfaces and structures. - explain the significance of the counter current flow system. - describe the role of the brain in controlling breathing.	Structural adaptation of gaseous exchange surfaces in protozoa, worms, insects, fish, amphibians and mammals - Significance of the counter current flow system - The role of the brain in controlling breathing
		(Practical) The learner should be able to: - dissect, display and draw gaseous exchange systems in	- Structure of gaseous exchange systems in tadpoles, toad, fish,

		animals. - collect and analyse data on factors affecting breathing rate in animals.	insect, and mammal - Factors affecting rate of breathing in animals.
Respiration (6 Periods)	Respiration	explain the relationship between gaseous exchange and respiration. - describe the structure and function of the mitochondrion. - describe the role of electron transport system, hydrogen acceptors, acetyl coenzyme A and pyruvic acid. - explain the role of acetyl coenzyme A in the carbohydrate, lipid and protein metabolism.	Relationship between gaseous exchange and respiration - Structure and function of mitochondrion - Role of electron transport system, hydrogen acceptors, acetyl coenzyme A and pyruvic acid - Role of acetyl coenzyme A in the metabolism of: carbohydrates, lipids, proteins
		(Practical) The learner should be able to: - carry out experiments to demonstrate products of respiration. - carry out experiments to show the effect of temperature and activity on rate of respiration. - carry out experiments and analyse data on factors affecting aerobic and anaerobic respiration processes. - demonstrate fermentation process in yeast cells.	- Products of respiration: carbon dioxide, energy, ethanol, water, lactic acid - Factors affecting the rate of respiration: temperature and activity - Factors affecting aerobic and anaerobic respiration processes - Fermentation process: use in yeast cells.
Homeostasis **(25 Periods)**	General principles of Homeostasi	explain the significance of a constant internal environment. - state the factors which must be	Significance of a constant internal environment - Factors which must be kept

	s	kept constant in the internal environment of the body. - discuss the role of negative feedback mechanism. - explain the feedback mechanism related to the endocrine and nervous systems. - identify the main internal and external causes of changes in the internal environment.	constant in the body: glucose, temperature, pH, water, ions, respiratory gases, osmotic pressure of body fluids - Role of negative feedback mechanism - Feedback mechanism related to the endocrine and nervous systems in homeostatic activities - Causes of changes in the internal environment
		(Practical) - The learner should be able to relate organisms' ways of life to their environmental conditions.	- Adaptation of organisms to different environmental conditions.
	Regulation of Glucose	describe the role of hormones in sugar regulation. - explain the negative feedback mechanism in the process of blood glucose control. - discuss the causes and effects of blood sugar imbalances in the body. - discuss the functions of the liver and the pancreas in regulation of glucose in the body.	Action of insulin, glucagon and adrenalin in blood sugar control. - The negative feedback mechanism in the process of blood glucose control - Causes and effects of blood sugar imbalances in the body - Role of the liver and the pancreas in glucose regulation
		(Practical) The learner should be able to: - test urine samples for sugar.	- Identification of sugar in urine - Histology of liver and

		- relate structure of liver and pancreas to their function.	pancreas: microstructure and their function.
	Regulation of respiratory gas	describe the regulation of respiratory gases. - discuss the role of feedback mechanism in response to oxygen deprivation. - explain the effects of fluctuations of respiratory gases on the rate of breathing. - explain the role of respiratory centre in the brain in controlling respiration and blood circulation. - describe the different physiological changes that take place during exercise and at high altitude.	Control of respiratory gases - Role of feedback mechanism in response to oxygen deprivation - Effects of fluctuations in oxygen and carbon dioxide gases on the rate of breathing - Role of medullary centres in controlling respiration and blood circulation - Physiological changes that take place during exercise and at high altitude
		(Practical) - The learner should be able to determine the rate of breathing at different levels of activity.	- Effect of different levels of activity on the rate of breathing.
	Excretion	describe the formation of urea and urine.	Formation of urea and urine
		(Practical) The learner should be able to: - identify and draw sections of parts of kidney. - dissect, display, draw and label the urinary system.	- Histology of the kidney: cortex, medulla, different regions of the nephron - Urinary system of a toad, rat/ rabbit/goat/cattle.
	Osmoregulation	describe the role of the brain, endocrine glands and nephrons in osmoregulation.	Role of the hypothalamus, pituitary gland, adrenal gland and

		- explain the negative feedback mechanism involving antidiuretic hormone (ADH). - discuss principles of osmoregulation in organisms living in marine, fresh water and terrestrial habitats. - explain animals' adaptations to varying water availability in their habitats. - explain osmoregulation in plants and how plants are adapted to varying water availability in their habitats.	nephrons in varying osmotic pressure of blood - Role of negative feedback mechanism involving anti-diuretic hormone (ADH) - Principles of osmoregulation in marine, fresh water and terrestrial organisms - Adaptations of animals to varying water availability in habitats - Osmoregulation in plants (xerophytes, hydrophytes, mesophytes, halophytes)
Coordination (30 Periods)	Concept of Reception and Response in Plants	interpret data from experiments on how day length affects the flowering process.	Effects of day length on flowering process
	Plant Hormones	discuss the influence of hormones on plant growth and related processes. - explain the economic importance of plant hormones.	- Influence of hormones on plant growth: Role and effects of plant hormones (e.g. auxins, cytokinins, gibberellins, abscisic acid, and ethane) in regulating processes - Economic importance of plant hormones
		(Practical) The learner should be able to: - design and perform experiments on effects of plant hormones on plant	- Effects of plant hormones e.g. Auxins / Indole acetic acid (IAA), gibberellic acid on different plant

		growth processes. - demonstrate the economic importance of plant hormones.	growth process: dormancy, weed control, flowering, fruiting etc - Economic importance of plant Hormones.
	Response and behaviour in Animals	explain how types of behaviour result from sequential responses.	Types of behaviour: orientation (kinesis, taxis, territorial, breeding, instinct and migration) learning (habitual, conditioned reflex, imprinting exploration, insight, trial and error
		(Practical) The learner should be able to: - demonstrate the welfare of animals. - design and perform experiments on orientation behaviour.	- Practices of animal welfare - Orientation behaviour
	General Principles of Reception and Response in Animals	describe the types of stimuli. - describe the structure and role of receptor organs in relation to the environmental stimuli. - state the importance of different effectors in organisms.	Types of chemical and physical stimuli - Role of simple and complex receptors (including reception mechanisms) in relation to the environmental stimuli - Importance of effectors in organisms
		(Practical) **The learner should be able to:** - identify sections of: skin, eye, retina, cochlea from prepared slides. - identify locations of different taste buds on the tongue.	- Structure of: skin, eye, retina, cochlea from prepared slides - Location of taste buds

			on the tongue.
	Nervous Coordination in Animals	distinguish between the roles of the autonomic and other peripheral nerves. • explain the events of generating and transmitting impulses. - describe the structure and functioning of the synapse and neuromuscular junction. - explain the importance of transmitter substances. • explain summation, facilitation and inhibition.	Role of the autonomic and peripheral nerves - Events of generating and transmitting impulses -Synapse and neuromuscular junction structure and functioning - Importance of transmitter Substances System functions: summation, facilitation and inhibition
		(Practical) The learner should be able to: - observe and record human responses to different stimuli. - dissect, display, draw and label the major parts of the insect's /toad's/ frog's, mammal's nervous system below the head.	- Reflex actions in human beings - Nervous system of a cockroach/toad /frog/rat/ rabbit/Guinea pig.
	Hormonal Coordination in Animals	explain the principle of negative feedback mechanism of hormonal action. - explain why hormonal balance is necessary for coordinating functions in the body. - explain effects of hormonal imbalances.	Principles of negative feedback mechanism of hormonal action: between pituitary and thyroid - Necessity of hormonal balances - Hormonal imbalances effects: diabetes, goitre, dwarfism, gigantism

Support and Movement (24 Periods)	Support systems in plants and animals	• explain the role of modified roots, leaves and stems in support. • describe the role of secondary - growth /thickening in support. • describe the micro structure of - cartilage and bone and relate their structure to function.	Importance of plant organs modifications of: tendrils, prop roots, clasping roots, buttress roots - Role of secondary growth/ thickening in support • Micro structure and function of cartilage and bone
		Support Systems in Organisms (Practical) The learner should be able to: - observe organisms of different sizes and relate their support systems to their sizes. - identify and draw support structures and tissues in plants and animals.	- Supporting systems and organism's size - Support structures and tissues in plants and animals.
	Muscles	describe the arrangement and function of muscles and joints. - explain the sliding hypothesis of muscular contraction.	Arrangement and function of muscles and joints - The sliding filament hypothesis of muscle contraction
	Movement /Locomotion.	- describe support and movement on land.	Support and movement on land/ muscular skeletal basis of locomotion, propulsion in the: walking tetrapods (mammals), birds and annelids - Flight /movement in air in birds and insects
		(Practical) The learner should be able to:	

		- observe and explain the relationship between muscles, joints and musculo-skeletal attachments. - observe and describe skeletal modifications in birds. - observe and explain how the support structures are related to the environment of the animal.	- Relationship between muscles, joints and musculo-skeletal attachments: Antagonistic muscles in animals: fish myotomes, pectoral muscles in birds, hind limb muscles and muscles in the pelvic region of amphibians and mammals - Fore limb and sternum modification in birds - Support structures in relation to the environment of the animal

Reproduction, Growth and Development (27 Periods)	Sexual Reproduction in Animals	state the functions of reproductive system structures/parts in animals. - describe the structure and function of gametes. - describe the stages of oogenesis and spermatogenesis processes. - describe the relationship between stages of gametogenesis and meiosis. - explain the significance of gametogenesis. - describe copulation, Fertilization and implantation. - explain the role of the placenta in the development of an embryo. - explain the physiological changes in females during pregnancy. - explain gestation period and birth. - discuss the events and role of hormones in menstrual cycle. - discuss birth control methods and their limitations. - state the causes and ways of prevention of STDs.	Reproductive system in animals: structure and function(s) of parts - Gamete structure and function - Stages of oogenesis and spermatogenesis processes - Relationship between gametogenesis to meiosis - Significance of gametogenesis - Copulation, fertilization and implantation - Role of placenta in the development of an embryo - Physiological changes in females during pregnancy - Gestation period and birth - Events and role of hormones in the menstrual cycle: menstruation, follicular development, ovulation, corpus lutetium. And FSH, LH, oestrogen and progesterone. Mention the oestrous cycle - Birth control methods and limitations - Causes and prevention of Sexually Transmitted

			Diseases (STDs) .e.g. infections by fungal bacterial and viral (HIV and AIDS).
		(Practical) The learner should be able to: - prepare or use prepared slides to study structure of gametes. - identify and draw the external features of the cockroach for sex identification. - dissect, observe, draw and label the major parts of the insect's reproductive system - identify and draw the external features of the toad/ frog for sex identification. - dissect, examine, draw and label the major parts of the toad's reproductive system. - relate the structure of reproductive parts to their functions. - identify and draw the external features of the rat /rabbit/Guinea pig for sex identification. - dissect, examine, draw and label the major parts of the rat's reproductive system. - relate the structure of reproductive parts to their functions.	- Structure of gametes Cockroach - external features for sex identification - Reproductive system of a cockroach - External features of a toad or frog for sex identification - Reproductive system of a toad/frog. - Rat/ rabbit/guinea pig external/features for sex identification -Reproductive system of a rat/rabbit/Guinea pig.
	Sexual reproductio	describe the types and structure of flowers.	Types and structure of flowers : (insect and wind

	n in Lower Organisms and plants	describe the types and structure of seeds and fruits.	pollinated flowers) Types and structure of seeds and fruits
		(Practical) The learner should be able to: - relate floral structures to the mode of pollination. - observe and draw pollen grain. - describe floral parts. - Write floral formulae of different flowers. - draw floral diagrams of different flowers. - draw and label structures of different fruits and seeds. - dissect fruits to display and draw arrangement of seeds. - describe the mechanisms of fruit and seed dispersal. - distinguish between endospermic and non endospermic seeds.	- Structures of a flower and inflorescence in relation to pollination - Pollen grain structure in relation to pollination - Arrangement of floral parts in flowers with free petals, fused petals, keel and standard wing, and a grass flower - Floral formulae - Floral diagrams - Types and structure of fruits and seeds - Placentation - Mechanisms of fruit and seed dispersal - Endospermic and non endospermic seeds
	Growth and Developme nt	distinguish between growth and development. - explain factors affecting growth. - discuss the parameters of measuring growth in plants / animals. - distinguish between primary and secondary meristems. - discuss the role of meristems in plant growth.	Differences between growth and development - Factors affecting growth: internal and external - Parameters used in measurement of growth in an individual plant /animal: weight, length, height, volume, area

			• Primary and secondary meristems in plants - Primary and secondary growth in plants - Role of meristems in plant growth
		(Practical) The learner should be able to: - Carry out germination of seeds that exhibit epigeal and hypogeal germination. - Demonstrate factors affecting growth. - Examine and draw sections showing apical meristems and secondary thickening in dicotyledonous stems. - Make accurate measurements of growth in an organism and record. - Demonstrate hormonal control of plant growth.	- Epigeal and hypogeal seed germination - Factors affecting growth e.g. temperature, light, water, etc - Apical growth, secondary growth - Parameters of measuring growth - Hormonal control of plant Growth.

AGRICULTURE

RATIONALE OF THE AGRICULTURE SELECTED CONTENT FOR TEACHING

Agriculture teaching and learning at secondary school builds on the foundation made in primary school integrated science. Teaching agriculture in primary school classrooms introduces young people to basic scientific procedures of growing crops and rearing animals. It shows them how to apply these integrated science lessons into daily life. For example, a great primary school science teacher can teach pupils about the art and science of growing crops, rearing animals and processing both crop and animal products. This means that it is not only teaching learners how to be farmers, but also train tomorrow's scientists, nutritionists, processors, teachers and so much more.

The selection of the topics is done carefully to ensure that those who participate in secondary school agricultural training graduate with the skills necessary to become productive citizens as practitioners of crop and animal production. This lends itself into learning about tools, equipment, land tenure, farm building, farm structures and basic science. This is to say that agriculture puts machines, engineering, building technology, food processing, marketing, chemistry, biology and physics into everyday-life application.

Those topics above emphasize a mix and a combination of classroom instruction and application of agriculture experiences outside of the classroom. At the same time, it equips the learners with experience to succeed in postsecondary education or the workforce for the labor market. The selection allows you to build the foundation for educated consumers and agriculturists.

SN	CRITICAL CHANGES	JUSTIFICATION
	The curriculum design has been maintained, but only key topics have been selected as shown in the teaching sequence.	Emphasis is on growing crops, rearing animals and using the current knowledge o**f production** Basic science and crops: Chemicals of life (carbohydrates, proteins, fats); plant morphology and physiology; reproduction in plants; crop improvement, pasture management; crop protection; ecology; soil fertility; soil microorganisms. Emphasis should be put on practical production of crops. Animal: Animal anatomy and physiology; animal nutrition; livestock rearing; livestock management practices; animal health; poultry breeding; poultry rearing; work animals. Emphasis should be put on practical rearing of animals. Mechanization: farm tools and equipment; construction materials and farm structure. Agriculture economics: factors of production; production theory; marketing agricultural products; agricultural policies and role of government.

SYLLABUS TEACHING SEQUENCE

Class	Term	Topics	Sub-Topics	Periods
S6	**I**	**Basic Science II**	- **Chemicals of Life** - **Plant Morphology and Physiology** - **Reproduction in Plants** - **Animal Anatomy and Physiology** - **Micro and Macro**	**45**

			Organisms of Agricultural Importance	
		Crop Production II	- Soil Fertility II	24
		Animal Production II	- Poultry Breeding - Livestock Management	21
		Basic Science III	- Ecology I - Ecology II	18
		Animal Production III	- Animal Nutrition	20
S6	II	Crop Production IV	- Crop Improvement	24
		Animal Production IV	- Investigation and Projects Guidelines - Animal Health Pasture Management	45
		Agricultural Economics and Farm Management II	- Production Theory - Factors of Production - Marketing Behaviour and Strategies Farm Planning and Management	54
		Agricultural Engineering & Farm Mechanisation I	Management of Work Animal	15
S6	III	Crop Production VI	- Crop Protection Project Reports	18
		Agricultural Engineering and Farm Mechanisation II	- Construction Materials - Farm Equipment and Tools Farm Structures	27
		Agricultural Economics and Farm Management III	- Agricultural Policies Farmers' Organisations	18

TERM ONE

Topic 4: Basic Science II (45 Periods)

Overview

In most of the cell, organelles are water and a group of molecules, many of which are organic compounds. These organic compounds all contain carbon, hydrogen, nitrogen, sulphur and phosphorus. However, there are three main types of organic compounds found in living cells, that is, carbohydrates, lipids and proteins. The chemicals that make up the bodies of plants, animals or other organisms are known as organic molecules, whereas molecules that form part of surroundings of organisms, such as carbon dioxide in air or water in the soil are called inorganic molecules. So you need to know about the chemical nature of these materials.

Ecology is the study of plants and animals in relation to each other and to the physical and chemical environment in where they naturally occur. However, much of the agriculture and farming emphasise individual organisms as if they occur in isolation. To bring the relationship of plants and animals, in addition to their effect on the environment, is of much importance as seen in this topic.

Learning Outcome

By the end of the topic, the learner should be able to:

- Appreciate the chemical and biological composition of plants and animals.
- Appreciate the cycling of water and nutrients between soil, plants and air.
- Demonstrate an understanding of the main structural parts of the digestive, reproductive and respiration systems of farm animals.
- Apply the need for a balance between harmful and beneficial organisms.
- Display consciousness in the need for a balance between the biotic and abiotic component of the agriculture/farming environment.

Sub-Topic 1: Chemicals of Life

Competences	Content
The learner: • **Explains the functions of lipids, protein, water, carbohydrates, vitamins and minerals.** • **Describes the working and characteristics of enzymes.**	• **Functions of:** - **proteins** - **lipids** - **carbohydrates** - **water** - **minerals and vitamins** • **Enzymes**

Methodology:

- Lead a guided discussion and ask learners to state the functions of carbohydrates, proteins, lipids, vitamins, minerals, enzymes, water, and ask the learners to summarise them.
- Ask learners to research on and summarise:
- Essential and non-essential proteins.
- Monosaccharide, disaccharides and polysaccharides.
- Lignification and cellulose.
- Using a demonstration method, ask learners individually or in a group to conduct an experiment:
- To identify the properties and factors that affect enzyme activity.
- To investigate the effect of PH and temperature on enzyme activity and ask the learners to tabulate the results and plot the graphs of the findings.
- To investigate the effect of varying amounts of hydrogen peroxide on equal amounts of catalase made from fresh liver of a cow.
- To determine the amount of hydrogen peroxide remaining by a titration with potassium permanganate solution.
- To investigate the presence of carbohydrates, proteins, lipids and ascorbic acids.
- Visit a feed mill or feed supplier and test the products on the market for carbohydrates, fats and proteins.
- To classify animal feeds and farm products basing on their composition.
- Use guided discovery to enable learners identify symptoms of mineral and vitamin deficiency in plants and animals.

- Brainstorm so that learners can recall and write the deficiency symptoms of vitamins and mineral salts in plants and animals.
- Display crops and animals with mineral deficiency so that learners can identify and record observable symptoms. Then ask the learners to suggest ways of rectifying the deficiency symptoms.

Practical

- Investigate the presence of proteins, lipids and carbohydrates in feeds and agricultural products in their community.
- Investigate the working of enzymes in available agricultural products.

Resources:

- Reagents for food tests; fresh liver from a cow.
- Sample of different seeds and ingredients of animal feeds.
- Agricultural farm products.
- Measuring cylinders, muslin cloth, glass rod, pipette and burette.
- Beakers, test tubes and boiling tubes.
- Litmus paper, hydrogen peroxide, potassium permanganate and sulphuric acid.
- Heat source of paraffin stove/charcoal stove/Bunsen burner.
- Bromothymol blue/universal indicator, droppers and a white tile.

Hints to the Teacher:

- Get support from the school administration to provide the relevant inputs to the learners such as liver from a cow/goat/hen, food reagent, test materials, food materials and animal feeds containing sugars/lipids/proteins/ascorbic acid, plants and animal showing deficiency symptoms of vitamins and minerals.
- Carry out investigations of the mode of action, characteristics and factors influencing enzyme activities before presenting it to learners.

Assessment:

- Practical exercise on determining the presence of reducing sugars, non-reducing sugars, proteins, lipids and ascorbic acids.
- Examples in each case of farm products which supply carbohydrates, reducing sugars, non-reducing sugars, proteins and lipids.
- Types of carbohydrates like monosaccharide, disaccharides and polysaccharides.

- Composition of sucrose, lactose, maltose and starch.
- The essential amino acids.
- Enzymes mode of action and its characteristics.
- The factors that influence enzyme action.
- Functions of carbohydrates, proteins and lipids.
- Deficiency symptoms in plants and animals.

Sub-Topic 2: Plant Morphology and Physiology

• Competences	• Content

• The learner:
  • Describes the structure and functions of leaves, roots, flowers, fruits and the vascular system of plants.
  • Describes the processes of photosynthesis and transport (transpiration, translocation) in plants.
• Demonstrates the factors influencing photosynthesis, translocation and transpiration.
	• External and internal structures of plant stems, leaves, roots, flowers and fruits in relation to their functions.
	• Modified plant parts like bulbs, root/stem tubers, corms, rhizomes or stolons.
	• Process of photosynthesis (light and dark stages).
	• Factors affecting photosynthesis
	• Absorption of water and minerals.
	• Translocation of materials within the plant.
	• Process of transpiration:
	  - Effects of transpiration.
	• Factors affecting transpiration.

Methodology:

- Lead a guided discussion for learners to identify:
- The external and internal structures of leaves, stems and roots in plants.
- The functions and adaptation of the observed external and internal structure.
- Discuss and ask learners to:
- Describe the plant storage organs and their importance in agriculture.
- Explain the techniques, procedures and methods of budding, layering, tissue culture, grafting and cloning in plants.
- Mount prepared slides of the internal structures of leaves, stems and roots onto a

microscope and ask learners to observe, draw and label five main parts observed in each structure.

- Provide the learners with charts/ pictures/computer simulation or video showing the techniques and different methods of budding, grafting, layering, cloning and tissue culture.
- Put emphasis on the factors to be considered for successful budding, grafting, cloning, tissue culture and layering.
- Through guided discussion, ask the learners to explain the concept of:
- Germination.
- Asexual reproduction and sexual reproduction.
- Photosynthesis in green plants.
- Transpiration and translocation.
- Guide learners to describe the:
- Types and causes of seed dormancy.
- Procedure of breaking seed dormancy.
- Ask learners to demonstrate how a photometer is used to illustrate the factors that affect transpiration.
- Using guided discovery, make learners:
- Identify the leaf adaptations for photosynthesis and transpiration.
- Clarify the stages of photosynthesis like carboxylation, reduction, regeneration and prodct synthesis; plus the factors that influence photosynthesis (light, carbon dioxide, chlorophyll and water) and transpiration in green plants.
- Using a guided discussion, lead the learners in defining photosynthesis, translocation and transpiration in plants.
- Project on role of photosynthesis in production of agricultural products like Irish potatoes/banana/vegetables
- Ask learners to carry out a demonstration to determine:
- The light compensation points around the school using an osomometer experiment.
- The presence of proteins, sugars and lipids in modified plant structure, and ask learners to recall the procedure and carry out their own food tests on modified plant structures.
- Organise a field study for learners to practice random sampling, record a transect walk section, identify and collect different planting materials.
- Review the project methods then ask learners to carry out project work on

determining the suitable length of cassava cuttings / sweet potato vines/elephant grass rootstock that can give best yields under different treatments.
- Using a video camera, ask learners to make a film on the transect walk, propagation, germination, photosynthesis, transpiration and breaking of seed dormancy.

Practical
- Identifying parts of the plant structures.
- Cutting and observing sections of plant parts to study the internal structures.
- Observing and describing modified plant parts.
- Carrying out experiments to demonstrate the factors affecting photosynthesis, translocation and transpiration.

Resources:
- Osomometer, photometer, microscopes and stop clock.
- Food test reagents, test tube, boiling tubes and heat sources.
- Different plant parts like leaves, stems and roots.
- Microscopes and accessories; hand lenses and dyes.
- Video slides, video camera, video player and power source.
- Modified plant parts: tubers, stems, rhizomes, runners, bulbs, roots and leaves.
- Propagation materials for plants.
- Chemical for testing seed viability.
- Growing medium of soil like gravel, chalk dust, sand, clay, loam, subsoil, wood ash, wood shaving and toilet tissue.
- Specimen tubes that are longer with plastic cap/rubber bung.
- Bicarbonate indicator/dyes that can change colour.
- Supply of more or less mature leaves of similar size.
- Different plant parts like stems, roots, leaves, flowers and fruits, growing plants.
- Materials and apparatus for experiments on photosynthesis, translocation and transpiration in plants.

Hints to the Teacher:
- Consult the biology teachers on possible practicals on photosynthesis, transpiration, germination and seed dormancy.

- Get support from the school administration to provide the relevant inputs to the learners such as land, planting materials, working tools/equipment, fertilizers, pesticides, space, funds and time.

Assessment

- Adaptations of plant leaves, stems and roots in order to perform their functions.
- Meaning of photosynthesis, carboxylation, photo phosphoralyration, transpiration, translocation, vegetative propagation, germination and seed dormancy.
- The factors influencing germination, photosynthesis and transpiration.
- Seed dormancy and ways of breaking seed dormancy.
- Calculation of the germination percentage of a sample of seed and stating reasons whether they are suitable as planting materials.

Sub-Topic 3: Reproduction in Plants

• Competences	• Content
• The learner: • Describes the process of reproduction in plants. • Differentiates between asexual and sexual reproduction. • Demonstrates the factors that influence seed germination. • Performs breaking of seed dormancy.	• Reproduction in plants. • Asexual reproduction, vegetative propagation and sexual reproduction. • Seed germination: - adaptation of seeds - structure of seeds - seed viability • Seed dormancy.

Methodology:

- Lead a guided discussion for learners to identify:
- The external and internal structures of leaves, stems and roots in plants.
- The functions and adaptation of the observed external and internal structure.
- Discuss and ask learners to:
- Describe the plant storage organs and their importance in agriculture.
- Explain the techniques, procedures and methods of budding, layering, tissue culture, grafting and cloning in plants.

- Mount prepared slides of the internal structures of leaves, stems and roots onto a microscope and ask learners to observe, draw and label five main parts observed in each structure.
- Provide the learners with charts/ pictures/computer simulation or video showing the techniques and different methods of budding, grafting, layering, cloning and tissue culture.
- Put emphasis on the factors to be considered for successful budding, grafting, cloning, tissue culture and layering.
- Through a guided discussion, ask the learners to explain the concept of germination, seed dormancy, asexual reproduction and sexual reproduction.
- Guide learners to describe the:
- Types and causes of seed dormancy.
- Procedure of breaking seed dormancy.

- Ask learners to brainstorm the:
  - Importance of using seed as a planting material (with relevant examples).
  - Advantages and disadvantages of using seed as a planting material.
  - Identify different crops planted using vegetative propagation and give the vegetative material/structure used in each crop.
  - Advantages and disadvantages of using vegetative materials for planting.
  - Select suitable materials for planting from an assortment of seeds or vegetative materials, then suggest the reasons for their choice.
- Ask learners to demonstrate:
- Growing of different seed samples under suitable germination conditions from the known amount of seeds provided in petri dishes/plates/tins/containers/plastic cups and make them to count and record the number of seeds which germinate after 7days out of the total planted.
- Ability to calculate seed germination percentage when using their experimental results.
- Make them compare seed samples grown in sand, clay, subsoil, wood ash, wood shavings, toilet tissues and distilled water.
- Lead learners in groups to:
- Discuss the process of reproduction in plants.
- Observe and find out the difference between sexual and asexual reproduction.

- Investigate the factors that influence germination.
- Brainstorm the causes and ways of breaking seed dormancy.

Practical

- Investigating sexual and asexual reproduction in high value crops.
- Carrying out seed viability tests and germination percentage test using materials from input dealers in the community.
- Carry out breaking of seed dormancy using different methods and compare them.
- Provide space for learners to set up marketing stalls for seed viability and germination test services at appropriate points in the school or community to sell.

Resources:

- Modified plant parts: tubers, stems, rhizomes, runners, bulbs, roots and leaves.
- Propagation materials for plants like seeds.
- Chemical for testing seed viability
- Growing medium of soil like gravel, chalk dust, sand, clay, loam, subsoil, wood ash, wood shaving and toilet tissue.
- Viability testing chemicals such as tetrazolium salt and potassium permanganate.

Hints to the Teacher:

- Consult the teachers of biology on possible practical exercises, on photosynthesis, transpiration, germination and seed dormancy.
- Get support from the school administration to provide the relevant input s to the learners such as land, planting materials, working tools/equipment, fertilizers, pesticides, space, funds and time.

Assessment:

- Seed dormancy and ways of breaking seed dormancy.
- Calculation of the germination percentage of a sample of seed and stating reasons whether they are suitable as planting materials.
- Difference between sexual and asexual reproduction.

Sub-Topic 4: Animal Anatomy and Physiology.

• Competences	• Content

• **The learner:** • **Describes the structure and functioning of the digestive, reproductive and respiratory systems in farm animals.** • • **Identifies the observable structural features of the digestive, respiratory and reproductive system.** • **Relates the functions of the parts to the structures identified on the digestive, respiratory and** • **reproductive systems.**	**i) Digestive system** • **Structure and functioning of the digestive system of:** - **poultry** - **ruminants** - **non-ruminants** • **ii) Reproductive system** • **Structure and functioning of the reproductive systems of birds and mammals** • **iii)Respiratory system** • **Structure and functioning of the respiratory systems of birds and mammals.**

Methodology

- Acquire small livestock like birds/poultry, goats, rabbits, pigs, sheep and other farm animals from the school administration to carry out demonstrations for the learners.
- Carry out a demonstration of dissecting a small livestock for each of the systems and ask the learners to observe, identify and draw the structural features of the digestive, reproductive and respiratory system.
- Display the parts of the digestive, respiration and reproductive system of a dissected farm animal and ask learners to relate the identified parts to their functions.
- Demonstrate how to preserve the dissected parts of the digestive, reproductive and respiratory systems in formalin. Each system should be put in its own container and given a clear label.
- Using a guided discussion, ask the learners to describe the structures identified in the systems displayed.
- Brainstorm with learners on:
  - the role of hormones during reproduction in livestock such as oestrogen, progesterone, prolactin, adrenalin, oxytocin, follicle stimulating hormone, luteinising hormone, corpus letum, pituitary glands and thyroid glands.

  - The role of enzymes in the digestion of food such as salivary amylase/ptyalin, insulin and pepsin.
  - Scout opportunities of slaughtering animals so that learners can participate in examining the digestive parts of the reproductive system
- Exhibition /display of a dissected livestock for learners to observe, manipulate the parts like gizzard, gullet, trachea, heart, lungs, liver, gall bladder and drawing of conclusions about their findings relating to structural adaptations and functions.

Practical

- Carrying out dissections to identify parts of the digestive systems of poultry, ruminants and non-ruminants.
- Carrying out dissections to identify the parts of the reproductive systems of birds and mammals.
- Carrying out dissections to identify the parts of the respiratory systems of mammals and birds.

Resources:

- Live birds or small livestock and other mammals from the school or the community.
- Dissection kits, razor blade plus knife, preservatives of live materials, dressing board, and materials for dissection.
- Live ruminant and non-ruminant.

Hints to the Teacher:

- Light treatment covering the functions of parts of the digestive, reproductive and respiratory systems should be made.
- Get support from the school administration to provide the relevant inputs to the learners such as small ruminant and non-ruminant livestock, working tools/equipments and preservatives.

Assessment

- The names of the parts of the digestive, reproductive and respiratory systems plus stating their functions.
- Digestion in ruminants and non-ruminants.

- Well labelled diagrams describing digestion in a pig, cow, rabbit, hen and goat.
- The process of digestion in ruminant and non-ruminants.
- Egg formation in birds.
- The male and female reproductive systems in a named livestock
- How the end product of digestion is absorbed in animals.

Sub-Topic 5: Importance of Micro and Macro Organisms in Agriculture

Competences	Content
The learner: • Identifies the different types of micro-organisms. • Categorises the different types of micro-organisms. • Explains the importance of micro-organisms. • Enumerates the harmful effects of micro-organisms. • Identifies the different types of macro-organisms that are important in agriculture. • Describes the different types of macro-organisms that are • Important in	• Micro-organisms • Basic structure and characteristics of microorganisms: - Viruses and bacteria - Protozoa and fungi - Nematodes - Beneficial micro-organisms - Fermenters /decomposers - Nitrogen fixers - Biological control agents • Importance of micro-organisms • Harmful micro-organisms such as pathogens • Macro-organisms • Morphology of: - Earthworms - Liver flukes - Nematodes - Ticks - Tapeworm • Beneficial macro-organisms: - Pollinators • Decomposers

agriculture. • **Explains the importance of macro-organisms.** **Enumerates the harmful effects of macro-organisms.**	• - **Soil aerators** • **Adaptations of harmful macro- organisms to their mode of life** • **Harmful macro-organisms and their effects:** - **Parasites like ticks, liver flukes, tapeworms, round worms, mites, lice and nematodes.** **Vectors like snails, tsetse flies, ticks, insects, nematodes, pests, insects, vermin and birds.**

Methodology:

- Organise learners in groups to discuss and compare the adaptation features on the different micro- and macro-organisms selected.
- Organise a field visit to the selected sites around the school and ask learners to collect, observe and locate the homes of different micro- and macro-organisms.
- Lead learners in a guided discovery of the harmful and beneficial effects of both micro- and macro-organisms on farm products like but not limited to maize, beans, wood, meat, milk, hides and skins.
- Through a guided discovery, ask learners to collect, observe and estimate the population of different parasites, vectors, earthworms, millipedes, centipedes, rhizobium on beans/soya in selected gardens of high value crops and insects.
- Lead the learners to observe and brainstorm both harmful and beneficial effects of macro- and micro-organisms.
- Ask learners to mount slides on a light microscope with different macro- and micro-organisms or provide a hand lens then observe, draw and label five structural characteristics of each.
- Through a demonstration, enable the learners to:
  - Calculate the population density of macro- and micro-organisms.
  - Estimate the number of earthworms (the learners should be in pairs to be able to use a quadrat and methanol procedures).
  - Adhere to the procedure of capture-recapture method of estimating population size.
  - Identify and classify different organisms whose densities could make up a project work using reference books or the internet.
  - culture bacteria and fungi in the laboratory.

- Brainstorm so that learners can summarise the:
  - Problems encountered when estimating population of terrestrial organisms such as catchability (size, speed of movement, camouflage, animal learning of the trap), migration, birth rate (fecundity, generation time, sex ratio and food security), death rate and accurate identification.
  - Adaptation features of ticks, fleas, tapeworms, liver flukes, pig lice, bees, termites, wasps, millipedes, centipedes, mice, rats and pests on high value crops.

Practical

- Observing fungal colonies under natural conditions on the agricultural products
- Culturing bacteria and fungi and observing their growth and characteristics using materials commonly found in the community.
- Observing mounted slides of micro-organisms.
- Observing specimens of macro-organisms.
- Studying the activity of earthworms in the soil.
- Collecting and observing the different types of parasites, vectors and pests.
- Observing the harmful effects of macro-organisms on their hosts through experimental methods such as allowing one animal or a garden to have them for learning the effects.
- Observing adaptation features in macro-organisms.
- Estimating the number of vectors, pests, earthworm/ millipedes/ centipedes/nematodes in a selected site.
- Provide space for learners to set up marketing stalls for micro and macro organisms at appropriate points in the school or community to sell such as earthworms and maggots

Resources:

- Mounted slides of micro and macro organisms.
- Microscopes with accessories, hand lens and white tile.
- Materials with fungal growth like cassava, bread, old walls on farm buildings.
- Culturing materials for bacteria and fungi.
- Undiluted 30% methanol or ethanol.
- Soil samples from school farm/nearby farms.
- Two jam jars, basin and bucket.
- Quadrat of 0.5x0.5 metres and map extracts of the area.
- Procedure of capture-recapture method, waterproof paint and brush, forceps, traps, pooters and specimen tubes.
- Biermann /Tullgren funnel (wire gauze, lamp, funnel, beaker, porous bag).
- Preserved earthworms, liver flukes, ticks, lice, tapeworms, nematodes, mites, tsetse flies, vermin, rats, birds and insects.

Hints to the Teacher:

- Request the school or community members to allow experimental methods to be performed using their resources where you can have a control and experimental specimens.
- Caution should be taken when handling organisms to observe the structural characteristics of micro- and macro-organisms because some are vectors of diseases of human being.
- Only emphasis of the population changes of micro- and macro- organisms on high value crops should be made.

Assessment

- Calculation of the estimated population of selected micro- and macro- organisms around the school and in the gardens of high value crops.
- Calculating the population of earthworms in the school hedge and mulched school garden.
- The beneficial and harmful effects of micro- and macro-organisms in high value crops.
- The adaptations of selected micro- and macro-organisms on the farm.
- The functions of any five structural features on selected micro- and macro-organisms.
- The problems encountered when sampling terrestrial organisms.

Topic 5: Crop Production II (24 Periods)

Sub-Topic 1: Soil Fertility II

Competences	Content
The learner: • Explains the meaning of organic manure. • Identifies the different types of organic manure. • Prepares different types of organic manure and manure tea. • Describes the procedure of making compost manure. • Discusses the factors influencing the quality of farmyard manure. • Differentiates between macro- and micro-nutrients/trace elements. • Describes the deficiency symptoms of each macro- nutrient. • Distinguishes between liming and fertilizer elements. • Applies inorganic fertilizers correctly on high value crops. • Assesses the choice of fertilizer for a crop. • Evaluates the effects of inorganic fertilizers on the environment. • Explains the role of nitrogen, phosphorus and potassium in crop production. • Discusses the safety precautions when handling and applying • Inorganic fertilizers.	• Organic manure • Types of manure • Methods of preparation of compost manure, green manure, manure tea, garden tea, night soil and farm yard manure. • Factors influencing quality of organic manure. • Role of macro- and micro- nutrients in plant growth. • Deficiency symptoms of macro- nutrients (NPK). • Liming materials. • Effectiveness of inorganic fertilizers. • Advantages and limitations of organic and inorganic fertilizers. • Safety precautions when using fertilizers

Methodology

- Using guided discussion, ask learners to:
  - Suggest the different types of organic manure.
  - Give the meaning of organic manure, farmyard manure, compost manure, green manure and inorganic fertilizers.
  - Analyse inorganic fertilizers for their nitrate and phosphate content.
  - Analyse the soil chemical properties after using fertilizers.
  - Justify the factors influencing the effectiveness of fertilizers in crop plants.
  - Describe the advantages and limitations of organic and inorganic fertilizers.
  - Explain the main differences between organic and inorganic fertilizers.
  - Explain advantages and limitations of organic and inorganic fertilizers.
- Guide learners in groups and lead a demonstration of the:
  - Different activities of the compost manure-making process.
  - Steps of how to carry out soil sampling of farming land to get soil samples for use in testing for soil PH.
  - Procedures of how to raise seedlings in nutrient culture solutions.
  - Different methods of applying the right types of fertilizers in high value crops at school.
- Through guided discovery, enable learners to:
  - Prepare manure (farmyard manure, liquid/manure tea, garden tea and green manure) so that they can write down the procedure.
  - Test for PH on soil samples collected and recall the procedure.
  - Test the nutrient composition of fertilizers particularly for nitrate, sulphate and phosphate nutrients.
- Brainstorm with learners as they make notes on:
  - Characteristics of farm yard manure.
  - Factors influencing the quality of farm yard manure.
  - Advantages and disadvantages of using organic manure.
  - The meaning of inorganic fertilizers.
  - Classes of inorganic nitrogenous, phosphates and potassic fertilizers.
  - The role of nitrogen, phosphorous, potassium and sulphur in plants.
  - Deficiency symptoms of some important micro- and macro- nutrients.
  - Factors influencing the choice and effectiveness of inorganic fertilizers.
  - Reasons, benefits, limitations and effects of liming soil.

  - Factors influencing the effectiveness of fertilizers.

- Ask learners to role-play the:
  - Safety precaution when handling and applying fertilizers.
  - Effects of fertilizers on the environment.

- Ask the learners individually to collect, display and describe plants with nutrient deficiency symptoms in and around the school.
- Design with learners, ways of collecting urine and household waste/used water for use in agriculture.
- Arrange a display of different fertilizers for learners to observe, analyse, interpret, identify and draw conclusions relevant to crop production.

Practical

- Observing plants for mineral deficiency symptoms.
- Applying fertilizers and manures.
- Have gardens where fertilizers and manures can be applied.
- Request the school or community members to allow experimental methods to be performed using their resources where you can have control and experimental specimens.
- Prepare biological tea/organic manure and apply it in school or community gardens.
- Provide space for learners to set up marketing stalls for fertilizers and biological manure at appropriate points in the school or community to sell. Carrying out soil erosion control measures.

Resources:

- Crops showing nutrient deficiency symptoms.
- Eroded sites.
- Samples of different organic manure and inorganic fertilizers.
- Materials for making manure.
- Tools and equipment for making manure.
- Pits, containers, materials for making manures (such as animal excreta, kitchen wastes, grass, leaves, crop residues), tools and equipment.

- Brown ring test and phosphate test reagents including boiling tubes, 2M sulphuric acid and iron (II) sulphate.
- Specimen crops, crop products like fruits/seeds/roots displaying deficiency or good supply of plant nutrients.
- Land/soil bags/wooden soil boxes for projects and demonstration.
- Urine manure slurry (drum, strong sack/gunny/nylon bag, strong pole, rope, small plastic sheet, comfrey, tobacco, Tithonia).
- Photographs/pictures, charts, video slides showing growing plants.

Hints to the Teacher:

- Make a list of the major and trace elements that plants need from the soil.
- Emphasise the deficiency symptoms of these elements and the role of organic manure in putting back nutrients.
- The soil amendment practice and fertilizer use in Uganda is low but most of it is being done in growing of flowers.

Assessment

- Macro- and micro-nutrients/trace elements.
- The role of organic manure in maintenance of soil fertility.
- Importance of maintaining soil fertility.
- The safety precautions when handling and applying fertilizers and manures.
- The effects of fertilizers applications on the environment.
- Soil acidity and soil amendment.
- Benefit of liming soils by farmers.

Topic 6: Animal Production II (21 Periods)

Overview

Livestock management includes among other things but not limited to feeding, housing, breeding, record keeping, disease and pest control. These activities are carried out on livestock to ensure high production.

Learning Outcome:

By the end of the topic, the learner should be able to:

- Apply the knowledge of good diets in livestock management.
- Apply appropriate skills of recommended routine practices in livestock.
- Demonstrate knowledge and proficiency in poultry production.
- Justify the reasons for livestock improvement.
- Demonstrate proficiency in poultry, beekeeping and fish production.
- Prepare different rations for feeding livestock on the farm.
- Adhere to the guidelines of providing suitable animal rearing environment.
- Clarify their knowledge of handling livestock records and animal health.
- Manage dairy production, poultry breeding, fishpond stocking and beekeeping on a farm.

Sub-Topic 1: Poultry Breeding

Competences	Content
The learner: • **Initiates appropriate poultry breeding practices.** • **Develops criteria for selecting poultry breeding stock.** • **Describes the routine management practice of poultry breeding stock.** • **Compares the theoretical poultry**	• **Poultry breeding practices.** • **Selection of breeding stock, i.e. cocks and hens.** • **Management of breeding stock, mating ratios and egg** • **collection.** • **Hatchery and hatchery management:** - **Hatchery hygiene.** - **Conditions for a hatchery (temperature, humidity, aeration).** - **Selecting/grading eggs for hatching.**

breeding management practices with the farmer's actual practice. **Describes the routine hatchery management practices.**	- **Turning eggs in the incubator.** - **Hatching period.** - **Candling of eggs.** - **Sexing of chicks.** - **Brooding chicks.** **Improved management of natural incubation of eggs.**

Methodology

- Project on poultry breeding and egg production for breeding
- Lead learners in a guided discussion on the:
- Practice of natural and artificial poultry breeding.
- Selection and management of poultry breeding stock.
- Qualities of good quality eggs for breeding.
- Breeding principles in poultry.
- Methods of raising poultry in Uganda.
- Using brainstorming with learners, identify the suitable conditions for incubating eggs.
- Organise a field visit with prepared questionnaires for learners to:
- Find out what breeds and hatchery management practices are being used.
- Compare their routine management practices with those being carried out at the farm.
- Consolidate their knowledge on the selection of poultry breeding stock.
- Explain the conditions necessary for successful incubation of eggs on this farm.
- Carry out egg candling on this farm.
- Describe the care given to young chicks until maturity at the poultry farm.
- Mix poultry feeds and participate in the procedure of home mixing of poultry feeds.
- Project on designing and making an incubator to hatch eggs in a shorter time
- Using a demonstration, prepare learners to:
- Select cocks and hens suitable for breeding stock.
- Select eggs for incubation.
- Candle eggs for fertility.
- Adhere to a vaccination schedule/regime.
- Carry out candling of eggs in the incubator.

Practical

- Managing breeding stock for the school or community members by performing feeding, brooding chicks, rearing growers, vaccinating, de-beaking, collecting eggs, grading/packing of eggs, egg candling and selling of birds.
- Selecting of cocks and hens as breeding stock.
- Visiting a poultry breeder to observe management of breeding stock.
- Provide space for learners to set up marketing stalls for poultry and poultry product at appropriate points in the school or community to sell.

Resources

- Poultry unit of layer birds of both local and exotic poultry birds.
- Incubator and brooding materials.
- One-day old chick/pullet/brooding equipment.
- Egg tray, egg boxes, candler and light source.
- Nest boxes, water trough/drinker, feed/food trough, roosting box or perches.
- Spade with tarpaulin, gunny bags/sacks.
- Poultry feeds for different stages including the following: fish meal, maize bran/ rice/ wheat bran, cotton seed cake, sunflower cake, bone meal, oyster shells, primix, general purpose/common /layer salt, broken maize/cassava flour/sorghum meal.
- A farm with a hatchery and live birds of different categories.
- Various materials like candler, de-wormers, de-beakers, vaccines and bio-safe as a disinfectant.

Hints to the Teacher:

- Young chicks are valuable in successful poultry production. Therefore, wide knowledge on the principles and methods of breeding would be required. Hence, careful poultry breeding will be emphasised so that chicks with good breed characteristics are produced.
- Get support from the school administration to provide the relevant inputs to the learners so that factors influencing incubation and production of good quality eggs are achieved.
- Organise field trips to a hatchery farm to show learners important poultry breeding practices. However, breeding in poultry will be examined in detail. Poultry includes: chicken, ducks, geese, turkey and guinea fowl. Currently chicken is raised in greater numbers. Chicken must be produced to meet the increasing

demand for table birds.

Assessment

- The limitations of natural poultry breeding today.
- Production of good quality eggs for hatching on the farm.
- How to care for young newly hatched chicks.
- Conditions necessary for successful incubation of eggs.
- Characteristics of a good quality egg for incubation.
- Management practices that a poultry farmer should carry out to produce good quality eggs.
- The valuable characteristics used in selecting poultry breeding stock.
- Routine management practices for a poultry breeding stock.
- How to improve on quality and production of local poultry in Uganda.

Sub-Topic 2: Livestock Management

Competences	Content
The learner: • **Explains the principles and practices of livestock feeding.** • **Classifies various livestock feeds.** • **Examines the nutritional requirements for various kinds and types of livestock.** • **Carries out appropriate livestock feeding practices.** • **Demonstrates the principles and practices of good livestock.** • **housing.** • **Demonstrates appropriate livestock and housing practices.** • **Describes the meaning, purpose, procedure, advantages and limitations of routine livestock management practices.** • **Demonstrates the routine livestock management practices.**	• **Principles and practices of good livestock feeding:** - **adequate feeding** - **balanced ration** - **clean water and clean feeds** • **Livestock feeds.** • **Nutritional requirement of different livestock.** • **Livestock feeding practices.** • **Principles and**

• **Differentiates between silage and hay.** • **Describes the procedure of making silage and hay.** • **Demonstrates the preparation of silage and hay at school for feeding livestock.** **Justifies the factors that influence the quality of silage and hay.**	**practices of good livestock housing.** • **Routine livestock and housing management practices.** **Silage and hay**

Methodology

- Lead learners in a discussion on the:
  - Principles and practices of good livestock feeding and housing.
  - Nutritional requirements of different livestock at various stages of growth.
  - Meaning, purpose, procedure, advantages and limitations of routine livestock management practices.
  - Factors influencing the qualities of good silage and hay.
- Using demonstration, guide learners on the skills of how to:
  - Feed and water animals.
  - Clean the feeding and watering equipment.
  - Mix feed rations for different livestock.
  - Clean and disinfect livestock houses.
  - Maintain and repair livestock houses.
  - Carry out routine management practices.
  - Make silage and hay.
- Ask and have the learners in groups to:
  - Identify various feedstuffs presented.
  - Classify various feedstuff as proteins, carbohydrates, fats, minerals, vitamins, roughages, concentrates, supplements, succulents and additives.
  - Feed and water livestock.
  - Record feeding regimes of different livestock.
  - Administer right dosage of drugs.
  - Demonstrate how to carry out appropriate livestock feeding practices.

- Demonstrate and have learners participate in the real procedures of carrying out:
  - De-beaking, castration, dehorning, hoof trimming, identification, livestock record keeping.

- Hand spraying dosing, drenching, branding, tattooing, docking, grooming, kindling, de-worming, tooth clipping, ear notching, culling, vaccination and ear tagging.
- Home feed mixing.
- Dipping and spraying livestock.
- Silage, hay and calf pellet making.
- Designing a feeds outlet shop (but you are expected to be fully knowledgeable about each skill so as to guide learners effectively).

- Provide learners with the proper guidance, right materials, enough time and equipment so that they can carry out/perform/do the following tasks:
  - Branding cattle/young calves.
  - Dosing/drenching of calves.
  - Disbudding of calves and injecting of cattle.
  - Hand spraying of livestock.
  - Taking the anal temperature of cattle.
  - Tattooing of goats, hoof trimming of goats and dehorning.
  - Caponising of male birds.
  - Ear tagging of goats/pigs/cattle.
  - Castration of young piglets.
  - Ear notching of pigs, tooth-clipping in pigs and creep feeding.
  - Debeaking of layers and culling of birds.
  - Docking lambs/raddling/ crutching/tupping/serving/ringing.
  - Shearing of wool from sheep.
  - Dusting livestock houses.
  - Steaming-up/ drying-off/ flushing of livestock.
  - Designing and construction of rabbit kindling boxes.

Practical

- Feeding and watering animals
- Cleaning feeding and watering equipment, among others
- Brand/dose/drench/dock/steam-up/dry-off livestock.
- Administer and perform tattooing/caponizing/debeaking.
- Provide space for learners to set up marketing stalls for hay and silage at

appropriate points in the school or community to sell.

Resources

- Live poultry and farm animals such as cattle, sheep, goats, pigs, rabbits and guinea pigs.
- Livestock feeds (roughages: grass, Lucerne, cereal stalk, sweet potato, moringa, hay, silage or concentrates: cotton seed cake, groundnut cake, soya bean cake, sunflower cake, fish meal, blood meal, bran, premix, additives, dairy/sow and weaner/layer mash/grower mash meal, mineral salt, calf pellets, milk booster, molasses, feed additives (terramycin).
- Equipment for routine management operations (elastrator, burdizzo, hot iron dehorner, hoof trimmer, hand spray pump, scissors, branding iron, ear notcher, neck straps/chain, electric de-beaker, knife, tooth clipper, sharp knives, razor blades, tattooing machines and thermometer).
- Feeding and watering equipment.
- Livestock sanitation equipment including a hand spray pump.
- Cattle dip/crush/spray race and silage pit.
- Animal feed mill and feed outlet shop.

Hints to the Teacher:

- Whereas there are many routine management practices to be carried out under this topic, learners at this level cannot handle all but you should be knowledgeable enough about each before going to demonstrate any one of them.
- Get support from the school administration to provide the relevant inputs to the learners such as live farm animals, livestock routine management equipment, livestock feed materials and silage making requirements. Otherwise, organise with farmers or a veterinary officer where you can take learners to have practical experience of the different routine management operations.

Assessment

- Procedures of determining anal temperature of a given livestock.
- Precautions a farmer should take before using a cattle dip.
- Qualities of good silage and hay.
- Drawing a beef animal and labelling the parts suitable for branding.
- Advantages and limitations of open/surgical castration in livestock.

- Importance of identification as a routine management practice in livestock.
- Importance of feeding roughages to livestock.
- Importance of feed additives in the diet of livestock.
- Consideration when siting a good housing of a named livestock.
- Reasons for using limited amounts of protein when making feeds for livestock.
- Importance of adequate supply of water in feeding of livestock.
- Procedure of using a hand spray pump when treating a named livestock.
- Methods of de-beaking, castration, identification, dehorning and feeding of young livestock.
- Advantages and disadvantages of steaming up, flushing, creep feeding, livestock identification, drying off and closed castration.
- Classification of feedstuff in terms of correct names, nutrient supplied to livestock and its group.

This could be done using a table as shown below:

Specimen/Feed		Name	Class of feed	Nutrient supplied
1.	**Cotton seed cake**			
2.	**Potato vine**			
3.	**Maize bran**			
4.	**Dairy meal**			
5.	**Calf pellet**			
6.	Mineral lick/salt block			
7.	Blood meal			
8.	Fish Meal			
9.	Hay			
10.	Oyster shell			
11.	Elephant grass			
12.	Sodium chloride			
13.	Desmodium spp			
14.	Molasses			

Topic 7: Basic Science III (18 Periods)

Overview

Ecology is the study of the relationship between plants and animals in relation to the physical and chemical environment in which they naturally occur. Although much of the agriculture and farming emphasises individual organisms as if they occur in isolation.

The relationship between plants and animals and their effect on their environment is of much importance and will be analysed in this topic. Among the many things that are used in the environment by man are farm chemicals. These are chemical manufactured specially for agricultural use. They can be applied in farming activities in order to increase yield, improve quality of produce or protect plants and animals. The way they are handled plus their impact on the environment is of concern in agriculture.

Learning Outcome

By the end of the topic, the learner should be able to:

- Explore the characteristics of both the terrestrial and aquatic ecosystem.
- Demonstrate the extent to which the patterns in vegetation and animals can be explained by human activity and the related biotic factors of now and the past.
- Demonstrate an understanding of when to use and methods of using farm chemicals.
- Apply different farm chemicals with proper understanding of their effect in agriculture.

Sub-Topic 2: Ecology II

Competences	Content
The learner: • **Describes the different types of ecosystems.** • **Explains the factors affecting plant and animal distribution in an ecosystem.** • **Demonstrates the effects of agricultural activities on an**	• **Types of ecosystems:** - **terrestrial** - **aquatic** • **Factors affecting plant and animal distribution in an ecosystem.** • **Adaptation of plants and animals to an ecosystem.**

ecosystem. • **Predicts a succession of organisms in a given habitat** **around the school.**	• **Effects of agricultural activities on ecosystems.** **Succession and climax in a community.**

Methodology

- Before the lesson, prepare an investigation on ecological study guideline for flowering plants and animals in a given area then have learners read and use it.
- Using a guided discussion, have the learners:
- Explain the meaning of ecology.
- Define the term ecosystem.
- Identify the biotic and abiotic component of an ecosystem.
- Explain the factors affecting plant and animal distribution in an ecosystem.
- Brainstorm so that learners can predict the main issues of the:
- Investigation guide for plants and animals in an ecological study.
- Effect of agricultural activities on an ecosystem.
- Through a guided discovery, help learners to estimate the:
- Fauna and flora population like along a stream on the farm with effluent running into it.
- Weed species density in a high value crop or farming areas around the school.
- Provide guidelines for the following ecological field studies so that learners can engage in:
- Determining the population of species in a given ecosystem.
- Comparing two homogeneous ecological habitats.
- Measuring environmental factors on agricultural land and water. This can be done by comparing light compensation point, air humidity, slope, levelling using ranging poles, amount of soil moisture/organic content, suspended solids content in water, turbidity of water on the farm and water flow rate using a Pooh stick.
- Examine zonation along belt transect.
- Investigate the water and air content, and PH of a soil sample from a high value crop.
- Use a quadrat frame in sampling of organisms.
- Estimate the number of earthworms and soil nematodes (using Biermann/Tullgren funnel).
- Write up an ecological research project paper emphasising introduction,

methods, results/observations, discussion of results, discussion of significance and references consulted.

Practical

- Visiting both terrestrial and aquatic ecosystems to compare their components and asses the condition of the components.
- Comparing two homogeneous habitat ecological characteristics in both the terrestrial and aquatic ecosystem.
- Investigating the present flora and fauna of a pond, rook pool, protected spring or a dam.
- Examining zonation along the belt transect.

Resources:

- Sites representing terrestrial and aquatic habits.
- Sites degraded by agricultural activities like swamps and wetlands.
- Hand net, bucket, white tray, hand lens, record sheet, suitable key of plant and animal in the area, glass tube, plastic bags, measuring cylinder.
- Appropriate equipment for measuring physical factors like quadrat frames, point quadrat, species list of the area, record sheet, tape measure.
- Equipment to measure environmental factors like wooden pegs, mallet, felt tip pen, record sheet, site sketch/pond/ dam/rook pool map, graph papers.
- Equipment to sample motile animals like the hand net; gumboots and an overall coat.

Hints to the Teacher:

- Plants and animals are distributed according to the ecological conditions prevailing. You should clearly indicate the difference between a terrestrial and aquatic ecosystem.
- Use of simple procedures of estimating population will be needed. So get support from the school administration to provide the relevant inputs for learners to determine population of organisms in the two ecosystems.

Assessment

- Components of an ecological research report.
- Factors affecting plant and animal distribution in an ecosystem.
- The effects of agriculture on a terrestrial and aquatic ecosystem.

- Procedure of estimating population of a terrestrial flowering plant or animal.

Topic 9: Animal Production III (45 Periods)

Overview

Fish farming has not been developed as much as it should be in Uganda, considering the protein requirements of its people. Despite the fact that fish is heavily consumed in Uganda, the population still depends very much on natural waters such as lakes, streams and rivers for fish supply. However, with this awareness of advantages, the importance of cultivating fish in ponds should now be emphasised. The large-scale production of fish can provide raw materials for industries. Less importantly, fish can be raised for aesthetic purposes in an aquarium and for sports, as well as for financial benefit.
Traditional methods of beekeeping are still predominant in Uganda where it remains an important seasonal activity. The introduction of modern beekeeping, including modern beehives and technological practices, has resulted in quite remarkable gains.
The quality of the livestock environment on which most farmers depend is declining. Yet livestock rearing is undergoing a complex process of technical and geographical change. Production is shifting from the traditional countryside to either urban or peri-urban areas and towards sources of feeds or easy access to the market. It is entering a direct competition for the dwindling and scarce land, water and other natural resources. On the other hand, intensive animal production systems are producing high levels of nitrogen and phosphorus wastes and concentrated discharges of toxic material. Yet those systems are often located in areas where effective waste management is more difficult. This poses an environmental concern today.

Learning Outcome

By end of the topic, the learner should be able to:

- Demonstrate skills of modern fish farming and beekeeping practices in Uganda.
- Demonstrate an understanding of fishpond and apiary management.
- Explore ways of fish preservation, fish products marketing and honey marketing.
- Prepare different rations for fish and other livestock on the farm.
- Adhere to the rules and regulations of fishing and beekeeping in Uganda.

Sub-Topic 3: Livestock Rearing and the Environment

Competences	Content
• The learner: • Evaluates environmental problems in routine rearing practices of livestock. • Explains the environmental problems resulting from livestock rearing. • Initiates the care for the environment while rearing and treating animals. • Describes the practices/measures that can be taken to care for the environment while rearing livestock. • Designs innovative ways of livestock waste management.	• Environmental problems due to livestock rearing and treatment e.g. - Over grazing. - Pollution of the environment by chemicals (drugs, pesticides). - Contamination of livestock products by agrochemicals. - Transmission or spread of zoonotic diseases. • Caring for the environment using: - The correct stocking rate - Rotational (controlled) grazing - Grazing pasture at the right stage - Drugs and sprays according to manufacturer's instructions and in specified places, e.g. constructed places - Drugs and sprays safely - Safe disposal of animal waste - Medicinal plants to treat livestock • Safe disposal of diseased carcass and animal wastes

Methodology

- Demonstrate for learners and allow learners to perform the activities of the:
- Correct use of drugs and acaracides based on manufacturer's instructions.
- Ways of maintaining hygienic conditions in animal quarters.
- Methods of safe disposal of diseased carcass.
- The correct use of drugs and livestock treatment chemicals.
- Ways of handling and using animal wastes.
- Guide learners to demonstrate and perform the procedure of using acaracides on the farm.

- Organise a study visit for learners to a nearby animal slaughter house and an intensive livestock farm to observe and document environmental problems.
- Lead a brainstorm session for learners to suggest:
- Innovative ways to handle and use animal wastes safely.
- Practices taken to care for the environment while rearing livestock.
- Ask learners to role-play the animal care.
- Provide the environment management policy so that learners in groups can discuss the key areas that are used today.

Practical

- Demonstrating correct use of drugs and acaracides based on manufacturer's instructions.
- Maintaining hygienic conditions in animal quarters.
- Handling and using animal wastes.
- Demonstrating methods of safe disposal of diseased carcass.
- Provide space for learners to set up marketing stalls for offering services on livestock rearing practices like determining the stocking rate at appropriate points in the school or community to sell.

Resources:

- Charts, video tapes and computer simulations.
- Overgrazed sites or charts showing/ illustrating impact of overstocking/ over grazing on the environment.
- Contaminated drugs/animal chemicals dumping site.
- Video showing effects of animals and use of drugs on the environment.

Hints to the Teacher:

- Before the lesson, acquire the Animal Health Care Act to understand the rules and regulations.
- Whereas there are many environmental challenges posed by rearing livestock, at this level the learners can emphasise animal waste management and how to innovatively deal with it.

Assessment

- Impact and indicators of environmental degradation due to livestock rearing.
- Designing a poster to sensitise farmers about the environmental hazards from livestock wastes.
- Environmental problems due to intensive livestock rearing in Uganda

Sub-Topic 4: Animal Nutrition

Competences	Content
The learner: • **Describes the concept of balanced diet and digestibility in farm animals.** • **Explains the common animal nutrition terms.** • **Explains the effects of nutrient deficiencies on farm animals.** • **Adheres to the nutritional requirements for various kinds and types of livestock from the locally available materials.** • **Formulates, prepares and uses suitable feeds to feed various categories of livestock.** • **Computes animal rations from available ingredients.**	**Animal Nutrition** • **Animal nutrient requirements:** - **concept of a balanced ration and other animal nutrition terms like digestibility.** • **Nutrient deficiencies and their effects on farm animals.** • **Basis for animal nutrient requirements and the factors determining the type of feed given to animals.** • **Ration formulation:** - **Methods of ration computation (Pearson square or algebraic)** - **Weighing ingredients** - **Assembling ingredients** - **Grinding and mixing** - **Bagging and storage**

Methodology

- Through brainstorming, ask learners to explain the:
- Reasons for feeding farm animal and the concept of balanced diet.
- Factors that influence digestibility of feeds in farm animals.
- Effects of nutrient deficiencies in farm animals.
- Lead a demonstration for learners to:
- Classify various livestock feed ingredients.
- Assemble and weigh ingredients when preparing to make an animal ration.
- Formulate feed rations, grinding ingredients and mixing them properly.
- Put well-mixed rations into bags, pack, and store them safely.

- Organise a field visit with prepared questionnaires for learners to:
- Compare their routine management practices with those being carried out on the farm.
- Mix poultry feeds and participate in the procedure of home mixing of poultry feeds.
- Go to a nearby animal feed mill or feed outlet shop to clarify the procedures in feed ration formulation.
- Ask learners in groups to:
- Draw up a timetable for feeding animals on the farm and participating in the animal feeding.
- Investigate the nutrient composition of different feeds particularly the presence of proteins, fats, reducing and non-reducing sugars.

Practical

- Observing and determine nutritional deficiency symptoms in farm animals
- Computing rations (using Pearson square and algebraic methods).
- Prepare rations using the computed rations.
- Demonstrating the procedure of safe storage of prepared animal ration on the farm.
- Preparing a feed by weighing ingredients, assembling ingredients, grinding, mixing, bagging and storage.
- Provide space for learners to set up marketing stalls for livestock feeds and ingredients for feed making at appropriate points in the school or community to sell.

Resources:

- Live farm animals (cattle, sheep, goats, pigs, rabbits).
- Livestock feeds (roughages: grass, lucerne, cereal stalk, sweet potato, moringa, hay, silage or concentrates: cotton seed cake, groundnut cake, soya bean cake, sunflower cake, fish meal, blood meal, bran, premix, additives, dairy/sow and weaner/layer mash/grower mash meal, mineral salt, calf pellets, milk booster, molasses, etc.
- Photocopies of feed nutrient tables, charts of digestive systems, manila, markers.
- Feeding and watering equipment, and dressing equipment (knives, razor blades).

- Animal feed mill and feed outlet shop.
- Spades, wheelbarrows and gunny bags, calculators, weighing scale, tarpaulins.
- Feed mixtures/rations like layers' mash, broiler starter, sow and weaner meal, dairy meal.

Hints to the Teacher:

- Get support from the school administration to provide the relevant inputs to the learners for formulating feeds for livestock. First, the feed ingredients to be used must be obtained and their composition established from the standard feed composition table. Otherwise, use the expertise of the feed outlets' managers to make livestock rations, but be precise and accurate with non-ruminants and poultry when they are totally confined indoors.

Assessment

- Definition of terms used in livestock feeding: production ration, maintenance ration, starch equivalent, digestibility, crude protein, biological value, digestible crude protein.
- Ways of feeding farm animals in order to get high yields.
- Classification of feed ingredients.
- Types of feed rations.
- The common equipments used in feeding farm animals.

TERM TWO

Topic 10: Crop Production IV (24 Periods)

Overview

Crop production, like crop improvement, has been practiced by human kind for thousands of years, since the beginning of civilisation. This has been possible through selection and breeding practices. These activities have led to changes of the genetic makeup of plants. As a result, man has developed crops with more beneficial characteristics to humans, for example: larger fruits or seeds, drought tolerant plants, fast growing crops, as well as pest/disease resistant and high yielding varieties. But this has generated arguments about values which are neither absolute nor universal and controversies of crop improvement integrity. Concerns about the consequences of this development in terms of risks, benefits and impacts on human remain an issue of discussion.

Learning Outcome

By the end of the topic, the learner should be able to:

- Demonstrate understanding of crop improvement principles.
- Apply appropriate new ways of increasing crop yields in agriculture.
- Adapt crop improvement practices that are relevant today.

Sub-Topic 1: Crop Improvement

Competences	Content

• **The learner:**
  • **Justifies the importance of crop improvement.**
  • **Explains principles of crop improvement.**
  • **Applies various crop improvement methods and technologies.**
	• **Reasons and importance of crop improvement.**
	• **Principles of crop improvement:**
	  - **Selection**
	  - **Breeding**
	  - **Introduction of new varieties**
	  - **Introduction of genetically modified organisms (GMOs)**
	  - **Cloning of crops**
	  - **Grafting**

• **Discovers the current issues** • **and developments in crop improvement.**	- **Budding** • **Current issues and** • **developments in crop improvement**

Methodology

- Through guided discussions, make the learners to:
- Explain the meaning, reasons and achievements of crop improvement.
- Describe the ethical issues in crop improvement.
- Explain the desirable characteristics for breeding in crops.
- Ask learners to demonstrate and perform vegetative propagation by budding, grafting, tissue culture and the use of specialised vegetative organs.
- Lead learners in a brainstorming session to explain the:
- Techniques of crop improvement.
- Factors to consider in vegetative propagation.
- Importance, advantages and disadvantages of each technique of vegetative propagation.
- Organise the learners in groups or individually to:
- Carry out germination percentage calculations with different propagation materials.
- Carry out grafting, budding and tissue culture.
- Prepare rooting of cuttings and carry out seed inoculation of selected legumes.
- Design innovative methods of breaking seed dormancy.
- Determine plant population and density using the quadrat methods.
- Watch video shows/charts and describe crop improvement practices.
- Organise a field visit to research stations for learners to:
- Observe crop breeding practices.
- Clarify their knowledge on crop improvement procedures and importance.

Practical

- Raising seedlings.
- Carrying out grafting and budding on the farm.
- Field visits to selection and breeding centres to observe crop-breeding practices.

- Preparing cuttings for rooting like coffee, tea and ornamental plants.
- Provide space for learners to set up marketing stalls for propagation materials and propagation services such as grafting at appropriate points in the school or community to sell.

Resources:

- Grafting tools and equipment e.g. grafting knife, seedlings, root stocks, scions, rooting hormones like welgrow and seradix, rooting media like saw dust and lake sand, polythene sheets and tapes plus budding tools or equipment.
- Slides, video/camera pictures/charts showing different methods of vegetative propagation
- Availability of suitable materials for budding, grafting, tissue culture and seedling.
- Rootstocks and screen nets.
- Scalpels, pruning knives, grafting/budding knives, budding tapes, water buckets, metre rules, rooting media, wax and polyethene sheets/bags.

Hints to the Teacher:

- Basically crop improvement is aimed at increasing food and fibre production for human beings. However, propagation by use of bulbs, corms, tubers, rhizomes, tissue culture, graft or buds faces the challenge that they are food storage structures. Therefore, emphasise crop improvement techniques and their importance.

Assessment

- Defining vegetative propagation, grafting, budding, bud-grafting, tissue culture, seed dormancy
- Procedure of successful transplanting, and preparing cuttings for rooting
- Advantages and disadvantages of vegetative propagation, budding, grafting and tissue culture.
- Reasons for crop improvement and seed dormancy.
- Suggesting the different ways of breaking seed dormancy in agriculture.
- Ethical issues that are in crop improvement.

Topic 11: Animal Production IV (21 Periods)

Overview

Investigation and project work are also an important part of the agriculture course because they offer much scope for applying scientific process into practice by learners rather than simply learning about it. Each project or investigation/study is to some extent unique and the learners' observations are original. It also prepares the learners to be at the sharp end of scientific research.

Health in animals is the normal functioning of the body. If any of the bodily processes are upset, then the animal is unwell. Consequently, it will not give the expected yield. The best way of ensuring good health among livestock is to provide them with good food or pasture and to manage the animals under the best conditions.

Pasture based production offers farmers the ability to let the ruminants' environment and immune system work together so that farmers can have acceptable production levels. Ugandan milk production is largely dominated by small-scale farmers who own over 90% of the national cattle population (FAO 2004).

In rural areas, where 96% of poor Ugandans live, (Okidi et al, 2004) up to about 60% of the households keep mostly indigenous cattle (NAADS; King 2002). By far, the majority of milk production systems in Uganda are characterized by (a) a 'low input-low output' approach, (b) livestock is not an important source of cash, but a source of food, store of wealth and status symbol, and (c) milk demand is increasing and driving more and more of these dairy farms to intensify and often to diversify as to increase household

returns. For this to be successful, one needs good farm documentation. Farm records are essential to good farm management. The exact record kept depends on the farming enterprise. Livestock owners need records of breeding and general accounts of the farm operations like inventories, farm diary, farm accounts, labour records, cash accounts and other financial records.

Learning Outcome

By the end of the topic, the learner should be able to:

- Apply scientific knowledge learned or experienced and practical skills.
- Appreciate that prevention of diseases is better than control and demonstrate a caring attitude towards livestock.
- Demonstrate an understanding of a good plan of dairy production and marketing dairy products on the farm.
- Demonstrate ability to write and keep good farm records.
- Differentiate the different types and uses of farm records.
- Adhere to appropriate practices in the management of pastures, fodder crops and agro-forestry fodder trees.

Sub-Topic 2: Animal Health

• Competences	• Content
• The learner: • Describes the life cycles of livestock disease vectors. • Categorises transmission of livestock diseases. • Recognises diseases in livestock and takes appropriate measures to control them. • Understands the laws governing animal health in Uganda. • Recognises parasites in livestock and takes appropriate control measures. • Describes the life cycles of livestock parasites.	• Disease vectors (tsetse flies, ticks). • Causes of diseases and their mode of transmission. • Diagnosis and control of common diseases of animals: - Anthrax - Newcastle and swine fever - Trypanosomiasis - Foot and mouth - CBPP and ECF - Scabies • Laws/ regulations governing animal health and public health in Uganda • Parasites like external parasites (ticks, lice, mite, mange, fleas) and internal parasites (round worms, liver flukes, tape • worms).

Methodology

- Ask learners to demonstrate the:
  - Control of parasites and diseases in farm animals.
  - Drenching, spraying, vaccinating, injecting and dipping of farm animals.
- Lead learners in a guided discussion to explain the causes of livestock diseases.
- Prepare an exhibition for learners to:
  - Identify signs and symptoms of common livestock diseases.
  - identify some common parasites and their effects on livestock so that they can make recommendation on treatment.

Practical

- Observing and identifying signs of sickness in animals.
- Drugs administration methods such as drenching, dosing, spraying and applying

pour-on acaracides.
- Provide space for learners to set up marketing stalls for services like drenching, dosing, spraying and injecting livestock with ill health at appropriate points in the school or community to sell
- Identification and description of internal and external livestock parasites and disease vectors

Resources:
- Sick animals, materials and equipment used to control parasites/disease.
- Diagrams, pictures/video slides showing healthy animals and diseased ones.
- Thermometer, drugs, tablets, drenching gun, injection/hypodermic syringe.
- Preserved collection of livestock parasites (internal and external).
- Public health and animal health acts.

Hints to the Teacher:
- Health in animals is the normal functioning of the body. If any of the bodily processes are upset, then the animal is unwell. Unhealthy animals do not produce well, yields are low and the qualities of products are poor. Animals with some diseases and pests have to be killed to avoid spreading infection.
- When handling causes of diseases especially those caused by viruses, inform and remind the learners about HIV/AIDS.
- Finally let learners observe and practice safe handling of animals during disease control practices and other operations.

Assessment
- The main causes of livestock diseases on the farm.
- Procedure of taking body temperature, getting a blood sample for the laboratory, injecting drugs into the body and administering tablets into the mouth of a farm animal.
- Drawing and labelling the observable features of some common livestock parasites and pests.
- Regulations governing livestock and public health in Uganda.
- Public health and animal health act.

Sub-Topic 5: Pasture Management

Competences	Content
The learner: • Describes the importance of pasture and fodder in livestock feeding. • Classifies pasture grasses, legumes and forage crops. • Justifies the limitations of tropical grasslands. • Demonstrates the correct methods and procedures for establishing pasture grasses, legumes and forage crops. • Determines the correct seed rate, spacing and ecological zones for establishing different pasture grasses, legumes and forage crops. • Inoculates legume seeds with correct rhizobium bacteria. • Selects pasture species for livestock. • Establishes a pasture, fodder crop and agro-forestry trees for fodder. • Demonstrates how to improve natural pastures. • Describes the steps taken to improve natural grasslands. • Explains different management practices in pastures, fodder crops and agro-forestry fodder trees. • Explains the effects of poor pasture management. • Differentiates between overstocking and under stocking of a grazing land.	• Importance of pastures and fodder trees/shrubs for feeding livestock. • Classification of pastures and forage crops. • Limitations of tropical natural pasture grasslands. • Establishment of pastures. • Ways of improving natural pastures and grasslands • Grazing management • Preservation of pastures (grasses, legumes and fodder crops) • Factors influencing quality of pastures, silage and hay

• **Explains the different methods of utilising fodder and pasture crops in livestock feeding.** • **Compares the different grazing systems in pasture management.** • **Explains the need for forage and pasture conservation.** • **Preserves pastures for livestock.** • **Describes the procedure of hay and silage making.** • **Judges the quality of hay and silage.** • **Categorises the factors that influence the quality of pastures, hay and silage.**	

Methodology

- Using a guided discussion, ask learners to:
  - Explain the importance of pastures in feeding livestock.
  - Identify the limitations of natural grasslands.
  - Point out ways of improving natural grasslands.
  - Explain the factors that influence the quality of pastures, hay and silage.

- Ask learners to make groups and carry out a project on pasture establishment and silage making.
- Make learners establish a pasture garden with a good botanical composition.
- Lead a demonstration so that learners can:
  - Prepare a seedbed for pasture grasses and legumes then establish a pasture museum.
  - Establish an agro forestry plot for livestock feeding.
  - Carry out different silvi-culture practices like thinning, pruning, lopping, and coppicing, pollarding, shading and trimming.
- Organise a field visit with questionnaires for learners to complete on how farmers

are managing pastures on their farms.

Practical

- Project on pasture establishment.
- Identifying pasture species that is five grasses and legumes (by seeds and plants).
- Preparing a pasture seedbed.
- Planting pasture grasses, legumes and fodder trees.
- Fertilizing, weeding, and topping/slashing pastures.
- Inoculating legume seeds with rhizobium bacteria.
- Constructing and maintaining watering points in pastures.
- Planting shade trees.
- Using a wire strainer in fencing/ paddocking.
- Preparing mineral salt blocks.
- Investigating grasses and legumes that can grow together.
- Making hay and silage.
- Investigating the effect of moisture, drying and age of pasture materials on the quality of hay and silage.

Resources

- Pasture species, fodder and agro-forestry fodder trees then preserved pasture (hay and silage).
- Plot of land and facilities for inoculating legume seeds.
- Tools, equipment and materials for making silage such as elephant grass, young maize stalks, manure, lactic acid, molasses and chopping machine/knife.
- Photographs, slides showing different systems of grazing.
- Equipment for weed control including slashing tools plus seedbed preparation tools.
- Fertilizers and manure for top dressing of pasture areas.
- Planting materials of pasture species.
- Implements for seedbed preparation (hoes and rake).
- Slashers for topping.
- Old pastures or natural grassland/rangelands.
- Pasture grasses like elephant grass, Rhodes grass, thatching grass, guinea grass and palisade grass.
- Pasture legumes like green leaf and silver leaf desmodium, stylo, centrosema,

glycine, lab, caliandria, moringa.
- Pasture grasses and legumes/fodder crops ready for preservation.
- Cereals and legume crops just before flowering like maize and beans.
- Additives and supplement like molasses, maize bran and maize seeds.
- Fencing materials and equipment for making paddocks.

Hints to the Teacher:
- Good pastures are made up of good quality grasses, a proportion of legumes and few pasture weeds. Emphasise the characteristics of a good pasture including; palatability, nutritious, digestibility, high yield, resistance to trampling, compatibility and reliable reproduction rate.
- Get support from the school administration to provide the relevant inputs to the learners to establish pasture plots of pure grass, pure legume, mixed stand and fodder crops or visit where such practices are being carried out.

Assessment
- Importance of pastures in livestock feeding.
- The procedures of making hay and silage on the farm.
- Conservation of pastures on the farm.
- Methods of pasture improvement.
- Establishing a good sward for grazing of livestock.
- Importance of legumes in a grazing area for livestock.
- Grazing methods that can be employed on an established pasture.
- Stocking rate, carrying capacity, over grazing, rotational grazing, strip and zero grazing.
- The main causes of pasture deterioration.
- Improvement of an established pasture.
- Role of manure in pastures.

Topic 12: Agricultural Economics and Farm Management I (21 Periods)

Overview

Population is the number of organisms of the same species or people occupying a certain area at any one time. In Uganda there is rapid population growth rate of 3.5% per annum. As a result, many resources are in short

supply including shortage of food, space, energy and water. On the other hand, this population interacts with the environment and well above 70% of the working population is employed in the agricultural sector. The role of agriculture increases as population grows.
Gender is widely used to refer to the socially constructed differences and distinctions between boys, girls, men and women of a given population. Gender is a tool of analysing boys, girls, men and women's lives in the population of Uganda and how they contribute to agriculture and development.

Learning Outcome

By the end of the topic, the learners should be able to:

- Appreciate the crucial role of gender in agricultural production.
- Demonstrate an understanding of the effects of population on agriculture development in Uganda.

Topic 13: Agricultural Economics II (54 Periods)

Overview

Supply and demand is perhaps one of the most fundamental concepts of economics and the backbone of a market economy. Demand refers to how much (quantity) of a product or service is desired by buyers. The quantity demanded is the amount of a product people are willing to buy at a certain price; the relationship between price and quantity demanded is known as the demand relationship.
Supply represents how much the market or farmer can offer. The quantity supplied refers to the amount of a certain good producers or farmers are willing to supply when receiving a certain price. The correlation between price and how much of a good or service is supplied to the market is known as the supply relationship. Price, therefore, is a reflection of supply and demand of an agriculture product in the market.

Learning Outcome

By the end the topic, the learner should be able to:

- Demonstrate an understanding of the key principles of production.
- Demonstrate an understanding of the factors affecting demand, supply and

elasticity.
- Demonstrate an understanding of the factors that ensure good productivity on the farm.
- Manage the factors of production to increase farm output.
- Evaluate the costs of production in order to increase farm profit.
- Adhere to the principles of production and marketing of farm products.
- Explore an innovative marketing system of a farm product produced at school.
- Design a marketing strategy for farm products.
- Demonstrate an understanding of the essential components of a business plan.
- Assess the roles of government and other players in agricultural production and development.
- Examine the land policies and other government interventions towards agriculture development.

Sub-Topic 1: Production Theory

• Competences	• Content
• The learner: • Explains the meaning of agricultural economics. • Explains the concept of scarcity, choice and opportunity cost. • Explains the factors of production of land, labour and capital. • Demonstrates the roles of the factors of production in agriculture. • Describes the factors influencing labour supply and labour efficiency in agriculture. • Describes the attributes of a good farm manager. • Describes the characteristics of an agricultural entrepreneur/	• • Definition of agricultural economics. • Basic concepts of scarcity, choice, preference and opportunity cost. • Factors of production: land, labour and capital. • Labour, entrepreneurship and intrapreneurship in farming. • Capital and agricultural credit. • Production function.

intrapreneur. • Compares the characteristics of a farm manager with those of an entrepreneur. • Describes the procedure of acquiring a loan and managing it successfully. • Describes how to overcome the challenges associated with agricultural credit. • Designs an innovative agricultural credit financial transaction/ product. • Discriminates the factors influencing agricultural credit repayment. • Administers the different zones of a production function and relates • them to agricultural production.	• Law of diminishing returns. • Costs of production such as: - Average costs - Marginal costs - Fixed costs - Variable costs - Explicit costs - Implicit costs • Total costs

Methodology

- Lead a discussion for learners to explain the:
  - Meaning of agriculture economics, demand, supply, elasticity and production function.
  - Relationship between inputs and outputs (production functions) on the farm.
  - Law of diminishing returns as it applies to agricultural production.
  - Law of demand and supply in agricultural production.
  - Price elasticity in relation to agricultural production.
- Lead a guided discovery for learners to identify the ways of reducing costs of production.
- Ask learners to demonstrate:
  - Curves showing relationships between inputs and outputs in agricultural production.
  - The factors affecting demand, supply and elasticity of agricultural products.
  - Production function curves, demand curves and supply curves using available

data.

- Elasticity of demand and supply to agricultural production.
- The various types of production costs.
- Different type/zones of the production functions.
- How to gather data about farm product price and quantities in the neighbouring market over a period of 4 months.
- The causes and effects of price fluctuation and measures to stabilise prices.
- The factors affecting demand and supply of a high value crop or animal product.

Practical

- Collect data on supply and demand of agricultural products in the community for one month.
- Drawing and interpreting the supply and demand curve.
- Investigating the factors influencing choice of an agricultural enterprise.
- Field visit to a land office, micro credit office and labour office to interview them about the services offered.
- Completing a land registration form from the land office.
- Identifying sources of agricultural finance in Uganda.
- Visiting an agricultural credit service provider to study the procedure of obtaining a loan.
- Investigating innovative and alternative forms of collateral including warehouse receipt, accounts receivable, equipment, standing crops, and livestock.
- Completing a loan application form from a financial services provider.
- Plotting production function curves using available data.

Resources:

- Farm production records.
- Charts illustrating production functions, production costs, supply and demand.
- Graph papers and calculators.
- Data for selling and buying of goods and services.
- A case study of a successful agricultural entrepreneur.
- A farm unit and existing farm records on factors of production.

- Local market with interview schedule and a selected family intended expenses.
- Report format for the survey to the land office (land title) and title deed
- Banks, SACCOs, micro credit facilities and agricultural traders.

Hints to the Teacher:

- Illustrate that if prices of farm products fall, demand will increase and many people will have ability to buy more of that product. However, if prices are too high more will be offered for sale but the demand for farm product will decrease. Thus a need to stabilise prices of agricultural products should be emphasised by mentioning the causes and effects of price fluctuation.
- The least combination of the land, labour and capital to produce increased output should be emphasised. Furthermore, farmers' entrepreneurial characteristics like ability to cope with change, creativity, innovation, motivation, risk taking, negotiation, personal branding, good listening and communication skills must be brought out. The idea of zipping finance with farming should be lightly handled.

Assessment:

- Land tenure systems in Uganda.
- Labour supply to agricultural farms in Uganda.
- Agricultural credit and micro finance.
- Challenges associated with agricultural credit in Uganda.
- The factors influencing choice of an agricultural enterprise by a farmer in Uganda.
- The law of demand, law of supply and law of diminishing returns.
- Factors affecting supply and demand of agricultural products.
- Differentiating between constant, increasing and diminishing returns.
- Price fluctuation and measures to stabilise prices.
- Differentiating between production costs.
- How production costs can be minimised by farmers on the farm.
- Different types of demand, supply and elasticity.
- How a farmer can exploit the forces of demand and supply.

Sub-Topic 2: Factors of Production.

Competences	Content
• The learner: • Explains the concept of scarcity, choice and opportunity cost. • Explains the factors of production: land, labour and capital. • Justifies the need for land tenure and land reform. • Describes the procedure of acquiring a loan and managing it successfully • Demonstrates the roles of the factors of production in agriculture. • Describes the attributes of a good farm manager. • Describes the characteristics of an agricultural entrepreneur/intrapreneur. • Compares the characteristics of a farm manager with those of an entrepreneur. • Describes the factors influencing labour supply and labour efficiency in agriculture. • Describes how to overcome the challenges associated with agricultural credit. • Designs innovative agricultural credit financial transaction/products. • Discriminates the factorsinfluencing agricultural credit repayment.	• Basic concepts of scarcity, choice, preference and opportunity cost. • Land, land tenure and land reform. • Labour, entrepreneurship and intrapreneurship in farming. • Capital and agricultural credit.

Methodology

- Through guided discussions, make learners to explain the:
  - Meaning of land tenure, land reform, agricultural credit, entrepreneurship and intrapreneurship in farming.
  - Basic concepts of scarcity, choice and opportunity cost.
  - Factors of production of land, labour and capital.
- Organise a field visit to a nearby market and ask the learners using a prepared

interview schedule to:
  - Interview traders and consumers on farm goods and services in relation to scarcity, choice and opportunity cost.
  - Record the types, prices, amount available and number of buyers expected for goods and services on a market.
  - Prepare a report on the market survey carried out
- Guide learners to have a role-play on the functions of a good farm manager and the underachieving farm manager.
- Lead learners to discuss in groups and share in plenary the:
  - Factors influencing labour supply and labour efficiency in agriculture.
  - Roles of factors of production in agricultural production.
  - Factors influencing agricultural credit repayment.
- Organise learners to summarise the outcome of their brainstorming on the:
  - Procedure of acquiring a loan and managing it successfully.
  - Characteristics of an agricultural entrepreneur/intrapreneur as in Case Study 5.
  - Factors influencing labour supply and labour efficiency in agriculture.
  - Challenges associated with agricultural credit and how to overcome them.

Practical
- Examine a loan application form and land lease title to point out key issues to be keenly observed.
- Open a bank account with a financial institution and highlight the key steps.
- Design a questionnaire for gathering information about the market of agricultural products, labour market in agriculture and agricultural traders.

Resources:
- A farm unit and existing farm records on factors of production.
- Local market with interview schedule and a selected family intended expenses.
- Report format for the survey to the land office (land title).
- Banks, SACCOs and agricultural traders.

Hints to the Teacher:
- The least combination of the land, labour and capital to produce increased

output should be emphasised. Furthermore, farmers' entrepreneurial characteristics like ability to cope with change, creativity, innovation, motivation, risk taking, negotiation, personal branding, good listening and communication skills must be brought out. The idea of zipping finance with farming should be lightly handled.

Assessment

- Land tenure systems in Uganda.
- Labour supply to agricultural farms in Uganda.
- Agricultural credit.
- Challenges associated with agricultural credit in Uganda.
- The factors influencing choice of an agricultural enterprise by a farmer in Uganda.

Sub-Topic 3: Marketing of Agricultural Products.

• Competences	• Content
• The learner: • Defines the concept of a market and its related terms. • Explains the functions of marketing. • Describes types of markets of agricultural products. • Recalls the problems of marketing agriculture products. • Creates an effective marketing strategy for a farm product. • Communicates effectively for marketing agricultural products. • Brands, blends and packages. • agricultural produce properly to enhance marketing. • Describes the agricultural business plan structure.	• Define market and marketing. • Functions of marketing. • Types of markets: - Perfect competition - Imperfect competition - Monopoly - Oligopoly - Oligopsony - Cartels - Introduction to warehouse receipt and e-marketing of agriculture products • Marketing strategies • Effective branding with emphasis on choice of a brand name, labelling, packaging, display and sealing • Business plan

Methodology

- Make learners to discuss the:
  - Meaning of market, monopoly, oligopoly, cartel, country buyer, wholesaler, retailer, speculators, broker and agent.
  - Functions of marketing, characteristics of agricultural products and problems affecting marketing of agricultural products.
- Organise a field visit to a nearby market for the learners to:
  - Observe and record, display on charts the observations and discuss the various activities involved in marketing.
  - Conduct a market survey using a prepared guide.

- Role-play in manageable groups the major players/actors in marketing on return.

- Ask learners in groups to read Case Study 2 and 6 then:
  - Make innovative advertising posters, branding, packaging, brand name and exhibition for selected high value crops or animal products.
  - Design innovative marketing strategies for selected, high value crops and animal products.
  - Analyse the role of intermediaries in marketing of agricultural products.
  - Design appropriate marketing practices, for agricultural products.
  - Develop a simple business plan.

Practical

- Develop a simple business plan for an agricultural product.
- Complete a business model canvas for one agricultural product.
- Brand and pack an agricultural product.
- Design and make a packaging box /container for one agricultural product.

Resources:

- Market for agriculture products.
- Advertisements.
- Branded products and branding departments in marketing institutions.
- Packaging materials.
- Creative artist, marketing officers and brand development managers as facilitators.

Hints to the Teacher:

- Agriculture marketing means that farmers' produce has to undergo a series of transfer or exchanges from one hand to another before it finally reaches the consumers. It is a process that starts with a decision made by a farmer to produce a saleable farm commodity/service and involves all aspects of the market structure which are both functional and institutional, basing on technical and economic considerations. This may include pre and post-harvest operations, assembling, grading, processing, packaging, branding, storage, risk-taking, advertising, transportation and distribution. Agriculture marketing, therefore,

means a link between the farm and the non-farm sectors. This points to the fact that it includes marketing functions, agencies, channels, efficiency and costs, price spread and market integration, farmer surplus and post-harvest handling.

- While the objectives of efficient agriculture marketing should be emphasised as:
  - Enabling the farmers to get the best possible returns/rewards for the efforts put in production.
  - Providing farmers the lifting of taxes on all farm output, not clear he or she is willing to sell at an incentive/motivating price.
  - Reducing the price difference between the farm gate price and the ultimate consumer price.
  - Making available all products and services of farm origin to consumers at a reasonable price without impairing quality.

Assessment

- Functions of marketing.
- The role of marketing in agriculture.
- Differentiating between a cartel and wholesaler.
- Reasons for processing, packaging and branding of farm products.
- Warehouse receipt and e-marketing in agriculture.
- Challenges in marketing agricultural products.

Sub-Topic 4: Farm Planning and Management

Competences	Content
• The learner: • Adapts good plans for a farm. • Develops a business plan for a farm enterprise. • Adheres to the main components of a business plan. • Justifies a good plan for efficient farm management. • Describes the stages in the process of farm management. • Examines the tools for managerial decisions on the farm. • Explains management functions and relates them to farm production. • Explains the factors that promote farm efficiency. • Compares two farms for their efficiency standards.	• Farm planning and factors affecting planning decisions. • Farm business plan. • Farming efficiency. • Farm management. • Farming efficiency.

Topic 14: Agricultural Engineering and Farm Mechanisation I (27 Periods)

Overview

As more food production is required to feed the ever-increasing population, the means and amount of power used definitely increases beyond what human hands can do. Alternative ways must be found to do work to meet the increasing demand for food hence the use of machines. These machines have a better speed at which they do work which is known as power. Power is used to produce food, fibre and energy. This power can be got from animals or machines.

Learning Outcome:

By the end of the topic, the learner should be able to:

- Appreciate the principles in the working of machines.
- Demonstrate an understanding of the factors influencing the level of mechanisation on the farm.
- Demonstrate skills of designing common farm tools to improve production in crops and animals.
- Demonstrate an understanding of the working of a mould board plough.
- Verify the factors influencing the level of mechanisation on the farm.
- Design farm tools to improve production in crops and animals.

Sub-Topic 2: Management of Work Animals.

Competences	Content
The learner: • **Understands the importance of animal as source of farm power.** • **Describes the training of traction animals.** • **Harnesses animal power to do** • **farm work.**	• **Importance of animals as a source of farm power.** • **Training of traction animals, selection of good animals for traction and feeding traction** • **Animals.** • **Handling or care of traction animal and using animals for** • **Traction.**

Methodology

- Ask learners to discuss the:
  - Different sources of farm power in Uganda.
  - Factors considered by the farmer before mechanising agriculture activities.
  - Factors influencing the choice of animals to be used in traction.
  - Handling and care given to traction animals.
- Ask learners in groups to:
  - Debate reasons that can lead to successful implementation of traction technology.
  - Assemble the mould board plough ready for use.
  - Identify the characteristics of animals suitable for traction.
  - Identify the components of a mould board plough.

Practical

- Selecting and Training animals for traction.
- Preparing feed rations and feeding the traction animals.
- Handling of and caring for traction animals.
- Identifying component parts of traction equipment like the mould board plough.
- Design and make a mould board plough.

Resources:

- Slides or video shows, photographs and charts showing sources of farm power, training of animals to provide power and traction equipment.
- Traction animals like bull/oxen, camels, donkey and horses.
- Traction equipment such as but not limited to mould board plough.
- Animal traction training manual.
- Facilitator in traction technology.
- Mould board plough components.

Hints to the Teacher:

- Farm power embraces all forms of power inputs into agricultural production. It includes among others, animal power. The use of animals, particularly cattle and donkeys, as a source of farm power, is still not extensive.

Over 25% of cultivated land in Africa is worked with animal traction. Furthermore, the common mould board plough is the implement used in animal traction. It is an important primary tillage machine that completely inverts and pulverises the soil, uproots all weeds, trashes crop residues and buries them. It is designed to cut down the soil and invert it to the right side, completely burying the undesired growth which is subsequently turned into manure. Its coulter cuts vertically into the ground just ahead of the share or frog. The other parts like the frame, mould board, main beam, depth rod, furrow wheel, landside and plough chain are for supporting. Therefore, get support from the school administration to provide this equipment for the learners to use during demonstration.

Assessment:

- The advantages and disadvantages of the main sources of power on the farm.
- Animal power.
- Characteristics of areas suitable for the use of animal traction/draft technology.
- Factors to consider for the success of traction technology in Uganda.
- Mould board plough and its components.

TERM THREE

Topic 15: Crop Production VI (18 Periods)

Overview

Pests are the organisms that cause damage to our crops. Diseases may be physiological or as a result of disease agents like fungi, bacteria or viruses that grow and survive by feeding on plant material. On the other hand, weeds are any plants that grow where they are unwanted. All these things cause serious loss for the farmers and call for the protection of crops.

Learning Outcome

By the end of the topic, the learner should be able to:

- Appreciate the harmful effects of pests, diseases and weeds in agricultural production.
- Explore the effects of common pests, diseases and weeds.
- Demonstrate an understanding of the effects of pests, symptoms of diseases that attack garden crops and economic importance of weeds.

Sub-Topic 1: Crop Protection (General Principles of Crop Protection)

Competences	Content
The learner: • **Demonstrates crop protection measures for different crops.** • **Differentiates the effects of weeds, pests and diseases in crop production.** • **Administers the methods of managing weed, pests and diseases on crops.** • **Explains the effects of crop protection measures on the environment.** • **Demonstrates ways of**	• **Crop protection measures.** • **Effects of weeds, pests and diseases in crop production.** • **Methods of managing weeds, pests and diseases on crops:** - **Cultural practices** - **Physical** - **Mechanical** - **Biological** - **Chemical** - **Integrated pest management** - **Legal methods** - **Plant resistance** - **genetic manipulation**

minimising the effects of crop protection measures on the environment.	• **Effects of crop protection measures on the environment** • **How to minimise crop protection effect on the Environment.**

Methodology

- Ask learners in groups to:
  - Collect, identify and record ten common diseases, ten common pests and ten common weeds of the high value crop plants.
  - Classify and identify the different pests, weeds and diseases of the high value crop plants.
  - Preserve the common diseases, pests and weed specimens.
- Guide learners to individually demonstrate how to collect, observe, label and preserve samples of common weeds, pests and plant parts infected by diseases.
- Through a guided discussion, ask learners to explain the:
  - Appropriate methods of controlling diseases, pests and weeds.
  - Effects of diseases, pests and weeds on crop production.
  - Botanical features of pests and weeds that make them successful in farmers' crops.
  - Symptoms of common diseases in crops.

- Lead learners to brainstorm the effects of crop protection measures on the environment and suggest ways of reducing these effects.
- Organise a debate for learners on the merits and demerits of using chemicals in crop protection.
- Ask the learners to demonstrate weed, pest and disease control on their school plots with high value crops.
- Put learners in groups to:
  - Explain the effects of crop protection measures on the environment.
  - Classify and identify agrochemicals, weeds, pests, and diseases.
  - Describe the factors that make weeds more competitive than crops.

- Explain the harmful effects of weeds, pests and diseases on crops.
- Describe the methods of managing weeds, pests and diseases in the environment.
- Demonstrate weed, pest and disease control in the school plots using different methods: cultural, mechanical, biological and chemical means.
- Suggest the most appropriate methods of pest, disease and weed control in crops.
- Suggest ways of minimising the effects of crop protection measures on the environment.
- Identify and nurture plant and animal material that can be used in crop protection.
- Identify the botanical features of diseased plants, weeds and pests.
- Compare different methods of weed, pest and disease control in terms of effectiveness, costs and safety.
- Identify pests and pathogens on mounted slides.
- Investigate and compare the effects of biological and chemical control of diseases, pests and weeds in a high value crop.

Practical

- Investigate the effects of weeds, pests and diseases on crops.
- Identification of common weeds, pests and diseases.
- Designing suitable control measures for the common weeds, pests and diseases.
- Prepare biological pesticides and plant derived material for controlling weeds, pests and diseases on the farm.
- Provide space for learners to set up marketing stalls for crop protection materials at appropriate points in the school or community to sell.

Resources:

- Chemicals for crop protection.
- Sweep nets, traps and bags, specimen preservatives and specimen bottles.
- Damaged crops, common weeds, pests, and diseased plants, a field with weed infestation.
- Photographs, slides and videos showing pests, diseased plants and common weeds.
- Equipment and materials for chemical, biological, mechanical and cultural

control measures.
- Microscopes and their accessories.
- Crop protection equipment including overalls, gumboots, gloves and first aid box.
- Charts/slides, video - illustrating effects of agrochemicals on the environment.

Hints to the Teacher:
- In farming, a large part of the farmer's time, income and labour is taken up by controlling weeds and reducing heavy losses that may arise from pests and diseases. When weeds, pests and diseases are not controlled, they interfere with growth of crops, development of products and crop yields. This in turn will affect crop and animal production both in quality and quantity. This is why learners need to recognise the effects of weeds, pests and diseases. Innovative solutions of crop protection methods can make an important contribution towards improving the health of the crops used to produce food, animal feeds, fibres and bio fuels.
- Crop protection can help crops reach their potential yield. Some agrochemicals help plants in their critical growth stages to develop strong roots, which are the basis for healthy crops, and promote high yields. Insecticides and fungicides protect crops from pests and diseases, improve plant vigour and lead to efficient use of soil nutrients, while herbicides control weeds, which are known to reduce yields through competition for water, light, and nutrients. It is therefore important to get support from the school administration to provide the relevant inputs to enable you demonstrate the use of crop protection measures as a way of controlling the weeds, pests and diseases in crops.

Assessment
- Economic importance of weeds.
- Factors that make weeds more competitive than farmers' crops.
- Harmful effects of weeds.
- Classification of weeds as perennial and annual or broad and narrow leaved weeds.
- Methods of controlling weeds, pests and diseases.
- Insects as crop pests.
- Predators and prey in crop pests.

- Fungal diseases in crops.
- Ways of minimising the effects of chemical control of diseases, pests and weeds on the environment.
- Considerations that may reduce the effects of diseases, pests and weeds in crops.
- Measures that can be taken to prevent plant diseases.

Topic 16: Agricultural Engineering and Farm Mechanisation II (27 Periods)

Overview

Mechanisation can make farming less tedious and more profitable. This can begin with construction of farm structures. The materials used must be of good quality, reasonable price and suitable for the farming activity. Advance planning can ensure that constructed structures are exactly right for their functions.

Using good quality tools designed for a particular job can save money. Remember that a job done with bad tools take longer and are less effective.

Learning Outcome

By the end of the topic, the learner should be able to:

- Compute accurately the cost of construction materials.
- Demonstrate an understanding of designing, interpreting and using construction drawing for buildings on the farm.
- Demonstrate skills of handling, repairing, using and maintenance of tools and equipment.
- Demonstrate skills of making models/proto types.

Sub-Topic 1: Construction Materials

Competences	Content
• **The learner:** • **Describes the properties of construction materials.** • **Develops criteria for selecting appropriate materials for constructing**	• • **Types of construction materials and their properties.** • **Selection of materials**

farm structures. • **Estimates the amount and costs of different types of construction materials needed for a given construction job.** • **Costs the materials required in the construction of farm structures (buildings, fences, roads, irrigation and drainage systems, crushes, dips, water** • **Storage facilities).**	**for different construction jobs basing on their properties.** • **Basic principles of quantity surveying.**

Methodology

- Arrange for a visit with a prepared interview guide to a place where learners will be able to observe and participate in:
- Preparation of bricks, blocks, stones, concrete mixture, mortar, plaster, rough cast, tiles, roofing materials, timber, poles, grass thatch, sand, earth, mud and wattle.
- Selecting, estimating the amount and costing of materials for building and construction.
- Laying of bricks/blocks with mortar and roofing of the truss.
- Organise an exhibition for learners to identify the different building and construction materials on the farm.
- Lead a guided discussion for learners to explain the:
- Properties/characteristics of the different building and construction materials.
- Advantages and disadvantages of different building and construction materials.
- Factors to consider when choosing building and farm structure construction materials.
- Estimation of bills of quantities in building and constructing of farm structures.
- Costing of building and construction materials.
- Ask learners in groups to:
  - Identify different construction materials.
  - Describe the properties of different construction materials.
  - Select suitable materials for construction and make models of simple farm structures.

- Estimate the quantities and costs of construction materials.
- Prepare a budget of construction materials for a simple farm structure model.
- Construct models or proto types of some common building and farm structures.

Practical

- Identifying different materials for construction.
- Subjecting materials to compression forces, tensional forces, heat and moisture to test their strength.
- Carrying out tests to determine material strength.
- Determining the quantities of materials required to put up a given farm structure and costing them.
- Using appropriate materials in construction/ modelling of simple farm structures.
- Provide space for learners to set up marketing stalls for construction materials and products at appropriate points in the school or community to sell.

Resources:

- Building and construction tools.
- Timber of different specification' timber boards and poles.
- Corrugated iron sheets, tiles, thatching grass, plastic sheets.
- Nails, wire mesh, woven wire mesh, tidal netting and gauze wire/sisal balls.
- Building and construction materials like cement, paint, vanish, terrazzo, lime, lake sand, river sand, bricks, blocks, stone, mud and wattle.
- Ropes/chains, measuring tapes, spirit level and pegs.
- Farm structure models.

Hints to the Teacher:

- Construction material is anything used for building farm structures.
- Get support from the school administration to provide the relevant construction materials that may include metals and non-metals.
- Emphasise the properties of these construction materials and how to make them more durable.

Assessment:

- The reasons for painting metals and timber to be used in farm structures.
- Procedure of curing concrete, bricks and blocks as building materials.
- Computing the number of bricks for a small calf pen of 2m by 1m by 1.5m with a

joining mortar, door and open space area of 1.2 square metres.

- Computing the number of iron sheet needed to roof a house which is 6m long by 4m wide when each sheet covers 3m by 0.8m.

Sub-Topic 2: Farm Equipment and Tools

Competence	Content
• **The learner constructs simple models of livestock rearing equipment.**	• **Designing and construction of livestock rearing equipment: beehives, bailing boxes, forage harvesters, forage choppers, feeders, waterers/drinkers, nesting boxes and feed mixers.**

Methodology

- Organise an exhibition so that learners can identify the use of:
- Livestock production tools, protection tools and equipment.
- Carpentry workshop and builders' tools.
- Dismantled component parts of tools and equipments on the farm.
- Put learners in groups to demonstrate how to:
- Dress appropriately when using tools and equipment.
- Handle all tools and equipment properly and safely.
- Repair and maintain the livestock tools and equipment.
- Apply correctly workshop safety procedures.
- Demonstrate the proper storage of the livestock tools and equipment.
- Design and construct simple farm tools and equipment.
- Construct livestock production equipment like feeders, nest boxes, candlers, rabbit hutch/pen and mobile pet houses.
- Maintain the workshop, builders', livestock tools and equipment.
- Properly and safely, handle the workshop, builders', livestock tools and equipments.
- Ask learners to brainstorm the:
- Safety procedures when using workshop, builders' and livestock tools and equipment.
- Procedure of making feeding equipments on the farm.
- Ask learners to:
- Draw, identify and label parts of workshop, builders' and livestock tools and equipments.

- Repair damaged parts, tighten loose bolts/nuts, replace worn out parts and sharpen cutting edges.
- Assemble common workshop, builders' and livestock tools and equipments.

Practical

- Constructing simple livestock rearing equipment.
- Design poster of how to observe occupational health, safety and environmental practices on the farm.
- Administer first aid.

Resources

- Overall coat used when handling the livestock tools and equipment such as a hand spray pump.
- Slides, photographs or charts illustrating how to use, handle, repair, maintain and store different livestock tools and equipment.
- Knapsack sprayer, hand spray pump, syringe, drenching gun, hand brace, ear tags, burdizzo, elastrator, hot iron dehorner, candler, spoke shave, slot screw driver, hand saw, claw hammer, chisel, mallet, grease/oil, water, soap, towel, strip cup, milk strainer, milking pail, wooden feeder trough, nest box, fodder preparation tools, milking tools and equipment, tools for measuring length, rasps, nuts and bolts.
- Materials and tools for constructing simple equipment and tools like beehives, bailers, forage choppers, feeders, feed mixers, waterers/drinkers, nesting boxes.

Hints to the Teacher:

- Farm equipment can be divided into garden tools, workshop tools, animal equipment and building tools.
- The material used in making these tools should be designed well to be useful to the farmer.
- Light treatment should be made on the component parts, but clear description of how it is used to perform its function is vital.
- Get support from the school administration to provide the relevant farm equipment for learners to have hands-on experience.
- Proper storage with a well-documented inventory of the farm equipment will save the school.

Assessment

- Livestock tools, garden tools and workshop tools.
- Maintenance practices of tools, equipment and machines.
- Use of farm tools, equipment and machines.
- Identification of common tools as shown below:

No.	Specimen	Name	Function	Maintenance
1.	Knapsack sprayer			
2.	Syringe			
3.	Drenching gun			
4.	Ear tag			
5.	Burdizzo			
6.	Hand brace			
7.	Dehorner			
8.	Candler			
9.	Spoke shave			
10.	Milk strainer			
11.	Feeder trough			
12.	Chisel			
13.	Rasps			
14.	Tenon saw			

Sub-Topic 3: Farm Structures

Competence	Content
The learner: • **Understands basic principles of technical drawing.** • **Designs simple building plans for farm structures.** • **Constructs / models a simple farm structures.**	• **Basic principles of technical drawing in farm structures.** • **Building and construction drawing of farm structures.** • **Constructions/modelling a simple farm structures.**

Methodology

- Ask learners in small groups to:
- Draw building plans of basic farm structures.
- Study and interpret building and construction drawings/plans.
- Construct models of simple farm structures.
- Identify materials used in construction of farm structures.
- Prepare a budget for a simple farm structure.
- Organise learners in a group to:
- Relate the use of farm structures to their design.
- Interpret simple building and construction drawings correctly.
- Identify the suitable construction materials for simple farm structures.
- Explain the factors to consider when planning any farm structure construction like a dairy unit, calf pen, rabbit hutch, fishpond, pigsty, deep litter house, milking parlour, farm store and machinery shed.
- Outline the procedure for constructing a fishpond, beehive, rabbit hutch, cattle crush, nest boxes/feeders, pet's house, dairy shed, goat house and pigsty.
- Describe the procedures of maintaining farm structures.
- Prepare and justify a budget for construction of a simple farm structure like a beehive, rabbit hutch, pet house, poultry cage/deep litter house, goat or turkey house and pigsty.
- Visit a farm with cattle dips, crushes, spray races to identify siting of the structures and construction features.
- Construct a crush starting with a drawing plan, estimating the materials, costs

and actual construction.
- Repair a crush, cattle dip, crop store/crib.
- Lead learners to demonstrate the procedure of constructing a fishpond, beehive, rabbit hutch, cattle crush, nest boxes/feeders, pet's house, dairy shed, goat house and pigsty.
- Through brainstorming, ask learners to:
- Justify a budget for construction of a simple farm structure like a beehive, rabbit hutch, pet house; poultry cage/deep litter house, goat or turkey house and pigsty.
- Explain the procedures of maintaining farm structures.

Practical
- Taking the measurements of different farm structure in and around the school.
- Designing simple plans for farm structures.
- Constructs / models a simple farm structures for the school or the community members
- Estimate the quantities of building materials required such as paint, bricks, fencing posts, roofing materials.

Resources:
- Mathematical set.
- Drawing boards, paper, T-squares, set squares, rulers and pencils.
- Building and construction plans, sketches and drawings of farm structures.
- Artistic photos/pictures of completed farm structures
- Different construction materials and tools used
- Actual housing structures constructed from building plans, sketches and drawings
- Project plan and diagrammatic representation of ground/floor plan, left/right or side and front/back elevations

Hints to the Teacher:
- Farm structures are anything that is constructed on the farm. Farm structures include fences, buildings, roads, canals and stores.
- In order to improve the living standards of farmers, structures and buildings should have a comfortable and a healthy living environment, which includes

clean water and sanitation facilities.

- Handling and management operations on the farm require different structures to ensure safety of livestock, crops and the operator, as well as efficiency of the operation. For instance, a cow being milked should conveniently be restrained with enough space in a milking crush. Good enough these are provided for in a building plan.
- Review of basic farm structures like animal crush, dip tank, spray race, barn, calf pen, pigsty, deep litter house, fishpond and rabbit hutch is a good introduction here. These farm structures are an investment made by the farmer so should be developed from a well-designed plan and bill of quantities specified. These should be used when assessing the net worth of the farm.
- Get support from the school administration to provide the relevant building plans for the learners to use.

Assessment

- The main components of a budget for a simple farm structure.
- Construction materials and tools used in simple farm structures.

Topic 16: Agricultural Economics III (18 Periods)

Overview

The government should be involved in order to get an abundant food supply, increased agricultural export get foreign exchange and efficient land use. Most importantly, Uganda needs to be self-sufficient in food. Government involvement in agriculture is fundamentally to ensure food availability to its people, particularly moving the financial resources to rural areas.

Land is taken as a resource in terms of the space it provides, the environment it covers, the resources it contains and support as well as the capital it represents and generates. It is therefore important that all issues surrounding land are not only addressed, but are transformed into a robust engine for social and economic development in Uganda. This can be done by enacting a good land policy, increasing land rights awareness and the related agricultural policies plus mapping out the implications for each stakeholder.

Learning Outcome:

By the end of the topic, the learner should be able to:

- Explain the role of government in agricultural development.
- State the current agricultural policies in Uganda.
- Explain the recent agricultural initiatives and programmes in Uganda.
- Explain the roles of research institutions and organisations in agricultural development.
- Explain the role of extension service in agricultural development in Uganda.
- State the role of other players in agricultural development.
- Describe the impact of socio-economic policies on agriculture development in Uganda.
- Relate the issues in agriculture extension with all the players.
- Demonstrate an understanding of the role of government and policies in agricultural development.
- Explore how to create and manage a farming organisation.
- Appreciate the need for land reforms and increased awareness of land rights in Uganda.

Sub-Topic 1: Agricultural Policies and Government Role in Agricultural Development.

Competences	Content
The learner: • Identifies the role of government in agricultural development. • Interprets agricultural policies and relates them to agricultural production. • Describes the importance of research, research • Organisations, extension services and other partners in agricultural production and development. • Classifies the roles of various players in agricultural production. • Evaluates the effects of the different socio-economic policies on	• Role of government in agricultural development. • Current agricultural policies and programmes in Uganda. • Plan for Modernisation of Agriculture (PMA). • National Agricultural Advisory Services (NAADS). • Programme for Elimination and Alleviation of Poverty (PEAP). • Agricultural Sector Programme Support (ASPS). • Research organisations in Uganda and their roles in agricultural. Sector development. • Extension services and their role in agricultural production and development. • Research - extension - farmer linkages in relation to agricultural production and development. • Roles of various players in agricultural production and develop ent in areas like: extension/ education/ advisory, financing, marketing and research. • Other players in the agricultural sector development such as: • international organisations like FAO, IFRI, WFP, NGOs • donor organisations like IMF, ADB, World

agriculture.	**Bank, MDI, micro** • **finance institutions, insurance and private firms.** • **Socio-economic and other polices that affect agriculture like PAF, WTO, DISP, NEPAD, AGOA, structural adjustment programmes, fair trade,** • **Privatisation, liberalisation, import and export policy.**

Methodology

- Before the lesson:
- Acquire the different current agriculture policies and related socio- economic policies of Uganda.
- Study FAO report on Uganda agricultural development to identify policy issues.
- Organise learners in groups to:
- Identify agricultural service providers/stakeholders according to the level of importance to the farmer using Venn diagram analysis. Also identify the key actors in this area.
- Identify the current sources of support and state the type of service to farming the people in this area are getting.
- Read NAADS and PMA documents then summarise their roles in agricultural development so that learners recognise the need for government involvement in agriculture.
- Organise for learners a field visit with a prepared questionnaire to:
- Observe new technologies at one-research organisations in Uganda.
- Watch films/video shows on the works of FAO, WFP, ILO, USAID and IFFRI.
- Listen to a guest speaker/resource person.
- Through a discussion, allow learners to:
- Analyse available policy documents, brochures and agricultural development organizations'/institutions' information.
- Explain the role of government in agricultural development.
- Justify the place of extension in agricultural development.
- Examine the recent agricultural development programmes and initiatives.
- Assess the effects of the socio-economic policies on agriculture.

- Debate the role of NGOs and NAADS in agricultural extension service delivery.
- Organise a drama skit using a group of learners to show a sick person who sought help from traditional healer, church minister, a medical officer and a personal close friend. The sick person got treatment from all of them. Brainstorm on who helped the sick person to heal or die quickly. Relate this to the farmers who interact with all sorts of service providers in agriculture.

Practical

- Visiting research stations to observe new agricultural technologies that can be adopted by farmers in their community.
- Case study of PMA, NAADS and PMA working papers to highlight key messages for farmers in their community.
- Visiting NGOs, NAADS and district agricultural offices and find key messages for farmers in their community.
- Visiting Bank of Uganda and rural commercial banks branch offices and find key messages for farmers in their community.

Resources

- Uganda Government Agriculture Policy documents.
- Guest speaker from the Ministry of Agriculture, Animal Industry and Fisheries, agricultural research stations.
- Charts, posters, video tapes depicting new agricultural technologies and research activities and brochures.
- Resource persons from MAAIF, NGOs (CARE-Uganda, Heifer International, CIDA, UNDP, DFID, GIZ, FINCA, CARITAS, IFFRI, FAO, World Vision, Concern).
- Video/films on research programmes.
- Brochures on research organisation mandates.
- Agricultural research stations.
- Agricultural trade show/national exhibitions.
- Development Strategy and Investment Plan (DSIP).
- Players in the agriculture sectors and agri-value chains.

Hints to the Teacher:

- Government in most of the developing countries is in charge of setting the agenda

for development, with a big presence in agriculture.

Assessment

- Current agricultural policies in Uganda.
- The role of NAADS in agricultural development.
- The main areas of focus for PMA.
- The role of donor organisations in agricultural development.
- Challenges of NAADS in delivering extension services to farmers.
- Recent agricultural programmes that are supporting the development of agriculture in Uganda.

Sub-Topic 2: Farmers' Organisations

Competences	Content
The learner: • **Describes the principles that govern operations of farming organisations.** • **Explains the roles of farming organisations in agricultural**	• **Principles a n d operation of farming organisations.** • **Roles of farming organisations in agricultural development.**
• **development.** • **Examines and appreciates the role of farming organisations in** • **agricultural production and development.**	• **such as:** - **farmers' associations** - **farming organisations** • **co-operatives**

Methodology:

- Organise a field visit for learners to a farming organisation with guiding questions to investigate its functions, operation and structure.
- Ask learners to point out the names of farming organisations in their home area so that you can clarify the definition.
- Lead a guided discussion for learners to explain the role of farming organisations in agricultural development.
- Invite a resource person to facilitate in explaining the principle and status of

farming organisations in Uganda.

Hints to the Teacher:

- Farmer organisations are in form of cooperatives and commodity organisations intended to provide various inputs, marketing, educational and other social services. They are the farmers' mouthpiece. You should know that the farmers' voice cannot be obtained without the farmers' organisations.

Assessment:

- Farming organisations' benefits to farmers.
- Main principles of farming organisations like the cooperative society or agricultural credit and saving association/ farmer business school/farm field school/out growers scheme/beekeepers' association.

Practical

- Visiting farming organisations to study their functions and the way they are organized.
- Attend a meeting of a farmers' organization to learn how to participate in such activities.

Resources

- Policy on farming organisations in Uganda.
- Brochure of the farming organisations.
- Documents belonging to farming organisations.
- Resource persons from farming organisations.

CHEMISTRY

Topic 1: The Chemistry of Group VII Elements

Duration: 16 Periods

General Objective

By the end of this topic, the learner should be able to demonstrate appreciation of the behaviour of group VII elements and their compounds.

Sub-Topic 1: Trends in Physical Properties of the Elements

Specific Objectives	Content
The learner should be able to: 1) Describe the general methods for preparing halogens. 2) Explain the trends in the variation of physical properties down Group.	a) General methods of preparing halogens b) Variation in physical properties of the elements c) M.pts, B.pts, ionization energy, atomic and ionic radius and electronic structures, electron affinity, electronegativity, electrode potential d) Structure and bonding

Suggested Teaching and Learning Strategies

i) Discuss the physical appearance of the elements, electronic structures, structure and bonding, trends in melting point, boiling point and ionization energy.

ii) Discuss the trends in atomic and ionic radius, ionisation energy, electron affinity, electronegativity and electrode potential.

Practical problems

Guide the learners in the construction and interpretation of graphs from provided data on atomic and physical properties of the elements.

Assessment Strategies

Give class exercises requiring learners to

i) State general trends in atomic and physical properties of the elements.
ii) Describe the physical appearance of the elements.
iii) Explain the trends in the atomic and physical properties of the elements.
iv) State any anomalies in the general trends.
v) Explain any anomalies in the general trends.
vi) Accurately draw graph variations in atomic and physical properties.
vii) Interpret graphs on atomic and physical properties of the elements.

Sub-Topic 2: Chemical Reactions of the Elements of Group VII of Periodic Table

Specific Objectives	Content
The learner should be able to i) Explain the trend in chemical properties of the elements. ii) Explain the chemical reactions with the identifying reagents.	- a) Chemical properties of the elements - b) Reaction with hydrogen, water, sodium hydroxide.

Suggested Teaching and Learning Strategy

Discuss the reactions of halogens with: water, sodium hydroxide solution and their oxidising action.

Practical Problems

1. Guide learners to carry out test tube experiments to show displacement reactions of the halogens
2. Guide learners to carry out test tube experiments between dilute sodium hydroxide and aqueous solutions of bromine and iodine.

Assessment Strategies

Give class exercises requiring learners to

i) Describe the reactions of the halogens with: water, sodium hydroxide solution.
ii) State conditions for the reactions.

Sub-Topic 3: Compounds of the Elements

Specific Objectives	Content
The learner should be able to i) Write the chemical formulate of the hydrides. ii) Explain the physical properties of the hydrides. iii) Explain the trend in acid strength of the hydrides. iv) Carry out test tube experiment to identify Cl-, Br- and I-.	- a) Compounds of the elements Hydrides b) Hydrogen Bonding (Its effect on physical properties of the hydrides) c) Test tube experiments for Cl, Br, and I -

Suggested Teaching and Learning Strategies

i) Discuss the properties of hydrogen halides, trend in boiling points, thermal stability and acid strength

ii) Discuss the trends in reducing action of the hydrogen halides and qualitative analysis for the halides.

Practical Problem

Guide learners to carry out simple qualitative tests to identify Cl-, Br-, I-.

i) Assessment Strategies

ii) Give class exercises requiring learners to

iii) Carry out simple qualitative tests to identify Cl-, Br- and I-.

iv) Explain the trends in ·boiling points of the hydrogen halides.

v) Explain the trends in thermal stability of the hydrogen halides.

vi) Explain the trends in acid strength.

i) Explain the trends in reducing action of the hydrogen halides.

ii) Explain the anomalous behaviour of fluorine and hydrogen fluoride.

TERM II

Topic 2: The Chemistry of the d-block (Transition Elements)

Duration: 06 Periods

General Objective

By the end of this topic, the learner should be able to show appreciation of the behaviour of d-block transition elements and their compounds.

Sub-Topic 1: The d-Block Transition Elements

Specific Objectives	Content
The learner should be able to i) Define transition elements. ii) Distinguish between transition element and d-block elements. iii) Explain the trend in physical properties of the elements. iv) Compare the physical properties of the d-block and main block elements. v) Explain the general characteristics of the transition elements.	a) Concept of the transition elements (first series of the d-block) b) Physical properties c) M.pts, B.pts, ionization energy, atomic and ionic radius, electronic structure, electrode potential, electro-positivity and conductivity d) General characteristics of d-block elements - Variable oxidation states - Formation of interstitial compounds - catalytic activities e.g., iron in Haber, complex formation (H_2), Cl, NH_3, OH-, CN-, I, ligands) - Paramagnestism and formation of coloured compounds

Suggested Teaching and Learning Strategies

i) Brainstorm the concept of d-block elements, the transition elements and physical properties (M.pts, B.pts, ionization energy, atomic and ionic radius, electronic structure; electrode potential, electropositivity, conductivity).

ii) Discuss the general characteristics of transition elements (variable oxidation states, formation of interstitial, compounds, catalytic).

iii) Provide activities on complex formation, paramagnetism, formation of coloured compounds.

Practical Problems

1) Guide learners to model the structures of different complexes.
2) Guide learners to also carry out class experiments to make solutions of some complexes e.g. by reacting ammonia solution with copper (II) Sulphate.
3) Guide learners to carry out an experiment to investigate the use of cobalt (II) Ions as a catalyst for oxidation of 2,3-dihydroxybutanedioate by hydrogen peroxide.
4) Guide learners to carry ·out a class experiment to investigate variable oxidation states using ammonium vanadate (V) and zinc.

Assessment Strategies

Give class exercises requiring learners to

i) Explain what is meant by a d-block element.
ii) Explain what is meant by a transition element/ metal.
iii) Distinguish between a transition element and d-block elements.
iv) Explain the trends in the physical properties of the elements.
v) Compare the physical properties of the d-block and main block elements.
vi) Explain the general characteristics of the transition elements.
vii) Draw and name some common complexes.

Sub-Topic 2: Chemical Properties of the Elements and their Compounds

Specific Objectives	Content
The learner should be able to i) Explain the chemical properties of the elements.	a) Chemistry of each element b) Chemical properties of the

ii) Describe the preparation of common oxides, hydroxides and chlorides. iii) Identify transition metal cations except Ti, Sc, V. iv) Identify oxo-anions of V, Cr, Mn. v) Explain the amphoteric behaviour of Zn, Cr. vi) Draw and name the shapes of the common oxo-anions. vii) Explain the redox behaviour of the oxo-anions. viii) Explain the importance of oxo-anions in redox titrations. ix) Carry out test tube experiments to identify d-block oxo-anions. x) Describe how iron, and copper are extracted from their ores. xi) Explain how steel is formed from Iron.	elements (reaction with H_2O, acids, air, NaOH and oxidizing agents) c) Compounds of the element oxides, hydroxide, oxo-anions (for V, Cr, Mn), chlorides, oxo-salt d) Test tube experiments for identification of transition e) Metal cations except Ti, Sc, V f) Identification of d-block oxo-anions g) Amphoteric behaviour of the compound (oxides of Cr, Zn) h) Structures and names of the shapes of the common oxo-anions i) Redox reactions of the oxo-anions j) Volumetric analysis k) permanganate l) Dichromate (acidification with H_2SO_4) m) Extraction of Fe, Cu n) Production of steel from pig iron

Suggested Teaching and Learning Strategies

Lead a discussion on the reactions of transition metals with water, acids, sodium hydroxide solution and oxidizing agents.

1) Let them also discuss the preparation of the common oxides, hydroxides and chlorides. Let the learners understand the techniques of identification of the metal ions and

2) Practically carry out the experiments. Guide the learners to understand the importance of oxo anions in redox titrations. Lead a discussion on the extraction of some named· metals

3) Discuss the general procedures for extraction of metals, including iron, zinc and iron. Let them also discuss the uses of the metals.

Practical Problems

1) Give group practical work on electrochemical purification of copper.
2) Guide learners to carry out test tube experiments to identify transition metal cations using dilute sodium hydroxide, aqueous ammonia solutions and other confirmatory reagents.

Suggested Assessment Strategies

Give class exercises requiring learners to

i) State the three main stages involved in the extraction of a metal.
ii) Explain the underlying principles of each of the three main stages of metal extraction.
iii) Name the ores of Iron.
iv) Write chemical formulae of the ores of Iron.
v) Describe the conversion of siderite/spathic ore, iron pyrites to iron (III) oxide.
vi) Describe the chemical reduction of haematite, or magnetite differentiate between wrought and pig iron.
vii) Give uses of pig and wrought and pig iron.
viii) Name the main components of steel.
ix) Give the uses of steel.
x) Name the ores of copper.
xi) Write the chemical formulae of the ores of copper.
xii) Describe the concentration and roasting of copper ores.
xiii) Describe the process of smelting.
xiv) Describe the reduction and refining processes in copper extraction. Give uses of copper.
xv) Name the common alloys of copper.

REMOVED CONTENT

SN	Content	Justification	Periods
	Group 7		
1	Preparation of hydrogen halides	Covered at O-level	2
2	Extraction of NaCl from natural deposits	Covered at O-level	2
	Transition elements		
1	Compounds of vanadium	Reduce the amount of work	2
2	Redox behaviour of oxo-ions in volumetric analysis	Done in physical S 5	2
3	Extraction of Zinc	Same principle of chemical reduction	2

TERM II

Topic 3: Ionic Equilibria

Duration: 20 Periods

General Objective

By the end of this topic, the learner should be able to describe the behaviour of acids, bases and salts in aqueous solutions.

Sub-Topic 1: Acids, Bases and Salts

Specific Objectives	Content
The learner should be able to: i) Explain the concepts of acids and bases according to various theories. ii) Explain the concept of conjugate bases and conjugate acids. iii) Classify acids and bases on basis of their degree of ionization. iv) Explain ionization constants for weak acids and weak bases Ka and Kb. v) Derive a general expression for Ka and Kb. vi) Correctly apply knowledge about Ka and Kb in calculations. vii) Explain auto ionization (self-ionization) of water. viii) Derive an expression of Kw. ix) Explain the concept of pH scale of 1-14.	a) Acids and Bases b) Concepts of acids and bases definitions of acids, bases according to Arrhenius, Bronsted – Lowry and Lewis c) Conjugate Acid – base Pair ○ Conjugate base and acid d) Classifying strong acids and bases, weak acids and bases ○ Strong acids, strong bases, weak acids and weak bases e) Relative strength of Bronsted – Lowry acids and bases f) Ka and Kb as measures of strengths of acid dissociation constant, Ka and base dissociation constant, Ka and base dissociation constant, Kb ○ Calculations involving Ka and Kb g) The Ammonization (Self ionization) of water.

Specific Objectives	Content
The learner should be able to: x) Explain the concept pH and p0H.	○ Ionic product of water ○ Kw = [H30+][0H-] = 10-14 h) The pH Scale (1-14) i) Concept of pH

xi) Correctly apply knowledge pH and p0H and pKw in calculation involving strong acids and bases. xii) Explain the relationship between Ka and Kb for an acid base conjugate pair. xiii) Derive expression of pH for weak acids and bases. xiv) Carry out calculation on pH for weak acids and bases.	○ pH = -log10 [H30+] ○ p0H = -log10[0H-] ○ pKw = -log10Kw j) The relationship between Ka and Kb for an Acid-base conjugate k) Consider the acid base conjugate pair of NH_4^+ and NH_3 l) Derivation of the relationship, Ka x Kb = Kw m) Expression of pH for weak acids and bases n) pH calculations pH calculation for weak acid and weak base

Suggested Teaching and Learning Strategies

i) Guide learners to brainstorm the theories of acids and bases according to Arrhenius, Bronsted and Lowry and Lewis; conjugate acids and bases and classification of acids and bases on the basis of their degree of ionisation

ii) Explain the derivation of a general expression for Ka and Kb, deducing strength of acids and bases using their ionisation constants; explaining ionisation constants for weak acids· and weak bases Ka and Kb and correctly applying knowledge about Ka and Kb in calculations

iii) Discuss auto ionisation of water, deriving an expression of Kw, the · concept pH and pOH, calculation of involving pH of strong acids and 1 bases, relationship between Ka and Kb for an acid-base conjugate pair, I deriving the expression of pH for weak acids and bases, carrying out calculation on PH for weak acids and bases and carrying out a class I experiment on comparing pH of different' solutions.

Practical Problems

Guide learners to carry out laboratory experiments to compare the pH of different solutions using:

- A pH meter (if available)
- pH papers
- universal indicator

Caution: Most strong acids are corrosive and should be handled with care or using gloves.

Assessment Strategies

Give class exercises requiring learners to

i) explain the concepts of acids and bases, according to various theories
ii) Explain the meaning of conjugate bases and conjugate acids. Classify acids and bases on ·basis of their degree of ionisation
iii) derive a general expression for Ka and Kb
iv) Deduce strength of acids and bases using their ionisation constants. explain ionisation constants for weak acids and weak bases Ka and Kb
v) correctly apply knowledge about Ka and Kb in calculations
vi) explain auto ionization (self-ionisation) of water
vii) derive an expression of Kw
viii) explain the meaning of pH and pOH
ix) carry out calculations involving pH of strong acids and bases
x) explain the relationship between Ka and Kb for an acid-base conjugate pair
xi) derive expression of pH for weak acids and bases
xii) Carry out calculation on pH for weak acids and bases.

Sub-Topic 3: Buffer Solutions

Specific Objectives	Content
The learner should be able to: i) Explain the concept of buffer. ii) Classify buffer and give examples of each type. iii) Explain the action of a buffer. iv) Describe the preparation of a buffer. v) Derive the Henderson-Hasselbalch equation. vi) Carry out calculations of pH for buffers. vii) Explain application of buffers.	a) Buffer solutions b) What buffer solution is c) Types of buffers: Acidic and Basic a basic d) Action of an acidic and basic buffer solutions e) Preparation of buffer solutions f) Henderson – Hasselbalch Equation pH = $pK_a + \log \frac{[conjugate\ base]}{[weak\ acid]}$ pOH = $pK_b + \log \frac{[conjugate\ acid]}{weak\ base]}$ g) Calculations involving buffer solutions h) Application of buffers

Suggested Teaching and Learning Strategies

i) Discuss the concept of buffer, classifying buffers and giving examples of each type, the action of a buffer, describing the preparation of a buffer and derivation of the Henderson-Hasselbalch's equation.

ii) Discuss calculations involving pH of buffers, application of buffers and carrying out a class experiment on preparation of a buffer.

Practical Problems

Allow learners to carry out a laboratory experiment to prepare a buffer by mixing

- Molar solutions of ethanoic acid and sodium ethanoate.
- Molar solutions of ammonia and ammonium chloride.

Assessment Strategies

i) Give class exercises requiring learners to

ii) Explain the rr1eaning of a buffer.

iii) Classify buffers and give examples of each type.

iv) Explain the action of a buffer.

v) Describe the preparation of a buffer.

vi) Derive the Henderson-Hasselbalch equation.

vii) Carry out calculations on pH of buffers.

viii) Explain applications of buffers.

Sub Topic 4: Acid-Base Titrations

Specific Objectives	Content
The learner should be able to i) Explain the concept of titration. ii) Define the terms used in titration. iii) Explain the action of an indicator.	a) Titrations b) What titration is c) Titrant, titrand (analyte0 equivalent point, end point d) Acid-Base indicators

iv) Give examples of indicators. v) Describe how an indicator works. vi) Explain the concept of pH range. vii) Choose a suitable indicator for use in acid base titrations. viii) Carry out acid-base titrations. ix) Sketch different types of pH volume curves for acid-base titration. x) Calculate pH changes during acid-base titrations.	e) What an indicator is (Hln) f) Examples of indicators g) How an indicator works h) pH ranges for indicators i) choice of indicator j) types of Acid –Base titrations k) Titrations of strong acid-strong bases: (Examples NaOH and HCl); weak acid-strong base titrations: (Examples HCl and NH3 solution) and weak acid-weak base (example: CH3COOH and NH3 solution) l) Titration curves for the various types of titrations m) Calculations involving acid-base titrations

Suggested Teaching and Learning Strategies

i) Guide learners to brainstorm the meaning of an indicator, examples of indicators, and the action of an indicator, the meaning of pH range and identification of pH ranges of different indicators.

ii) Discuss the choice of suitable indicators for use in acid-base titrations, basing on pH range, pH changes during titration, calculating pH changes during acid-base titrations, sketching different types of pH-volume curves for acid-base titrations and interpreting pH-volume curves for acid-base titrations.

Practical Problem

Let the learners carry out acid-base titrations in the laboratory as individuals or in groups of at most five students.

Assessment Strategies

Give class exercises requiring learners to

i) Explain the meaning of an indicator.

ii) Give examples of indicators.

iii) Explain how an indicator works.

iv) Explain the meaning of pH range.

v) Identify pH ranges of different indicators.

vi) Choose suitable indicators for use in acid base titrations basing on pH range.

vii) Explain pH changes during titration.

viii) Calculate pH changes during acid - base titrations.

ix) Sketch different types of pH-volume curves for acid-base titrations.

x) Interpret pH-volume curves for acid- base titrations.

Sub-Topic 5: Solubility Equilibria

Specific Objectives	Content
The learner should be able to: i) Explain the concept of solubility. ii) Carry out an experiment to determine solubility of a salt. iii) Plot solubility curves for soluble salts. iv) Interpret solubility curves. v) Explain the applications of solubility curves. vi) Explain the concept of dynamic. Equilibrium in a saturated salt solution. vii) Explain the factors that affect solubility of sparingly soluble salts. viii) Carry out calculations for solubility. ix) Derive an expression for solubility product. x) Carry out an experiment to	• Solubility • What solubility is; soluble slats • Molar solubility • Experimental determination of solubility of a salt • Factors affecting solubility • Solubility curves • Application of solubility curves (fractional crystallization) • Calculation of solubility • Soluble and sparingly soluble salts • Factors affecting solubility of sparingly soluble salts • Solubility product • What solubility product is • Expressions for solubility product • Experimental determination of

determine solubility product. xi) Calculate Ksp. xii) Carry out calculations involving solubility product. xiii) Explain the relationship between ionic product, Ksp and precipitation. xiv) Explain the applications of Ksp. xv) Explain the concept of common ion effect. xvi) Explain the application of common ion effect.	solubility product • Calculations involving solubility and solubility products • Solubility product and precipitation • When does precipitation take place? • Ionic product • Effective concentration • Application of Ksp

Suggested Teaching and Learning Strategies

i) Brainstorm the concept of solubility, factors that affect solubility of a salt, drawing and interpreting solubility curves, applications of solubility in fractional crystallisation, calculations for solubility, and also carrying out a class experiment to determine solubility of a salt.

ii) Discuss the concept of dynamic equilibrium in a saturated salt solution, the concept of solubility product, -the factors that affect solubility of sparingly soluble salts, deriving an expression for solubility product, calculations involving solubility product, relationship between ionic product solubility product and precipitation, applications of solubility product, concept of common ion effect, and application of common ion effect and carrying out an experiment to determine solubility product.

Practical Problems

1) Guide learners to carry out a laboratory experiment to determine the solubility of a salt at different temperatures using potassium nitrate or potassium chlorate (VJ).

2) Let learners also carry out a class experiment to determine the solubility product of calcium_ hydroxide.

Assessment Strategies

Give the class exercises requiring learners to

i) Explain the concept of solubility
ii) Describe an experiment to determine solubility of a salt
iii) explain the factors that affect solubility of a salt
iv) draw and interpret the solubility curves
v) explain the applications of solubility in fractional crystallization and carry out calculations on solubility
vi) explain the concept of dynamic equilibrium in a saturated salt solution
vii) explain the concept of solubility product
viii) explain the factors that affect solubility of sparingly soluble salts and derive an expression for solubility products
ix) describe an experiment to determine solubility product
x) carry out calculations involving solubility product

xi) explain the relationship between ionic product, solubility product and precipitation
xii) explain the applications of solubility
xiii) explain the meaning of common ion effect
xiv) Explain the applications of common ion effect.

Topic 4: Chemical Kinetics

Duration: 06 Periods

General Objective

By the end of this topic, the learner should be able to show appreciation that different reactions occur at different rates and explain why they do so.

Sub-Topic 1: Simple Rate Equations

Specific Objectives	Content
The learner should be able to i) Explain the concept of rate of reaction. ii) Explain the law of mass action and its application. iii) Explain order of a reaction and rate constant. iv) Define the different terms used in kinetics. v) Relate mechanism of reactions to kinetics. vi) Describe the experimental procedure to determine the orders of a reaction. vii) Explain the concept of half –life.	• Introduction of rates of chemical reactions • What chemical kinetics is • Law of mass action • Simple rate equations • Definition of rate equations, rate constant, order of reaction and molecularity • Mechanism of reactions • Mathematical derivation of zero, first and second order rate equations • Half-lives t ½

Suggested Teaching and Learning Strategies

i) Guide learners to brainstorm the concept of chemical kinetics and rate of reaction. Let them practically demonstrate experimental determination of rate of reaction.

ii) Explain the term, order of reaction, relating mechanism of reaction and kinetics of reaction, molecularity and distinguishing between molecularity and order of a reaction.

iii) Guide a discussion on the derivation of expressions for order of reaction, half-life and sketching and interpreting the graphs obtained.

iv) Lead learners to experimentally determine orders of reaction.

Practical Problems

Guide learners to carry out laboratory experiments to determine rates of reaction and orders of reaction using

- Reaction between iodine and propanone.
- Sodium thiosulphate and hydrochloric acid.
- Hydrogen peroxide and potassium manganate (VII).
- Hydrogen peroxide and potassium iodide.

Assessment Strategies

Give the class exercises requiring learners to:

i) Explain the law of mass action and its application.

ii) Explain the term “rate of reaction”.

iii) Describe an experiment for determination of the rate of reaction.

iv) Explain the terms order of _a-reaction and rate constant.

v) Explain the relationship between orders and rates of reactions.

vi) Explain the term molecularity of a reaction.

vii) Distinguish between order and molecularity.

viii) Apply the knowledge rate equations in sketching and interpreting graphs.

ix) Explain the concept of half-life.

Sub-Topic 2: Factors Affecting Rates of Reactions

Specific Objectives	Content
The learner should be able to i) Explain the theories of collision. ii) Use theories of reaction to explain factors affecting rates of reaction. iii) Derive an expression for half-life of zero order, first order and second order reactions in terms of rate constant. iv) Use the theories of reaction to explain factors that affect rates of reaction. v) Apply the knowledge rate equations in sketching and interpreting graphs. vi) Discuss the relationship between mechanism of a reaction and molecularity. vii) Carry out designed experiments to generate kinetic data for determining order of reaction, rate of reaction and rate constants. viii) Carry out calculation rates of reaction.	a) Factors affecting rates of reactions b) Theories of reaction (Collision theory, transition theory) c) Effects of temperature 9energy barrier concept; activation energy of activates complex), concentration (pressure and volume for gases), catalyst (industrial production of polymers, processes such as Haber process, manufacture of HNO_3 acid etc.) particle size d) Differentiate and integral forms of first order reaction, half-life (only zero and first order) e) Molecularity and mechanism of reactions f) Effect of temperature on reactions, Arrhenius theory – activation energy, collision theory of reaction rate (no derivation) - Experiments - 1^{st} order - 2^{nd} order g) Calculations involving the given experiments

Suggested Teaching and Learning Strategies

i) Guide learners to brainstorm the collision and transition state theory of chemical reaction
ii) Discuss the factors that affect chemical reactions, which include temperature, light, concentration, particle size, pressure for gaseous reactants and catalysis
iii) Guide learners to discuss the calculations on rates of reactions
iv) Guide learners to experimentally investigate the factors affecting rates of chemical reactions.

Practical Problems

Guide learners to carry out laboratory experiments to demonstrate the effect of different factors on rate of reaction using

- Calcium carbonate and hydrochloric acid (particle size).
- Sodium thiosulphate and hydrochloric acid (concentration and temperature).

Assessment Strategies

- Give the class exercises requiring learners to

i) Use the theories of reaction to explain factors that affect rates of reaction.
ii) Explain the types and working of catalysts.
iii) Give applications of the factors that affect rates of chemical reaction.
iv) Carry out calculations involving rates of reaction.
v) Draw graphs from rate of reaction data.
vi) Interpret graphs obtained from rate of reaction data. Interpret rate of reaction data.

Topic 5: Electrochemistry

Duration: 4 Periods

General Objective

By end of the topic, the learner should be able to outline the effect of electric current on substances and· the· ability of substances to generate electricity.

Sub-Topic 2: Conductance and its Measurements

Specific Objectives	Content
The learner should be able to	
i) Explain the concept of conductance.	a) Concept of conductance and terms used in conductance
ii) Explain the factors affecting conductivity of electrolytes.	b) Factors affecting conductance of electrolytes
iii) Explain conductance in weak and strong electrolytes.	c) Conductance in different types of electrolytes
iv) Differentiate between molar and specific conductance.	d) Conductance of weak and strong electrolytes
v) Explain relationship between molar and specific conductance.	e) Types of conductance: (Molar conductance and specific conductance)
vi) Describe measurement of conductance.	f) Molar conductance and specific conductance
vii) Apply Kholrausch's law in calculation of molar conductivity at infinite dilution of weak electrolytes.	g) Measurement of conductance h) Kholrausch's law of independent migration of ions and its application
viii) Apply the concept of conductance in conductimetric titrations, determination of solubility and solubility product, and degree of ionisation.	i) Application of conductance j) Conductimetric titrations: (strong acid-strong base, strong acid-weak base, weak acid – weak base): determination of solubility and solubility products; determination of degree of ionisation of weal electrolytes
ix) Carry out calculations involving electrolytic conductance.	k) Calculations involving electrolytic conductance

Suggested Teaching and Learning Strategies

i) Lead a discussion to brainstorm the concept of conductance and factors affecting conductance, with examples.

ii) Guide learners on how to carry out calculations involving molar conductivity at infinite dilution of weak electrolytes, by applying Kalrauch's law, electrolytic conductance and solubility of sparingly soluble salts.

Practical problems

Guide the learners to carry out laboratory experiments on conductimetric titrations and determination of solubility of sparingly soluble salts like calcium hydroxide.

Assessment Strategies

Give the class exercises and tests requiring the learners to:

i) Explain the concept of conductance and factors affecting conductivity of electrolytes.

ii) Explain conductance in weak and strong electrolytes and differentiating between molar and specific conductance.

iii) Explain the relationship between molar and specific conductance and measurement of conductance.

iv) Apply Kholrausch's law in, calculations of molar conductivity at infinite dilution of weak electrolytes, the concept of conductance in Conductimetric titrations, determination of solubility and solubility product, and degree of ionisation.

REMOVED CONTENT

Content	Justification	Periods
Salt hydrolysis	Not very crucial	6
Electrolysis	Basics of the concept at O level	4
Electrochemical cells	Can go to physics	4

ORGANIC CHEMISTRY

Topic 6: Carbonyl Compounds (Ketones and Aldehydes)

Duration: 08 Periods

General Objective

By the end of this topic, the learner should be able to demonstrate appreciation of the nature, chemistry and uses of carbonyl compounds.

Sub-Topic 1: Introduction to Carbonyl Compounds and their Physical Properties

Specific Objectives	Content
The learner should be able to i) State general formulae of carbonyl compounds. ii) Name aldehydes and ketones using IUPAC system. **iii)** Prepare the preparations of carbonyl compounds. iv) Explain the physical properties of carbonyl compounds. v) Compare the physical properties of aldehydes and ketones in relation to their structure. vi) Relate the physical properties of carbonyl compounds and those of alcohols.	a) Introduction (general formula, functional groups, nomenclature using IUPAC rules) b) Laboratory preparations - oxidation of alcohols - hydrolysis of dihalides c) Solubility - physical states d) Boiling points and melting point e) Physical properties

Suggested Teaching and Learning Strategies

- Discuss the general formula, preparation, nomenclature and physical properties of aldehydes and ketones.

Practical Problems

Guide learners to carry out an experimental demonstration to prepare carbonyl compounds by oxidation of alcohols using acidified potassium dichromate.

Assessment Strategies

Give class exercises requiring learners to:

i) State general formulae of carbonyl compounds.
ii) State how carbonyl compounds are prepared.
iii) Name aldehydes and ketones using IUPAC system.
iv) Explain the physical properties of carbonyl compounds.
v) Compare the physical properties of aldehydes and ketones in relation to their structure.
vi) Compare the physical properties of carbonyl compounds and those of alcohols.

Sub-Topic 2: Chemical Properties and Uses of Carbonyl Compounds

Specific objectives	Content
The learner should be able to i) Explain the chemical properties of carbonyl compounds, giving mechanisms for the reactions (except oxidation, reduction). ii) interpret chemical reactions with Fehling`s and Tollens' reagent. **iii)** Carry out tests to identify the carbonyl functional groups**.** iv) Carry out tests to distinguish between aldehydes and ketones.	a) Chemical properties addition reactions ($NaHSO_3$, CN-) b) Reduction ($LiAlH_4$, $NaBH_4$, Na/ethanol, H_2/Ni) c) Condensation reactions (hydroxy-amines, hydrazine, phenyl hydrazine, 2,4-dinitrophenyl hydrazine (Brady's reagent) d) Oxidation reactions (Cr_2O_7 2- /H+, $KMnO_4/H^+$,I_2/OH^-) e) Distinguishing reaction between aldehydes and ketones

Suggested Teaching and Learning Strategies

Discuss the chemical properties and uses of carbonyl compounds and also carrying out laboratory experiments on the chemical properties of carbonyl compounds.

Practical Problems

1) Guide learners to identify the carbonyl functional group.
2) Guide learners to distinguish between aldehydes and ketones of carbonyl compounds.

Assessment Strategies

Give the class exercises requiring learners to

i) Explain the chemical properties of carbonyl compounds, giving mechanisms for the reactions (except oxidation, reduction).
ii) Carry out tests to identify the carbonyl functional group.
iii) Explain the chemical reactions for the identification of the functional group.
iv) Carry out test tube experiments to show the chemical properties of carbonyl compounds.
v) Carry out tests to distinguish between aldehydes and ketones of carbonyl compounds.
vi) State the uses of carbonylcompounds.

Topic 7: Polymers and Polymerisation

Duration: 06 Periods

General objective

By the end of this topic, the learner should be able to explain polymers and polymerisation and describe formation of natural and synthetic polymers with their uses.

Sub-Topic 1: Introduction to Polymers

Specific Objectives	Content
The leaner should be able to i) Explain the process of polymerisation. ii) Differentiate between addition and condensation polymerisation. iii) Describe the structures of the different classes of polymers. iv) Explain the different types of polymers.	a) What Polymers are - Concept of polymers and polymerisation. b) Types of polymerisation (addition and condensation) c) classes of polymers (natural and synthetic polymers) d) Types of Polymers - rubbers, fibres and plastics

Suggested Teaching and Learning Strategies

Discuss the process of polymerisation, the difference between addition and condensation polymerisation, different classes of polymers, as well as the different types of polymers.

Practical Problems

You can use models to show the different monomers and how they can combine to form polymers.

Assessment Strategies

Give the class exercises requiring learners to

i) Explain the process of polymerisation.
ii) Differentiate between addition and condensation polymerisation.
iii) Describe the structures of the different classes of polymers.
iv) Explain the different types of polymers.

Sub-Topic 3: Fibres

Specific objectives	Content
The learner should be able to: i) Mention the occurrence of natural fibres and their uses. ii) Explain the properties of natural fibres. iii) Give examples of natural and artificial fibres. iv) Explain the preparation of synthetic fibres. v) Explain the properties of artificial fibres. vi) Give the uses of artificial fibres.	a) Fibres b) Natural fibres (occurrence, examples and uses) c) Examples: starch, cotton, silk, proteins d) Synthetic fibres (preparation, structure and uses) e) Examples: nylon and terylene, Propeno-nitrile fibre

Teaching and Learning Strategies

Discuss the occurrence, structure, properties, examples and uses of natural fibres, process of manufacture, properties examples and uses of artificial fibres.

Practical Problems

Guide learners to identify natural and synthetic fibres.

Assessment Strategies

Give class exercises requiring learners to:

i) Describe the occurrence of natural fibres and their uses.
ii) Explain the properties of natural fibres.
iii) Give examples of natural and artificial fibres.
iv) Explain the preparation of synthetic fibres.
v) Explain the properties of artificial fibres.
vi) Give the uses of artificial fibres.

Sub-Topic 4: Plastics

Specific Objectives	Content
The learner should be able to i) Explain the concept of plastics. ii) Explain the differences between thermo setting and thermo softening plastics. iii) Describe the process of preparation of selected plastics. iv) Identify monomers and the related polymers of plastics. v) Construct a unit structural formula of a polymer from a monomer. vi) Give uses of natural and synthetic polymers. vii) Identify environmental effects of artificial polymers.	a) Plastics - thermo setting plastics (thermoplastics) - thermo plastics (thermo softening) - structure - preparation - properties - examples: PVC, polyethene, polypropene b) Uses c) Effects of plastics on the environment.

Suggested Teaching and Learning Strategies

Discuss the preparation, structure, properties, examples, and uses of plastics and also the environmental effects of artificial polymers.

Practical Problems

You can organise a field trip to a plastic manufacturing plant.

Assessment Strategies

Give class exercises requiring learners to

i) Explain the meaning of plastics.

ii) Explain the differences between thermosetting and thermosoftening plastics.

iii) Describe the process of preparation of selected plastic.

iv) Identify monomers and the related polymers of plastics.

CHANGES MADE

Content	Justification	Periods
Carboxylic acids	Done at O level	06
Esters	Linked to acids but produced in alcohols	04
Amines	Reduce content	08
Soap and detergents	Done at O level	02
Chemistry of rubber	Subset of polymers covered	O2

PHYSICS

Introduction

The abridged Physics Syllabus for Senior Six has been designed to address the learning gaps that were created as a result of the Covid 19 pandemic. It is hoped that you were able to cover the some aspects of Mechanics and General Physics and Light before lockdown, and also in the previous classes. Critical content has been sorted and put together to be taught in a period of one year. The syllabus combines work which was not taught in Senior Five before the lock down and that for Senior Six, in a condensed way. In order to avoid repetition of related concepts, learning has been structured around the major thematic areas i.e. Mechanics, Light, Heat and thermodynamics, Waves and Sound, Electricity and Magnetism and then Modern Physics. It is hoped that the content areas included in this syllabus will enable the learner to acquire the target knowledge, understanding, skills and values for the progression in Physics, in addition to what was covered in the previous classes.

The critical changes are highlighted in the matrix below.

SN	CRITICAL CHANGES	JUSTIFICATION
	Solid friction was supposed to be carried forward from S.5to S.6 but was left out	Were omitted due to time constraints and the basic concepts were covered at O level
	Work, energy and power was supposed to be carried forward from S.5 to S.6 but was left out.	
	Statics was supposed to be carried forward from S.5 to S.6 but was left out.	
	Surface tension was supposed to be carried forward from S.5 to S.6 but was left out	
	Change of state; was supposed to be	Those left out were covered at O level

	carried forward from S.5 to S.6 but some learning outcomes were left out	
	Diffraction of waves, stationary waves, resonance, sound and polarization of waves; were supposed to be carried forward from S.5 to S.6 but were left out	The basic concepts were covered in O level and the remaining concepts will not affect the progress of the learner
	Survey of energy	Some of the basic concepts that were covered in O level were left out
	Electric fields, capacitors, current electricity	
	Electronic devices	
	Magnetism in matter	
	Radioactivity was left out	The basic concepts were covered in O level

Topic/sub-topic	**Objectives** ***The learner should be able to***	**Key concepts**	**Teaching/learning activities**	**Assessment strategy** ***Task learners on:***
TOPIC: Refraction of light through a prism				
• **deviation through a triangular prism** • **the spectrometer**	a. measure the refracting angle of a triangular prism b. derive the expression for the deviations through a triangular prism c. describe the structure and action of a	Light rays are deviated in a prism as a result of refraction, which	• Practical measurement of A and D using a spectrometer should	• Derivation and use of expressions in solving numerical problems • Explanation of the

• **deviation by thin prisms** • **applications for triangular prisms**	spectrometer d. describe applications for glass prisms	has a number of applications	be emphasised • Guide learners in the derivation of the expressions for: - n in terms of A and D - d in terms of n and A	phenomenon of dispersion.
Topic: Refraction through a thin lens				
• **thin lens formula** • **displacement of a lens keeping object and screen fixed** • **Newton's relation** • **Lens defects** -	- Derive the lens formula for both concave and convex lenses - Derive the expression ***$l^2 - d^2 = 4df$*** - Measure the focal length of a convex lens using displacement method - Derive Newton's relation; $xy = f^2$ - Derive the expressions $\frac{1}{f} = (n-1)(\frac{1}{r_1} + \frac{1}{r_2})$	Light rays from an object get refracted by the lens to form images and this has many applications,	• Involve learners in hands-on activities to: - Determine nature and position of the images formed by lenses at different positions of the object - Verify the lens formula - Measure the focal length and radius of curvature (consider the	- Exercise on: • definitions of terms involved, derivations of expressions and explanations of concepts • Description of experiments • Numerical calculations

	$\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}$ - Measure focal length and radius of curvature lenses - Explain the occurrence and minimization of spherical and chromatic aberrations in lenses.		displacement method too). • Use guided discovery on accurate drawing of ray diagrams to show formation of images by lenses and derivation of expression involved.	involved.
TOPIC: Optical instruments				
• **The simple microscope** • **Compound microscope** • **Refracting and reflecting telescopes**	• Define the terms near point, far point and accommodation and visual angle • explain the relationship between visual angle and apparent size of objects • Define magnifying power of an optical instrument • Describe the structure and action of a simple microscope • derive the expression ***M =*** $\frac{D}{f}-1$ for a simple microscope • Explain why an image formed by a simple lens microscope is free of chromatic aberration • Describe the structure	Optical instruments use the laws of reflection and refraction of light to aid vision in many different cases.	Use guided discovery to: - Draw accurate ray diagrams - Derive expressions of angular magnification • Demonstrate to the learners the use of optical instruments • Discuss	Exercises on: 1. Derivation and use of expressions in solving mathematical problems 2. Describing use of the various optical instruments.

	and action of a compound microscope in normal adjustment • Derive the expression for the angular magnification of a compound microscope; - in normal adjustment - When the final image is at infinity • Describe the structure and action of astronomical and Galileo's telescopes in normal adjustment and with the final image at the near point • derive the expressions - M′ = $\frac{f_o}{f_e}$ - $M = \frac{f_o}{f_e}\left(1+\frac{f_e}{D}\right)$ for the astronomical and Galileo's telescopes • Define the eye-ring and explain its significance • derive the expression $M = \frac{dianeter\ of\ objective}{diameter\ of\ eye-ring}$ • Describe the structure and action of Cassegrain, Coude′ and Newtonian reflecting telescopes. • Compare the use of refracting and reflecting telescopes.		methods of obtaining erect images in an astronomical telescope • Use two lenses to view distant objects in the neighborhood Note, the learner must not point the telescope at the sun.	

	• Describe the action of prism binoculars, a projection lantern and a simple lens camera • Describe a terrestrial method of measuring the speed of light.			
TOPIC: Fluid Flow				
• **Streamline and turbulent flow** • **Viscosity**	• Explain streamlines, streamline flow and turbulent flow • Derive the expression $A_1v_1 = A_2v_2$ for an incompressible fluid • State Bernoulli's Principle • Derive Bernoulli's equation $p + \frac{1}{2}\rho v^2 + \rho gh =$ ***constant.*** • Describe applications of Bernoulli's Principle • Describe experiments to measure fluid velocity • Explain the design of aerodynamic shapes. • Define viscosity • Describe the effects of viscosity on an object moving in a fluid • Define the terms velocity gradient and coefficient of viscosity. • Derive Stokes' formula. • Derive the formula, $\frac{V}{t} = \frac{\pi pa^4}{8\eta l}$	Pressure variations at different points of a flowing fluid have a variety of applications.	Demonstrate the following: • Streamline and turbulent flow (may be done using digital technology) • Bernoulli's Principle by blowing a stream of air above a piece of paper • Determination of coefficient of	• Demonstration on the coefficient of viscosity • Describing an experiment to distinguish between laminar flow and turbulent flow • Derivation of Stoke's Formula, Bernoulli's Principle, equation of continuity and Poisseuille's Formula • Definitions of terms used and explanation

	• Measure coefficient of viscosity of a liquid • Explain effect of temperature on viscosity of liquids and gases using molecular theory.		viscosity (may be done using digital technology or web animations) • The effect of temperature on viscosity of liquids • Determination of the coefficient of viscosity • The effect of temperature on viscosity of liquids.	of temperature effects on viscosity in liquids and gases using the molecular theory.
TOPIC: Mechanical Properties of Matter				
• **Hooke's Law** • **Young's**	• Investigate the behavior of a wire/spring under	Different pieces of	• Practical approach to	• Project of making a weighing

Modulus	stress to bring out the concept of Hooke's Law. • Explain the special features of a stress-strain curve • Investigate ductility, brittleness, stiffness and strength of materials • measure stress, strain and Young's Modulus • Derive an expression for the work done during an extension or compression process of an elastic material • Describe applications of deformation of solids.	matter have differences in the molecular arrangement of particles, which has varied implications and applications.	determine Young's Modulus and to verify Hooke's Law. • Demonstration of elasticity using a rubber cord • Graphical representation and calculation of total work done in stretching an elastic material • Verify Hooke's Law, practically, using various materials.	scale using a spring or rubber • Graphical interpretation of results obtained from the experiment to verify Hooke's Law • Exercise on definitions of terms, explanations of special features of a stress-strain curve and derivation of expressions involved.

Topic: Uniform Motion in a Circle

• **Motion on a circular track** • **Angular acceleration** • **Conical pendulum** • **Motion of rigid bodies** -	• Define angular velocity. • Derive the expressions $v = \omega r$ and $a = \frac{v^2}{r} = \omega^2 r$ • Explain the equilibrium of forces in circular motion. • Identify the forces acting on a car moving round a circular track. • Explain the conditions for skidding by a car or a cyclist moving round a circular track • Identify the forces acting on a car moving on a banked circular track • Derive the expression $\tan\theta = \frac{v^2}{rg}$ for a conical pendulum • Define moment of inertia • Derive the expression for rotational kinetic energy of a rigid body about an axis • Distinguish between rotational kinetic energy and translational kinetic energy.	Centripetal acceleration can make objects move in circles and this has a lot of applications.	• Practical whirl of an object to demonstrate motion in a circle either vertical or horizontal. • Guided discovery to derive the expressions $a = \frac{v^2}{r} = \omega^2 r$ $v = \omega r$ $tan\theta = \frac{v^2}{rg}$ • Practically demonstrate the action of centrifuges.	• Derivation of the expressions, definition of terms and calculations involved • Learners should demonstrate centripetal force using water in a bucket and whirled in a vertical plane without any water pouring out. • Assessment on applications of circular motion.

Topic: Gravitation				
• **Kepler's laws** • **Newton's law of gravitation** • **Orbits round the earth**	•State Kepler's laws •State Newton's law of gravitation •Define gravitational field intensity. •Describe the principle of laboratory determination of the gravitational constant, **G** •Derive the dimensions of **G** •Derive Kepler's third law using Newton's law of gravitation •Derive expressions for masses of sun and earth •Explain the variation of **g** with latitude •Explain weightlessness in a satellite •Derive expressions for **g** above and below the earth's surface •Define parking orbit. •Derive an expression for the period of a satellite in a parking orbit •Define gravitational potential and velocity of escape •derive expressions for -Gravitational potential and velocity of escape -Kinetic energy, potential energy and total energy of a satellite in the	There exists an inherent attraction between bodies and this has many implications and applications	• Guided discovery on; - derivations of Kepler's third law from Newton's law of gravitation - Dimensions of **G.** - Expressions of the mass of the sun and the earth - **g** above and below the earth's surface - Expression for the period of a satellite	• Statement of Newton's law of gravitation • Derivation of Kepler's third law • Description of the laboratory determination of the gravitational constant • Related calculations and derivations of related formulae.

	earth's orbit • Explain the effect of friction on orbits of satellites • Describe applications of communication satellites.		in a parking orbit, gravitational potential of a satellite. - Relationship between potential energy, kinetic energy and total energy of a satellite in the earth's orbit.	
Topic: Simple Harmonic Motion				
• **Simple Harmonic Motion**	• Define simple harmonic motion (SHM) • Derive the expressions for acceleration, velocity and displacement in SHM • Draw sketch graphs to show - variation of displacement, velocity, acceleration and with time - acceleration and force	The repeated back-and-forth movement of objects about an equilibrium position	• Practical approach demonstrating examples of SHM • Experimental determination of **g** using	• Practical exercise on determination of acceleration due to gravity using SHM • Identification of a simple harmonic

	with displacement • Verify that the resulting motion of a system, when slightly displaced, is SHM. • Derive expressions for period, **T,** in each of the cases above. • Determine acceleration due to gravity, **g**, using a simple pendulum and a loaded helical spring/rubber band. • Derive expressions for kinetic energy, potential energy and total energy in SHM • Draw sketch graphs for kinetic energy, potential energy and total energy in SHM • Describe the interchange of energy in SHM • Describe situations where SHM is applied. • Solve numerical problems.	has many real applications	SHM method • Guided discovery on derivations involved • Bring out relationship between SHM and circular motion. That is, use of motion of a body moving in a circle to derive the defining equation and other related equations • Verification of motions of the following being SHM	motion •Definitions of terms, derivation of expressions, calculations and practical applications of SHM.

			when slightly displaced : - Simple pendulum - Floating cylinder - Liquid in a U-tube - Mass at the end of a vertical and horizontal spring on a smooth surface - Mass between two coupled springs on a smooth horizontal surface - Mass at the end of two coupled vertical springs	

			- Mass at the end of two parallel vertical springs • Emphasize an experimental approach should be emphasized • Discuss limitations • Discuss the principle of conservation of energy in SHM • Emphasize the significance of the negative sign in the expressions for acceleration in SHM.	
Topic: Wave Theory				
• **Progressive wav**	• Explain progressive wave motion. • State the characteristics of a progressive wave.	Mechanical and electro magneti	• Demonstrate using the ripple tank	• Give learners an exercise on

es • **Wave fronts**	• Mention examples of progressive waves. • Explain phases of vibration. • derive the expression $y = a \sin 2\pi\left(\frac{t}{T} \pm \frac{x}{\lambda}\right)$ • Explain the significance of ±in the progressive wave equation. • Determine the equation of resultant of two superimposed progressive waves • define a wave front, ray and optical path • demonstrate circular and straight wave fronts • demonstrate the reflection and refraction of waves • Describe applications of reflection and refraction of waves • state Huygens' postulate • explain Huygens' construction of wave fronts • apply Huygens' construction to reflection and refraction of light.	c vibrations result in energy that can propagate through matter and vacuum	experiment, the concept of: - Circular and straight wave fronts. - Refraction and reflection of waves.	progressive waves and the general wave equations. • Definition of terms, derivation of expressions and calculations involved. • Linking geometrical and physical optics
Topic: Interference of Waves				
• **Constructive and destructive interference** • **Young's double slit**	• Define coherent sources and path difference • State the factors that determine the energy of a wave • Explain the terms division of amplitude	Superimposition of waves can result into	• Use ripple tank to demonstrate the interference of water	• Observation of patterns using a setup of a narrow double slit

experiment • **Thin films, thin wedges, Lloyd's mirror, Fresnel's bi-prism and Newton's rings**	and wave front. • State the conditions for constructive and destructive interference to occur. • Explain the principle of Young's double slit experiment. • derive the expression $\Delta y = \frac{\lambda D}{a}$ • Explain the appearance of fringes. • describe Young's double slit experiment for measuring; - wavelength - slit separation - Fringe separation • Explain the occurrence of interference in thin films, thin wedges, Lloyd's mirror, Fresnel's bi-prism and Newton's rings • Derive the mathematical expressions for the fringe separation in each of the above cases • Mention applications of interference.	enhancement or cancellation of the propagated energy.	waves either using two spherical or a straight dippers and a barrier with two slits. • Guided discovery on interference of sound from coherent source and a microphone connected to a CRO • Explain change of phase • Demonstrate other cases where interference occurs • State the conditions for the occurrence of constructive and	and Newton ring experiment • Explanation of causes of interference in each of the cases studied •Derivations of expressions involved •Applications of interference in daily life.

			destructive interference • Describe Young's double slit experiment for measuring wavelength, slit separation and fringe separation • Explain the occurrence of interference in thin films, air wedge film, Lloyds mirror, Fresnel's bi-prism and Newton's rings and derivation of mathematical expressions for fringe	

			separation in each case.	
Topic: Thermometry				
• **Types of thermo meters**	• Describe measurement of temperature using different types of thermometers • Compare temperatures measured using different types of thermometers.	The working of thermo meters depend on physical properties of matter that vary linearly with temperature.	• Guide learners to improvise an air thermometer. -	Exercises on: • comparison of different types of thermometers • definitions of terms, derivation of expressions, description of experiments and calculations.
Topic: Heat content				
• **Heat capacity and specific heat capacity** • **Newton's law of cooling** • **Latent heat** -	• Measure specific heat capacity using different methods • Discuss the causes of heat leakage in calorimetric experiments • State and verify Newton's law of cooling, and the factors that affect the rate of cooling • Explain (using molecular theory) melting, boiling, evaporation and cooling	Different pieces of matter require different quantities of heat to change temperature by 1°C or change	• Practical approach to measure specific heat capacity of both solids and liquids and verification of Newton's law of cooling	- Exercises on: • Derivation of expressions, description of experiments and calculations • Comparison of the different methods of measuring specific heat

	by evaporation. • Measure specific latent heat (fusion and evaporation) using the method of mixtures and the electrical method.	state. This has many applications in everyday life.	• Demonstration of factors affecting the rate of cooling • Practical measurement of specific latent heat. • Emphasize difference between latent heat and specific heat capacities • Discuss real life examples. • Explain behaviour of gases in terms of behaviour of molecules.	capacity • Explanation of change of state using kinetic theory.

Topic: Gas Laws and Kinetic Theory of Gases

• **Equation of state** • **Kinetic theory of gases**	• state the gas laws • verify the gas laws • Sketch the graphical representation of the laws • derive the equation of state ***PV = n R T*** • define pressure and	Particles of a gas are in constant random collisions	• Hands-on activities to verify and sketch graphical represent	Exercises on: • describing experiments to verify gas laws • definition of terms,

	volume coefficients of expansion α_v and α_p • prove that $\alpha_v = \alpha_p$ • describe Brownian motion • explain what is meant by kinetic theory of gases • explain why a gas exerts pressure • derive the expressions - $P = \frac{1}{3}\rho\overline{c^2}$. - $\frac{1}{2}m\overline{c^2} = \frac{3}{2}KT$ stating the assumptions made • state - Avogadro's law - Dalton's law of partial pressures. - Grahams law of diffusion. • deduce Avogadro's law, Boyles's law, Charles' law, Pressure law, Graham' s law of diffusion and Dalton's law of partial pressures from the expression $\frac{1}{2}m\overline{c^2} = \frac{3}{2}KT$ • Explain behavior of a real gas • Distinguish between real and ideal gases • write down Van der	betwee n themsel ves and the walls of the contain er. This has an effect on pressure , volume and tempera ture of the gas.	ation of the gas laws • Guided discovery on derivatio n of the equation of state, definition s of terms used and solving related mathema tical problems • Graphical represent ation of the gas laws. • Discuss real life examples • Explain behavior of gases in terms of behavior of molecule s • The concept of 'root mean	derivation of expressions and calculations involved • Explanation of behaviour of gases in terms of behaviour of molecules • Observation of the random motion of gas molecules • Explanation of kinetic theory of gases • Explanation of Brownian motion in terms of kinetic theory of gases • Explanation on why a gas exerts pressure • Definition of terms, derivation of expressions and calculations involved. -

	Waal's equation: $\left(P + \frac{a}{V^2}\right)(V - b) = RT$ • State the significance of constants **a** and **b** in Van der Waal's equation • Sketch a volume-pressure graph for a real gas • Account for the difference between the ideal and real gas equations • State the significance of critical temperature.		square' should be clarified and its proper notation emphasized Use numbers to clarify it • Demonstrate Brownian motion using; • Smoke cell experiment • Pollen grains on water • Dust particles in air. • Explain Brownian motion in terms of kinetic theory. -	
Topic: Thermodynamics				
• **Internal energy** • **Principal specific heat**	• Define internal energy of an ideal gas • State the factors on which the internal energy of an ideal gas	In this section, learners will explore	• Discussion of concepts, derivati	• Defining reversible isothermal and adiabatic

capacities • **Isothermal and adiabatic changes**	depends • Define the terms isobaric and isovolumetric processes. • Derive the expression ***W = ∫PdV*** and relate it to the area under a **P - V** graph. • Define the principal specific heat capacities C_p and C_v of an ideal gas. • Show that ***ΔW = n C_vΔT*** and ***ΔW = n C_p ΔT*** for isovolumetric and isobaric processes respectively. • state the first law of thermodynamics • derive the relationship ***C_p- C_v = R.*** • calculate the ratio γ = $\frac{C_p}{C_v}$ for molecules of different atomicity. • Explain what is meant by reversible isothermal and reversible adiabatic processes. • derive the expression **PV^{γ} = constant.** • derive expressions for the work done during isothermal and adiabatic processes • describe processes that involve isothermal and adiabatic changes.	the relationship between heat, work, temperature and energy.	ons and calculations involved • Guided discovery on drawing sketch graphs for isobaric, isothermal, isovolumetric and adiabatic processes • Derivation of expressions and calculations involved • Discussion on the changes which occur to an expanding or compressed gas • Explain why C_p is greater than C_v.	processes • Drawing graphs of the following processes: isothermal, isovolumetric and adiabatic. -

			• Draw sketch graphs for isothermal, adiabatic, isobaric and isovolumetric processes. • Knowledge of indices is necessary. -	
Topic: Transfer of Heat				
• **Conduction, convection and radiation**	• Explain the mechanism of heat transfer in solids, liquids and gases • State the factors which determine the rate of heat transfer in a material • define thermal coefficient conductivity, **k** • describe experiments to measure thermal conductivity, **k**, for solids • Describe how radiation can be detected • state properties of good and bad radiators /absorbers	The mode of heat transfer in matter depends on the arrangement of particles and will flow due to temperature difference.	• Practical approach to measuring thermal conductivity of solid • Discussion of definitions, derivations of expressions and calculati	• Definition of terms, derivation of expressions and calculations involved • Describing behaviour of black bodies. -

	• define a black body • describe examples of systems that approximate to a black body • sketch a graph to show variation of relative intensity with wavelength of radiation • state - Stefan's law - Wien's displacement law - Provost's theory of exchanges • Estimate the temperature of the sun and other black bodies • Describe systems that use the principles of heat transfer • Describe how cooling corrections are made for both good and bad conductors.		ons involved • Draw sketch graphs to show the variation of temperature along a bar (lagged and unlagged). -	
Topic: Electrostatics and capacitors				
• **Coulomb's law of electrostatics** • **Electric field intensity** • **Electric potential** • **Capacitors**	• State Coulomb's law of electrostatics • Calculate the resultant force on a point charge due to a number of point charges • Define electric field intensity • Calculate electric field intensity at a point due to a number of point	Charges on bodies can cause attractive and repulsive forces, which have many	• Discuss definitions, derivations of expressions and calculations involved • Demonst	• Definitions, derivations of expressions and calculations involved • Sketching graphs of potential and electric

	charges • sketch a graph showing the variation of intensity with distance - from a point charge - from the center of a charged metal sphere • Derive an expression for the energy stored in an electric field • Derive an expression of potential at a point due to a point charge • sketch a graph showing variation of potential with distance - from a point charge - from the center of a charged metal sphere • derive a relationship between electric intensity and electric potential • Derive an expression for the electric potential energy • Define the electron volt • define capacitance and Farad • explain the charging and discharging processes of a capacitor • investigate the factors which affect the capacitance of a parallel plate capacitor • Define a dielectric and dielectric constant • explain the action of a dielectric using	applications.	rate Coulomb's law and the effect of a charged body near charged electroscope • Practical approach to: - measure capacitance using a ballistic galvanometer - practically charge and discharge a capacitor using a red switch circuit - Experimentally determine the factors affecting the capacitance of a	field intensity • Explain working of a capacitor in electronic devices.

	molecular theory • measure the dielectric constant of a material • derive expressions for the effective capacitance of capacitors in series and in parallel • derive expressions for the energy stored in a charged capacitor • account for the energy loss when two isolated charged capacitors are connected in parallel • Describe applications of capacitors.		parallel plate capacitor • Demonstrate using a circuit board the arrangement and application of capacitors • Study trips to electronic workshops are recommended.	
Topic: Current electricity				
• **Resistivity** • **Heating effect of a current** • **Maximum power theorem** • **Kirchhoff's laws** • **The slide wire potentiometer** • **Wheatstone bridge**	• Define resistivity and temperature coefficient of resistance • Explain the heating effect of current • Derive expressions for energy and power in an Ohmic resistor • Sketch graphs for variation of efficiency, power output and terminal potential difference (p.d.) with load resistance • State Kirchhoff's laws of electricity • Explain the action of a potential divider and	The energy carried by charges in a conductor can be transformed into different forms.	• Practical approach to: - determine resistivity - measure temperature coefficient - Determine emf and internal resistance of a	• Measurement of values of given resistors either on a potentiometer or on a metre bridge • Calibration of voltmeters and ammeters • Modification of galvanometers to

	principle of operation of a slide wire potentiometer • Carry out experiments using a slide wire potentiometer • Compare the use of the slide wire potentiometer with the use of a moving coil instrument • Derive the condition for balance using a Wheatstone bridge and a slide wire meter bridge.		cell - using a potentiometer - measure resistance using a meter bridge - Investigate Kirchoff's laws. • Explain why the Wheatstone bridge is not suitable for comparing very small or very big resistances or resistances which are not of the same order • Brainstorm to bring out sources of emf. -	measure p.d and current using shunts and multipliers • Definitions, derivations of expressions and calculations involved. -

Topic: Electromagnetism

• **Magnetic flux and magnetic flux density** • **Force on a current carrying conductor** • **Electromagnetic Induction** • **A.C. Circuits** -	• Define magnetic flux, flux density and Tesla • derive the expression $\varphi = BA\cos\theta$ • Quote Biot-Savart's law and the expression for the flux density at the centre of a narrow circular coil, due to a long straight wire and inside a solenoid • Derive the expression ***F = BIl sin ϑ.*** • Derive the expression for the magnetic force between two long parallel current carrying conductors • Describe a simple form of a current balance • Derive the expression **F = Bqv sin θ.** • derive an expression for the Hall voltage • derive the expression for the torque on a coil in a magnetic field: ***τ = BANI sin ϑ*** • Describe the structure and action of a moving coil galvanometer and its modifications • Derive the expressions - ***E = Blv sin ϑ*** - ***E = BANω sin ωt*** • Derive the expression $V_a I_a = E_b I_a + I_a^2 R_a$	Electric currents have associated magnetic fields and equally conductors moving in a magnetic field generate electric current. This has many applications	• Experimental determination of magnetic flux and magnetic flux density • Demonstrate Biot-Savart's law • Demonstrate practically: - Lenz's law - Faraday's law - The action of a motor and generator (a.c and d.c.) - The action of transformers - Fleming's right-hand rule • Ensure learners distinguish between use of the	• Derivations of expressions and calculations involved -

	• Explain the relationship between the speed of rotation of the coil and current flowing in the coil • Describe applications of Eddy currents • Explain self and mutual induction • Derive the expressions $E = -L\frac{dI}{dt}$ and $E = -M\frac{dI}{dt}$ • Describe the principle of a method for direct determination of resistance such as rotation of a disc within a solenoid. • Describe the structure and mode of operation of a.c. meters • Derive the r.m.s expressions - $I_{r.m.s} = \frac{I_{max}}{\sqrt{2}}$ and - $V_{r.m.s} = \frac{V_{max}}{\sqrt{2}}$ • Explain how a capacitor conducts A.C. • Derive expressions for V, I and reactance for a capacitor and inductor in a circuit separately • Sketch the curves of reactance against frequency • Compare the effects of L,		left and right hand • Demonstrate Faraday's and Lenz's laws of electromagnetic induction • Discuss the advantages and disadvantages of a.c. and d.c. generators • Describe other applications of electromagnetic induction • Practical approach to the measurement of a.c. • Demonstrate the effects of L, R and C on the current through an A.C circuit to determine	

	R and C separately on the current through an a.c circuit • Derive the condition for resonance in an a.c. circuit with L, C and R in series • Use the expression $E = \frac{1}{2} LI^2$ • Describe how sparking is minimized in inductive circuits • Calculate the average power in a capacitor, inductor and resistor connected separately in an A.C. circuit • Describe applications of capacitors and inductors in A.C circuits.		resonant frequency, f • Use the CRO to show the **V – I** relationships • Use of capacitors and coils in a.c circuits should be discussed.	

Topic: Atomic and nuclear physics

• **Charged Particles** • **Quantum Theory** • **Nuclear Physics** • **Radioactivity**	• Describe the structure and mode of operation of the Geiger Müller tube and counter, cloud chamber (expansion and diffusion), scintillation counter and photographic emulsion • Define background radiation and state its sources • state the law of radioactivity ($\frac{dN}{dt} \alpha$ N) • define the decay constant and derive the expression **$N = N_o e^{-\lambda t}$** • Draw the decay curve • Derive the expression $\lambda T_{\frac{1}{2}}$ **= ln 2** and use it to calculate half-life.	Particles can be added or ejected from the nucleus of an atom when a specific packet of energy has been absorbed or radiated by the nucleus.	• Guided discovery on production of positive rays, motion of cathode rays in electric and magnetic fields and operation of a mass spectrometer • Discussion of Millikan's oil drop experiment • Qualitative and quantitative explanation on behaviour of electron and ion beams in	Exercises on: • definitions, derivations of expressions and calculations involved • Behaviour of electron and ion beams in electric and magnetic fields Describing Rutherford's and Bohr's atoms • Analysing a graph of binding energy per nucleon against mass number. • Exercise on production of artificial isotopes and applications of radiations in medicine and

			electric and magnetic fields • Experimental treatment of photo-electric effects and characteristics of photo-electric emission • Experimental approach to verification of Einstein's equation and measuring of Planck's constant • Guided discovery on derivation of formulae	industries • Assign numerical problems.

			involved, applications of photoelectric effect, Rutherford's discovery and the alpha scattering experiment and writing balanced equations representing nuclear fusion and fission • Practical demonstrations on: - Detection of radioactivity - Distinction between	

			different radiations - Penetrating powers.	

MATHEMATICS

PREAMBLE

Due to Covid 19, schools were closed and the learners have lost content equivalent to two school academic terms. During this period of closer NCDC developed home study material which were printed and uploaded onto its website www.ncdc.go.ug . The Ministry Of Education and Sports guided that learners will be automatically promoted to the next class. As a result, National Curriculum Development Centre reorganized the content for senior six.
The content has been reorganized by merging, removal and forwarding of content/topics of senior five and senior six to form the abridged curriculum. The first four topics viz, Indices, surds and logarithms, linear and simultaneous equations, equations reducing to quadratics and roots of quadratics are assumed to have been covered.
It is possible that the sequencing of the topics covered was not uniform in all schools.

The teacher is expected to use hybrid teaching and learning techniques to ensure learning takes place. Formative assessment will be done as the lessons are ongoing and a record of learners' attainment is recorded. There will be no termly assessment.
The teaching/Learning will be for fourteen weeks a term. The abridged curriculum will guide the teacher in the different schools. If a teacher notices that their learners had covered the content in the abridged curriculum, then there is no need to repeat but rather proceed to the next topics
The following matrix is showing the teacher on what has been done with senior five and six syllabus to get the abridged curriculum for senior six.

MATRIX SHOWING CRITICAL CHANGES.

SN	CRITICAL CHANGES	JUSTIFICATION
1	Series. Finite series and proof by induction has been removed.	Basic content covered in the other parts of series.

SN	CRITICAL CHANGES	JUSTIFICATION
2	Permutation and combinations. Exclude restricted arrangementsand selections	Basic content covered in the otherparts
3	**Coordinate geometry1.**Some key concepts wereremoved. These include: (i) forming Cartesian equations oflines (ii) identifying linear equations finding the gradient of a straight line using the generalequation of a line finding the intercept of a line finding the coordinates of the midpoint of a line finding the distance between two points (vii) Finding the point(s)of intersection by solving the equations simultaneously. (viii) determining the relationshipbetween the gradients of parallel And perpendicular lines.	Since they were covered at O'level.
4	Differentiation I Merging of gradient function, curve sketching 1, velocity andacceleration as one topic	They apply the same concept of differentiation.
5	Integration I. Merging of indefinite, definiteintegrals and applications of integration as one topic.	They apply the same concept of integration.
6	**Trigonometry.** Trigonometry and calculus of trigonometry have been merged. Proofs, solutions, simplificationsof expressions involving inverse	Key concepts are sufficient.

SN	CRITICAL CHANGES	JUSTIFICATION
	trigonometric functions, derivatives of inverse trigonometric functions and solutions of triangles have been Removed.	
7	Differentiation II. This topic cannot be merged with differentiation 1 Maclaurin's theorem has been removed.	It requires prior knowledge of trigonometry. To reduce content.
8	Integration II Partial fractions have beenmerged with this topic. However, integration of thefunctions of the form (i) $\frac{1}{\sqrt{(a^2-b^2x^2)}}$ (ii) $\frac{1}{a^2+b^2x^2}$ and the Use of the t–formulae substitution Have been removed.	To avoid repetition and save time. To reduce content.
9	Differential Equation. Nothing has been changed, however solution of differentialequations should not involve problems leading to integration of Inverse trigonometric functionsand t-substitution.	These methods of integration havebeen omitted under integration II.
10	Inequalities. Linear inequalities and sketching graphs of inequalities have been removed. Curve sketching II has been removed	Linear inequalities have beencovered at O level. Knowledge of curve sketching 1 is adequate and at higher levels calculators are allowed to sketch those curves

11	Vectors. The knowledge of position vectors, displacement vectors, magnitude, equal vectors, vector	They were covered at O level.

ɴN	CRITICAL CHANGES	JUSTIFICATION
	Algebra has been removed.	
12	Complex numbers. De Moiré's theorem and the proof have been removed. Sketching of regions have been removed.	To reduce on the content. The algebra of complex numbers issufficient enough. Finding and sketching the locus is sufficient.
13	Coordinate geometry II. Coordinate geometry II and III have been merged as coordinate geometry II. Only two of the conic sections, the circle and the parabola have been considered. The ellipse, hyperbola and the rectangular hyperbola have been removed. Under the circle , intersection of circles internally, externally and orthogonally have been removed .	To reduce on the content, andknowledge of the circle and parabola is sufficient enough. At higher levels the conic sectionare plotted by calculators and modern software applications.

TOPIC 1: SERIES

In this topic, finite series and proof by induction have been removed.

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY
ARITHMETIC PROGRESSION The learner should be able to: a) distinguish h between a sequence and a series b) Generate an arithmetic c progressi on (A.P.). c) derive d) and use the formula of finding the sum of an AP	i. One requires methods from sequences and series to analyze the data arranged in a ii. Particular pattern.	i) Through teacher exposition, the learners in their groups should indicate if a series is an AP Through group discussions, guide learners to develop the relation for the nth term of an A.P. Bajo has 500 Kg of the flour on the first day of the month and uses no flour on that day. If he uses 25 Kg per day, how much will she have by the 20th day of the month? Use the formula: un = a + (n — 1)d to explain your reasoning.	I. Whetherthe learnerscan recognizea series and distinguish betweenn an A.P. i. Task the learnersto use $u_n = a + (n — 1)d$ find thevalues of a, n and d.
GEOMETRIC PROGRESSION a. identify a geometric progression (G.P.).	i In a G.P.a termis deter mine	i. Guide the learners to generate a G.P. Guide the learners to: i) relate the knowledge of a ii) G.P. to real life situationsinvolving compound iii) Interests.	i. Task the learners to use un =

a) Generate a geometric progression (G.P.). b) Derive and use the formula of finding the sum of a geometric progression. c) deduce the formula for the sum to infinity d) apply e) Knowledge to compound interest.	**d by** Multiplying the previous termby a common ratio. **i. This series s allows onewho borrow money froma bankto knowthe amount is expected** **To pay back.**	a) Deduce and apply sum to infinity. b) Attempt the question Jojo wishes to save shs 2,000 in the first week of the New Year 2022, if shetriples the amount she saves every week, how much will she have savedin the 2^{nd}, 3^{rd}, 4^{th}, 5^{th} and 6^{th} week of the year? c) Represent the information in the tablebelow, and explain yourreasoning. **Assuming the patterns continue, find the amount saved in the 30^{th} week, and 45th week.**	ar^{n-1} to findthe valuees of , a, nandr.

TOPIC 2: PERMUTATIONS AND COMBINATIONS

In this topic, Arrangements and selections with restrictions should beexcluded.

OBJECTIVES	EY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

PERMUTATIO NS The learner should be able to: a. Form arrangements of unlike items in a row. b. identify a permutationon c. Relate the number ofpermutationsto thefactorial notation. . **deduce And applythe formula of permutat ionson.** b. **determinethe Number of Ways objects can be arrangedin a circle.**	a. *Permutations* and *combinations* allow us to predict the chances of different events and outcomes withregards to *order*, or with respect to which outcomecomes first, second, etc. ii) . Permutation s develops the idea of arranging of outcomes and the order of the outcomes matters.	**i. Guide the learners to generate patterns from arrangements.** In how many different wayscan the lettersABC be arranged? **a. Ask the learners to use the counting principle to generate thefactorial notation and use it tofind the number of ways objects may be arranged.** **i. Guide the Learners to work out the: Otto was given ajob to painta room. He had three colors to use white, grey, and yellow paint. He was to use any two of the colorsto paint the room. Howmany different ways did he do this?**	**ask the learners to use factorial notation, permutatio nson formula in the problem situations.**

COMBINATION a) select from agroup of objects . identifyy a combi nation deduce and applythe formula	**combination develops the idea of selection of outcomes,where the order of the outcomes does not matter.**	. **Ask the learners to select objects in a set of items, and:** (i) To generatethe combination notation.	Task the learners to use the combination on formula to solve problems.
		i) To compute different combinatio ns.	
		i) **Kwagala is stringing four**	

TOPIC 3: BINOMIAL THEOREM

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY
The learner shouldbe able to: a) Construct Pascal's triangle and use it to generate coefficients of the terms in the expansion. b) State the binomial theorem. c) Expand in	**i. Binomial theorem develops observation al skills to explore the additional patterns formed by the coefficients of binomial**	Guide the learners to generate Pascal's triangle. Ask them to form groups offours, and eachgroup writes down the first seven rows of Pascal's triangle. Guide the learners on howto use Pascal's triangle to find the	Task The learnersto explainn how Pascal'strianglee can be used to findthe coefficients. Give exercisesand Assignments. .

ascending or descending order using binomial expansion. d) Find a particular term of a binomial expansion. Compute roots of numerical values using binomial expansion. state range of validity of binomial Expansion.	**expansions.**	coefficients of the terms with the powers of 'a' and 'b' shown, provided that all expansions are in the form $(a + b)^n$ Ask the learners to state and usethe binomial Theorem.	

TOPIC 4: COORDINATE GEOMETRY I

Some key concepts were removed since they were covered at O-Level. Theseinclude

(i) Forming Cartesian equations of lines

(ii) identifying linear equations

Finding the gradient of a straight line using the general equation of a line

Finding the intercept of a line

(v) Finding the coordinates of the midpoint of a line

(vi) Finding the distance between two points

(vii) Finding the point(s) ofintersection by solving the equations simultaneously.

(viii) Determining the relationship between the gradients of parallel and perpendicular lines.

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNIN GACTIVITIES	ASSESSMENT STRATEGY

The learner shouldbe able to: a) find the b) perpendicular distance between a lineand a point c) find the d) Relationship between the gradient and tangent of the angle. e) Find the area of polygons in the Cartesian plane. f) Locus of apoint: (i) **Equidistant from two points.** (ii) **Equidistant fr om a point.** (iii) **equidistant From two lines.**	I. *Coordinate; geometry* isneeded to offer a connection between algebra and geometry with the use of graphs of lines and curves	i) Through teacher exposition, guide the learner to find the perpendicular distance of a point from a line. ii) Ask the learners to iii) State the relationship between the gradient and the tangent of the angle. iv) Find the locus of a point. v) Find the area of a triangle in the Cartesian plane.	Task the learners to do exercises and assignments.

TOPIC 5: DIFFERENTIATION I

In this topic, the following applications of differentiation have been merged namely, gradient function, curve sketching 1, velocity and acceleration.

OBJECTIVES	KEY CONCEPTS	EACHING/LEARNING ACTIVITIES	SSESSMENT STRATEGY

The learner should be able to: a) find the b) gradient ofa chord c) identify thesmall incrementas δx a. define the gradient of a curve at a point d) Deduce the gradient ofthe tangent at a point on the curve.	Differentiation develops the skillsof analysis of the whole in terms of various components.	i) Use two straight rods meeting at 90° with a curved object to show how the chord changes into the tangent at same given point ii) Ask the learners to illustrate the trajectory of the maximumdistance attained iii) finding the maximum andminimum of some geometrical quantities such as length, area	i. Task the learners to do exercises and assignments.
a. differentiate from first principles, and deduce the formula of Differentiation.	Gradient functionis used in determining rate of change of two variables	i) Introduce the learners to theidea of a limit of a function **Guide the learners to differentiate polynomils** ii)	**i. Assess how learners apply differentiation :Tangents and normal Small changes.**

b. differentiate apolynomial find the equation of the tangents and at a pointon a curve, and calculate small changes. **c. calculate ratesof change.** **find greatestand least Values.**		Ask the learners to apply differentiation.	Greatest and least values. Rates of change.
a. find the natureof turning points using differentiation apply the second derivative to determine the nature of turning points sketch curves	Curve sketching develops the skill information presentation and determination of rates of change.	i) Guide the learners to sketch quadratic curves ii) Ask the learners identify the maximum andminimum points of quadratic curves iii) Guide the learners to sketch curves of higher order iv) functions	i. Assess how learners apply differenti ation to curve sketching .
Velocity andAcceleration a) . use differentiat ion to find velocity, acceleration n from Displacement.	Velocity and acceleration n are derivatives of displacement and time and are important in making decisions	i. Throwing bodies upwards to demonstratethe maximum distance attained by a body	I. Assess how learner s apply differen tiation to relate displacem ent velocity And acceleratio n

TOPIC 6: INTEGRATION I

In this topic, the following have been merged namely, indefinite and definite integrals and applications of integration.
Mean value of a function has been removed.

Applicationsof Integration Find the ı. Area undercurves and lines. ›. Area between two curves. ›) Volumes ofrevolutionfor rotations about the xand y axes. :) Displacement from accelerationn and velocity using initial conditions.			i) Assign the learners exercises to learn the skill of integration . ii) Evaluate definite integrals to find net area between a curve and the x-axis using the Fundamental Theorem of Calculus. iii) Use properties to definite **Integrals to solve graphicalnet area problems.** Use definite integrals to find the area between two curves.

TOPIC 7: TRIGONOMETRY

In this topic, Trigonometry and calculus of trigonometry have been merged. Inverse trigonometric functions, derivatives of inverse trigonometric functions, solutions of triangles have been removed

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY
The learner shouldbe able to: a) Relate angle measures to degrees and radians. b) Convert degreesto radians and vice versa. c) Find the value of length of an arc and area of a sector. d) derive e) trigonometrical ratios from a right-angled triangle f) find the sine, cosine, tangentof an angle of any magnitude using the quadrants of a unit circle g) deduce h) trigonometrical ratios of “special” angles i) draw j) trigonometrical	i. The common angle measures are radians and degrees. i. The simple formulae for findingarea of a sector andlength of an arc. i. Trigonometry develops the skills of understanding the propertiesof the triangles, applicationn and howto use them in various areas suchas Construction.	**i) Guide the learners on how to derivethe trigonometric ratios** **ii) Ask the learners to draw graphs of different trigonometric ratios** **iii) Help the learners to relate the Pythagoras theorem to the trigonometric ratios. Practical Problems / Activities** **iv) Using a graph paper, learners candraw a unit circle and useit to generatesines, cosines** **a. of both positive andnegative angles and draw graphsof sinθ, cos θ and tanθ**	**i. Give learners tests, exercises and assignments.**

graphs **h. use Pythagoras theorem to derive and simplify trigonometrical identities** **i. prove identities** **j. solve trigonometrical equations** **c. eliminate the parameter θ from a pair**			
The Compound Angle Formula a) use the ratios:sin (A±B) , cos(A±B), andtan (A±B) b) prove identities c) Solve trigonometrical equations. d) Derive the expression forthe angle between two lines. e) deduce f) formulae for double angles,half angles and other multi- angles using compound angle formula g) derive and use The factor Formulae. k. simplify, deriveand solve a) equations	i. The Compound angle Formula develops the skills of using the trigonometri cratios to derive and apply identities.	i. Guide the learners on how to derive the compound trigonometric ratios. ii. Guide the learners to prove and solve trigonometric equations iii. Ask the learners to prove trigonometric identities iv. Guide the learners on how to derive and apply the factor formula.	**v. Give learners tests, exercises and assignments.** **vi. Solve trigonometric equations involving multiple angle equations** **vii. Find all infinite solutions,as well as solutions just in the interval**

Harmonic identities a) Express b) asin θ ± bcos θ in the form c) Rsin(θ ± α) d) Express e) acos θ ± bsin θ in the form f) Rcos(θ ∓ α) g) Apply the harmonic identities to solve equations of the form asin θ ± bcos θ = c, acos θ h) ± bsin θ = c	i. The harmonic identities develops the skill of expressing the functions involving sumof sine and cosine as a single term.	i) Ask the learners to find the value of R and α ii) Guide the learners to solve trigonometric equations using the harmonic form.	i. Task the learners to (a) find the value of R and α (b) solve the equation using the harmonic form
Calculus of Trigonometry. a) find the b) Relationship between cosθ, sinθ , tanθ and θ(rad) for θ is a small angle. c) Use the limit definition to express the derivatives of the a) trigonometric	i. In calculus of trigonometry, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals.	i. Guide the learners to Justify, numerically the approximation n sin x ≈ x for small x and demonstrate that the approximation n may not be good for large	**i. Give learners tests, exercises and assignments.**

i) Functions. ii) Differentiate trigonometrical functions from first principles. iii) Differentiate trigonometrical functions directly. iv) Use the v) derivative rules to establish the derivative rules for tanx secx, cotx, and cscx• vi) integrate simple vii) Trigonometrical functions.		Angles. ii. Work with limit statements toobtain other approximationsns in a manner similar to the sin x ≈ x derivation	

TOPIC 8: DIFFERENTIATION II

This topic cannot be merged with differentiation 1 because it requires prior knowledge of trigonometry. Maclaurin's theorem has been removed.

OBJECTIVES	EY CONCEPTS	EACHING/LEARNINGACTIVITIES	SSESSMENT STRATEGY
ExponentialFunctions *The learner should be ableto:* a) differentiate exponential functions b) differentiate exponential functions where the base is a constant, linear exponents,and c) With quadratic exponents. d) use the e) chain, product, and quotient rules for differentiation in orderto **differentiate exponential functions,** **d. integrate** exponential functions	i. The exponential function is the only function whose derivative is equal to itself. This fact makes the natural exponential function appearas a solution formany different mathematical models of real-world problems.	i)Ask the learner to identify exponential functions. ii) Guide the learners to sketch smooth curves for exponential functions. iii) Ask the learners apply the derivative rules to differentiate the exponential functions. iv) The exponential function y = ex is the only function whose derivative is equal to v) itself.dy = ex vi) dx Instructions	i. Task the learners to do the exercises and assignments. Task thelearners to review the laws of Logarithm and work through multiple examples of how to calculate and simplify derivatives of logarithmic functions.

LogarithmicFunctions. a. **differentiate natural logarithmic functions** b. **use the chain, product, and quotient rules for differentiatio nto differentiate complicated functions that involve different types of logarithmic functions,** c. **use the laws of logarithms to simplify a function before Differentiating.**	i. logarithmic functions areinverses of exponenti al functions		1.

TOPIC 9: INTEGRATION II

Partial fractions have been merged with this topic. However, integration of The functions of the form (i) $\frac{1}{\sqrt{(a^2-b^2x^2)}}$ (ii) $\frac{1}{a^2+b^2x^2}$ and the Use of the t –

Formulae substitution have been removed.

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY
The learner should be able to: a. Integrate by: **recognizing a function and its derivative.** ii. **Odd and even powers of trigonometrical functions.** iii. **Products of trigonometrical functions** iv. **By change of variable.** v. **functions of the form** $\int f'(x)$ $f(x)$ vi. **Partial Fractions.** vii. **By parts.**	i) Recognizing a function and its derivative. ii) Choosing suitable change of variable to integrate. iii) Integration by parts.	i. **Ask the learners to recognize a function andits derivative.** ii. **Guide the learners through the systematic methods of integration.** iii. **Ask the learners to sketch smooth curves for exponential functions.** iv. **Guide the learners with the techniqueof partial fractions which involves decomposing a rational Function into a sum of twoor more simple rational functions.** v. **Guide the learners on how to choose the u and dv when integrating by parts dv mustbe a function that**	**i. Task thelearners with numerous exercisesfor:** **(a) recognizinga function and its derivative** (b) **even and odd powers oftrig functions** (c) **changeof variable** (d) **resolving into partial fractions (e) integrationby parts**

		we can integrate. vi. **Guide the learners on how to:** **a.** (a) **use Pythagorean identities to integrate odd powers of sine and cosine.** (b) **Use of double angle formula to integrate even powers of cosine andsines.** **Use of factor formula to integrate products of sine andcosine.**	

TOPIC 10: DIFFERENTIAL EQUATIONS

Nothing has been changed; however, solution of differential equations should not involve Problems leading to integration of inverse trigonometric functionsand t-substitution

OBJECTIVES	EY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY
The learner shouldbe able to: a) Form a differential equation recognize differential equations that can be solved by each of the three methods – (i)direct integration, (ii)separationn of variables (iii)integrating factor method and use the appropriate method to solve them use an initial condition tofind a particular solution of adifferential equation d. solve problemsinvolving exponential growth and decay	Many laws governing natural phenomena are equations involving rates at whichthings happen (derivatives). These Equations containing derivatives are called differential equations. Therefore many systemscan be well understood through differential equations	• Through brainstorming,guide the learners to recognize a differential equation. • Through teacher guided discussions, guide the learners to state the order of a differential equation. • Through teacher guided discussions, guide the learners to form a differential equation. • Through teacher • Exposition, guide the learners to solve the differential equation usingany one of the methods. • Through teacher exposition, guide the learners to solve word problems and understand the terms 'exponential growth/decay', 'proportionategrowth rate' and 'doubling/halving time' when applied to population models, and the terms 'exponential decay', 'decay constant' and 'half-life' when applied to radioactivity	**Give learners tests, exercises and assignments.**

TOPIC 11: INEQUALITIES

In this topic, linear inequalities, sketching graphs of inequalities and curve sketching II have been removed.

OBJECTIVES	EY CONCEPTS	TEACHING/LEARNING ACTIVITIES	SSESSMENT STRATEGY
The learner should be able to: i) solve: ii) Quadratic inequalities. iii) Rational inequalities. (iii) exponential iv) Inequalities.	i. Use of the table of analysis s in solving complex inequalities.	i) Ask the learners to solve (i) quadratic inequalities. ii) Rational inequalities. iii) Exponential inequalities.	i. Give class exercise to review o level properties of inequalities.
		—	ii. Give class exercise s, assignments and Tests.

TOPIC 12: VECTORS

In this topic knowledge of position vectors, displacement vectors, magnitude, equal vectors, and vector algebra has been removed.

BJECTIVES	EY CONCEPTS	EACHING/LEARNING ACTIVITIES	SSESSMENT STRATEGY

The learner should be able to: a. determinea unit vector.	Vector analysis involves handling vectors in calculations, giving rise to vector algebra, vector geometry and vector calculusin 2D and 3D.	• Guide the learner to express a vector as column vector in both 2Dand 3D. • Guide the learners on howto identify positionvector. • Unit vector. A unit vector can be found bydividing a vector by its modulus. • $\hat{a} = a$ • |a| • Guide the learners on howto apply the scalar and cross product	Task the learners to practice exercise onall the Concepts.
b. Perform operations on vectors in 2D and 3D			
c. use the dot product of two vectors.			
d. state and apply the ratio theorem.			
Lines in twoand three dimensions. a. form a vector equation of a line.	**The emphasis of vector geometry of lines in 2D and3D.**	Ask the learner to: • Derive the parametric and Cartesian equationsof lines. • Find the angle between two lines. • Guide the learners on how to find the point of intersection of two lines.	**Task the learners with practice exercises to be done in pairs**
b. write the parametric and the Cartesian			

a) Equation of a line. b) Apply the dot product to find the angle between two lines. c) Find the perpendicular distance from a point to a line. d) Find the point of intersection of two lines. e) Identify skew and parallel lines.			
planes **a. Form a vector equation of a plane.** **b. Write the parametric and Cartesian equations of a plane.** **c. find the perpendicular distance of a point**	**Plane geometry can be easily solved by vector methods; several forms of vector equations of a plane are being considered.**	• **Through teacher exposition, guide the learner to:** **(i) Derive the parametric and Cartesian equations of planes.** **(ii) (ii) Find the angle between two lines.** • **Through guided discussions, guide the learners on how to find the point of intersection of** **(i) A line and a plane.** **(ii) Three planes.**	Task the learners with practice exercises on the vector geometry of planes.

a) From a plane. b) Find the point of intersection a line and a plane. c) Find the point of intersection of three planes. a. Find the angle between a line and a plane using the dot product. d) find the angle between two e) Planes.			

TOPIC 13: COMPLEX NUMBERS

In this topic, regions in complex numbers and De Moivre's theorem have been removed.

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMEN T STRAT EGY

The learner should beable to: a) Identify the real and imaginary parts of a complex number. b) Identify and state a conjugate of a complex number. Carry out the algebra of complex numbers. Find the modulus and argument of a complex number. c) Represent complex numberson an argand diagram. d) Express complex numbers inpolar coordinates form. **a. find and define thelocus of the point P(x,y) representingthe complex number x +yi by:** **(i)equality of complex numbers**	**h. An element of the set of real numbers. The set of real numbers include the rational numbers and the irrational numbers, but not all complex numbers.** **Imaginary number: a numberof the form ai, where a is a real number and I the imaginary unit a number, of the form a+bi where a and b are real numbers and** $\sqrt{-1}$ **.**	i) Through teacher exposition, guide the learners to identify the square root of negative numbers. ii) Through teacher guided discussions, guide the learners to: (i) simplify powers of i. iii) (ii) Solve quadratic equations with complex roots. iv) Through brainstorming, guide the learners to identify and state a conjugate of a v) complex	Give learners tests,exercises and Assignment. .

(ii) modulus definition (iii)argument definition (iv)pure parts		Number. v. Through teacher exposition, guide the learners to carry out thealgebra of complex numbers. vi. Through teacher exposition, guide the learners to find the modulus and argument of a complex number. vii. Through teacher guided discussions, guide the learners to draw argand diagrams. viii. Through teacher guided discussions, guide the learners to express complex numbers in polar form. ix. Through teacher exposition,	

		Guide the learners to find, describe and representthe locus in the complex plane. x. Through teacher guided discussions, guide the learners to solve equations withcomplex roots.	

TOPIC 14: COORDINATE GEOMETRY II (THE CONIC SECTION

Coordinate geometry II and III have been merged as coordinate geometry II. Only two conic sections have been considered. The ellipse, hyperbola and the rectangular hyperbola have been removed.
Under the circle, intersection of circles internally, externally and orthogonally has been removed.

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY
The learner should be ableto: a) form and identify the equation of a	i. Develops skills to understandthe circle asa locus.	i. **Ask the learners to form and identify the equation of a circle.**	Task the learners with exercises and assignments.

circle b) Find the center andradius of a circle. c) Find the equation of a circle given any points. d) Determine the equation of the tangent ata given point. e) determine the length ofthe tangent f) To a circle.	**ii.** Geometric relationships and equations about circles.	ii. **How does the distance formula relate to the standard form equation of acircle?** iii. **Ask the learners to find or state the center and radius ofa circle.**	
Parabola a. **Identify a parabola .** b. **draw a sketchof a parabola and e. identify**	Conic sections are generated by the intersection of a plane with a cone. **If the plane is**	**i. Ask the learners to identify the conics. Identify a Parabola.**	i. Give learners tests, exercises and Assignments.

The equation of a parabola. **f. find the parametric equation of a parabola.** **g. find the equation of tangent, normaland chord of a parabola.**	Parallel to the generating line, theconic section is a parabola. Most of the real world shape is parabolic.	**ii. Ask the learners to find the equation of the tangent, normal and chord of each of the parabola. The parabola is defined as the locus of a point which moves so thatit is always the same distance froma fixed point (called the focus) and a given line (called the directrix)**	

APPLIED MATHEMATICS

PREAMBLE

Due to Covid 19, schools were closed and the learners have lost content equivalent to two school academic terms. During this period of closer NCDC developed home study material which were printed and uploaded onto its website www.ncdc.go.ug. The Ministry Of The Ministry Of Education and Sports guided that learners will be automatically promoted to the next class.As a result, National Curriculum Development Centre reorganized the content for senior

six.

The content has been reorganized by merging, removal and forwarding of content/topics of senior five and senior six to form the abridged curriculum. The first four topics viz, Descriptive Statistics, Index numbers, Scatter diagrams and linear motion are assumed to have been covered before the second lockdown. It is possible that the sequencing of the topics covered was not uniform in all schools.

The teacher is expected to use hybrid teaching and learning techniques to ensure learning takes place. Formative assessment will be done as the lessons are ongoing and a record of learner's attainment is recorded. There will be no termly assessment.

The teaching/Learning will be for fourteen weeks a term. The abridged curriculum will guide the teacher in the different schools. If a teacher notices that their learners had covered the content in the abridged curriculum, then there is no need to repeat but rather proceed to the next topics.

The following matrix is showing the teacher on what has been done with senior five and six syllabus to get the abridged curriculum for senior six.

MATRIX SHOWING THW CRITICAL CHANGES.

SN.	CHANGES	JUSTIFICATION
	PROBABILITY AND STATISTICS	
1	Discrete random variable: properties of E(X) and Var(X) has been removed i.e., $E(aX + b) = aE(X) + b$ $Var(aX + b) = a^2Var(X)$ etc.	Basic knowledge of E(X) and Var(X) has been acquired.
2	Continuous random variable: Properties of E(X) and Var(X) has been removed. i.e. $E(aX + b) = aE(X) + b$ $Var(aX + b) = a^2Var(X)$ etc. Use of the CDF should be restricted to calculating the quartiles only. (Lower, median and upper quartile).	Basic knowledge of E(X) and Var(X) has been acquired.

3	Uniform /rectangular distribution has beenremoved.	To reduce content.
4	Normal distribution and normal approximation to the binomial have been Merged.	To save time.
	MECHANICS	
5	Newton's laws, momentum and connected Particles have been merged into one topic.	They are closely related
6	circular motion Elasticity . }have all been Simple Harmonic motion Centre of gravity removed	Mostly required by the Physics students and has already been catered for in Physics. The topics left in Mechanics are adequate for all Combinations.
	NUMERICAL METHODS	
7	Error analysis: errors in functions has beenremoved	Basic knowledge hasbeen catered for.

SN.	CHANGES	JUSTIFICATION
		Knowledge acquired is Sufficient.
8	General iterative formula has been removed.	Newton Raphson's Method is sufficient.
9	Further linear interpolation has beenremoved	To reduce content. Basic knowledge of linear interpolation has Been acquired.

TERM ONE: PROBABILITY AND STATISTICS

TOPIC 1: PROBABILITY THEORY

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

The learner should be able to: a) Use of the contingency table to calculate the probabilities b) Calculate the probability of c) Mutually exclusive events d) Exhaustive events e) Independentevents f) Calculate Conditional probability g) Using the tree diagram to calculate probabilities.	i. **Probabilitytells us about the certainty ofany particular event.** ii. **Probability develops the skills of prediction of an outcome by calculating and using the theoretical probabilityof that outcome.**	a. Guide the learnersto calculate probabilities with different outcomes. b. Guide the learnersto use the contingency table to calculate probabilities c. Guide the learnersto use the set theory to calculate probabilities ii) Ask the learners to calculate probabilities using the tree diagram.	Task the learners to: Use the Probability laws and the contingency table to calculate probabilities . explicitly use the law P(A ∪ B) = P(A) + P(B) — P(A ∩ B) Use the Venn diagram to calculate probabilities use of P(A/B) = P(Æ∩B) ——— P(B) Some situations may require using the tree diagrams

TOPIC 2: DISCRETE RANDOM VARIABLE

OBJECTIVES	KEY CONCEPTS	EACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

The learner shouldbe able to: a. use the b) properties of c) p.d.f a discrete r.v to calculate probabilities d) calculate theE(X) and Var(X) e) find the f) mode and median of a discrete r.v g) determine the h) -cdf froma pdf i) -pdf from a cdf	i) Concept of discrete r.v. ii) Required to draw a Probability distribution table to calculate E(X), Var(X) and standard deviation ofa discrete r.v iii) Mode and median of a discrete r.v. iv) cdf, F(x) ofa discrete r.v	i) Ask the learners to determine the ii) p.d.f of a discrete r.v iii) Ask the learners to calculate E(X), Var(X) of a discrete r.v. iv) Ask the learners to usethe properties of a p.d.f to calculate probabilities v) Ask the learners to calculate themode and median of a discrete r.v. vi) Ask the learners to determine the cdf from a pdf and a pdf from vii) a cdf.	**Task thelearners to** identify discreterandom variablewith assignments, tests andexercises

TOPIC 3: BINOMIAL DISTRIBUTION

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

i) The learner should be able to: ii) identify the propertiesof a binomial distribution iii) state the notation of a binomial distribution iv) $X \sim B(n, p)$ v) Use the formula and or tables to calculatethe probabilities. vi) use the formula for the E(X) and Var(X) of a binomial distribution	i) Concept of a binomial distribution,have two possible outcomes, success, p and failure q. ii) Notation of a binomial distributionshould be emphasized. iii) Use of theformula iv) $P(X = r) =$ v) $n_{r\ n-r}$ vi) $(_r) p\ q$ vii) $E(X) = np$ and $varX = npq$ viii) Using mathematical tables to find the probabilitiesof a binomial distribution.	i) Guide the learners to identify a binomial distribution. ii) Ask the learners to use the formula to calculate probabilities iii) . iv) Ask the learners to use the mathematical tables to calculate probabilities v) . vi) Ask the learners tocalculate E(X), Var(X)and standard deviation.	Task the learners to i) Do practice on exercises in order to masterthe basic. ii) Use boththe calculation method and the mathematical tables.

TOPIC 4: CONTINUOUS RANDOM VARIABLE

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

a) The learner should beable to: a. Use the b) properties of c) p.d.f a continuous r.vto calculate probabilities d) Sketch graphs of f(x) e) Calculate the expectation, E(X) and variance Var(X) and standard deviation .of a continuous r.v f) Determine the g) cdf from apdf and sketchit. h) (ii)pdf from a cdf i) Find the mode using the graphs of f(x) and calculus j) Find the k) quartiles using the cdf	i) Conceptof a continuous random variable ii) Properties of a continuous r.v iii) Graphsof f(x) iv) E(X) and Var(X) of a continuous r.v v) Using the cdf to determine the median vi) Mode and medianof a vii) continuous r.v	i) Ask the learners to determine the p.d.f of a continuousr.v ii) Ask the learners to calculate E(X), Var(X) and standard deviation ofa continuousr.v. iii) Guide the learners to use the propertiesof a p.d.fto calculate probabilitiess iv) Ask the learners to calculate the mode and medianof a continuous **v. Ask the learners to determine the cdf froma pdf and apdf from a Cdf**	i) Task the learners to ii) Give examples of a Conti nuous r.v. e.g. ages of people e, heights, weight etc. iii) Applythe integration skills tofind the required probabilities.

TOPIC 5: NORMAL DISTRIBUTION AND NORMAL APPROXIMATION TO THE BINOMIAL

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY
The learner should be ableto: a) State the notation of a normal distributionn b) $X \sim N(\mu, \sigma^2)$ c) Standardizee the normal variable X to a standard normal variable d) Read/signand use the standard normal tables to calculate probabilities. e) De-**standardization Finding** μ f) And σ orboth.	i) When standardizing the normal variable, use of theformula ii) $Z = \frac{X-\mu}{\sigma}$ iii) iv) Should clearly beshown. v) Standard normal tables vi) Before De-standardization vii) Sketch the standard normal curves to illustratethe given probabilities.	i) Guide the learners to identify a normal distribution. ii) Guide the learners to standardizethe normal variables. iii) Ask the learners to use the mathematical tables to calculate probabilities. iv) Ask the learners to find the values of x when the probabilitiesare known. v) . Ask the learners to find μ, σ or both.	Task the learners to i) Apply propertiesof a normal distributionn to Sketch the standard normal curves to illustrate the required region ii) Find the probabilities from the mathematical tables.

• . transform a binomial distribution tothe normal distribution using end continuity correction ○ Standardize the normal variable usingZ = $\frac{X(\pm 0.5)-np}{\sqrt{npq}}$ • i. Calculate the probabilities using the standard normal tables.	End continuity correction When standardizi ngthe normal variable use ofthe formula Z = $\frac{X(\pm 0.5)}{\sqrt{npq}} - np$ Standard normal tables	a. Ask the learners to identify the conditions for the transformation of the normal approximation toa binomial. ii) Guide the learners to applythe end continuity correction. iii) x. Ask the learnersto use the mathematical tables to calculate probabilities.	i) Identify the conditions under which the normal distributionn is used as an approximation to thebinomial. ii) Transform the binomial to normal by applying the end continuity correction.

TOPIC 6: SAMPLING DISTRIBUTION

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

The learner should be ableto: a) understand that samplemean can be used asa random b) Variablee, $\bar{X}$. c) Calculatete the probabilities involvingg samplemean	i. **Include that since the sample mean is a r.v then** $E(\bar{X}) = \mu$ **and** **Var**$(\bar{X}) = \frac{\sigma^2}{n}$ ii. **If the r.v** $X \sim N(\mu, \sigma^2)$ **then the sample mean** **a.** $\bar{X} \sim N(\mu, \frac{\sigma^2}{n})$	i) Guide the learners to identifya sampling distributi on. ii) Guide thelearners to standardize the sample mean. iii) Ask the learners to usethe mathematical tables to calculate the probabilities of the sample iv) mean	Task the learners to i. **distinguish betweenn a sample and a population** ii. **Standardize thesample mean using** iii. $Z = \frac{\bar{X}-\mu}{\frac{\sigma}{\sqrt{n}}}$ iv. **Find the required probabilities**

TOPIC 7: INTERVAL ESTIMATION

OBJECTIVES	KEY CONCEPTS	EACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY
The learner should beable to: a) determine the confidence interval of thepopulation mean parameter	i.concept of interval estimation	Ask the learners to determine the confidence intervals.	Task the learners to i) Identifythe conditionson s when n is

when b) -Population is normal c) n is large($n > 30$) d) the varianceis unknownn e) calculate the unbiased estimates of the population mean and variance from a sample	ii. the centrallimit theorem m is only appliedif the sampleis large($n > 30$) then the distribution of the sample mean isapproxi mately normal		large and the variancee is known ii) When the variancee is unknown then use the unbiased estimator of the iii) Variance.

SECOND TERM: MECHANICS

TOPIC 1: COMPONENTS AND RESULTANTS OF FORCES

OBJECTIVES	EY CONCEPTS	EACHING/LEARNIN GACTIVITIES	SSESSMEN T STRATEGY

The learner should be able to: a) calculate resultants of parallel and non-parallell forces b) calculate the resultant forces in a polygon	i) Number of forces can be represented by a single force. ii) This force is the resultant force. iii) Case when two forces are pulling an object in the same direction. iv) consider a stone is being projected using a catapult to explain resultant and components of forces	i) Consider a case of two forces pulling an object in the same direction. The result is with a bigger effect than when one of the forces is used to pull the same object to explain resultant of forces ii) Consider a stone being projected using a catapult to explain resultant and components of forces	Task the learners to i) Obtain the resultant force and its inclination on in different situations. ii) Assess how they apply trigonometry to resolve forces.

TOPIC 2: FRICTION

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

The learner should be ableto: a) Calculatee the coefficient of friction b) Calculatee the frictionall force or any other forces acting on the body moving on horizontal - Inclined plane	a) Conceptof friction b) Limiting equilibrium c) Coefficient of friction d) Frictionon horizontal and inclined planes	Help the, learnersto explain the meaning of friction force a) -Considera man riding a bicycle ona rough road. b) Striking amatch stick on amatch box. c) A woodenblock on a rough anda smooth surface. d) Ask the learners to calculate the coefficient of friction for bodiesalong the horizontal and inclined planes.	Task the learners to i) Relatee limiting ii) equilibrium to maxi mum force iii) Use the formula to solve the problems when the surface is rough

TOPIC 3: NEWTON'S LAWS, MOMENTUM AND CONNECTEDPARTICLES

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY
The learner should be ableto: a) able to state and apply Newton's laws of motion b) Apply the relation	i) The presence ofa force affects the state of motion of abody e.g. ii) Case a book resting on table	i) Help the learners recallNewton's lawsof motion ii) Guide the learners to apply Newton's lawsof motion iii) Help the learners	i) Task the learners to ii) Assess how learners apply the relation F=ma in differentt

c) F = ma and Newton's third law to connec ted particles d) use the e) Newton's secondlaw to calculate linear **momentum and to apply the principle oflinear momentum forelastic and** inelastic tum e. apply the principlee of conservation of linear moment tum to solve numerical problems	iii) Lifting up and down iv) Car moving with constant velocity and then brakesare applied v) Car pulling a trailer vi) Resultant force on a body gives itan acceleration vii).Connecting strings should be light and inelastic Elastic and inelastic collisions	todraw clear force diagrams. iv) Guide learnersto solve problems involving different arrangementsof connected particles. v) Ask the learners to calculate collisions.	situations iii) Task learnersto drawforce diagrams for differentt situations. Assess how they apply the relation F = ma. iv) Give learners class exercises ,tests and assignments

TOPIC 4: WORK, ENERGY AND POWER

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

The learner should be able to: a) Calculate the work done by a constant force when its point of application undergoesa displacement b) calculatethe workdone against gravity c) calculatethe workdone against friction d) use appropriate formulae to calculate gravitational P.E and e) Kinetic f. **Energy. apply the principle of conservation of energy appropriat ely** g. **Relate work done to change in energy.** h. **Understand and use the definitionof power** i. **Find and use the**	i) Concept ofwork doneby a constant force , including W = ii) Fdcosθ iii) Concept ofwork doneagainst gravity iv) Concept of work done by against friction v) Gravitational vi) l P.E vii) Kineticenergy viii) principle of conservationn of energy Power ix) Block of wood pulledacross the horizontal surface **A cyclist riding a bicycle on a rough road when wind is blowing** Include Pump raising and ejecting water at a given speed	i) Ask the learners tocalculate the work done against gravity, work doneby a constant force and work done against friction. ii) Ask the learners to apply the principle of conservationof energy to solve problems involving work done and power.	Task the learners to Learn the different formulae of work done and power . Draw the relevant force diagrams correctly including all the necessary forces .

relationship between power, force and velocity fora force acting in the direction of motion. f. solve related problems			

TOPIC 5: RESULTANT VELOCITY AND RELATIVE MOTION

OBJECTIVES	KEY CONCEPTS	EACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

The learner should be able to: a) Find the b) Resultant velocity of more than one velocities. c) Find the d) resultant velocity of a body moving in a current e) Find the f) relative velocity g) Find the h) relative displacement i) Calculate the velocity of a body relative to another	i. **Resultant velocity** ii. **Body moving ina current i.e. water or air** iii. **Concept of relative velocity**	i. **Ask the learners to calculate the resultant velocity, where possible illustrate crossing a river by a boat or swimming .aircraft in wind** ii. **Guide the learners to calculate relative velocity and relative displacement** iii. **Ask the learners to determine**	Task the learners to a) Consider the case when two bodies moving in – the same direction b) opposite direction c) different direction
	iv. **Concept of relative displacement** v. **Closest distance and time when it occurs**		**ii.** ***The vectorial approach is more user friendly than the geometrical one.***

Calculate time , course , distance of closest approach **g. Calculate time taken for interceptio n to** ocr	**Interce ption**	**the distance of closes approach and the time taken.**	

TOPIC 6: VECTORS IN MECHANICS

OBJECTIVES	KEY CONCEPTS	EACHING/LEARNING ACTIVITIES	SSESSMENT STRATEGY

The learner should be able to: i) find the magnitude of a vector ii) determine the unit vector iii) apply the knowledge of calculus to find the acceleration, velocity, displacement iv) , work doneand power.	i) Knowledgeof vector equation ofa line is required. ii) Unit vector iii) Dot product iv) Vectors and calculus	i) Illustrate with the straight passes by footballers ii) A golf ball being projected inspace iii) Guide the learners to use the knowledge of calculus and vectors to find acceleration iv) , velocity, displacement, work done and v) Power.	Task the learners to i. Observe the use of vectorsymbols.

TOPIC 7: PROJECTILE MOTION

OBJECTIVES	EY CONCEPTS	EACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

The learner should be able to: a) Apply the terminologies: projectile, horizontal ranges, maximum horizontal range, trajectory, time of flight and greatest height to related numerical problems. b) Calculate numerical problems related to vertical and horizontal projectiles.	i) Consider abob projectedalong a table ii) , throwing a ball into a net like netball, basketball. iii) Concept of iv) vertical projection(ii) horizontal projection(iii) particle projectedat an angleto the horizontal	a) Illustrate to the learners the motion of projected bodies. b) i. Guide the learnersto calculate range, maximum height and other problems related to projectile motion.	**Task the learners to** give learners exercises ,tests and assignments
	N.B projectiles on an inclined plane should not be considered .		

TOPIC 8: COPLANAR FORCES

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

The learner should be able to: a) Apply the condit ions for forces in equili brium to exist b) Apply the principle of mome nts to solve problems on – ladder s- rods – jointed rods	Forces in equilibrium i) –triangles of forces ii) Lami's theorem iii) polygon of forces iv) Ladders v) Jointed rods vi) A man climbing a ladder vii) Bridges viii) Frames	i) Guide the learners to identify clockwise and anticlockwisee turnings ii) Ask the learners to calculate themoment of aforce about any point. iii) Help the learners to understandthe conceptof bodies in equilibrium iv) Ask the learners to apply the principle of moments todifferent bodies in equilibrium	Task the learners to give learners class exercises ,tests and assignment s

TERM THREE: NUMERICAL METHODS

TOPIC 1: LINEAR INTERPOLATION AND EXTRAPOLATION

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

The learner should be able to: a) Estimate the value between two given values using the gradient approach b) Estimate the value outside two given values using the gradient approach	Linear interpolation Linear extrapolation	i. Through teacher exposition, guide the learners to use the gradient of a line to linear interpolation and linear extrapolation	Task the learners to give learners class exercises , tests and assignments.

TOPIC 2: LOCATION OF ROOTS

OBJECTIVES	KEY CONCEPTS	EACHING/LEARNIN G ACTIVITIES	SSESSMENT STRATEGY

The learner should be able to: a) Show That a root(s) exist in the given interval using the change ofsign rule. b) Show that a root(s) exist in the given interval using thegraphical method. Estimate a root(s) of the equation c) $f(x) =$ d) 0 in the given interval using thechange of sign rule.	i) Sign- change rule ii) Graphical method , include the method of splitting the function into two smaller functions	i) Guide the learners to use the sign-change rule to locate the roots of an equation ii) $f(x) = 0.$ iii) Ask the learners to draw graphs and use them to locate the root of an equation.	Task the learners to use of radians when dealing with trigonometric functions should be emphasized.

TOPIC 3: ERROR ANALYSIS

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

The learner should be able to: a) Determinethe limits of accuracy Find absoluteerror, relativeerror and percentage errors of simple numbers Propagation of Errors Using Simple IntervalArithmetic Method a) Calculate the working / true value b) Determine the minimumand maximum values c) Find the b) maximum possible	i) Rounding off errors ii) Truncation errors iii) Limits of accuracy iv) Absolute error, relative error and percentage errors Working / true value v) Maximum and minimum values vi) Maximum possible error in addition , subtraction, multiplicatio n and division vii)iv. Limits , range and interval oftrue value	i) Guide the learners to identify the sources of errors. ii) Guide the learners to round off and truncate numbers to the given degree of accuracy. Guide the learners to calculate the maximum and minimum values iii) Guide the learners to propagate errors using the simple interval arithmetic method iv) Through guided discussions, guide the learners to find the limits, range and interval within which the working value lies.	Task the learners to distinguish between rounding off and truncation errors Find the maxim um and minimum valuesand hencethe maximum possible Error.. Do practice on numbers with multiple le operat ions.
Error in addition, subtraction, multiplication n and division of numbers. d. Find the limits, range and interval within which the working value lies			i.

Propagation of Errors Using the Absolute Error Method a. Derive and use the formulae for maximum possible error, relativeerror and percentage error in addition, subtraction , multiplication and division of numbers	i. formulaefor maximum possible error, relative error and percentage e error in addition, subtraction , multiplication and division of numbers	i. Guide the learners to derive the formulae for maximum possible error, relative error and percentageerror in addition, subtraction , multiplication and division of numbers	**i. Give learners class exercises ,tests and assignments**

TOPIC 4: TRAPEZIUM RULE

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

The learner should be able to: i) Use the ii) trapezium rule and approxi mate the value ofan integral iii) Determine the exact value of an integral iv) calculate the percentage error	i) Terminologies sordinates strips sub divisions sub interval ii) Trapezium rule to approximatethe value of an integral. iii) Percentage error	i) Ask the learners to sketch a curve and determine the area under the curve in the given range by dividing it into several equal trapezia and Find the area ofeach ii) trapezium Ask the learners to distinguish between the ordinates, strips, sub division and sub interval iii) Guide learners to iv) use the techniquesof integrationto find the exact valueof the given integral	Task the learners to i) Distinguish h between ordinate, strips, subdivision s and sub intervals ii) Derive the trapezium rule iii) Sketching of the curves is NOT required. avoid premature rounding off, when the expected answer is to n decimal places, first work with at least iv) n + 1 dps then round off at the end. v) v. Use the modulus sign when finding the percentage error

TOPIC 5: NEWTON RAPHSON'S METHOD

OBJECTIVES	EY CONCEPTS	TEACHING/LEARNING ACTIVITIES	SSESSMENT STRATEGY

The learner should be able to: i) use the general Newton Raphson's method to estimate the root of the equation $f(x) = 0$ ii) identify the initial approximation using either the graphical method or linear interpolation iii) test for convergence using TOL$\leq \frac{1}{2} \times 10^{-n}$	i) General formula for Newton Raphson's method ii) Testing for convergence using the TOL.	i) Guide the learners to derive and use the ii) General formula for Newton Raphson's method iii) to estimate the root of the equation $f(x) = 0$ iv) N.B. *handling of the function as a variable but not a constant e.g.* $f(x) = xe^x +$ *v)* $5x - 10$ *is a* *vi) Variable yet* $f(x_n) = x_n e^{xn} + 5x_n - 10$ *is a constant.* vii) Through teacher guided discussion, guide the learners to find the root of the functions whose roots are not exact.	**Task the learners to** derive the general Newton Raphson's method to avoid pre-mature rounding off, during the course of finding the root. Use to at least one more degree of accuracy than the expected degree of accuracy. Only round off to the expected degree of accuracy when convergence has been Achieved.

TOPIC 6: FLOW CHARTS

OBJECTIVES	KEY CONCEPTS	TEACHING/LEARNING ACTIVITIES	ASSESSMENT STRATEGY

The learner should be able to: a) identifythe common shapesof a flow chart b) draw c) flow chart for problem solving d) Interpret the purposee of a flow chart	i. Common shapes used in flow charts iii) Types of flow charts iv) Dry run	i) Guide the learners to identify the common shapesused in a flow chart ii) Ask the learners to draw the different types of flow charts e.g., for (i) counting , square, cube numbers, a. **(ii)Newton Raphson method** b. **(iii)compound interest** ii. **Guide the learners to perform a dry run and state the purpose of the flow chart.**	Task the learners to understand and use the definition of a flow chart i. Practiceusing theright shape foreach stage of the flow chart.

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