# THE UNITED REPUBLIC OF TANZANIA
# MINISTRY OF EDUCATION AND VOCATIONAL TRAINING


# PHYSICS SYLLABUS FOR ADVANCED SECONDARY EDUCATION

## FORM V- VI

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## 1.0 INTRODUCTION

### 1.1 Background Information

This new Physics syllabus for Form V and Form VI replaces the 1997 syllabus which has been phased out. The former syllabuses were not competence based and most teaching and learning strategies were not learner centred.

The revision process has observed a paradigm shift from that of content – based curriculum to a competence-based curriculum. The teaching and learning strategies used in this reviewed syllabus are learner-centred and activity oriented. Students are expected to be engaged in a variety of activities culminating to meaningful learning. Moreover the revision has also taken into consideration the requirements of the Secondary Education Development Plan (SEDP), and cross-cutting issues.

### 1.2 Subject Description

Physics in Advanced level Secondary Education provides with a contemporary and coherent understanding of energy, matter and their interrelations. It focuses on investigating natural phenomena and then applying patterns, principles, theories and laws to explain the physical behaviour of the universe.

The study of Physics relies on the understanding and application of a number of basic laws and principles that govern the microscopic and macroscopic holds. Physics provides students with an understanding of system that is the basis of the development of technological applications.

This syllabus is intended for Advanced level secondary schools students, using this syllabus teacher's will be able to apply different methods and strategies in guiding students to perform activities related to the subject content of their level. Students are expected to be engaged in a variety of activities that will end to a meaningful learning.

### 1.3 Rationale for the Review of the Physics Syllabus

The review of Physics syllabus was based on the stakeholders' comments, which indicated four areas of improvement. It was revealed that some content were outdated, difficult, repetitive and irrelevant.

In this revised syllabus; mechanics was split into three independent topics namely; mechanics, fluid dynamics and properties of matter in order to avoid repetitive of content. On the other hand to bring good flow of topics, dimension and error have been treated under one topic known as measurement. Some content have been shifted to appropriate/topic/subtopics such as AC theory which shifted from electromagnetism to current electricity, kinetic theory from Heat to properties of matter, and electrolysis to Chemistry subject. It should be noted that in this review Geophysics and Maser topics were dropped out and new topic of environmental

physics has been introduced so as to include the crosscutting issues and give room for some content from Geophysics. Likewise new sub-topics have been introduced in various topics.

Difficult topics have been addressed by reorganizing content and subtopics as well as improving teaching and learning strategies.

## 2.0 AIMS AND OBJECTIVES OF EDUCATION IN TANZANIA

The general objectives of education in Tanzania are to:

a) guide and promote the development and improvement of the personalities of the citizens of Tanzania, their human resources and effective utilization of their resources in bringing about individual and national development.

b) promote the acquisition and appreciation of culture, customs and traditions of the people of Tanzania.

c) promote the acquisition and appropriate use of literary, social, scientific, vocational, technological, professional and other forms of knowledge, skills and understanding for the development and improvement of man and society.

d) develop and promote self-confidence and an inquiring mind, an understanding and respect for human dignity and human rights and a readiness to work hard for personal self advancement and national improvement.

e) enable and expand the scope of acquisition, improvement and upgrading of mental, practical productive and other life skills needed to meet the changing needs of industry and the economy.

f) enable every citizen to understand the fundamentals of the national constitution as well as the enshrined human and civic rights, obligation and responsibilities.

g) promote the love for work, self and wage employment and to improve performance in the production and service sectors.

h) inculcate principles of national ethic and integrity, national and international cooperation, peace and justice through the study, understanding and adherence to the provision of the National Constitution and International basic charters.

i) enable a rational use, management and conservation of our environment.

## 3.0 AIMS AND OBJECTIVES OF SECONDARY EDUCATION

The aims and objectives of secondary education are to:

a) consolidate and broaden the scope of baseline ideas, knowledge, skills and principles acquired and developed at primary education levels.

b) enhance further development and appreciation of national unity, identify and ethnic personal integrity, respect for and readiness to work, human rights, cultural and moral values, customs, traditions and civic responsibilities and obligations.

c) promote the development of competency in linguistic ability and effective use of communication skills in Kiswahili and at least one foreign language

d) promote opportunities for the acquisition of knowledge, skills, attitudes and understanding in prescribed or selected fields of study.

e) prepare students to tertiary and higher education; vocational, technical and professional.

f) inculcate a sense and ability for self-study, self-reliance and self-advancement in new frontiers of science and technology, academic and occupational knowledge and skills.

g) prepare the student to join the world of work.

## 4.0 GENERAL SUBJECT COMPETENCES

By the end of the course student should have the ability to:

a) communicate using the language of Physics.

b) apply theories, laws and principles of Physics.

c) use the scientific method in designing and carrying out experiments in Physics.

d) apply scientific and technological knowledge and skills in management, conservation and sustainable use of the environment.

e) handle and manage various technological appliances in solving daily life problems.

f) work independently for self-advancement in new frontiers of physics.

g) use ICT to acquire and generate knowledge.

## 5.0 GENERAL SUBJECT OBJECTIVES

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

a) understand the language of Physics.

b) explain theories, laws and principles of Physics.

c) understand the scientific method in solving problems.

d) promote scientific and technological knowledge and skills in management, conservation and sustainable use of the environment.

e) promote manipulative skills to manage various technological appliances.

f) promote self-study for self-advancement in new frontiers of Physics.

g) appreciate the role of ICT in the process of learning Physics.

## 6.0 ORGANIZATION OF THE SYLLABUS

This Physics syllabus has a slightly different structure compared to that of 1997. The following changes were added for improvement:

a) general competences for the course.

b) competences for each class.

c) suggested areas for assessment.

d) number of periods per sub-topic.

### 6.1 Subject Competences

Competences have been stated for each class/level of Physics course. The class level competence is derived from the class level objectives.

### 6.2 Subject Objectives

When the stated class objective is achieved, then the expected competence is realized by learner. The general objectives for each class are stated in general terms to indicate the scope of content to be covered within each level.

### 6.3 Content Matrix

#### 6.3.1 Topics/sub-topics

The topics have been derived from the class level competences and objectives. Most of the topics in the 1997 Physics syllabus have been retained. However Error and Dimensions of Physical Quantities topics have been combined under one topic called Measurement. Mechanics topic has been split into three independent topics namely Mechanics, Fluid Dynamics and Properties of Matter. One new topic namely Environmental Physics has been introduced to replace Geophysics so as to allow treatment of environment as a cross-cutting issue. Likewise sub-topics have been arranged to attain a logical order. Some of sub-topics have been shifted to more appropriate topics or subjects.

#### 6.3.2 Specific objectives

Each sub-topic has more than one specific objective. These specific objectives are the expected learning outcomes. They also reflect the process to attain competences within the cognitive, affective and psychomotor domains.

#### 6.3.3 Teaching and learning strategies

The teaching and learning strategies indicate what the students and teacher are expected to do in the process of teaching and learning. Students are encouraged to work in small groups for maximum participatory and cooperative learning. The teacher shall assume the role of a facilitator to promote, guide and help students' learning activities. The whole teaching and learning process should be participatory

and interactive, where the student learns by doing a series of logical activities.

The suggested teaching and learning strategies are not exhaustive. The students and teacher may use any other strategies which suit the teaching and learning environment depending on the available resources.

### 6.3.4 Teaching and learning resources

In the teaching of Physics a variety of teaching and learning resources will be needed in quality and quantity. In case the standard teaching and learning resources are not available, the teacher should work with students to collect or improvise alternative resources available in their environment. The teaching and learning resources listed are not exhaustive, the teacher is advised to use relevant and more contextualized resources.

### 6.3.5 Assessment

For every specific instructional objective, there is a suggested question or area for assessment. Formative and summative assessment should be geared towards mastering all the competences and skills developed within the course. Teachers should use assessment tools to assess student's ability by the end of the lesson. Examples of these tools are: Tests, quizes, assignments, exercises, project work, experimental work and portifolios.

### 6.3.6 Estimated number of periods

The number of periods has been allocated per each sub-topic. Ten periods per week of 40 minutes each, have been allocated for both Form V and Form VI. According to the Education Circular No. 9 of 2004, there are a total of 194 effective teaching days per year. Each sub-topic is allocated with appropriate number of periods for teaching/learning depending on its content.

## 7.0 INSTRUCTIONAL TIME

This syllabus is to be covered in two academic years including two weeks reserved for mid-year and annual examinations each year. Lost instructional time should be compensated for.

## 8.0 ASSESSMENT FOR A-LEVEL PHYSICS SUBJECT

The table below shows the types of assessment and accompanied assessment measures to be used. The assessment measures listed in the table contributes to continuous and final assessment of the student achievement. The frequency for each assessment measure has been indicated with the weight in percentage (%). You are therefore strongly advised to apply a wide selection of assessment measures in order to develop students' ability for the mastering of the subject matter during the teaching and learning process.

| Types of Assessment | Assessment Measure | Frequency | | | | Weight |
|---|---|---|---|---|---|---|
| | | Form V | | Form VI | | |
| | | Term I | Term II | Term I | Term II | % |
| Continuous Assessment | Practical | 2 | 2 | 2 | - | 10 |
| | Tests | 2 | 2 | 2 | - | 10 |
| | Individual Assignments | 2 | 2 | 2 | - | 5 |
| | Portfolios | 1 | 1 | 1 | - | 5 |
| | Research Project | - | - | 1 | - | 5 |
| Examinations | Terminal Examinations | 1 | 1 | 1 | - | 15 |
| | National Examination | - | - | - | 1 | 50 |



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# FORM V

## Class Competences

By the end of Form V course the student should have the ability to:

1. Communicate effectively using the language of Physics.
2. Apply theories, laws and principles of mechanics, heat, vibration and waves, and electrostatics in daily life.
3. Make appropriate and accurate measurements.
4. Investigate physical phenomena scientifically.
5. Use and maintain domestic appliances.

## Class Objectives

By the end of Form V course, the students should be able to:

a) identify standard symbols and nomenclature used in Physics.

b) explain theories, laws and principles of mechanics, heat, vibrations and waves, and electrostatics.

c) demonstrate knowledge and skills in the use of measuring instruments.

d) design and perform experiments in mechanics, heat, vibration and waves and electrostatics.

e) design and construct simple technological appliances.

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| **1.0 MEASUREMENT**<br><br>1.1 Physical Quantities | By the end of this sub-topic the student should be able to:<br>a) distinguish between fundamental and derived physical quantities. | i) Teacher to guide students to discuss in groups fundamental and derived physical quantities.<br>ii) Teacher to guide students to summarize the distinction between fundamental and derived physical quantities. | Chart of fundamental and derived physical quantities. | Is the student able to distinguish between fundamental and derived physical quantities? | 10 |
| | b) describe the method of dimensional analysis. | i) Teacher to guide students in groups to relate units and dimension.<br>ii) Students to deduce the dimensions of a given physical quantity. | Charts with dimensions of physical quantities | Is the student able to describe the method of dimensional analysis? | |
| | c) use the method of dimensional analysis to check the correctness of a formula. | i) Teacher to guide students to verify equality of dimensions on the left hand side and right hand side of a formula.<br>ii) Students to verify the correctness of formula by dimensional analysis. | Charts with dimensions of physical quantities | Is the student able to use the method of dimensional analysis to check the correctness of the formula? | |
| | d) derive the relationship between physical quantities. | By using think-pair share, students to apply the method of dimensional analysis to derive unknown formula of a physical quantity. | Manila sheets | Is the student able to derive the relationship between physical quantities? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| | e) explain the limitations of using the method of dimensional analysis. | Teacher to guide students in groups to brainstorm on the limitations of dimensional analysis. | Manila sheets | Is the student able to explain the limitations of using the method of dimensional analysis? | |
| 1.2 Errors | By the end of this sub-topic the student should be able to:<br>a) identify types and sources of errors. | i) Students to brainstorm on the types of errors.<br>ii) Teacher to guide students to discuss in groups sources of errors.<br>iii) Students to discuss methods of minimizing errors in measurement. | Variety measuring instruments | Is the student able to identify types and sources of errors? | 16 |
| | b) determine errors in measurement. | i) Students to perform experiments to measure the fundamental physical quantities.<br>ii) Teacher to guide students to state errors in measurements. | • Metre rule<br>• Stopwatch<br>• Beam balance | Is the student able to determine errors in measurement? | |
| | c) estimate errors of derived physical quantities. | i) Students to brainstorm and discuss how to estimate error of a derived physical quantity. | • Metre rule<br>• Stopwatch<br>• Beam balance | Is the student able to estimate errors of derived physical quantities? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| | | ii) Teacher to guide students to estimate errors in sum, difference, product, quotient and exponents. | | | |
| | d) determine errors from agraph. | i) Students to plot the best fit-line for a linear graph.<br>ii) Teacher to guide students to determine errors from the graph. | • Graph paper<br>• Teacher notes | Is the student able to determine errors from a graph? | |
| | e) distinguish between accuracy and precision. | i) Teacher to guide students to distinguish between accuracy and precision.<br>ii) Students to discuss in groups the accuracy and precision of a given set of measured data. | Charts with graph of best-fit line | Is the student able to distinguish between accuracy and precision? | |
| **2.0 MECHANICS**<br><br>2.1 Newton's Laws of Motion | By the end of this sub-topic the student should be able to:<br>a) determine equilibrant forces on a body. | i) Student in groups to perform an experiment to measure equilibrant forces on a body resting on a horizontal and inclined plane.<br>ii) Teacher to guide students to compute equilibrant forces on a body of horizontal and inclined plane. | • Spring balances<br>• Pulleys<br>• Loads/masses<br>• In-extensible<br>• string<br>• Incline plane | Is the student able to determine equilibrant forces of a body? | 24 |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| | b) derive expressions for tension and acceleration for connected bodies. | i) Teacher to guide students in groups to discuss Newton's laws of motion<br>ii) Teacher to guide students to perform experiment to determine<br>iii) acceleration of connected bodies in horizontal and inclined planes.<br>iv) Teacher to guide students to derive expressions for tension and acceleration for the connected bodies. | • Pulleys<br>• Masses<br>• String<br>• Incline plane | Is the student able to derive expressions for tension and acceleration of connected bodies? | |
| | c) determine reaction forces. | i) Students in groups through role-play to demonstrate reaction forces on a hosepipe, firing gun, rocket and jet plane.<br>ii) Students to calculate reaction forces. | • Hosepipe<br>• Gun<br>• Rocket (water)<br>• Jet-plane<br>• Computer simulation | Is the student able to determine reaction forces? | |
| | d) state and apply the law of conservation of linear momentum. | i) Students to use Newton's Laws to deduce the principle of conservation of linear momentum.<br>ii) Students through group to discuss on distinction between elastic and inelastic collision. | • Balls<br>• Trolley<br>• Ballistic pendulum | Is the student able to state and apply the law of conservation of linear momentum? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| | | iii) Teacher to guide students in the applications of the principle of conservation of linear momentum. | | | |
| | e) describe applications of Newton's laws of motion in daily life. | Teacher to guide students to brainstorm and discuss applications of Newton's laws of motion. | Manila sheets | Is the student able to describe applications of Newton's laws of motion in daily life? | |
| 2.2 Projectile Motion | By the end of this sub-topic the student should be able to:<br>a) describe projectile motion parameters. | Teacher to guide students to discuss projectile motion, trajectory, time of flight, range, maximum height and angle of projection. | • Soccer ball<br>• Catapult<br>• Bow and arrow<br>• Gun and<br>• bullets (computer simulation) | Is the student able to describe projectile motion parameters? | 6 |
| | b) derive projectile motion parameters. | Teacher to guide students to derive expressions for trajectory, maximum height, angle of projection, range and time of flight. | Manila sheets | Is the student able to derive projectile motion parameters? | |
| | c) describe the applications of projectile motion. | Teacher to guide students in groups to discuss applications of projectile motion. | Manila sheets | Is the student able to describe applications of projectile motion? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| 2.3 Uniform Circular Motion | By the end of this sub-topic the student should be able to:<br>a) explain angular displacement, velocity and acceleration with respect to circular motion. | i) Students to whirl an object in a vertical and horizontal plane and observe the motion.<br>ii) Teacher to guide students to discuss displacement, velocity, acceleration and centripetal force.<br>iii) Teacher to guide students to deduce expression for tension and period of the vertical and horizontal motion. | • String<br>• Pendulum bob<br>• Stop watch | Is the student able to explain:<br>i) angular displacement<br>ii) velocity and acceleration with respect to circular motion? | 12 |
| | b) describe applications of circular motion. | i) Student to discuss concept of banking as applied to an object negotiating a corner.<br>ii) Teacher to guide students in groups to discuss conditions for studying and overturning.<br>iii) Student in groups to demonstrate centrifugal motion.<br>iv) Teachers to guide students to deduce the relationship between centripetal and centrifugal force.<br>v) Students in groups to discuss applications of centrifugal motion in daily life. | • Charts with<br>• diagram of vehicle, road and railways<br>• Aid plane (computer simulation)<br>• Bucket<br>• Test tube<br>• Water<br>• Granules | Is the student able to describe application of circular motion? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| 2.4 Simple Harmonic Motion (SHM) | By the end of this sub-topic the student should be able to:<br>a) describe Simple Harmonic Motion. | i) Students in groups to demonstrate Simple Harmonic Motion.<br>ii) Students in groups to demonstrate existence of restoring force.<br>iii) Teacher to guide students to relate SHM and circular motion. | • Helical spring<br>• Masses<br>• Simple pendulum<br>• U-tube<br>• Water<br>• Spring balance metre rule<br>• Graph paper | Is the student able to describe Simple Harmonic Motion? | 12 |
| | b) deduce displacement, velocity, acceleration and period for SHM. | i) Teacher to guide students to discuss and derive expressions for the<br>ii) displacement, velocity, acceleration and period of SHM.<br>iii) Students to solve problems for bodies executing SHM. | • Loaded spring<br>• Water in U-tube<br>• Simple pendulum<br>• Floating loaded test-tube<br>• Stop watch | Is the student able to deduce displacement, velocity, acceleration and period for SHM? | |
| | c) analyze energy changes in SHM. | i) Students in groups to discuss PE and KE changes in SHM.<br>ii) Students to sketch graph of energy changes in SHM. | Charts with graphs of energy changes in SHM | Is the student able to analyze energy changes in SHM? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| | d) explain the applications of SHM. | Students to brainstorm and discuss applications of SHM. | Manila sheets | Is the student able to explain the applications of SHM? | |
| 2.5 Gravitation | By the end of this sub-topic the student should be able to:<br>a) explain the three Kepler's laws of Planetary motion. | Teacher to lead students to state and illustrate Kepler's laws of planetary motion. | • Manila sheets<br>• Computer simulation | Is the student able to explain the three Kepler's laws of Planetary motion? | 14 |
| | b) deduce Newton's Law of Universal Gravitation. | i) Students in groups to discuss forces existing between two bodies.<br>ii) Teacher to guide students to deduce Newton's law of universal Gravitation. | • Manila sheets<br>• Computer simulation | Is the student able to deduce Newton's Law of Universal Gravitation? | |
| | c) derive Kepler's third law of planetary motion from Newton's law of universal gravitation. | Students to use Newtown's Law of Universal gravitation to derive Kepler's third law of planetary motion. | • Manila sheets<br>• Computer simulation | Is the student able to derive Kepler's third law of planetary motion from Newton's law of universal gravitation? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| | d) determine gravitational potential of a body. | i) Teacher to guide students to discuss the concept of gravitational potential.<br>ii) Students in groups to derive an expression for the gravitational potential of a body. | Manila sheets | Is the student able to determine gravitational potential of a body? | |
| | e) apply Kepler's laws and Newton's law of Universal gravitation in satellite motion. | i) Students in groups to examine satellite motion.<br>ii) Teacher to guide students to derive escape velocity, height and velocity of a parking orbit.<br>iii) Students to brainstorm and discuss importance of artificial earth satellites. | • Manila sheets<br>• Computer simulation | Is the student able to apply Kepler's laws and Newton's law of Universal gravitation in Satellite motion? | |
| 2.6 Rotation of Rigid Bodies | By the end of this sub-topic the student should be able to:<br>a) explain the concept of rotation of a rigid body. | Students in groups to demonstrate rigid body motion. | • Rigid rod<br>• Rotating stool<br>• Masses | Is the student able to explain the concept of rotation of a rigid body? | 32 |
| | b) determine the moment of Inertia of a rotating rigid body. | i) Teacher to guide students to discuss the meaning of moment of inertia.<br>ii) Students in groups to perform an experiment to determine the moment of inertia of a body. | • Rod<br>• Disc<br>• Cylinder<br>• Sphere<br>• Lamina | Is the student able to determine the moment of Inertia of a rotating rigid body? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| | | iii) Students to deduce expressions for moment of inertia.<br>iv) Students to use the expression of moment of inertia to determine the moment of inertia of a rod, disc, lamina, cylinder and sphere. | | | |
| | c) deduce the radius of gyration of a rotating rigid body. | i) Teacher to guide students to discuss the meaning of gyration.<br>ii) Students in groups to perform an experiment to determine the radius of gyration of a rod, disc, lamina, cylinder and sphere. | • Rod<br>• Disc<br>• Lamina<br>• Cylinder<br>• Sphere. | Is the student able to deduce the radius of gyration of a rotating rigid body? | |
| | d) deduce expression for torque. | i) Teacher to guide students to discuss the meaning of torque.<br>ii) Students to deduce the expression for torque through demonstration. | • Hinged door<br>• Disc<br>• Lamina | Is the student able to expression for torque? | |
| | e) derive expression for Kinetic energy of a rotating rigid body. | Teacher to guide students to derive expression for the kinetic energy of a rotating rigid body. | • Rigid body<br>• Disc<br>• Metre rule | Is the student able to derive expression for Kinetic energy of a rotating rigid body? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| | f) deduce expression for work done by a torque. | Students in groups to discuss and derive expression for work done by a torque. | • Rotating rod<br>• Metre rule | Is the student able to deduce expression for work done by a torque? | |
| | g) explain the concept of angular momentum. | Teacher to guide students to demonstrate and discuss the concept of angular momentum. | • Bicycle wheel on axle<br>• Rotating stool | Is the student able to explain the concept of angular momentum? | |
| | h) deduce the principle of conservation of angular momentum. | i) Students to demonstrateconservation of angular momentum.<br>ii) Teacher to guide students to deduce the principle of conservation of angular momentum. | Rotating body | Is the student able to deduce the principle of conservation of angular momentum? | |
| | i) describe the applications of rotational motion of rigid bodies in daily life. | Students in groups to brainstorm and discuss applications of rotational motion of rigid bodies. | Manila sheets | Is the student able to describe the application of rotational motion of rigid bodies in daily life? | |
| **3.0 FLUID DYNAMICS**<br>3.1 Streamline Flow and Continuity | By the end of this sub-topic the student should be able to:<br>a) explain the concepts of fluid motion. | i) Students in groups to brainstorm and discuss concepts of fluid motion. | Chart with stream lines | Is the student able to explain the concepts of fluid motion? | 6 |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| | | ii) Teacher to guide students to explain concepts of fluid motion (compressible and incompressible fluids, streamline flow, viscous flow, turbulent flow, critical velocity). | | | |
| | b) derive the law of mass continuity. | i) Students in groups to perform an experiment to determine volume rates of in-flow and out-flow of a liquid in a pipe.<br>ii) Teacher to guide students to derive the law of mass continuity. | • Water (liquid)<br>• Pipe<br>• Graduated container (large and small)<br>• stopwatch | Is the student able to derive the law of mass continuity? | |
| 3.2 Bernoulli's Principle | By the end of this sub-topic the student should be able to:<br>a) deduce Bernoulli's principle. | Teacher to guide students to deduce Bernoulli's equation from the continuity equation. | Manila sheets | Is the student able to deduce Bernoulli's principle? | 8 |
| | b) explain applications of Bernoulli's principle. | Students to demonstrate and discuss in groups the applications of Bernoulli's principle in jets and nozzles, aerofoils, venturi meter and Pitot tube. | • Bunsen burner<br>• Filter pump<br>• Paint sprayer<br>• Sail<br>• Venturi meter<br>• Pitot tube | Is the student able to examine applications of Bernoulli's principle? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| 3.3 Viscosity and Turbulent Flow | By the end of this sub-topic the student should be able to:<br>a) explain the concept of viscosity. | i) Teacher to guide students to discuss the concept of viscosity.<br>ii) Students in groups to perform an experiment to determine the coefficient of viscosity. | • Small sphere (ball)<br>• Viscous liquid<br>• Water<br>• Stop watch | Is the student able to:<br>i) explain the concept of viscosity?<br>ii) determine the coefficient of viscosity? | 30 |
| | b) deduce Poiseulli's formula. | i) Teacher to guide students to perform an experiment to determine flow rate of a liquid as a function of tube length, tube radius and pressure difference.<br>ii) Students to use the method of dimensional analysis to deduce Poiseulli's formula. | • Flow tubes<br>• Liquid<br>• Graduated container<br>• Stop watch | Is the student able to deduce Poiseulli's formula? | |
| | c) derive Stoke's law. | i) Teacher to guide students in groups to use dimensional analysis to derive Stoke's law.<br>ii) Teacher to guide students to perform an experiment to determine the coefficient of viscosity of a liquid by using Stoke's law . | • Hydrometer<br>• Meter rule<br>• Viscous liquid<br>• Steel balls of varying diameters<br>• Stop watch<br>• Measuring cylinder | Is the student able to derive Stokes law and determine the coefficient of viscosity? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| | d) explain the variation of coefficient of viscosity with temperature. | Teacher to guide students to perform experiment to determine coefficient of viscosity of a liquid at varying temperature. | • Viscous liquid<br>• Metre rule<br>• Steel ball<br>• Stop watch<br>• Measuring cylinder<br>• Heater | Is the student able to explain the variation of coefficient of viscosity with temperature? | |
| | e) Describe the applications of viscosity. | Teacher to guide students to discuss the applications of viscosity. | Manila sheet | Is the student able to describe the applications of viscosity? | |
| **4.0 PROPERTIES OF MATTER**<br><br>4.1 Surface Tension | By the end of this sub-topic the student should be able to:<br>a) describe surface tension in terms of the molecular theory. | i) Teacher to guide students to discuss surface tension in terms of the molecular theory.<br>ii) Students in groups to demonstrate and explain various phenomena due to surface tension. | • Water<br>• Mercury<br>• Beaker<br>• Computer simulation | Is the student able to describe surface tension in terms of the molecular theory? | 12 |
| | b) analyse surface tension in terms of surface energy. | Teacher to guide students to discuss how to deduce surface tension in terms of surface energy. | Manila sheets | Is the student able to analyse surface tension in terms of surface energy? | |
| | c) determine the coefficient of surface tension of a liquid. | Students in groups to perform an experiment to determine the coefficient of surface tension for various liquids. | • Various liquid<br>• Funnel<br>• Beaker<br>• Measuring cylinder | Is the student able to determine the coefficient of surface tension of a liquid? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| 4.2 Elasticity | By the end of this sub-topic the student should be able to:<br>a) explain elasticity in terms of the molecular theory. | Teacher to guide students through think-pair share method to discuss the concept of elasticity. | Chart of molecular dislocation and slip | Is the student able to explain elasticity in terms of the molecular theory? | 26 |
| | b) distinguish between brittle and ductile materials in terms of their molecular structures. | Through demonstration the teacher to guide students to distinguish between brittle and ductile materials. | • Glass rod<br>• Copper wire<br>• Rubber<br>• Steel rod | Is the student able to distinguish between brittle and ductile materials in terms of their molecular structures? | |
| | c) distinguish different moduli of elasticity. | i) Teacher to guide student to perform experiment to determine, Young's modulus, bulk modulus and shear modulus of elasticity.<br>ii) Students in groups to discuss the difference between moduli of elasticity. | • Balloon<br>• Vernier calipper<br>• Wires<br>• Slotted weights<br>• Metre rule<br>• Micrometer screw gauge | Is the student able to distinguish among the module of elasticity? | |
| | d) derive expression for the potential energy of a deformed solid body. | Teacher to guide students to derive the expression for potential energy in extending or compressing a material | • Vernier caliper<br>• Slotted masses<br>• Wires<br>• Micrometer screw gauge | Is the student able to derive expression for the potential energy of a deformed solid body? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | e) describe the applications of elasticity of materials. | Teacher to guide students to discuss the applications of elasticity. | Manila sheets | Is the student able to describe the applications of elasticity of materials? | |
| 4.3 Kinetic Theory of Gases | By the end of this sub-topic the student should be able to:<br>a) interpret the assumptions of the Kinetic theory of gases. | i) Teacher to guide students in groups to discuss the assumptions of the Kinetic theory of gases.<br>ii) Teacher to guide students to state the assumptions of the Kinetic theory of gases. | • Charts<br>• Computer simulation | Is the student able to interpret the assumptions of the Kinetic theory of gases? | 8 |
| | b) obtain expression for pressure of a gas. | Teacher to guide students in groups to deduce the pressure of a gas using the Kinetic theory of gases. | Manila sheets | Is the student able to obtain expression for pressure of a gas? | |
| | c) deduce the rms speed of a gas. | Teacher to guide students to derive the root mean square speed (rms) of a gas. | Manila sheets | Is the student able to deduce the rms speed of a gas? | |
| | d) establish the relationship between kinetic energy and temperature of a gas. | Students in groups to deduce the relationship between Kinetic energy and temperature from the pressure of the gas and the gas equation. | Manila sheets | Is the student able to establish the relationship between kinetic energy and temperature of a gas? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| **5.0 HEAT**<br><br>5.1 Thermometers | By the end of this sub-topic the student should be able to:<br>a) explain the thermometric properties of substance. | i) Teacher to guide students to demonstrate the thermometric properties of materials.<br>ii) Students in groups to discuss the thermometric properties of materials and fundamental interval. | • Mercury /alcohol thermometers<br>• Platinum thermometer<br>• Constant-volume thermometer | Is the student able to explain the thermometric properties of substance? | 10 |
| | b) describe thermodynamic scale of temperature. | i) Teacher to guide student to discuss thermodynamic temperature, triple point of water and absolute zero temperature.<br>ii) Students in groups to deduce the thermodynamic temperature. | • Mercury/alcohol thermometers<br>• Platinum thermometer<br>• Constant-volume thermometer | Is the student able to describe thermodynamic scale of temperature? | |
| | c) classify types and uses of thermometers. | i) Students in groups to identify different types of thermometers and their uses.<br>ii) Teacher to guide students on calibration of thermometers. | • Mercury /alcohol thermometers<br>• Platinum thermometer<br>• Constant-volume thermometer | Is the student able to classify types of and uses of thermometers? | |
| 5.2 Heat Transfer<br><br>5.2.1 Thermal conduction | By the end of this sub-topic the student should be able to:<br>a) explain thermal conduction in terms of the Kinetic theory of matter. | Teacher to guide students to discuss how molecules transfer heat energy. | Suspendedelastic balls in a row | Is the student able to explain thermal conduction in terms of the Kinetic theory of matter? | 16 |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| | b) derive an expression for the rate of flow of heat through a conductor. | i) Students in groups to perform an experiment to determine the rate of flow of heat.<br>ii) Teacher to guide students to deduce the heat flow equation. | • Lagged metal rod<br>• Thermometers<br>• Source of heat<br>• Ice<br>• Vernier caliper<br>• Manila sheets | Is the student able to derive an expression for the rate of flow of heat through a good conductor? | |
| | c) describe the applications of thermal conduction in domestic and industrial activities. | Teacher to guide students to describe the applications of thermal conduction in domestic and industrial activities. | Manila sheets | Is the student able to describe the applications of thermal conduction in domestic and industrial activities? | |
| 5.2.2 Thermal convection | By the end of this sub-topic the student should be able to:<br>a) explain the process of heat transfer by convection. | i) teacher to guide students to explain the process of heat transfer by convection.<br>ii) Teacher to guide students to discuss in groups the mechanism of heat transfer by convection.<br>iii) Teacher to guide students to discuss the concept of natural and forced convection. | • Water and air<br>• Container<br>• Source of heat<br>• Colour<br>• Heated surface<br>• Blower<br>• Hot liquids<br>• Stop watch<br>• Calorimeters<br>• Source of heat<br>• Thermometers<br>• Graph papers<br>• Stirrer | Is the student able to explain the process of heat transfer by convection? | 12 |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | b) investigate factors that affect the rate of cooling. | i) Students to perform experiments to determine factors that affect the rate of cooling.<br>ii) Teacher to guide students to deduce Newton's law of cooling. | • Calorimeter<br>• Source of heat<br>• Thermometer<br>• Stirrer<br>• Graph paper | Is the student able to investigate factors that affect the rate of cooling? | |
| | c) apply the knowledge of thermal convection in domestic and industrial activities. | Students to conduct project to investigate applications of thermal convection. | • Calorimeter<br>• Source of heat<br>• Thermometer<br>• Stirrer<br>• Graph paper | Is the student able to apply the knowledge of thermal convection in domestic and industrial activities? | |
| 5.2.3 Thermal radiation | By the end of this sub-topic the student should be able to:<br>a) explain the process of heat transfer by radiation. | i) Students to brainstorm on the process of heat transfer by radiation.<br>ii) Teacher to guide students to discuss the process of heat transfer by radiation. | • Charts<br>• Infrared thermometer<br>• Thermos flask<br>• em spectrum chart | Is the student able to explain the process of heat transfer by radiation? | 12 |
| | b) describe spectra of thermal radiation emitted by black body. | Teacher to lead students to discussion on the spectra produced by thermal radiation. | Diagram of spectrum for the black body radiation. | Is the student able to describe spectral of thermal radiation emitted by blackbody? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | c) state laws of blackbody radiation. | Students in groups discuss laws of blackbody radiation i.e. Wien's law and Stefan's law. | Spectrum of blackbody radiation | Is the student able to state laws of blackbody radiation? | |
| | d) apply the laws of blackbody radiation in daily life. | Teacher to guide students to discuss the applications of Wien's laws and Stefan's of blackbody radiation. | Manila sheets | Is the student able to apply the laws of blackbody radiation in daily life? | |
| | e) explain Prevost's theory of heat exchange. | i) Students to demonstrate Prevost'stheory of heat exchange.<br>ii) Teacher to guide students to state Prevost's theory of heat exchange. | • High vacuum electric lamp<br>• Can of water<br>• Thermometer | Is the student able to explain Prevost's theory of heat exchange? | |
| 5.3 First law of Thermodynamics | By the end of this sub-topic the student should be able to:<br>a) explain thermodynamic processes. | i) Students in groups to discuss the meaning of thermodynamic process.<br>ii) Teacher to guide students to discuss in groups Isothermal, isochoric, isobaric and adiabatic processes. | Charts (graph of thermodynamic process) | Is the student able to explain thermodynam-ic processes? | 18 |
| | b) identify specific heat capacity of gases. | i) Through library and internet search students to distinguish between Cv and Cp.<br>ii) Students to show the relation between specific heat capacities and the gas constant R. | Internet | Is the student able to identify specific heat capacity of gases? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | c) derive expressions for the work done during thermodynamic processes. | Teacher to guide students to derive expressions for the work done during thermodynamic processes. | • Charts (graphs)<br>• Manila sheets | Is the student able to derive expressions for the work done during thermodynamic processes? | |
| | d) establish the First law of thermodynamic. | i) Teacher to guide students to discuss partitioning of heat supplied to a system.<br>ii) Teacher to guide students to establish the First law of thermodynamics. | • Cylinder<br>• Piston<br>• Manila sheets | Is the student able to establish first law of thermodynamic? | |
| | e) identify applications of the First law of thermodynamics. | Teacher to guide students to conduct project to identify applications of the First law of thermodynamics. | Manila sheets | Is the student able to develop applications of the First law of thermodynamics? | |
| **6.0 VIBRATIONS AND WAVES**<br><br>6.1 Mechanical Vibrations | By the end of this sub-topic the student should be able to:<br>a) distinguish between free and forced vibrations. | i) Students in groups to demonstrate free and forced vibrations.<br>ii) Teacher to guide students to distinguish between free and forced vibrations. | • Water<br>• Helical spring<br>• Coupled pendulum<br>• Simple pendulum | Is the student able to distinguish between free and forced vibrations? | 6 |
| | b) distinguish between under- damped, critically-damped, and over-damped vibrations. | i) Teacher to guide students to demonstrate the concept of damping. | • Loaded helical spring<br>• Liquids of varying viscosity | Is the student able to distinguish among under-damped, critically-damped, and over-damped | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | | ii) Students in groups to demonstrate the three types of damping and sketch displacement versus time graphs.<br>iii) Students to discuss applications of damping (e.g. in cars and electrical meters) . | | vibrations? | |
| | c) derive the velocity of vibration. | Students in groups to use dimensional analysis to derive the expression for velocity of vibration. | Manila sheets | Is the student able to derive the velocity of vibration? | |
| 6.2 Wave Motion | The student should be able to:<br>a) distinguish between progressive and stationary waves. | i) Students in groups to demonstrate progressive and stationary waves<br>ii) Teachers to guide students to distinguish between progressive and stationary waves. | • String<br>• Slinky spring | Is the student able to distinguish between progressive and stationary waves? | 12 |
| | b) derive expression for progressive and stationary wave motion. | Teacher to guide students to derive expressions for displacement and velocity of waves motion. | Manila sheet | Is the student able to expression for progressive and stationary wave motion? | |
| | c) deduce the principle of superposition of waves. | i) Students in groups to demonstrate superposition of waves.<br>ii) Teacher to guide students to state the principle of superposition of waves. | • Ripple tank<br>• Slink spring<br>• String | Is the student able to deduce the principle of superposition of waves? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| 6.3 Sound | By the end of this sub-topic the student should be able to:<br>a) derive the velocity of sound in materials. | The teacher to guide students to derive velocity of sound in solids, liquids and gases. | Manila sheets | Is the student able to derive the velocity of sound in materials? | 16 |
| | b) determine the velocity of sound in air. | i) Students to perform an experiment to measure the velocity of sound in air. | • Turning fork<br>• Glass tube<br>• Water<br>• Glass jar | Is the student able to determine the velocity of sound in air? | |
| | c) describe the applications of mechanical vibrations and waves. | Teacher to guide students to describe the applications of mechanical vibrations and waves. | Manila sheets | Is the student able to describe the applications of mechanical vibrations and waves? | |
| 6.4 Electromagnetic Waves (em-waves) | By the end of this sub-topic the student should be able to:<br>a) explain nature of em waves. | Teacher to guide students to discuss the magnetic and electric vectors of em waves. | • Computer simulation<br>• Manila sheets | Is the student able to explain nature of em waves? | 6 |
| | b) describe propagation of em waves. | Students to discuss the propagation of em waves in terms of oscillating electric and magnetic vector. | Computer simulation | Is the student able to describe propagation of em waves? | |
| 6.5 Physical Optics<br>6.5.1 Interference | By the end of this sub-topic the student should be able to:<br>a) explain necessary conditions for interference of light. | i) Teacher to guide students in groups to demonstrate interference of two light beams.<br>ii) Teacher to guide students to state conditions for interference of light. | • Monochromatic light source<br>• Screen<br>• Double slit | Is the student able to explain necessary conditions for interference of light? | 12 |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | b) determine wavelength of amonochromatic light by interference method. | Teacher to guide students to perform experiment to determine the wavelength of monochromatic light using the Young's double slit and the Newton's rings methods. | • White light<br>• Convex lens<br>• Flat glass plate<br>• Traveling microscope | Is the student able to determine wavelength of a monochromatic light by interference method? | |
| | c) investigate production of interference by thin films. | Teacher to guide students to demonstrate production of interference by thin transparent films. | • Soap film<br>• Oil film | Is the student able to investigate production of interference by thin films? | |
| | d) identify applications of interference of light. | Students in groups to discuss applications of interference of light in length measurement, wavelength measurement and testing of optical surfaces. | Manila sheets | Is the student able to identify applications of interference of light? | |
| 6.5.2 Diffraction | By the end of this sub-topic the student should be able to:<br>a) explain necessary conditions for diffraction of light to occur. | i) Teacher to guide student in groups to demonstrate diffraction of a beam of light.<br>ii) Teacher to guide students to give the meaning and conditions for diffraction.<br>iii) Students to derive expression for wavelength for Fraunhofer diffraction by single slit. | • Source of light<br>• Single slit<br>• Screen<br>• Large aperture | Is the student able to explain necessary conditions for diffraction of light to occur? | 10 |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | b) explain principle of the diffraction grating. | i) Teacher to guide students in groups to explain the principle of the diffraction grating.<br>ii) Students to deduce the grating equation. | • Diffraction grating<br>• Source of light<br>• Screen | Is the student able to explain principle of the diffraction grating? | |
| | c) determine the wavelength of monochromatic light by diffraction method. | Student to perform experiment to determine the wavelength of monochromatic light using a diffraction grating. | • Diffraction grating<br>• Source of light<br>• Screen | Is the student able to determine the wavelength of monochromatic light by diffraction method? | |
| | d) identify applications of diffraction of light. | Teacher to guide students in groups to discuss applications of diffraction of light. | Manila sheets | Is the student able to identify applications of diffraction of light? | |
| 6.5.3 Polarization | By the end of this sub-topic the student should be able to:<br>a) explain the concept of polarization of light. | i) Students in groups to demonstrate polarization.<br>ii) Teacher to guide students to give the meaning of polarization. | • String<br>• Slit<br>• Polaroid | Is the student able to explain the concept of polarization of light? | 10 |
| | b) describe methods for producing plane polarized light. | Teacher to guide students to demonstrate production of plane polarized light by polaroid, reflection, double refraction and by scattering. | • Light source<br>• Polaroid<br>• Glass block<br>• Nicol prism<br>• Scattering medium | Is the student able to describe methods for producing plane polarized light? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | c) deduce Brewster's law. | Students in groups to derive Brewster's law. | | Is the student able to deduce Brewster's law? | |
| | d) examine optical activity of solutions. | Students to demonstrate optical activity of a solution. | Saccharimeter apparatus | Is the student able to examine optical activity of solutions? | |
| 6.6 Doppler Effect | By the end of this sub-topic the student should be able to:<br>a) explain Doppler effect with sound. | i) Students in groups to demonstrate the Doppler effect with sound.<br>ii) Teacher to guide student to derive the apparent frequency for approaching, receding and stationary observer. | • Source of sound<br>• Microphone<br>• Observer | Is the student able to explain Doppler effect with sound? | **10** |
| | b) explain Doppler effect with light. | i) Students in groups to examine Doppler effect with light.<br>ii) Teacher to guide students to derive apparent speed for approaching, receding and stationary source. | • Computer simulation<br>• Manila sheets | Is the student able to explain Doppler effect with light? | |
| | c) describe the applications of the Doppler effect. | Teacher to guide students to brainstorm and discuss the applications of the Doppler effect with sound and with light in daily life. | Manila sheets | Is the student able to describe the applications of the Doppler effect? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| **7.0 ELECTROSTATICS**<br><br>7.1 The Electric Field | By the end of this sub-topic the student should be able to:<br>a) describe the Coulomb's law. | i) Students in groups to brainstorm on the force between two charged bodies.<br>ii) Teacher to guide students to formulate Coulomb's law. | Computer simulation | Is the student able to describe the coulomb's law? | **6** |
| | b) describe the electric field of a point charge. | i) Students in groups to brainstorm on the concept of electric field and liner of force.<br>ii) Teacher to guide students to deduce the relationship between electric forces, amount of charge and electric field intensity. | Charts with diagrams of electric fields | Is the student able to describe the electric field of a point charge? | |
| | c) derive electric field intensity for simple symmetrical charge distribution. | Teacher to guide students to compute electric field intensity for simple symmetrical charge distributions. | • Point charge<br>• Charged sphere<br>• Plane conductor<br>• Line charge | Is the student able to derive electric field intensity for simple symmetrical charge distribution? | |
| 7.2 Electric Potential | By the end of this sub-topic the student should be able to:<br>a) explain the concept of electric potential. | i) Students in groups to discuss the concept of electric potential.<br>ii) Teacher to guide students to derive expression for electric potential at a point.<br>iii) Students to deduce relationship between electric potential and electric field intensity. | • Diagrams of point charge and plane Conductor<br>• Manila sheets | Is the student able to explain the concept of electric potential? | **8** |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| | b) derive electric potential due to a charge distribution. | i) Teacher to guide students to compute electric potential due to simple symmetric charge distributions. | • Charged sphere<br>• Point charge<br>• Plane conductor<br>• Line charge | Is the student able to derive electric potential due to a charge distribution? | |
| | c) analyse the motion of a charged particle in a uniform electric field. | i) Students in groups to deduce relationship between electrical potential and electric field intensity.<br>ii) Teacher to guide students to demonstrate and analyse the motion of a charged particle in a uniform electrical field. | • Air- filled parallel<br>• plate capacitor.<br>• Atomizer<br>• Stop watch | Is the student able to analyse the motion of a charged particle in a uniform electric field? | |
| 7.3 Capacitance | By the end of this sub-topic the student should be able to:<br>a) identify types of capacitors. | Students to use the think-pair share method to identify types of capacitors. | Various types of capacitors | Is the student able to identify types of capacitors? | **16** |
| | b) investigate factors which determine capacitance of a capacitor. | Students to perform experiment using a parallel plate capacitor to determine relationship between capacitance and plate area, plate separation and permittivity of a material. | • Parallel plate capacitor<br>• Various dielectric materials<br>• Voltmeter<br>• dc source | Is the student able to investigate factors which determine capacitance of a capacitor? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | c) deduce effective capacitance for series and parallel capacitors. | Students in groups to derive expression for effective capacitance for series and parallel capacitor connections. | Charts with diagrams of parallel and series connections. | Is the student able to deduce effective capacitance for series and parallel capacitors? | |
| | d) determine energy stored in a capacitor. | Teacher to guide students to derive the energy stored in a capacitor. | Charts with diagrams of capacitors. | Is the student able to determine energy stored in a capacitor? | |
| | e) investigate charging and discharging of a capacitor. | Teacher to guide students to perform experiment to determine charging and discharging rates and the time constant of a capacitor. | • Capacitor<br>• dc source<br>• voltmeter<br>• resistor<br>• stop watch | Is the student able to investigate charging and discharging of a capacitor? | |

## FORM VI

### Class Competences

By the end of Form Six, the student should have the ability to:

1. Apply theories, laws and principles of electromagnetism, current electricity, electronics, atomic physics and environmental physics in daily life.
2. Apply laboratory skills in solving daily life problems.
3. Use sustainable energy conversion systems for environmental conservation.
4. Use ICT tools in accessing information, simulating and modelling physical phenomena.

### Class Objectives

By the end of Form Six, the student should be able to:

a) explain theories, laws and principles of electromagnetism, current electricity, electronics, atomic physics and environmental physics.

b) design and perform experiments in electromagnetism, current electricity, electronics, atomic physics and environmental physics.

c) acquire skills in designing sustainable energy conversion systems.

d) understand computer aided programs in learning Physics.

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
|---|---|---|---|---|---|
| **1.0 ELECTRO-MAGNETISM**<br><br>1.1 Magnetic Fields | By the end of this sub-topic the student should be able to:<br>a) distinguish between magnetic flux density, B and Magnetic field intensity, H. | i) Students in groups to discuss the difference between magnetic flux density B and magnetic field intensity H.<br>ii) Teacher to guide students to deduce relationship between B and H. | • Magnet<br>• Iron filings<br>• Plane paper | Is the student able to distinguish between magnetic flux density, B and Magnetic field intensity, H? | 12 |
| | b) investigate the magnetic field density due to a conductor carrying current. | i) Students in groups to discuss the structure of the magnetic field for long straight conductor, a circular coil and a solenoid.<br>ii) Teacher to guide students to deduce the magnetic flux density B for a long straight conductor, circular coil and solenoid, using Biot-Savart law and Ampere's law. | • Conductors<br>• Coil<br>• Solenoid<br>• Galvanometer<br>• Battery | Is the student able to investigate the magnetic field density due to a conductor carrying a current? | |
| | c) analyse the motion of a charged particle moving in a magnetic field. | i) Teacher to assist students in groups to demonstrate movement of a charged particle in a uniform magnetic field.<br>ii) Students to derive relationship between magnetic flux density and force acting on the charged particle in a magnetic field. | • Helmholtz coils<br>• Charged oil drop | Is the student able to analyse the motion of a charged particle moving in a magnetic field? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| 1.2 Magnetic Properties of Materials | By the end of this sub-topic the student should be able to:<br>a) investigate magnetic permeability of materials. | i) Teacher to guide students to deduce the permeability from graph of B and H.<br>ii) Students in groups to perform experiment to determine the relationship between B and H. | • Search coil<br>• Ballistic galvanometer<br>• Solenoid<br>• Graph paper | Is the student able to investigate magnetic permeability of materials? | 16 |
| | b) examine magnetization of different materials. | i) Teacher to guide students to deduce relative permeability and susceptibility of a material.<br>ii) Students to drive the relationship between intensity of magnetization M and magnetic flux density B. | • Magnet<br>• Iron filings | Is the student able to examine magnetization of different materials? | |
| | c) interpret the hysteresis loop for B and H. | i) Students in groups to perform an experiment to determine relationship between B and H for a complete magnetic cycle.<br>ii) Students to deduce the coercive force and remanence from the hysteresis loop.<br>iii) Students to discuss in groups the distinction between magnetically soft and magnetically hard materials. | • Magnet<br>• Search coil<br>• Ballistic galvanometer<br>• Ammeter<br>• Solenoid | Is the student able to interpret the hysteresis loop for B and H? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | d) distinguish among Ferromagnetic, Paramagnetic and diamagnetic materials. | i) Teacher to guide students to brainstorm and discuss about atomic magnetism and magnetic domains.<br>ii) Students to demonstrate domains alignment under the influence of an external magnetic field.<br>iii) Teacher to guide student to distinguish among ferromagnetic, paramagnetic and diamagnetic materials by using concepts of the magnetic domain theory. | • Iron filings<br>• Helmhotz coil<br>• Hard paper<br>• Charts for magnetic domain | Is the student able to distinguish among Ferromagnetic, Paramagnetic and diamagnetic materials? | |
| 1.3 Magnetic Forces | By the end of this sub-topic the student should be able to:<br>a) investigate the factors which determine the magnetic force on a current carrying conductor in a magnetic field. | i) Students to perform experiment to determine relationship between magnetic force and magnetic flux density, current and length of a conductor.<br>ii) Students to discuss relationship between the Ampere and the force acting between two parallel current carrying conductors placed in air. | • Solenoid<br>• Rheostat<br>• Insulator<br>• Battery<br>• Magnets<br>• Ammeter | Is the student able to investigate the factors which determine the magnetic force on a current carrying conductor in a magnetic field? | 8 |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | b) determine the torque on a current loop in a magnetic field. | Students in groups to deduce the torque acting on a rectangular coil carrying a current. | Charts | Is the student able to determine the torque on a current loop in a magnetic field? | |
| | c) identify applications of magnetic forces. | Students in groups to brainstorm on applications of magnetic forces in daily life. | | Is the student able to identify applications of magnetic forces? | |
| 1.4 Electromagnetic Induction | By the end of this sub-topic the student should be able to:<br>a) Explain the concept of flux linkage. | i) Students to demonstrate electromagnetic induction<br>ii) Teacher to guide students to deduce expression for flux linkage. | • Galvanometer<br>• Magnet<br>• Coil | Is the student able to explain the concept of flux linkage? | 20 |
| | b) investigate factors which determine the induced *emf*. | i) Students in groups to perform experiment to determine the factors which affect magnitude of induced *emf*.<br>ii) Teacher to guide students to state Lenz's and Faraday's laws of electromagnetic induction.<br>iii) Teacher to arrange field trip to visit a power generating plant. | • Galvanometer<br>• Magnetic<br>• Set of solenoids | Is the student able to investigate factors which determine the induced *emf*? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | c) Distinguish between self-induction and mutual induction. | i) Teacher to guide students to demonstrate self-induction and mutual-induction.<br>ii) Students to derive expressions for self-induction and mutual induction.<br>iii) Students to discuss importance and applications of back-*emf* in practice. | • Galvanometer<br>• Battery<br>• Lamp<br>• Switch<br>• Rheostat | Is the student able to Distinguish between self induction and mutual induction? | |
| | d) determine the energy stored in an inductor. | Teacher to guide students to derive an expression for energy stored in an inductor. | | Is the student able to determine the energy stored in an inductor? | |
| 1.5 Magnetic Field of the Earth | By the end of this sub-topic the student should be able to:<br>a) explain the origin of the Earth's magnetic field. | i) Students to brainstorm and discuss in groups about the origin of the earth's magnetic field.<br>ii) Teacher to guide students to use the self-dynamo theory to explain the origin of the earth's magnetic field. | • Compass<br>• Bar magnet | Is the student able to explain the origin of the Earth's magnetic field? | 14 |
| | b) describe structure of Earth's magnetic field. | Students in groups to discuss the structure of the earth's magnetic field and compare with field on a bar magnet. | • Charts<br>• Computer simulation | Is the student able to describe structure of Earth's magnetic field? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | c) explain variations of Earth's magnetic field. | Teacher to guide students to discuss the three variations; secular variation, polar wondering and magnetic field reversal. | • Charts<br>• Global | Is the student able to explain variations of Earth's magnetic field? | |
| | d) analyse components of the Earth's magnetic field. | i) Students in groups to perform experiment to determine the components of the earth's magnetic field.<br>ii) Teacher to guide students to analyse the components of the earth's magnetic field. | • Dip needle<br>• Compass | Is the student able to analyse components of the Earth's magnetic field? | |
| **2.0 CURRENT ELECTRICITY**<br><br>2.1 Electric Conduction in Metals | By the end of this sub-topic the student should be able to:<br>a) describe the mechanism of electric conduction in metals. | i) Students to discuss mechanism of electric conduction in metals<br>ii) Teacher to guide students to derive expression for current in metallic conductor. | • Chart<br>• Computer simulation | Is the student able to describe the mechanism of electric conduction in metals? | 26 |
| | b) determine the resistivity of a conductor. | i) Students to perform experiments to determine resistivity of a wire by using Wheatstone Bridge and Meter Bridge.<br>ii) Teacher to guide students to compute resistivity of a given conductor. | • Connecting wires<br>• Graph paper<br>• Tungsten wire<br>• Manganin wire<br>• Resistors<br>• Galvanometer<br>• Battery | Is the student able to determine the resistively of a conduct? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | c) investigate the temperature coefficient of resistance. | i) Students to perform experiment to determine temperature coefficient of resistance.<br>ii) Teacher to guide students to establish relationship between temperature coefficient of resistance of the conductor and temperature. | • Wheat stone bridge or Meter Bridge<br>• Battery<br>• Source of heat<br>• Beaker<br>• Water<br>• Thermometer<br>• Connecting wires<br>• Sample fine wire<br>• Galvanometer | Is the student able to investigate the temperature coefficient of resistance? | |
| | d) analyse electrical networks. | i) Students to perform experiment to determine current at a junction of electrical network.<br>ii) Teacher to guide students to deduce Kirchhoff's laws for electrical networks.<br>iii) Students to apply the laws in electrical networks. | • Battery<br>• Galvanometer<br>• Potentiometer<br>• Ammeters<br>• Connecting wires<br>• Jockeys | Is the student able to analyse electrical networks? | |
| 2.2 Electric Conduction in Gases | By the end of this sub-topic the student should be able to:<br>a) investigate the conduction of electricity in gases. | i) Students to demonstrate conduction of electricity in gases.<br>ii) Teacher to guide students to interpret various bands observed in the discharge tube.<br>iii) Students to sketch and interprete the ionization curve. | • Discharge tube<br>• High voltage source<br>• Charts | Is the student able to investigate the conduction of electricity in gases? | 12 |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | b) explore optical spectra for gases. | i) Students to perform experiment to determine spectra of gases.<br>ii) Teacher to guide students to use spectral data to identify types of gases. | • Gas tubes<br>• Prism spectrometer<br>• Induction coil<br>• Diffraction grating. | Is the student able to explore optical spectra for gases? | |
| | c) identify applications of conduction of electricity in gases. | Students in groups to discuss applications of conduction of electricity in gases, e.g. fluorescent tube, vapor lamps. | | Is the student able to identify applications of conduction of electricity in gases? | |
| 2.3 Alternating Current(ac) | By the end of this sub-topic the student should be able to:<br>a) measure alternating current using appropriate instruments. | i) Students in groups to perform experiment to measure ac.<br>ii) Teacher to guide students to discuss difference between ac and dc meters. | • Moving coil meter<br>• Hot Wire meter<br>• Oscilloscope<br>• Digital meter | Is the student able to measure alternating current using appropriate instruments? | 26 |
| | b) establish the mean and r.m.s values of alternating current and voltage. | Teacher to guide students to derive expression for mean and root-mean square values of alternating current and voltage. | | Is the student able to establish the mean and r.m.s values of alternating current and voltage? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | c) analyse conduction of a.c through different circuit elements. | i) Students to demonstrate the passage of ac through resistor, inductor and capacitor.<br>ii) Teacher to guide students to sketch graphs of I and V against time for resistor, inductor and capacitor and their phasor diagram.<br>iii) Students to deduce expressions for capacitive and inductive reactance. | • ac source<br>• Oscilloscope<br>• Inductor<br>• Capacitor<br>• Resistor | Is the student able to analyse conduction of a.c through different circuit elements? | |
| | d) establish the resonant frequency for R, L, C circuits. | i) Students to demonstrate ac through CR, LR, LC and LCR in series and parallel circuits.<br>ii) Teacher to lead students to sketch V and I against time for CR, LR, LC and LCR in series and parallel circuits and their phasor diagrams.<br>iii) Students to derive the impedance for *a.c* through CR, LR, LC and LCR in series and parallel circuits. | • Source of a.c<br>• Signal generator<br>• Double beam CRO,<br>• Charts | Is the student able to establish the frequency band with and resonant frequency for R, L, C circuits? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | | iv) Students to sketch impedance versus frequency curves and hence determine resonant frequency. | | | |
| | e) determine power in R, L and C circuits. | i) Students to discuss power in R, Land C circuits.<br>ii) Teacher to guide students to derive expression for power in R, L and C circuits.<br>iii) Students to discuss power factor. | | Is the student able to determine power in R, L and C circuits? | |
| **3.0 ELECTRONICS**<br><br>3.1 The Band Theory of Solids | By the end of this sub-topic the student should be able to:<br>a) explain the significance of the Fermi level and energy gap in solids. | i) teacher to guide students to brainstorm on energy bands in solids.<br>ii) Students in groups to explain the significance of the Fermi level and the energy gap. | • Charts<br>• Computer simulation | Is the student able to explain the significance of the Fermi level in solids? Is the student able to analyse the effect of temperature on the conduction of solids? | 6 |
| | b) analyse the effect of temperature on the electrical conduction of solids. | Teacher to guide students in groups to discuss the effect of temperature on the electrical conduction of solid conductor, semiconductors and insulators. | • Electrical sources<br>• Conductor<br>• Semiconductor<br>• Insulator | | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| 3.2 Semiconductors | By the end of this sub-topic the student should be able to:<br>a) distinguish between intrinsic and extrinsic semiconductors. | i) Students in groups to brainstorm on difference between intrinsic and extrinsic semiconductors.<br>ii) Teacher to guide students to discuss the process of doping. | • Silicon<br>• Germanium<br>• Computer simulation<br>• Tri-valent and pentavalent element. | Is the student able to distinguish between intrinsic and extrinsic semiconductors? | 14 |
| | b) examine applications of semiconductors. | Students in groups to conduct projects on the applications of semiconductors. | | Is the student able to examine applications of semi conductor sensors? | |
| 3.3 Transistors | By the end of this sub-topic the student should be able to:<br>a) explain the mode of operation of a pnp and npn junctions.<br>b) interpret transistor characteristics. | i) Students in groups to discuss theconstruction of a *pnp* and *npn* junctions.<br>ii) Teacher to guide students to discuss the mode of action of the *npn* and *pnp* junctions. | • PnP transistor<br>• npn transistor | Is the student able to explain the mode of operation of a pnp and npn junction? | 24 |
| | | i) Students in groups to perform experiment to determine transistor characteristics for CE, CB and CC configuration.<br>ii) Teacher to guide students to interpret the measured characteristics | • Transistor<br>• Battery<br>• Lamps<br>• Resistors<br>• Ammeter<br>• Voltmeter | Is the student able to interpret transistor characteristics? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | c) determine the amplification and power gain in transistor circuits. | i) Students in groups to perform experiment to measure amplification, using CE transistor.<br>ii) Teacher to guide students to derive expression for amplification and power gain.<br>iii) Students to discuss applications of current and voltage amplification and power gain by transistors circuits. | • Capacitor<br>• Resistor<br>• Battery<br>• Transistor<br>• Oscilloscope<br>• Signal source | Is the student able to determine the amplification and power gain in transistor circuits? | |
| | d) assess the effect of temperature on transistor circuits. | i) Students in groups to perform experiments to demonstrate effect of temperature on transistor circuits.<br>ii) Teacher to guide students to explain effect of temperature on transistor circuits.<br>iii) Students to demonstrate how to control temperature variation in transistor circuits. | • CE transistor circuit<br>• Signal source<br>• Heat source<br>• Oscilloscope<br>• Capacitor<br>• Resistors<br>• Battery | Is the student able to assess the effect of temperature on transistor circuits? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | e) design and construct basic transistor switching circuits. | i) Teacher to guide students in groups to design and construct a transistor switching circuit.<br>ii) Teacher to guide students to interpret the response of a transistor switch. | • Transistor<br>• Battery<br>• Bulb<br>• Resistor | Is the student able to design and construct basic transistor switching circuits? | |
| 3.4 Logic Gates | By the end of this sub-topic the student should be able to:<br>a) identify basic types of logic gates. | i) Students in groups to discuss the various types of logic gates.<br>ii) Teacher to guide students to demonstrate action of the various gates. | • AND gate<br>• OR gate<br>• NOR gate<br>• NAND gate<br>• Computer simulation | Is the student able to identify basic types of logic gates? | 16 |
| | b) create logical truth tables of logic gates. | Teacher to guide students to create truth tables for NOT, AND, NAND, NOR and OR gates. | Chart showing logic gates | Is the student able to create logical truth tables of logic gates? | |
| | c) apply Boolean Algebra to analyze logic circuits. | i) Teacher to introduce principles of Boolean algebra.<br>ii) Students to analyze logic circuits by using Boolean algebra.<br>iii) Students to apply Boolean algebra to design logic circuits. | Chart showing the combination of logic gates | Is the student able to apply Boolean Algebra to analyze logic circuits? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| 3.5 Operational Amplifiers | By the end of this sub-topic the student should be able to:<br>a) describe the properties and mode of action of operational amplifiers. | i) Students in groups to discuss properties of operational amplifiers.<br>ii) Teacher to guide students to describe the mode of action of an operational amplifier.<br>iii) Students in groups to discuss transfer characteristics of operational amplifiers. | • OP amp<br>• Computer simulation | Is the student able to describe the properties and mode of action of operational amplifiers? | 14 |
| | b) identify applications of operational amplifiers. | Teacher to guide students in groups to demonstrate and discuss OP amp as voltage amplifier, voltage comparator, oscillator and as integrator. | • OP amp<br>• Oscilloscope<br>• Signal generator<br>• Power source | Is the student able to identify applications of operational amplifiers? | |
| 3.6 Telecommunication | By the end of this sub-topic the student should be able to:<br>a) explain Amplitude Modulation (AM) and Frequency Modulation (FM). | i) Students to brainstorm on the meaning of amplitude modulation and frequency modulation.<br>ii) Teacher to guide students to distinguish between AM and FM. | • Radio set<br>• TV set<br>• MP3 system<br>• Computer<br>• Internet | Is the student able to explain Amplitude Modulation (AM) and Frequency Modulation (FM)? | 26 |
| | b) identify basic components of a communication system. | Teacher to guide students, through question and answers, to discuss the basic components of a communication system. | Charts | Is the student able to identify the basic components of a communication system? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | c) describe the methods of reception and transmission of radio and TV signals. | i) Teacher to arrange for study visit to a radio and TV transmission station.<br>ii) Teacher to guide students to summarize the methods of transmitting and receiving radio and TV signals. | • Radio station<br>• TV station<br>• Radio set<br>• TV set | Is the student able to describe the methods of reception and transmission of radio and TV signals? | |
| | d) design simple telecommunication devices. | Students in groups to carry out projects to design simple radio receiver, transmitter and TV antennas. | • TV antennas<br>• Radio set<br>• Charts | Is the student able to design simple telecommunication devices? | |
| **4.0 ATOMIC PHYSICS**<br><br>4.1 Structure of the Atom | By the end of this sub-topic the student should be able to:<br>a) describe the Rutherford and Bohr models of the atom. | i) Students in groups to discuss the Rutherford and Bohr models of the atom.<br>ii) Teacher to guide students to summarize the main components of the Rutherford and Bohr models of the atom.<br>iii) Students to state Bohr postulates. | • Charts<br>• Computer simulation | Is the student able to describe the Rutherford and Bohr models of the atom? | 8 |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | b) analyse atomic energy levels. | i) Teacher to guide students to discuss the hydrogen energy levels, and derive expressions for the energy levels.<br>ii) Students to perform experiment to determine wavelengths in the Balmer series of the hydrogen spectrum. | • Hydrogen spectrum tube<br>• Diffraction grating<br>• Prism spectrometer<br>• Power supply | Is the student able to analyse atomic energy levels? | |
| 4.2 Quantum Physics | By the end of this sub-topic the student should be able to:<br>a) describe failures of classical physics. | Teacher to guide students to discuss failures of the classical laws of physics. | | Is the student able to describe failures of classical physics? | 30 |
| | b) explain Planck's quantum theory of blackbody radiation. | i) Teacher to guide students to discuss the quantum theory according to Planck.<br>ii) Students to discuss in groups spectral distribution of blackbody radiation according to Planck. | • Charts<br>• Computer simulation<br>• Black body | Is the student able to explain Planck's quantum theory of blackboard radiation? | |
| | c) explain Einstein quantum theory of light. | i) Teacher to guide students to discuss the quantum theory according to Einstein. | • Photocell<br>• Light source<br>• Prism | Is the student able to explain Einstein quantum theory of light? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | | ii) Students to perform experiment to determine the Planck's constant, *h* | • Micro ammeter<br>• voltmeter | | |
| | d) account for the photoelectric effect phenomenon. | i) Students to deduce stopping potential, threshold frequency and work-function of a metal.<br>ii) Teacher to guide students to explain the photoelectric effect. | • Computer simulation<br>• Charts | Is the student able to account for the photoelectric effect phenomenon? | |
| | e) deduce de Broglie wavelength for the electron. | i) Students in groups to discuss the wave-particle duality of the electron.<br>ii) Teacher to guide students to derive de Broglie's wavelength for the electron. | • Charts<br>• Computer simulation | Is the student able to deduce de Broglie wavelength for the electron? | |
| | f) describe production and uses of x-rays. | i) Teachers to guide students to brainstorm on the production of x- rays.<br>ii) Students to discuss uses of x-rays in medicine, industry and in sample analysis.<br>iii) Students to make a study visit to a laboratory or hospital with x-ray unit. | • X-ray tube<br>• Charts<br>• Computers simulation | Is the student able to describe production and uses of x-rays? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| 4.3 LASER | By the end of this sub-topic the student should be able to:<br>a) describe production of LASER light. | Teacher to guide students to discuss how LASER light is produced. | • Charts<br>• Computer simulation | Is the student able to describe production of LASER light? | 16 |
| | b) explain properties of LASER light. | Students in groups to demonstrate properties of LASER light | • He-Ne laser<br>• screen | Is the student able to explain properties of LASER light? | |
| | c) distinguish types of LASERS. | i) Teacher to guide students to discuss methods of pumping in LASER production.<br>ii) Students in groups to discuss different types of lasers. | | Is the student able to distinguish types of LASERS? | |
| | d) identify applications of LASER light. | Teacher to guide students to describe applications of LASER light in medicine, industry, military and domestic applications. | | Is the student able to identify applications of LASER light? | |
| 4.4 Nuclear Physics | By the end of this sub-topic the student should be able to:<br>a) describe the structure of the nucleus. | i) Students in groups to brainstorm and discuss the structure of the nucleus<br>ii) Teacher to guide students to review the Rutherford experiment. | • Models<br>• Charts<br>• Computer simulation | Is the student able to describe the structure of the nucleus? | 32 |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | b) determine half life and the decay constant of a radioactive substance. | Students in groups to perform experiment to measure half-life and decay constant | • Radioactive sources<br>• GM tube<br>• Scaler<br>• Timer | Is the student able to determine half life and the decay constant of a radioactive substance? | |
| | c) explain the relation of nuclear mass and binding energy. | i) Teacher to guide students to discuss Einstein's mass-energy equation.<br>ii) Students in groups to apply Einstein mass- energy relation to determine the binding energy of nuclei | | Is the student able to explain the relation of nuclear mass and binding energy? | |
| | d) identify criteria for stable and unstable nucleus. | i) Students in groups to compute and analyse the Neutron (N) and Proton (Z) ratio and plot of N against Z for radioactive elements.<br>ii) Teacher to guide students to establish criteria for stable and unstable nuclei. | • Periodic table of elements<br>• Charts | Is the student able to identify criteria for stable and unstable nucleus? | |
| | e) identify uses and hazards of radioisotopes. | i) Students in groups to brainstorm and discuss applications of isotopes.<br>ii) Teacher to guide students to identify hazards of isotopes. | • Periodic table of element<br>• Charts | Is the student able to identify uses and hazards of radioisotopes? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | f) distinguish between fission and fusion processes. | i) Students in groups to discuss the meaning of fission and fusion.<br>ii) Teacher to guide students to calculate the energy released in a nuclear fission.<br>iii) Students in groups to calculate the energy absorbed in a nuclear fusion.<br>iv) Students to discuss applications of nuclear fission and fusion processes. | Computer simulation | Is the student able to distinguish between fission and fusion processes? | |
| | g) describe operation of a nuclear reactor. | Students in groups to do literature search on the construction and operation of a nuclear reactor for safe applications. | • Internet.<br>• library | Is the student able to describe operation of a nuclear reactor? | |
| **5.0 ENVIRONMENTAL PHYSICS**<br><br>5.1 Agricultural Physics | By the end of this sub-topic the student should be able to:<br><br>a) explain the influence of the radiation environment on plant growth. | i) Students in groups to discuss the components of solar radiation.<br>ii) Students in groups to discuss the heating effect of solar radiation on plants. | Charts | Is the student able to explain the influence of the radiation environment on plant growth? | 20 |
| | b) explain the influence of the aerial environment on plant growth. | i) Students in groups to discuss how wind, rainfall, humidity and air temperature influence plant growth. | Computer simulation | Is the student able to explain the influence of the aerial environment on plant growth? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | | ii) Teacher to guide students to discuss the effect of windbelts on plant growth. | | | |
| | c) identify soil environment components which influence plant growth. | i) Students in groups to perform experiment to determine the rate of water flow in different soils.<br>ii) Teacher to guide students to discuss the movement of water in soils.<br>iii) Teacher to guide students to discuss heat transfer in soils. | • Clay soil<br>• Sand soil<br>• Loam soil<br>• Cylindrical glass tube<br>• Water reservoir<br>• Measuring cylinder<br>• Time | Is the student able to identify soil environment components which influence plant growth? | |
| | d) apply techniques for improvement of the plant environment. | Students to brainstorm and discuss the effect of shading, mulching, and wind breaks on the plant environment. | • Vegetation<br>• Polythene sheet<br>• Trees | Is the student able to apply techniques for improvement of the plant environment? | |
| 5.2 Energy from the Environment | By the end of this sub-topic the student should be able to:<br>a) describe the principles of a photovoltaic conversion system. | i) Teacher to guide students to discuss how a photocell works.<br>ii) Students in groups to deduce the resultant of connecting several photocells in series.<br>iii) Students in groups to analyse the efficiency of a photovoltaic system.<br>iv) Teacher to arrange field visit to study photovoltaic systems in practical use. | • Photocell<br>• Solar panel | Is the student able to describe the principles of a photovoltaic conversion system? | 20 |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | b) determine the amount of available and extractable wind energy. | i) Students in groups to discuss amount of energy for a given wind speed.<br>ii) Teacher to guide students to derive the amount of available and extractable wind energy. | Model of a wind turbine | Is the student able to determine the amount of available and extractable wind energy? | |
| | c) examine methods of extracting geothermal energy. | Students in groups to discuss methods of extracting geothermal energy. | • Computer simulation<br>• Charts | Is the student able to examine methods of extracting geothermal energy? | |
| | d) assess methods of extracting wave energy. | Students in groups to brainstorm and discuss methods of extracting wave energy from sea waves. | • Computer simulation<br>• Charts<br>• Sea waves | Is the student able to assess methods of extracting wave energy? | |
| 5.3 Earthquakes | By the end of this sub-topic the student should be able to:<br>a) describe the elastic rebound theory of earthquake formation. | Teacher to guide students to discuss formation of an earthquake according to the elastic rebound theory. | • Charts<br>• Computer simulation | Is the student able to describe the elastic rebound theory of earthquake formation? | 12 |
| | b) identify types of seismic waves. | Students in groups to brainstorm and discuss types of seismic waves and their characteristics. | Charts | Is the student able to identify types of seismic waves? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | c) describe the propagation of seismic waves. | Teacher to guide students to discuss the propagation of seismic waves. | • Charts<br>• Computer simulation | Is the student able to describe the propagation of seismic waves? | |
| | d) locate the centre of an earthquake. | i) Teacher to guide students to discuss how the centre of an earthquake can be located. | • Seismometer<br>• Charts | Is the student able to locate the centre of an earthquake? | |
| 5.4 Environmental Pollution | By the end of this sub-topic the student should be able to:<br>a) explain the concept of pollution. | i) Students in groups to brainstorm on the meaning of pollution<br>ii) Teacher to guide students to state the meaning of pollution | Charts | Is the student able to explain the concept of pollution? | 28 |
| | b) identify sources and types of pollutant in the environment. | Students to brainstorm and discuss the types and sources of pollutants in the environment. | • Motor vehicle<br>• Industries smoke<br>• Dumps | Is the student able to identify sources and types of pollutant in the environment? | |
| | c) classify particulate matter in the atmosphere. | Teacher to guide students to identify the classes of particulate matter in the atmosphere. | • Charts<br>• Graphs<br>• Computer simulation | Is the student able to classify particulate matter in the atmosphere? | |

| TOPIC/SUB-TOPIC | SPECIFIC OBJECTIVES | TEACHING AND LEARNING STRATEGIES | RESOURCES | ASSESSMENT | ESTIMATED NUMBER OF PERIODS |
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| | d) explain the transport mechanisms of atmospheric pollutant. | Teacher to guide students to examine transport mechanisms of atmospheric pollutants. | • Charts<br>• Computer simulation | Is the student able to explain the transport mechanisms of atmospheric pollutant? | |
| | e) identify nuclear wastes and their methods of disposal. | i) Students in groups to identify types of nuclear waste.<br>ii) Teacher to guide students to describe how nuclear waste is disposed. | • Charts<br>• Internet | Is the student able to identify nuclear wastes and their methods of disposal? | |
| | f) explain the effects of pollution on visibility and optical properties of materials and the environment. | Teacher to guide students in groups to discuss the effect of pollution on the visibility and optical properties of materials and the environment. | • Charts<br>• Internet<br>• Computer simulation | Is the student able to explain the effects of pollution on visibility and optical properties of materials and the environment? | |