231 - BIOLOGY

GENERAL SUBJECT OBJECTIVES

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

1. communicate biological information in a precise, clear and logical manner
2. develop an understanding of interrelationships between plants and animals and between humans and their environment
3. apply the knowledge gained to improve and maintain the health of the individual, family and the community
4. relate and apply relevant biological knowledge and understanding to social and economic situations in rural and urban settings
5. observe and identify features of familiar and unfamiliar organisms, record the observations and make deductions about the functions of parts of organisms
6. develop positive attitudes and interest towards biology and the relevant practical skills
7. demonstrate resourcefulness, relevant technical skills and scientific thinking necessary for economic development
8. design and carry out experiments and projects that will enable them understand biological concepts
9. create awareness of the value of cooperation in solving problems
10. acquire a firm foundation of relevant knowledge, skills and attitudes for further education and for training in related scientific field.

1.0.0 INTRODUCTION TO BIOLOGY

1.1.0 Specific Objectives

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

(a) define biology
(b) list branches of biology
(c) explain the importance of biology
(d) state the characteristics of living organisms
(e) state the main differences between plants and animals.

1.2.0 Content

1.2.1 Definition of biology
1.2.2 Branches of biology
1.2.3 Importance of biology
1.2.4 Characteristics of living organisms
1.2.5 Comparison between plants and animals

1.3.0 Practical Activities

1.3.1 Collecting, observing and recording external features of plants and animals

2.0.0 CLASSIFICATION I

2.1.0 Specific Objectives

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

(a) use the magnifying lens to observe the external features of plants and animals
(b) record observations of the main external characteristics of living organisms, preserved specimens and photographs
(c) state the necessity and significance of classification
(d) name the major units of classification
(e) state the application of binomial nomenclature in naming organisms.

2.2.0 Content

2.2.1 The use of magnifying lens
2.2.2 External features of Plantae, Arthropoda and Chordata
2.2.3 Necessity and significance of classification
2.2.4 Major units of classification:

Kingdoms: Monera, Protoctista, Fungi, Plantae, Animalia *(Give examples of each)*

For the kingdom Plantae and Animalia, cover phylum/division, class, order, family, genus and species. Show the relationship between the taxonomic units *(Give examples of each taxon)*

2.2.5 Binomial nomenclature

2.3.0 Practical activities

Use of collecting nets, cutting instruments and hand lens

Collection and detailed examination of external features of:

- Animals such as arthropods and chordates
- Plants - rhizoids, root systems (taproot, fibrous and adventitious), stems and leaves

3.0.0 CLASSIFICATION II

3.1.0 Specific Objectives

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

(a) state briefly the general principles of classification of living organisms
(b) state general characteristics of each of the five kingdoms
(c) state the main characteristics of arthropoda, chordata.
(d) state the main characteristics of major division of plantae
(e) state the characteristics of classes of spermatophyta
(f) describe the main characteristics of classes of arthropoda and chordata
(g) use observable external features to construct simple dichotomous keys of plants and animals
(h) Use already constructed dichotomous keys to identify organisms

3.2.0 Content

3.2.1 Review of binomial nomenclature
3.2.2 General principles of classification
3.2.3 General characteristics of kingdoms: Monera, Protoctista, Fungi, Plantae, Animalia.

3.2.4 Main characteristics of major divisions of plantae: Bryophyta, Pteridophyta, Spematophyta (cover subdivision Gymnospermae and Angiospermae).
For Angiopermae cover classes monocotyledonae and dicotyledonae.

3.2.5 Main characteristics of the Phyla Arthropoda and Chordata (cover up to classes as shown)

Arthropoda: diplopoda, chilopoda, insecta, crustacea, arachnida
Chordata: pisces (emphasis on sub-class osteochythes), amphibia, reptilia, aves, mammalia.

3.2.6 Construction and use of simple dichotomous keys based on observable features of plants and animals

3.3.0 Practical activities

3.3.1 Examine live/preserved specimens or photographs of representatives of major divisions of plantae and phyla arthropoda and chordata

3.3.2 Construct simple dichotomous keys using leaves/parts of common plants/arthropods/common chordates in the local environment

3.3.3 Use dichotomous keys to identify organisms

4.0.0 THE CELL

4.1.0 Specific Objectives

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

(a) define the cell
(b) state the purpose of a light microscope
(c) identify the parts of a light microscope and state their functions
(d) use and care of the light microscope and calculate the magnification
(e) identify the components of a cell as seen under the light and electron microscopes and relate the structures to functions
(f) compare plant and animal cells
(g) mount and stain temporary slides of plant cells
(h) describe animal cells as observed from permanent slides
(i) estimate cell size
(j) state the differences between cells, tissues, organs and organ systems.

4.2.0 Content

4.2.1 Definition of the cell

4.2.2 Structure and functions of parts of a light microscope

4.2.3 Use and care of the light microscope

4.2.4 Cell structure and functions as seen under

a light microscope
an electron microscope

4.2.5 Preparation of temporary slides of plant cells

4.2.6 Estimation of cell size

4.2.7 Cell specialization, tissues, organs and organ systems

4.3.0 Practical activities

4.3.1 Observe, identify, draw and state the functions of parts of the light microscope

4.3.2 Prepare and observe temporary slides of plant cells
4.3.3 Observe prepared slides of animal cells
4.3.4 Compare plant and animal cells
4.3.5 Observe, estimate size and calculate magnification of plant cells

5.0.0 CELL PHYSIOLOGY

5.1.0 Specific Objectives

By the end of the topic, the learner should be able to:
(a) define cell physiology
(b) correlate the membrane structure with cell physiology in relation to permeability
(c) differentiate between diffusion, osmosis and active transport
(d) state and describe factors affecting diffusion, osmosis and active transport
(e) carry out experiments on diffusion and osmosis
(f) explain the roles of diffusion, osmosis and active transport in living organisms
(g) explain turgor and plasmolysis in terms of osmotic pressure

5.2.0 Content

5.2.1 Meaning of cell physiology
5.2.2 Structure and properties of cell membrane (Theories of membrane structure not required)
5.2.3 Physiological processes – diffusion, osmosis and active transport
5.2.4 Factors affecting diffusion, osmosis and active transport
5.2.5 Role of diffusion, osmosis and active transport in living organisms
5.2.6 Water relations in plant and animal cells: tugor, plasmolysis, crenation and haemolysis
5.2.7 Wilting

5.3.0 Practical activities

5.3.1 Diffusion as demonstrated with potassium permanganate or potassium iodide/flower dyes/coloured plant extracts/smoke
5.3.2 Experiments using visking tubing and living tissues: fresh arrow roots/cassava/sweet potatoes/leaf petioles/irish potatoes/carrots
5.3.3 Plasmolysis can be demonstrated by using any of the following: Spirogyra, epidermal cells of onion or raw eggs that have been put in dilute hydrochloric acid overnight

6.0.0 NUTRITION IN PLANTS AND ANIMALS

6.1.0 Specific Objectives

By the end of the topic, the learner should be able to:
(a) define nutrition and state its importance in living organisms
(b) differentiate various modes of feeding
(c) describe photosynthesis and show its importance in nature
(d) explain how the leaf is adapted to photosynthesis
(e) explain the factors affecting photosynthesis
(f) distinguish between carbohydrates, proteins and lipids

(g) state the importance of various chemical compounds in plants and animals
(h) relate various types of teeth in mammals to their feeding habits
(i) describe internal structure of mammation (human) teeth
(j) differentiate between omnivorous, carnivorous and herbivorous modes of feeding
(k) relate the structures of the mammalian (human) alimentary canal to their functions
(l) explain the role of enzymes in digestion in a mammal (human)
(m) explain the properties and functions of enzymes
(n) explain the factors that determine energy requirements in humans.

6.2.0 Content

6.2.1 Meaning, importance and types of nutrition

6.2.2 Nutrition in plants (autotrophism)

Definition of photosynthesis and its importance in nature
Adaptations of leaf to photosynthesis
Structure and function of chloroplast
Process of photosynthesis – light and dark stages (omit details of electron transport system and chemical details of carbon dioxide fixation)
Factors influencing photosynthesis: light intensity, temperature, carbon dioxide concentration, water.

6.2.3 Chemical compounds which constitute living organisms

Chemical composition and functions of carbohydrates, proteins and lipids (omit details of (i) chemical structure of these compounds and (ii) mineral salts in plant nutrition)
Properties and functions of enzymes (omit lock and key hypothesis)

6.2.4 Nutrition in Animals (heterotrophism)

Meaning and types of heterotrophism

Modes of feeding in animals
Dentition of a named carnivorous, herbivorous and omnivorous mammal
Adaptations of the three types of dentition to feeding
Internal structure of mammalian human (human) teeth
Common dental diseases, their causes and treatment

6.2.5 Digestive system and digestion in a mammal (human)

Digestive system, regions, glands and organs associated with digestion
Ingestion, digestion, absorption, assimilation and egestion

6.2.6 Importance of vitamins, mineral salts, roughage and water in human nutrition

6.2.7 Factors determining energy requirements in humans

6.3.0 Practical Activities

6.3.1 Carry out experiments on factors affecting photosynthesis

6.3.2 Observe distribution of stomata from plant adapted to different habitats

6.3.3 Carry out experiments on food tests

6.3.4 Carry out experiments on factors affecting enzymatic activities

6.3.5 Investigate the presence of enzymes in living tissues (plants and animals) such as catalase.
6.3.6 Observe, identify, draw and label different types of mammalian teeth
6.3.7 Carry out dissection of a small mammal to observe digestive system and associated organs (demonstration).

7.0.0 TRANSPORT IN PLANTS AND ANIMALS

7.1.0 Specific Objectives

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

(a) define transport and explain the necessity of transport in plants and animals
(b) relate the structure of the root, root hair, xylem and phloem to their functions
(c) relate the internal structure of the leaf to transpiration
(d) explain possible forces involved in the movement of water and mineral salts through the plant
(e) explain the significance of and factors affecting transpiration
(f) demonstrate simple experiments on transpiration
(g) distinguish between closed and open circulatory systems
(h) relate the structure of the heart and the blood vessels to their functions
(i) trace the path taken by blood from the heart to all parts of the body, and back to the heart
(j) name the common diseases of the circulatory system in humans and suggest methods of control/prevention
(k) relate the structure of the components of blood to their functions
(l) explain how oxygen and carbon dioxide are transported in the blood
(m) describe the mechanism of blood clotting and its importance
(n) describe the human blood groups and their importance in blood transfusion
(o) explain immunity and describe immune responses

7.2.0 Content

7.2.1 Meaning and importance of transport systems
7.2.2 Absorption of water and mineral salts
- Internal structure of root and root hairs
- Absorption of water
- Active uptake of mineral salts

7.2.3 Transpiration
- Definition of transpiration
- Review of the structure of the leaf
- Structure and function of xylem
- Factors affecting transpiration
- Forces involved in water movement in plants: Transpiration pull, Cohesion and adhesion, Capillarity, Root pressure

7.2.4 Translocation
- Structure and function of phloem
- Materials translocated (omit mechanisms of translocation)

7.2.5 Comparison between open and closed circulatory system
7.2.6 Mammalian circulatory system

Structure and functions of the heart, arteries, veins and capillaries
Diseases and defects of the circulatory system (thrombosis, varicose veins, arterio-sclerosis) and how to control them

7.2.7 The Structure and functions of blood
Composition of blood
Functions of blood plasma
The structure and functions of red and white blood cells
Mechanism of blood clotting and its importance

7.2.8 Blood groups (ABO system and the Rhesus factor)

7.2.9 Immune responses
Natural and artificial immunity
Allergic reactions
Importance of vaccinations against diseases (tuberculosis, poliomyletis, measles, diphtheria, whooping cough)

7.3.0 Practical Activities

7.3.1 Observe permanent/temporary slides of sections of stems and roots of monocotyledonous and dicotyledonous plants

7.3.2 Carry out experiments to compare transpiration on lower and upper leaf surfaces

7.3.3 Observe wall charts/models

7.3.4 Analyse data on transpiration rate of structures involved in transport in plants under different environmental conditions

7.3.5 Dissect a small mammal and observe its transport system (demonstration)

7.3.6 Make a longitudinal section of the mammalian heart to display the chambers and associated blood vessels

7.3.7 Record pulse rate at the wrist before and after vigorous exercises and analyse the results

7.3.8 Demonstrate the unidirectional flow of blood in the cutaneous veins of the fore-arm

8.0.0 GASEOUS EXCHANGE

8.1.0 Specific Objectives

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

(a) explain the necessary for gaseous exchange in living organisms
(b) explain the mechanism of gaseous exchange in plants
(c) compare the internal structure of aquatic and terrestrial plant root, stem and leaves
(d) examine various types of respiratory structures in animals and relate them to their functions
(e) state the characteristics of respiratory surfaces
(f) describe the mechanisms of gaseous exchange in protozoa, insect, fish, frog and mammal (humans)
(g) describe the factors which control the rate of breathing in humans
(h) state the causes, symptoms and prevention of respiratory diseases.

8.2.0 Content

8.2.1 The necessity of gaseous exchange in living organisms

8.2.2 Gaseous exchange in plants

Mechanisms of opening and closing of stomata

The process of gaseous exchange in root, stem and leaves of both aquatic and terrestrial plants

8.2.3 Gaseous exchange in animals

Types and characteristics of respiratory surfaces - cell membrane, gills, buccal cavity, skin and lungs

Mechanism of gaseous exchange in : Protozoa (amoeba), Insect (grasshopper), Fish (bonyfish), Amphibia (frog), Mammal (human)

8.2.4 Factors affecting rate of breathing in humans

8.2.5 Respiratory diseases: asthma, bronchitis, pulmonary tuberculosis, pneumonia and whooping cough

8.3.0 Practical Activities

8.3.1 Observe permanent/temporary slides of cross-sections of aerial and aquatic leaves and stems

8.3.2 Examine the distribution of spiracles in insects such as grasshoppers

8.3.3 Examine the gills of a bony fish

8.3.4 Dissect a small mammal and identify the structures of the respiratory system (demonstration)

8.3.5 Construct and use models to demonstrate breathing mechanisms in a mammal (human)

8.3.6 Demonstrate the effect of exercise on the rate of breathing

9.0.0 RESPIRATION

9.1.0 Specific Objectives

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

(a) explain the significance of respiration in living organisms

(b) distinguish between aerobic and anaerobic respiration

(c) describe the economic importance of anaerobic respiration in industry and at home

(d) describe experiments to show that respiration takes place in plants and animals.

9.2.0 Content

9.2.1 Meaning and significance of respiration

9.2.2 Tissue respiration

Mitochondrion - structure and function

Aerobic respiration (Details of kreb's cycle not required)

Anaerobic respiration in plants and animals, the products and by-products

Application of anaerobic respiration in industry and at home

Compare the energy output of aerobic and anaerobic respiration

9.3.0 Practical Activities

9.3.1 Carry out experiments to investigate

The gas produced when food is burnt
The gas produced during fermentation
Heat production by germinating seeds

10.0.0 EXCRETION AND HOMEOSTASIS

10.1.0 Specific Objectives

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

(a) distinguish between excretion and egestion
(b) explain the necessity for excretion in plants and animals
(c) state the uses of excretory products of plants
(d) describe the methods of excretion in a named unicellular organism
(e) relate the structures of the human skin, lungs, liver and kidney to their functions
(f) name common kidney diseases
(g) explain the concept of internal environment and homeostasis
(h) compare responses to changes in temperature by behavioural and physiological methods in animals
(i) relate heat loss to body size in mammals
(j) describe methods by which mammals gain and lose heat
(k) explain how the functions of the following relate to homeostasis - skin, hypothalamus, liver and kidney
(l) discuss the role of antidiuretic hormone, insulin and glucagon
(m) describe simple symptoms of *Diabetes mellitus* and *Diabetes insipidus*.

10.2.0 Content

10.2.1 Excretion in Plants

Methods of excretion in plants
Useful and harmful excretory products of plants and their economic importance e.g. caffeine in tea and coffee, quinine, tannins, colchicine, cocaine, rubber, gum, papain from pawpaw and products of cannabis sativa (bhang) and khat (miraa)

10.2.2 Excretion and homeostasis in animals

Distinction between excretion, homeostasis and egestion
Excretion in a named unicellular organism
Structure and functions of skin and kidney
Neuro-endocrine system and homeostasis
- Water balance - blood osmotic pressure
- Blood sugar level
- Temperature regulation - mention the role of hypothalamus

10.2.3 Common kidney diseases, their symptoms and possible methods of prevention and control

10.2.4 The role of the skin in thermoregulation, salt and water balance

10.2.5 Major functions of the liver and their contributions to homeostasis

10.2.6 Common diseases of the liver, their symptoms and possible methods of prevention/control

10.3.0 Practical Activities

10.3.1 Examine and draw the mammalian kidney
10.3.2 Make a vertical section of the kidney to identify the cortex and medulla
10.3.3 Observe permanent slides of a mammalian skin
10.3.4 Investigate the effect of catalase enzyme on hydrogen peroxide

11.0.0 ECOLOGY

11.1.0 Specific Objectives

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

(a) define the terms ecology, habitat, biomass, ecosystem and carrying capacity
(b) identify the physical (abiotic) and biological (biotic) factors in a given ecosystem
(c) describe the inter-relationships of organisms in the ecosystem
(d) differentiate between saprophytism, parasitism and symbiosis
(e) explain the importance of fungi and bacteria as decomposers
(f) relate the mode of transmission to prevention/control of named parasites
(g) describe the adaptive characteristics of named parasites to hosts
(h) explain the importance of symbiotic bacteria in leguminous plants
(i) describe the nitrogen cycle
(j) explain the flow of energy in the ecosystem
(k) identify and construct food chains and food webs, pyramids of numbers, pyramids of biomass
(l) explain the use of various methods of estimating population
(m) relate adaptations of plants to various habitats
(n) describe the effects of pollutants in air, water and soil on humans and other living organisms
(o) identify symptoms of different types of human diseases, methods of transmission and control.

11.2.0 Content

11.2.1 Concepts of Ecology: Ecology , Habitat, Niche, Population, Community, Ecosystem, Biomass, Carrying capacity
11.2.2 Factors in an ecosystem

Abiotic factors (environmental factors) - light, temperature, atmospheric pressure, salinity, humidity, pH and wind

Biotic factors

Inter-relationships - competition, predation, saprophytism, parasitism and symbiosis

Nitrogen cycle

11.2.3 Energy flow in an ecosystem: Food chains, food webs, decomposers, pyramids of numbers and pyramids of biomass
11.2.4 Population estimation methods: Quadrant, Line transect, Belt transect, Capture-recapture

11.2.5 Adaptations of plants to various habitats: Xerophytes, Mesophytes (common terrestrial plants), Hydrophytes - *Nymphea, Salvinia* spp, Halophytes - mangrove

11.2.6 Effect of pollution on human beings and other organisms: Causes, effects and control of pollutants in air, water and soil

11.2.7 Human diseases

Bacterial diseases - cholera and typhoid

Protozoa - malaria and amoebic dysentry (amoebiasis)

Ascaris lumbricoides and Schistosoma: Mode of transmission, Effects of the parasites on the hosts, Adaptive characteristics of the parasites, Control/prevention of diseases associated with the parasites

11.3.0 Practical Activities

11.3.1 Collect, record, analyse and interpret data from ecological studies. Food chains should be used to make food webs. Calculate ratios of consumers to producers from data provided

11.3.2 Examine specimens of hydrophytes, mesophytes and xerophytes and identify the features that adapt them to their habitat

11.3.3 Examine roots of legumes taken from fertile and poor soils to compare the number of root nodules

11.3.4 Estimate populations using sampling methods

11.3.5 Measure pH, temperature, wind direction and humidity

12.0.0 REPRODUCTION IN PLANTS AND ANIMALS

12.1.0 Specific Objectives

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

(a) describe location and appearance of chromosomes and chromosome movements during mitosis and meiosis

(b) differentiate between mitosis and meiosis stating their significance in reproduction

(c) describe and state the importance of asexual eproduction (binary fission, spore formation and budding)

(d) compare adaptations of wind and insect pollinated flowers

(e) describe the process of fertilization in flowering plants

(f) describe and explain how different fruits and seeds are formed and dispersed

(g) differentiate between internal and external fertilization as exhibited by amphibians and mammals (humans)

(h) relate the structure of the human reproductive system to functions

(i) describe the role of hormones in human reproduction

(j) identify the symptoms and explain the method of transmission and prevention of sexually transmitted infections (S.T.Is)

(k) explain the advantages and disadvantages of sexual and asexual reproduction.

12.2.0 Content

12.2.1 Concept of reproduction

- Importance of reproduction

12.2.2 Chromosomes, mitosis and meiosis (relate to gamete formation)

12.2.3 Asexual reproduction
- Binary fission in amoeba
- Spore formation/production in mucor/Rhizopus
- Budding in yeast

12.2.4 Sexual reproduction in plants
- Structure and functions of parts of named insect and wind pollinated flowers
- Pollination and agents of pollination
- Features and mechanisms that hinder self-pollination and self-fertilization
- The process of fertilization
- Fruit and seed formation and dispersal

12.2.5 Sexual reproduction in animals
- External fertilization in amphibians
- Structure of the reproductive system of a named mammal (human)
- Functions of parts of the reproductive system
- Fertilization, implantation and the role of placenta
- Gestation period
- Role of hormones in reproduction in humans (secondary sexual characteristics, menstrual cycle)
- Sexually transmitted infections (S.T.Is): Gonorrhoea, Herpes simplex, Syphilis, Trichomoniasis, Hepatitis, Candidiasis, HIV/AIDS (Acquired Immune Deficiency Syndrome)

Emphasize preventive measures especially behavioural

12.2.6 Advantages and disadvantages of sexual reproduction

12.3.0 Practical Activities

12.3.1 Examine stages of mitosis using squashed young onion root tip/charts/electron micrographs

12.3.2 Examine stages of meiosis using anthers of a flower

12.3.3 Grow bread mould and examine using a hand lens

12.3.4 Examine spores in sori of a fern

12.3.5 Examine various types of insect and wind pollinated flowers and relate structure to function

12.3.6 Collect, classify and dissect fruits and seeds and relate their structure to mode of dispersal

12.3.7 Dissect a small mammal to show organs associated with reproduction (demonstration)

13.0.0 GROWTH AND DEVELOPMENT

13.1.0 Specific Objectives

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

(a) differentiate growth from development

(b) analyse experimental data on growth rates

(c) identify parts of a named seed and factors affecting viability and dormancy in seeds
(d) investigate conditions necessary for germination and distinguish the types of germination
(e) measure one aspect of growth in a given seedling
(f) determine the region of growth in seedlings
(g) explain apical dominance
(h) distinguish between complete and incomplete metamorphosis in insects
(i) explain the role of hormones in regulating growth and development

13.2.0 Content

13.2.1 Concept of growth and development

13.2.2 Growth and development in plants

Dormancy and ways of breaking it
Conditions necessary for germination
Epigeal and hypogeal germination
Measurement of one aspect of growth in a named seedling e.g. region of growth
Primary and secondary growth
Role of growth hormones in plants
Apical dominance

13.2.3 Growth and development in animals

Complete and incomplete metamorphosis in insects
Role of growth hormones in insects

13.3.0 Practical activities

13.3.1 Examine, draw and differentiate between monochotyledonous & dicotyledonous seeds

13.3.2 Determine region of growth in shoots and roots

13.3.3 Investigate hypogeal and epigeal germination

13.3.4 Carry out experiments to demonstrate apical dominance

13.3.5 Observe stages of complete and incomplete metamorphosis in insects

13.4.0 Project work:

Measure either length of intenodes/breadth of leaves/height/dry weight of seedlings over a known period of time, analyse and present the data obtained in form of graphs, charts or histograms

14.0.0 GENETICS

14.1.0 Specific Objectives

By the end of the topic, the learner should be able to:
(a) distinguish between continuous and discontinuous variations
(b) describe the structure and properties of chromosomes
(c) state the first law of inheritance and describe Mendel's work
(d) construct and use punnet square/checker board

(e) distinguish between F_1 and F_2 generations, genotype and phenotype, haploidy and diploidy, homozygosity and heterozygosity, dominance and recessiveness, linkage and sex linkage, mutations and mutagens
(f) predict and explain the inheritance of the ABO blood groups and Rhesus (Rh) factor
(g) give examples of genetically inherited disorders
(h) explain causes of chromosomal mutations
(i) explain the practical application of genetics

14.2.0 Content

14.2.1 Concepts of genetics
- Variation within plant and animal species
- Review of chromosomes
- Brief mention of genes and DNA (without details of the molecular structure of genes and DNA)

14.2.2 First law of heredity
- Mendel's experiments - monohybrid inheritance (3:1 ratio)
- Complete and incomplete dominance, backcross/testcross
- Inheritance of ABO blood groups and Rh factor

14.2.3 Sex determination in humans

14.2.4 Linkage

Sex linked genes, sex linked characteristics e.g. colour blindness, haemophilia, hairy ears and nose

14.2.5 Mutations
- Types of mutations
- Causes and consequences of chromosomal mutations
- Gene mutation-cover the following examples of genetic disorders:-- albinism, sickle cell anaemia, haemophilia, colour blindness

14.2.6 Practical applications of genetics
- Blood transfusion
- Plant and animal breeding using artificial selection
- Genetic counseling
- Genetic engineering (details of techniques not required)

14.3.0 Practical Activities

14.3.1 Measure and record heights of classmates and represent data in graphs

14.3.2 Demonstrate chromosome behaviour in mitosis and meiosis by using clay/plasticine/insulated coloured wires/coloured threads

14.3.3 Carry out investigations of finger prints/tongue rolling

15.0.0 EVOLUTION

15.1.0 Specific Objectives

By the end of the topic, the learner should be able to:
(a) explain the meaning of evolution and the current concepts of evolution
(b) describe the struggle for existence and survival for the fittest
(c) describe the evidences for organic evolution

(d) explain resistance organisms to antibiotics, fungicides and pesticides

15.2.0 Content

15.2.1 Meaning of evolution

15.2.2 The origin of life: Special creation, Chemical evolution (omit details)

15.2.3 Evidences for organic evolution

Fossil records - brief mention of human evolution
Geographical distribution - continental drift
Comparative embryology
Comparative anatomy (convergent and divergent evolution based on homology and analogy)
Cell biology

15.2.4 Mechanisms of evolution

Lamarck's theory
Evolution by natural selection
Natural selection in action e.g. peppered moth (industrial melanism)
Resistance to drugs, pesticides and antibiotics

15.3.0 Practical Activities

15.3.1 Compare vertebrate limbs

15.3.2 Compare wings of birds and insects

15.3.3 Education tour to an archeological site/local museum

16.0.0 RECEPTION, RESPONSE AND COORDINATION IN PLANTS AND ANIMALS

16.1.0 Specific Objectives

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

(a) define irritability, stimulus and response
(b) explain differences between tactic and tropic responses and their survival values
(c) explain the production of plant hormones and their effects on tropisms (growth responses)
(d) relate the structure of the mammalian nervous system to its functions
(e) distinguish between simple and conditioned reflex actions
(f) explain the role of the endocrine system in humans
(g) state the effects of drug abuse
(h) relate structure to function of the human ear and eye
(i) explain defects of the eye and ear
(j) explain correction of eye defects

16.2.0 Content

16.2.1 Meaning of stimulus, response and irritability

16.2.2 Reception, response and coordination in plants

Response to a variety of external stimuli
Tropisms and tactic movements and their survival values
Productions of auxins and their effects on plant growth

16.2.3 Reception, response and coordination in animals
- Components of the nervous system in a mammal
- Structure and functions of the neurones
- Functions of major parts of human brain
- Simple and conditioned reflex actions

16.2.4 The role of hormones in coordination in a mammal
- Effects of over secretion and under secretion of adrenaline and thyroxine in humans
- Functional differences and similarities between endocrine and nervous systems

16.2.5 Effects of drug abuse

16.2.6 Structure and functions of parts of the mammalian (human) eye
- Accommodation, image formation and interpretations
- Common eye defects and their corrections

16.2.7 Structure and functions of parts of the mammalian (human) ear
- Hearing (omit details of cochlea)
- Balance and posture (omit details)

16.3.0 Practical Activities

16.3.1 Carry out experiments to investigate tactic responses e.g. chemotaxis - use any of the following organisms: worker termites/fly maggots/earthworms/honey bees/grasshoppers/woodlice

16.3.2 Carry out experiments on tropisms and etiolation

16.3.3 Determine the distance of blind spot

16.3.4 Carry out knee jerk experiment

17.0.0 SUPPORT AND MOVEMENT IN PLANTS AND ANIMALS

17.1.0 Specific Objectives

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

(a) explain the necessity of support and movements in animals and plants
(b) describe the arrangement and the role of supporting tissues in young and old plants
(c) list functions of the exoskeletons and endoskeletons
(d) describe locomotion in a named finned fish
(e) identify the bones of the axial and appendicular skeleton in a mammal
(f) describe he structure and functions of different types of joints in a mammal and explain how muscles bring about movement
(g) distinguish between the different types of muscles, their locations and functions.

17.2.0 Content

17.2.1 Plants
- Necessity for support and movement in plants
- Review of tissue distribution in monocotyledonous and dicotyledonous plants (Histological details of tissues are not required)

17.2.2 Animals

Necessity for support and movement in animals
Types and functions of the skeleton: exoskeleton in arthropods, endoskeleton in vertebrates

17.2.3 Locomotion in a finned fish
17.2.4 Identification of the bones of axial and appendicular skeletons (names of individual bones of coccyx not required)
17.2.5 Types and functions of movable joints (ball and socket, hinge joint)
17.2.6 Structure, function and location of cardiac, smooth and skeletal muscles (Details of fine structure not required)
17.2.7 Role of muscles in movement of the arm in humans

17.3.0 Practical Activities

17.3.1 Observe permanent/temporary slides of transverse sections of the stems of herbaceous and woody plants
17.3.2 Observe wilting in young herbaceous plants
17.3.3 Examine the exoskeleton in arthropods
17.3.4 Observe and identify external features of a finned fish
17.3.5 Examine and draw different types of bones in mammals.

232 – PHYSICS

GENERAL OBJECTIVES

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

(a) select and use appropriate instruments to carry out measurements in the physical environment;
(b) use the knowledge acquired to discover and explain the order of the physical environment;
(c) use the acquired knowledge in the conservation and management of the environment;
(d) apply the principles of Physics and acquired skills to construct appropriate scientific devices from the available resources;
(e) develop capacity for critical thinking in solving problems in any situation;
(f) contribute to the technological and industrial development of the nation;
(g) appreciate and explain the role of Physics in promoting health in society;
(h) observe general safety precautions in all aspects of life;
(i) acquire and demonstrate a sense of honesty and high integrity in all aspects of Physics and life in general;
(j) acquire positive attitude towards Physics;
(k) acquire adequate knowledge in Physics for further education and/or training.

1.0.0 INTRODUCTION TO PHYSICS

1.1.0 Specific Objectives

By the end of this topic, the learner should be able to:
(a) explain what the study of physics involves
(b) relate physics to other subjects and to technology
(c) identify career opportunities related to physics
(d) state and explain basic laboratory safety rules.

1.2.0 Content

1.2.1 Physics as a Science (reference to Primary Science Syllabus)
1.2.2 Meaning of Physics
1.2.3 Branches of Physics
1.2.4 Relation between Physics, other subjects and technology
1.2.5 Career opportunities in Physics
1.2.6 Basic laboratory safety rules
1.2.7 **Testing on any aspect of this topic should be in relation to other topics**

2.0.0 MEASUREMENT I

2.1.0 Specific Objectives

By the end of this topic, the learner should be able to:
a) define length, area, volume, mass, density, time interval and state the corresponding symbols and SI units
b) convert other metric units to SI units

c) estimate length, mass and time
d) use accurately various measuring instruments:
e) determine experimentally the densities of substances
f) solve numerical problems on density

2.2.0 Content

2.2.1 Definition of length, area, volume, mass, density and time
2.2.2 SI units and symbols
2.2.3 Estimation of quantities
2.2.4 Conversion of units
2.2.5 Measuring instruments: metre rule, tape measure, beam balance, stop clock/watch, measuring cylinder, pipette and burette
2.2.6 Experiments on density
2.2.7 Problems on density

3.0.0 MEASUREMENT II

3.1.0 Specific Objectives

By the end of this topic the learner should be able to:
a) measure length using vernier callipers and micrometer screw gauge
b) estimate the diameter of a molecule of oil
c) solve numerical problems in measurement

3.2.0 Content

3.2.1 Measurement of length using Vernier callipers and micrometer screw gauge
3.2.2 Decimal places, significant figures and standard form
3.2.3 Estimation of the diameter of a molecule of oil (relate to the size of the HIV virus, mention effects of oil spills on health and environment)
3.2.4 Problems in measurements

4.0.0 FORCE

4.1.0 Specific Objectives

By the end of this topic, the learner should be able to:
a) define force and state its SI unit
b) describe types of forces
c) describe experiments to illustrate cohesion, adhesion and surface tension
d) state the effects of force
e) state the difference between mass and weight
f) state the relation between mass and weight, W=mg
g) define scalar and vector quantities
h) solve numerical problems involving W=mg

4.2.0 Content

4.2.1 Definition of force
4.2.2 Types of forces (including cohesive, adhesive and surface tension)
4.2.3 Experiments to demonstrate cohesion, adhesion and surface tension (actual measurement of surface tension not required)

4.2.4 Effects of force
4.2.5 Mass, weight and their relationship
4.2.6 Scalar and vector quantities
4.2.7 Problems involving W=mg

5.0.0 PRESSURE

5.1.0 Specific Objectives

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

a) define pressure and state its SI units;
b) determine pressure exerted by solids;
c) describe experiments to investigate factors affecting pressure in fluids;
d) derive the formula $p=\rho gh$;
e) state the principle of transmission of pressure in fluids (Pascals principle);
f) explain atmospheric pressure and its effect;
g) state and explain the applications of pressure;
h) solve numerical problems involving pressure.

5.2.0 Content

5.2.1 Definition of pressure
5.2.2 Pressure in solids
5.2.3 Factors affecting pressure in fluids (Experimental treatment required)
5.2.4 Derivation of $p =\rho gh$
5.2.5 Atmospheric pressure
5.2.6 Simple mercury barometer, manometers
5.2.7 Applications of pressure: drinking straw, syringe, siphon, hydraulic press, hydraulic brakes, bicycle pump, force pump, lift pump
5.2.8 Problems on pressure

6.0.0 PARTICULATE NATURE OF MATTER

6.1.0 Specific Objectives

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

a) Give evidence that matter is made up of tiny particles
b) describe experiments to show that particles of matter are at constant random motion
c) explain the states of matter in terms of particle movement
d) explain diffusion

6.2.0 Content

6.2.1 Experiments to show that matter is made up of tiny particles (e.g. cutting papers into small pieces, dilution experiments etc.)
6.2.2 Brownian motion
6.2.3 States of matter
6.2.4 Diffusion (Graham's law not required)

7.0.0 THERMAL EXPANSION

7.1.0 Specific Objectives

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

a) define temperature;
b) describe the functioning of various thermometers;
c) describe thermal expansion in solids, liquids and gases;
d) explain expansion in terms of particle behaviour;
e) describe the unusual expansion of water and its effects;
f) explain the effects and applications of thermal expansion.

7.2.0 Content

7.2.1 Temperature
7.2.2 Thermometers: Liquid-in-glass, including Clinical and Six's maximum and minimum
7.2.3 Expansion of solids, liquids and gases
7.2.4 Effects of expansion and contraction
7.2.5 Unusual expansion of water (Anomolous expansion)
7.2.6 Applications of thermal expansion, include Bimetallic strip

8.0.0 HEAT TRANSFER

8.1.0 Specific Objectives

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

a) state the difference between temperature and heat
b) state and explain the modes of heat transfer
c) describe experiments to illustrate factors affecting heat transfer
d) explain applications of heat transfer

8.2.0 Content

8.2.1 Heat and temperature
8.2.2 Modes of heat transfer
8.2.3 Factors affecting heat transfer (Experimental treatment required)
8.2.4 Applications of heat transfer on vacuum flask, domestic hot water system, solar concentrators

9.0.0 RECTILINEAR PROPAGATION OF LIGHT AND REFLECTION AT PLANE SURFACE

9.1.0 Specific Objectives

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

a) perform and describe experiments to show that light travels in a straight line;
b) describe the formation of shadows and Eclispses;
c) explain the functioning of a pin-hole camera;
d) state the laws of reflection;
e) verify experimentally laws of reflection;
f) state the characteristics of images formed by plane mirrors;
g) explain the applications of reflection at plane surfaces;

h) solve numerical problems involving pin-hole camera and mirrors inclined at an angle.

9.2.0 Content

9.2.1 Rectilinear propagation of light (experimental treatment required)
9.2.2 Formation of shadows and eclipses (umbra and penumbra)
9.2.3 Pin-hole camera: image formation and magnification
9.2.4 Laws of reflection
9.2.5 Images formed by plane mirrors, ray diagrams, parallel and inclined mirrors
9.2.6 Devices based on reflection: periscope, kaleidoscope
9.2.7 Problems on pin-hole camera and mirrors inclined at an angle

10.0.0 ELECTROSTATICS I

10.1.0 Specific Objectives

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

a) describe electrostatic charging of objects by rubbing;
b) explain the source of electrostatic charges;
c) state the two types of charges;
d) state the basic law of charges;
e) state the unit of charge;
f) construct a simple leaf electroscope;
g) explain the charging of a leaf electroscope;
h) use a charged leaf electroscope to identify conductors, insulators and types of charge.

10.2.0 Content

10.2.1 Electrostatic charging of objects by rubbing (experimental treatment required)
10.2.2 Types of charges and law of charges
10.2.3 The source of charge
10.2.4 The coulomb
10.2.5 Leaf electroscope: features, charging and discharging
10.2.6 Charging by contact and by induction
10.2.7 Identification of charge
10.2.8 Conductors and insulators

11.0.0 ELECTROSTATICS II

11.1.0 Specific Objectives

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

a) sketch electric field patterns around charged bodies;
b) describe charge distribution on conductors of various shapes;
c) define capacitance and state its SI unit;
d) describe charging and discharging of a capacitor (calculation involving curves not required);
e) state the factors affecting the capacitance of a parallel plate capacitors;
f) state the applications of capacitors;
h) solve numerical problems involving capacitors.

11.2.0 Content

11.2.1 Electric field patterns
11.2.2 Charge distribution on conductors: spherical and pear shaped conductors
11.2.3 Action at points: lightning arrestors
11.2.4 Capacitance: unit of capacitance (farad, microfarad) factors affecting capacitance
11.2.5 Applications of capacitors
11.2.6 Problems involving capacitors {using $Q=CV$, $C_T=C_1+C_2$},

$$\left.\begin{array}{l} \frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} \end{array}\right\}$$

12.0.0 CELLS AND SIMPLE CIRCUITS

12.1.0 Specific Objectives

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

a) draw and set-up simple electric circuits;
b) identify circuit symbols;
c) define electric current;
d) explain the working of primary and secondary cells;
e) explain the care and maintenance of secondary cells.

12.2.0 Content

12.2.1 Simple electric circuits: cell, ammeter, voltmeter, variable resistor, connecting wires, bulb and switches
12.2.2 Circuit symbols
12.2.3 Electric current and its units
12.2.4 Primary and secondary cells. (simple cell, dry Leclanche' cell, Lead acid cell)
12.2.5 Care and maintenance of secondary cells

13.0.0 MAGNETISM

13.1.0 Specific Objectives

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

a) describe the properties and uses of magnets;
b) identify magnetic and non-magnetic materials;
c) state the basic law of magnetism;
d) describe patterns of magnetic field;
e) describe methods of magnetisation and demagnetization;
f) explain magnetisation and demagnetisation using the domain theory;
g) construct a simple compass.

13.2.0 Content

13.2.1 Magnets: properties and uses
13.2.2 Magnetic and non-magnetic materials
13.2.3 Basic law of magnetism
13.2.4 Magnetic field patterns
13.2.5 Magnetisation and demagnetisation

13.2.6 Domain theory of magnetism
13.2.7 Care of magnets
13.2.8 Construction of a simple magnetic compass

14.0.0 TURNING EFFECT OF A FORCE

14.1.0 Specific Objectives

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

a) define moment of a force about a point and state its SI unit;
b) state and verify the principle of moments;
c) solve problems involving the principle of moments.

14.2.0 Content

14.2.1 Moment of a force, SI unit of moment of a force
14.2.2 Principle of moments
14.2.3 Problems on principle of moments (consider single pivot only)

15.0.0 EQUILIBRIUM AND CENTRE OF GRAVITY

15.1.0 Specific Objectives

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

a) define centre of gravity;
b) determine experimentally the centre of gravity of lamina objects;
c) identify and explain the states of equilibrium;
d) state and explain factors affecting stability of an object;
e) explain the applications of stability;
f) solve numerical problems involving centre of gravity and moments of a force.

15.2.0 Content

15.2.1 Centre of gravity (Experimental treatment required)
15.2.2 States of equilibrium
15.2.3 Factors affecting stability
15.2.4 Problems on centre of gravity and moments of a force(consider single pivot only)

16.0.0 REFLECTION AT CURVED SURFACES

16.1.0 Specific Objectives

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

a) describe concave, convex and parabolic reflectors;
b) describe using ray diagram the principal axis, principal focus, centre of curvature and related terms;
c) locate images formed by curved mirrors by construction of ray diagrams;
d) determine experimentally the characteristics of images formed by a concave mirror;
e) define magnification;
f) explain the applications of curved reflecting surfaces.

16.2.0 Content

16.2.1 Concave, convex and parabolic reflectors

16.2.2 Principal axis, principal focus, centre of curvature and related terms
16.2.3 Location of Images formed by curved mirrors by ray diagram method (Experiments on concave mirrors required)
16.2.4 Magnification formula
16.2.5 Applications of curved reflectors

17.0.0 MAGNETIC EFFECT OF ELECTRIC CURRENT

17.1.0 Specific Objectives

By the end of this topic, the leaner should be able to:

a) perform and describe experiments to determine the direction of the magnetic field round a current carrying conductor;
b) construct a simple electromagnet;
c) state the factors affecting the strength of an electromagnet;
d) determine experimentally the direction of a force on a conductor carrying current in a magnetic field (motor effect);
e) state the factors affecting force on a current carrying conductor in a magnetic field;
f) explain the working of simple electric motor and electric bell.

17.2.0 Content

17.2.1 Magnetic field due to a current
17.2.2 Oersted's experiment
17.2.3 Magnetic field patterns on straight conductors and solenoid (right hand grip rule)
17.2.4 Simple electromagnets
17.2.5 Factors affecting strength of an electromagnet
17.2.6 Motor effect (Flemings left hand rule)
17.2.7 Factors affecting force on a current carrying conductor in a magnetic field (Qualitative treatment only)
17.2.8 Applications - Electric bell, Simple electric motor.

18.0.0 HOOKE'S LAW

18.1.0 Specific Objectives

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

a) state and verify experimentally Hooke's law ;
b) determine the spring constant;
c) construct and calibrate a spring balance;
d) solve numerical problems involving Hooke's law .

18.2.0 Content

18.2.1 Hooke's law
18.2.2 Spring constant
18.2.3 Spring balance
18.2.4 Problems on Hooke's Law

19.0.0 WAVES I

19.1.0 Specific Objectives

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

a) describe the formation of pulses and waves;
b) describe transverse and longitudinal waves;
c) define amplitude(a), wavelength(λ), frequency(f) and periodic time(T) of a wave;
d) derive the relation $v = f\lambda$;
e) solve numerical problems involving $v = f\lambda$.

19.2.0 **Content**

19.2.1 Pulses and waves
19.2.2 Transverse and longitudinal waves
19.2.3 Amplitude (a),
Wavelength (λ),
Frequency(f), periodic time (T)
19.2.4 Relation $v = f\lambda$
19.2.5 Problems involving $v = f\lambda$

20.0.0 WAVES II

20.1.0 Specific Objectives

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

a) describe experiments to illustrate the properties of waves;
b) sketch wave-fronts to illustrate the properties of waves;
c) explain constructive interference and destructive interference;
d) describe experiments to illustrate stationary waves.

20.2.0 Content

20.2.1 Properties of waves including sound waves, reflection, refraction, diffraction and interference (Experimental treatment required)
20.2.2 Constructive interference and destructive interference (qualitative treatment only)
20.2.3 Stationary waves (qualitative and experimental treatment required)

21.0.0 SOUND

21.1.0 Specific Objectives

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

a) perform and describe simple experiments to show that sound is produced by vibrating bodies;
b) perform and describe an experiment to show that sound requires a material medium for propagation;
c) explain the nature of sound waves;
d) determine the speed of sound in air by the echo method;
e) state the factors affecting the speed of sound;
f) solve numerical problems involving speed of sound.

21.2.0 Content

21.2.1 Sound: nature and sources (experimental treatment required)
21.2.2 Propagation of sound: compressions and rarefactions
21.2.3 Speed of sound by echo method
21.2.4 Factors affecting speed of sound
21.2.5 Problems involving speed of sound

22.0.0 FLUID FLOW

22.1.0 Specific Objectives

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

a) describe streamline flow and turbulent flow;
b) derive the equation of continuity;
c) describe experiments to illustrate Bernoulli's effect;
d) explain the Bernoulli's effect;
e) describe the applications of Bernoulli's effect;
f) solve numerical problems involving the equation of continuity.

22.2.0 Content

22.2.1 Streamline and turbulent flow
22.2.2 Equation of continuity
22.2.3 Bernoulli's effect (Experimental treatment required)
22.2.4 Applications of Bernoulli's effect: Bunsen burner, spray gun, carburetor, aerofoil and spinning ball
22.2.5 Problems involving equation of continuity

23.0.0 LINEAR MOTION

23.1.0 Specific Objectives

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

a) define distance, displacement, speed, velocity and acceleration;
b) describe experiments to determine velocity and acceleration;
c) determine acceleration due to gravity;
d) plot and explain motion time graphs;
e) apply the equations of uniformly accelerated motion;
f) solve numerical problems on uniformly accelerated motion.

23.2.0 Content

23.2.1 Distance, displacement, speed, velocity, acceleration(Experimental treatment required)
23.2.2 Acceleration due to gravity free - fall, simple pendulum
23.2.3 Motion-time graphs- displacement time graphs, Velocity time graphs
23.2.4 Equations of uniformly accelerated motion
23.2.5 Problems on uniformly accelerated motion

24.0.0 REFRACTION OF LIGHT

24.1.0 Specific Objectives

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

a) describe simple experiments to illustrate refraction of light;
b) state the laws of refraction of light;
c) verify Snell's law ;
d) define refractive index;;
e) determine experimentally the refractive index;
f) describe experiments to illustrate dispersion of white light;
g) explain total internal reflection and its effect;
h) state the application of total internal reflection;
i) solve numerical problems involving refractive index and critical angle.

24.2.0 Content

24.2.1 Refraction of light – laws of refraction (Experimental treatment required)
24.2.2 Determination of refractive index- Snell's law , Real/apparent depth, Critical angle
24.2.3 Dispersion of white light (Experimental treatment required)
24.2.4 Total internal reflection and its effects: critical angle
24.2.5 Applications of total internal reflection - Prism periscope, Optical fibre
24.2.6 Problems involving refractive index and critical angle

25.0.0 NEWTON'S LAWS OF MOTION

25.1.0 Specific Objectives

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

a) state Newton's laws of motion;
b) describe simple experiments to illustrate inertia;
c) state the law of conservation of linear momentum;
d) define elastic collision, inelastic collision and impulse;
e) derive the equation F = ma;
f) describe the application of frictional force;
g) define viscosity;
h) explain terminal velocity;
i) solve numerical problems involving Newton's laws and the law of conservation of linear momentum.

25.2.0 Content

25.2.1 Newton's laws of motion (Experimental treatment on inertia required)
25.2.2 Conservation of linear momentum elastic collisions, inelastic collisions, recoil velocity, impulse (oblique collisions not required)
25.2.3 The relation F = ma
25.2.4 Frictional forces:
Advantages and disadvantages,
Viscosity and terminal velocity (qualitative treatment only).
25.2.5 Problems involving Newton's Laws and law of conservation of linear momentum (exclude problems on elastic collisions).

26.0.0 WORK, ENERGY, POWER AND MACHINES

26.1.0 Specific Objectives

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

a) describe energy transformations
b) state the law of conservation of energy
c) define work, energy, power and state their SI units
d) define mechanical advantage, velocity ratio and efficiency of machines
e) solve numerical problems involving work, energy, power and machines.

26.2.0 Content

26.2.1 Forms of energy and energy transformations
26.2.2 Sources of energy- Renewable, Non-renewable.
26.2.3 Law of conservation of energy
26.2.4 Work, energy and power (work done by resolved force not required)
26.2.5 Kinetic energy and potential energy
26.2.6 Simple machines
26.2.7 Problems on work, energy, power and machines

27.0.0 CURRENT ELECTRICITY

27.1.0 Specific Objectives

By the end of this topic, the learner should be able to:
a) define potential difference and state its SI unit;
b) measure potential difference and electric current in a circuit;
c) verify Ohm's law;
d) define resistance and state its SI unit;
e) determine experimentally the voltage – current relationships for various conductors;
f) define emf and explain internal resistance of a cell;
g) derive the formulae for effective resistance of resistors in series and in parallel;
h) solve numerical problems involving ohm's law, resistors in series and in parallel.

27.2.0 Content

27.2.1 Scale reading: Ammeter, Voltmeter
27.2.2 Electric circuits: current, potential difference
27.2.3 Ohm's law (experimental treatment required)
27.2.4 Resistance: types of resistors, measurement of resistance, unit of resistance
27.2.5 Electromotive force (emf) and internal resistance of a cell The relation (E = V + Ir)
27.2.6 Resistors in series and in parallel
27.2.7 Problems involving Ohm's law, resistors in series and in parallel

28.0.0 HEATING EFFECT OF AN ELECTRIC CURRENT

28.1.0 Specific Objectives

By the end of this topic, the learner should be able to:
a) Perform and describe experiments to illustrate heating effect of an electric current;
b) State the factors affecting heating by an electric current;

c) Derive the equations for electrical energy and electrical power;
d) Identify devices in which heating effect of an electric current is applied ;
e) Solve numerical problems involving electrical energy and electrical power.

28.2.0 Content

28.2.1 Simple experiments on heating effect
28.2.2 Factors affecting electrical energy, The relation E=VIt and P =VI
28.2.3 Heating devices: electric kettle, electric iron, bulb filament, electric heater
28.2.4 Problems involving electrical energy and electrical power

29.0.0 QUANTITY OF HEAT

29.1.0 Specific Objectives

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

a) define heat capacity and specific heat capacity;
b) determine experimentally specific heat capacity of solids and liquids;
c) define specific latent heat of fusion and specific latent heat of vaporization of steam;
d) determine experimentally the specific latent heat of fusion of ice and the specific latent heat of vaporization of steam;
e) state factors affecting melting point and boiling point;
f) explain the functioning of a pressure cooker and a refrigerator;
g) solve problems involving quantity of heat.

29.2.0 Content

29.2.1 Heat capacity, specific heat capacity, units(Experimental treatment required)
29.2.2 Latent heat of fusion, latent heat of vaporization, units(Experimental treatment required)
29.2.3 Boiling and melting points
29.2.4 Pressure cooker, refrigerator
29.2.5 Problems involving quantity of heat ($Q = mc\Delta\theta$, $Q = mL$)

30.0.0 GAS LAWS

30.1.0 Specific Objectives

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

(a) state the gas laws for an ideal gas;
(b) verify experimentally the gas laws;
(c) explain how the absolute zero temperature may be obtained from the pressure – temperature and volume-temperature graphs;
(d) convert Celsius scale to Kelvin scale of temperature;
(e) state the basic assumptions of the kinetic theory of gases;
(f) explain the gas laws using the kinetic theory of gases;
(g) solve numerical problems involving gas laws.

30.2.1 Content

30.2.1 Boyle's law, Charles' law, pressure law, absolute zero

30.2.2 Kelvin scale of temperature
30.2.3 Gas laws and kinetic theory of gases
30.2.4 ($p = \frac{1}{3}\rho\bar{c}^2$ not required)
30.2.4 Problems involving gas laws [including $\frac{V}{T} = \frac{p}{T}$ constant]

31.0.0 THIN LENSES

31.1.0 Specific objectives

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

a) describe converging lenses and diverging lenses;
b) describe using ray diagrams the principal focus, the optical centre and the focal length of a thin lens;
c) determine experimentally the focal length of a converging lens;
d) locate images formed by thin lenses using ray construction method;
e) describe the characteristics of images formed by thin lenses;
f) explain image formation in the human eye;
g) describe the defects of vision in the human eye and how they can be corrected;
h) describe the use of lenses in various optical devices;
i) solve numerical problems involving the lens formula and the magnification formula.

31.2.0 Content

31.2.1 Types of lenses
31.2.2 Ray diagrams and terms used
31.2.3 Images formed - Ray diagrams, Characteristics, Magnification.
31.2.4 Determination of Focal length: (Experimental treatment required) - estimation method, lens formula, lens-mirror method
31.2.5 Human eye, defects (short sightedness and long sightedness)
31.2.6 Optical devises - Simple microscope, Compound microscope, The camera
31.2.7 Problems involving the lens formula and the magnification formula

32.0 UNIFORM CIRCULAR MOTION

32.1.0 Specific Objectives

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

a) define angular displacement and angular velocity;
b) describe simple experiments to illustrate centripetal force;
c) explain the applications of uniform circular motion;
d) solve numerical problems involving uniform circular motion.

32.2.0 Content

32.2.1 The radian, angular displacement and, angular velocity
32.2.2 Centripetal force;
The relations $F = \frac{mv^2}{r}$, $F = mr\omega^2$
(derivation of formulae not necessary experimental treatment is required)

32.2.3 Applications of uniform circular motion
32.2.4 Centrifuge, vertical, horizontal circles banked tracks (calculations on banked tracks and conical pendulum not required).
32.2.5 Problem solving (application of relations
$F = \frac{mv^2}{r}$, $F=mr\omega^2$ in numerical calculations)

33.0.0 FLOATING AND SINKING

33.1.0 Specific Objectives

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

a) state Archimedes' principle;
b) verify Archmedes' principle;
c) state the law of floatation;
d) define relative density;
e) describe the applications of Archimedes' principle and relative density;
f) solve numerical problems involving Archimedes' principles.

33.2.0 Content

33.2.1 Archimedes' principle law of flotation. (experimental treatment required),
33.2.2 Relative density
33.2.3 Applications of Archimedes' principle and relative density
33.2.4 Problems on Archimedes' principle

34.0.0 ELECTROMAGNETIC SPECTRUM

34.1.0 Specific Objectives

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

a) describe the complete electromagnetic spectrum;
b) state the properties of electromagnetic waves;
c) describe the methods of detecting electromagnetic radiations;
d) describe the applications of electromagnetic radiations;
e) solve numerical problems involving $c= f\lambda$.

34.2.0 Content

34.2.1 Electromagnetic spectrum
34.2.2 Properties of electromagnetic waves
34.2.3 Detection of electromagnetic (e.m.) radiations
34.2.4 Applications of e.m. radiations (include green house effect)
34.2.5 Problems involving $c= f\lambda$

35.0.0 ELECTROMAGNETIC INDUCTION

35.1.0 Specific Objectives

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

a) perform and describe simple experiments to illustrate electromagnetic induction;
b) state the factors affecting the magnitude and the direction of the induced emf;
c) state the laws of electromagnetic induction;
d) describe simple experiments to illustrate mutual induction;

e) explain the working of an alternating current (a.c) generator and a direct current (d.c) generator;
f) explain the working of a transformer;
g) explain the applications of electromagnetic induction;
h) solve numerical problems involving transformers.

35.2.0 Content

35.2.1 Simple experiments to illustrate electromagnetic induction
35.2.2 Induced emf - Faradays' law, Lenz's law
35.2.3 Mutual induction
35.2.4 Alternating current generator, direct current generator
35.2.5 Flemings right hand-rule
35.2.6 Transformers
35.2.7 Applications of electromagnetic induction
35.2.8 Problems involving transformers

36.0.0 MAINS ELECTRICITY

36.1.0 Specific Objectives

By the end of this topic, the learner should be able to:
a) state the sources of mains electricity;
b) describe the transmission of electric power from the generating station to the consumer;
c) explain the domestic wiring system;
d) define the kilowatt hour;
e) determine the electrical energy consumption and cost;
f) solve numerical problems involving mains electricity.

36.2.0 Content

36.2.1 Sources of mains electricity e.g. geothermal, hydro, nuclear etc.
36.2.2 Power transmission (include dangers of high voltage transmission)
36.2.3 Domestic wiring system
36.2.4 kWh, consumption and cost of electric energy
36.2.5 Problems involving mains electricity

37.0.0 CATHODE RAYS AND CATHODE RAY TUBE

37.1.0 **Specific Objectives**

By the end of this topic, the learner should be able to:
a) describe the production of cathode rays;
b) state the properties of cathode rays;
c) explain the functioning of a Cathode RayOscilloscope (C.R.O) and a Television tube (TV tube);
d) explain the uses of a Cathode Ray Oscilloscope;
e) solve problems involving Cathode Ray Oscilloscope.

37.2.0 **Content**

37.2.1 Production of cathode rays, cathode ray tube

37.2.2 Properties of cathode rays
37.2.3 C.R.O and TV tubes
37.2.4 Uses of C.R.O
37.2.5 Problems involving C.R.O

38.0.0 X-RAYS

38.1.0 Specific Objectives

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

(a) explain the production of X-rays;
(b) state the properties of X-rays;
(c) state the dangers of X-rays;
(d) explain the uses of X-rays.

38.1.0 Content

38.2.1 Production of X-rays, X-rays tube
38.2.2 Energy changes in an X-ray tube
38.2.3 Properties of X-rays.
38.2.4 Soft X-rays and hard X-rays
38.2.5 Dangers of X-rays and precautions
38.2.6 Uses of X-rays (Bragg's law not required)

39.0.0 PHOTOELECTRIC EFFECT

39.1.0 **Specific Objectives**

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

a) perform and describe simple experiments to illustrate the photoelectric effect;
b) explain the factors affecting photoelectric emission;
c) apply the equation $E = hf$ to calculate the energy photons,
d) define threshold frequency, work function and the electron volt;
e) explain photoelectric emission using Einstein equation ($hf_0 + \frac{1}{2}mv^2 = hf$);
f) explain the applications of photoelectric effect;
g) solve numerical problems involving photoelectric emissions.

39.2.0 Content

39.2.1 Photoelectric effect, photons, threshold frequency, work function, Planck's constant, and electron-volt
39.2.2 Factors affecting photoelectric emission
39.2.3 Energy of Photons
39.2.4 Einstein's equation, $hf_0 + \frac{1}{2}mv^2 = hf$
39.2.5 Applications of photoelectric effect - Photo emissive cells, Photo conductive cells, Photovoltaic cells.

40.0.0 RADIOACTIVITY

40.1.0 Specific Objectives

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

a) define radioactive decay and half-life;
b) describe the three types of radiations emitted in natural radioactivity;
c) explain the detection of radioactive emissions;

d) define nuclear fission and fusion;
e) write balanced nuclear equations;
f) explain the dangers of radioactive emissions;
g) state the applications of radioactivity;
h) solve numerical problems involving half-life.

40.2.0 Content

40.2.1 Radioactive decay
40.2.2 Half-life
40.2.3 Types of radiations, properties of radiations
40.2.4 Detectors of radiation,
40.2.5 Nuclear fission, nuclear fusion
40.2.6 Nuclear equations
40.2.7 Hazards of radioactivity, precautions
40.2.8 Applications
40.2.9 Problems on half-life (integration not required)

41.0.0 ELECTRONICS

41.1.0 Specific Objectives

By the end of this topic, the learner should be able to:
a) state the differences between conductors and insulators;
b) define instrinsic and extrinsic semi-conductors;
c) explain doping in semi-conductors;
d) explain the working of a p-n junction diode;
e) sketch current-voltage characteristics for a diode;
f) explain the application of diodes in rectification.

41.1.0 Content

41.2.1 Conductors, semi-conductors, insulators
41.2.2 Intrinsic and extrinsic semi-conductors
41.2.3 Doping
41.2.4 p-n junction diode
41.2.5 applications of diodes: half wave rectification and full wave rectification