General Certificate of Education (Advanced Level)

Grads 12-13

Physics Syllabus

(Implemented from 2017)

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INTRODUCTION

Physics is the major science dealing with the fundamental constituents of universe, the forces they exert on one another and the results produced by these forces. It is the root of every field of science and underlies all natural phenomena. Studying physics and physicist's methods of acquiring and evaluating knowledge should therefore be regarded as an integral part of the education for all science students.

G.C.E (Advanced Level) Physics syllabus is designed as a two year course to provide the basic background in physics that would be required by those intending to proceed to higher studies as well as by those who would utilize the knowledge of physics in various fields and daily life.

1.1 National goals

1. Based on the concept of respecting human values and understanding the differences between the Sri Lankan multi-cultural society, building up the nation and confirming the identity of Sri Lanka by promoting national integrity, national unity, national coherence and peace.

2. While responding to the challenges of the dynamic world, identifying and conserving the national heritage.

3. Creating an environment which comprises the conventions of social justice and democratic life to promote the characteristics of respecting human rights, being aware of the responsibilities, concerning each other with affectionate relationships.

4. Promoting a sustainable life style based on the people's mental and physical wellbeing and the concept of human values.

5. Promoting positive feelings needed for a balanced personality with the qualities of creative skills, initiative, critical thinking and being responsible.

6. Developing the human resources, needed for the progress of the wellbeing of an individual, the nation as well as the economic growth of Sri Lanka, through education.

7. Preparing the people for the changes that occur in a rapidly changing world by adapting to it and controlling them; developing abilities and potentialities of people to face the complex and unexpected occasions.

8. Sustaining the skills and attitudes based on justice, equality, mutual respect which is essential to achieve a respectable place in the international community.

National Education Commission Report (2003).

1.2 Basic Competencies

The competencies promoted through the education mentioned below help to achieve the above mentioned National Goals.

i. Competencies in Communication

This first set of competencies is made up of four subsets - Literacy, Numeracy, Graphics and Information Communication skills:

Literacy : Listening, carefully speaking clearly, and reading for comprehension, writing clearly and accurately.

Numeracy: Using numbers to count, calculate, code and to measure, matter, space and time.

Graphics : Making sense of line and form, expressing and recording essential data, instructions and ideas with line, form, colour, two and three-dimensional configurations, graphic symbols and icons.

ICT Competencies: Knowledge on computers, and the ability to use the information communication skills at learning or work as well as in private life.

ii. Competencies relating to personality development

- Generic skills such as creativity, divergent thinking, initiative, decision making, problem-solving, critical and analytical thinking, team work, inter-personal relationships, discovering and exploring
- Values such as integrity, tolerance and respect for human dignity.
- Cognition

iii. Competencies relating to the environment

This is the second set of competencies related to the Social, Biological and Physical Environments.

Social Environment: Awareness, sensitivity and skills linked to being a member of society, social relationship, personal conduct, general and legal conventions, rights, responsibilities, duties and obligations.

Biological Environment: Awareness, sensitivity and skills linked to the living world, man and the ecosystem, the trees, forests, seas, water, air and life - plant, animal and human life.

Physical Environment: Awareness, sensitivity and skills relating to space, energy, fuel, matter, materials and their links with human living, food, clothing, shelter, health, comfort, respiration, sleep, relaxation, rest, waste and excretion, media of communication and transport.

Included here are the skills in using tools to shape and for materials for living and learning.

iv. Competencies relating to preparation for the world of work

Employment related skills to maximize their potential and to enhance their capacity to contribute to economic development; to discover their vocational interests and aptitudes; to choose a job that suits their abilities and to engage in a rewarding and sustainable livelihood.

v. Competencies relating to religion and ethics

- Develop competencies pertaining to managing environmental resources intelligently by understanding the potential of such resources.
- Develop competencies related to the usage of scientific knowledge to lead a physically and mentally healthy life.
- Develop competencies pertaining to becoming a successful individual who will contribute to the development of the nation in collaboration, engage in further studies and undertake challenging job prospects in the future.
- Develop competencies related to understanding the scientific basis of the natural phenomena and the universe.
- Use appropriate technology to maintain efficiency and effectiveness at an optimum level in utilizing energy and force.

2.0 Aims of the syllabus

At the end of this course students will be able to;

1. acquire sufficient understanding and knowledge to become confident citizens in a technological world.
2. recognize the usefulness and limitations of scientific method and to appreciate its applicability in everyday life
3. develop abilities and skills that are relevant to the study and practice of physics in day- to -day life.
4. develop attitudes relevant to physics such as concern for accuracy and precision, objectivity, enquiry, initiative and inventiveness.
5. stimulate interest and care for the environment.
6. acquire manipulative, observational and experimental skills together with hands- on experience on the equipments used by physicists.

List of topics and allocated number of periods

	Topic	Number of periods
Unit 01	Measurement	30
Unit 02	Mechanics	110
Unit 03	Oscillations and Waves	100
Unit 04	Thermal Physics	60
Unit 05	Gravitational Field	20
Unit 06	Electrostatic field	60
Unit 07	Magnetic Field	40
Unit 08	Current Electricity	70
Unit 09	Electronics	40
Unit 10	Mechanical Properties of Matter	40
Unit 11	Matter and Radiation	30
	Total	**610**

Grade	Term	Competency Levels
Grade 12	First Term	From 1.1 to 2.5 (11 Competency Levels)
	Second Term	From 2.6 to 3.5 (08 Competency Levels)
	Third Term	From 3.6 to 4.9 (15 Competency Levels)
Grade 13	First Term	From 5.1 to 7.6 (12 Competency Levels)
	Second Term	From 8.1 to 10.2 (10 Competency Levels)
	Third Term	From 10.3 to 11.6 (07 Competency Levels)

3.0- Syllabus
3.1 – Grade 12

Unit 1 - Measurement **(30 periods)**

Competency	Competency Level	Content	Learning outcomes	No. of Periods

1. Uses experimental and mathematical frames in physics for systematic explorations.	1.1 Inquires the scope of physics and how to use the scientific methodology for explorations.	• Introduction to physics
		  ◦ Explaining simply the subject area of physics and how it relates to daily life and nature
		  ◦ How physics contributed to the development of society
		  ◦ Basic concepts in scientific methodology
			Student will be able to;
			• explains physics as the study of energy, behavior of matter in relation to energy and transformation of energy.
			• describes physics as a subject that focuses from fundamental particles to the Universe.
			• expresses how to use principles of physics in day-to-day life and to explain natural phenomena.
			• elaborates how physics has been applied in development of new technologies in areas such as
			  ◦ Transportation
			  ◦ Communication
			  ◦ Energy production and energy usage
			  ◦ Medicine
			  ◦ Earth and space explorations
			• uses the scientific method for scientific explorations.
			• accepts that advancements in physics are based on observations and inferences made on them.
				02

Competency	Competency Level	Content	Learning outcomes	No. of Periods

	1.2 Use units appropriately in scientific work and daily pursuits.	• Physical quantities and units
		  • Fundamental physical quantities
		  • International system of units (SI units)
		    ▪ Base units
		    ▪ Supplementary units
		  • Derived physical quantities and derived units
		  • Physical quantities without units
		  • Multiples and submultiples of units
			Student will be able to;
			• identifies basic physical quantities and derived physical quantities.
			• uses appropriate SI base units and derived SI units.
			• appreciates that all physical quantities consist of a numerical magnitude with or without a unit.
			• uses the prefixes and their symbols to indicate multiples and submultiples.
			• converts units appropriately.
			• uses the knowledge of significant figures.
				04

	1.3 Investigates physical quantities using dimensions.	• Dimensions
		  • Dimensions of basic physical quantities used in mechanics
		    • Mass
		    • Length
		    • Time
		  • Dimensions of derived physical quantities
		  • Uses of dimensions
		    • Testing the correctness of a physical equation
		    • Finding the units of a given quantity
		    • Deriving expressions
			Student will be able to;
			• checks the correctness of equations dimensionally.
			• uses dimensions to derive expressions
			• uses dimensions to determine units of physical quantities.
				04

Competency	Competency Level	Content	Learning Outcomes	No. of Periods

	1.4 Takes measurements accurately by selecting appropriate instruments to minimize errors.	• Measuring instruments
		• Principle, Least count and Range
		• Errors of measurement
		• Systematic Error
		• random Error
		• Fractional error and percentage error
		• Laboratory measuring instruments
		  • Metre ruler
		  • Vernier calipers
		  • Micrometer screw gauge
		  • Spherometer
		  • Travelling microscope
		  • Triple beam balance/Four beam balance/ Scientific electronic balance
		  • Stop clock/stopwatch/ Digital stopwatch
		  • Digital multimeter
		• **Laboratory practical's Using measuring instruments**
		  • **Vernier calipers**
		  • **Micrometer screw gauge**
		  • **Spherometer**
		  • **Travelling microscope**
			Student will be able to;
			• describes the importance of taking measurements during experiments and in day-to-day activities
			• identifies the least count of an instruments
			• select suitable measuring instruments for measurements.
			• explains vernier principle and micro meter principle
			• uses vernier caliper, travelling microscope, micrometer screw gauge, spherometer, triple beam balance, electronic balance, stopwatch and digital stop watch to take readings.
			• explains the effects of systematic errors (including zero errors) and random errors in measurements.
			• calculates fractional error and percentage error.
			• appreciates the purpose of calculating fractional error and percentage error.
				12

	1.5 Uses vector addition and resolution appropriately.	• Scalars and vectors
		  • Scalar quantities
		  • Vector quantities
		  • Geometrical representation of a vector quantity
		  • Resultant vector of
		    • two vectors in the same line and parallel lines
		    • Two inclined vectors
		      • Parallelogram law
		      • Triangle method
		    • System of vectors
		      • Polygon method
		  • Resolution of vectors
			Student will be able to;
			• distinguishes between scalar and vector quantities and give examples of each.
			• represents a vector geometrically.
			• add and subtract coplanar vectors.
			• finds the resultant of two inclined vectors using vector parallelogram law.
			• finds the resultant of vectors using triangle method and polygon method.
			• resolves a vector into two perpendicular components.
			• Give examples for instances where a simple force is applied instead of several forces and vise verse.
				08

Unit 2 - Mechanics **(110 periods)**

Competency	Competency Level	Content	Learning outcomes	No. of Periods

2. Lays a foundation for analyzing motion on the basis of principles of physics.	2.1 Analyze one dimensional and two dimensional motion	• Kinematics
		  • Relative motion
		    • Motion in the same direction
		    • Motion in the opposite directions
		  • Rectilinear motion under constant acceleration
		    • Graphs of motion
		      • *s*-*t* graphs
		      • *v*-*t* graphs
		  • Equations of motion
		    • Motion in a straight line
		    • Projectile motion under gravity
			Student will be able to;
			• Give examples for the instances that can be described using the concept of relative motion.
			• calculates the velocity of an object relative to another object moving at constant velocity on parallel paths in the same direction and in opposite directions.
			• uses graphs of displacement vs. time and velocity vs. time to calculate displacement, velocity and acceleration as appropriate.
			• uses equations of motion for constant acceleration to describe and predict the motion of an object along a straight path on a horizontal plane, vertical motion under gravity and motion on a frictionless inclined plane.
			• calculates the position and velocity of a projectile.
			• identifies applications related to projectiles
			• represents the motion of an object graphically
			• describes the motion of an object using graph of motion
			• carry out numerical calculations to solve problems using graphs and equations of motion.
				15

Competency	Competency Level	Content	Learning Outcomes	No. of Periods

	2.2 Uses resultant force and moment of force to determine the centre of gravity of a body.	• Resultant of forces
		  • Resultant of two forces
		• Resultant of a system of coplanar forces
		• Moment of a force
		  • Moment of a force about a point
		  • Moment of a couple (of forces)
		  • Resultant of parallel forces and the line of action(parallel forces in the same direction)
		  • Centre of gravity of a body (using the resultant of parallel forces)
		  • Centre of gravity of regular shaped bodies
		  • Centre of gravity of regular shaped compound bodies
		  • Centre of mass
		  • **Determination of weight of a body using the law of parallelogram of forces**
			Student will be able to;
			• resolves and add forces appropriately.
			• uses force resolution method and force parallelogram law to find the resultant of system of coplanar forces
			• finds the centre of gravity of regular shaped compound bodies.
			• explains the motion of a body when the force acts through the centre of mass.
			• explains the motion of a body when the force acts away from the center of mass.
			• finds the resultant of two parallel forces and the line of action
			• finds the moment of a force and the moment of couple
			• conducts simple activity to find the centre of gravity of a plane object
				15

	2.3 Uses Newton's laws of motion to analyze the motion of a body.	• Force and motion
		  • Mass
		    • Inertial mass
		    • Gravitational mass
		  • Inertial and non – inertial frames
		  • Newton's first law of motion
			Student will be able to;
			• states that inertia of a body as the reluctance to change the state of motion.
			• realizes mass as a measure of translational inertia.
			• uses Newton's laws of motion and the concept of momentum to analyze dynamic situations involving constant mass and constant forces.
				20

Competency	Competency Level	Content	Learning outcomes	No. of Periods

		• Momentum
		• Newton's second law of motion
		  • Obtaining $F = ma$
		  • Defining the unit 'newton'
		  • Impulse and impulsive forces
		  • Principle of conservation of linear momentum
		  • Newton's third law of motion
		  • Applications of Newton's laws
		  • Self adjusting forces
		    • Tension
		    • Thrust / compression
		    • Frictional forces
		      • Static friction
		      • Limiting friction
		      • Dynamic friction
		    • Free body force diagrams
			• uses free body force diagrams to analyze the forces acting on a body and determine the net force.
			• identifies the action force and the reaction force.
			• realizes that these forces (action and reaction) always exist .
			• realizes that the impulsive force is generally a variable force acting only for a short time.
			• gives examples for instances where impulsive forces are used.
			• identifies the nature of self adjusting forces.
			• analyzes the effects of friction on dynamic systems.
			• carries out numerical calculations to solve problems using Newton's laws
			• carries out calculations related momentum and its conservation.
			• carries out calculations related to limiting friction and dynamic friction.
			• conducts simple activities to demonstrate Newton's laws	

	2.4 Manipulates the conditions necessary to keep a body in equilibrium.	• Equilibrium
		  • Conditions for equilibrium
		  • Principle of moments
		  • Equilibrium under two forces
		  • Equilibrium of coplanar forces
		  • Three non parallel forces
		  • Three parallel forces
		  • Theorem of triangle of forces
		  • Polygon of forces
		• States of equilibrium
		  • Stable
		  • Unstable
		  • Neutral
		  • **Determination of weight of a body using the principle of moments**
			Student will be able to;
			• conducts activities to identify the conditions for equilibrium of a point object.
			• conducts activities to identify identifies the conditions for equilibrium of a rigid object under system of coplanar forces.
			• describes the conditions for equilibrium of three parallel and three non parallel coplanar forces.
			• uses the theorem of triangle of forces and the principle of moments to solve simple problems related to equilibrium of forces.
			• uses the concepts of equilibrium to stabilize a system.
			• identifies three states of equilibrium.
				10

	2.5 Consumes and transforms mechanical energy productively.	• Work, energy and power
		  • Work
		    • Work done by force in translational motion
		  • Mechanical energy
		    • Kinetic energy
		      • Translational kinetic energy
		    • Potential energy
		      • Gravitational potential energy
		      • Elastic potential energy
		  • Power and efficiency
		  • Principle of conservation of energy
		  • Principle of conservation of mechanical energy
		  • Work-energy principle
			Student will be able to;
			• uses the expressions for work done, kinetic energy, potential energy and power to calculate energy changes and efficiencies.
			• uses principle of conservation of energy and the principle of conservation of mechanical energy to solve numerical problems.
			• recalls and understands the concepts of power and efficiency.
			• applies the conservation of energy and conservation of linear momentum in problem solving related to collisions and explosions.
			• explains the difference between an elastic collision and inelastic collision.
				15

Competency	Competency Level		Learning outcomes	No. of Periods

	2.6 Investigates the concepts related to rotational motion and circular motion.	• Rotational motion
		• Angular displacement
		• Angular velocity
		• Frequency of rotation
		• Angular acceleration
		• Equations of rotational motion under uniform angular acceleration
		• Moment of inertia
		  • Thin uniform rod
		  • Thin uniform ring
		  • Uniform circular disk and cylinder
		  • Uniform sphere
		• Angular momentum
		• Torque
		• Relationship between torque, moment of inertia and angular acceleration
		• Principle of conservation of angular momentum
		• Work done in rotational motion
		• Rotational kinetic energy
		• Analogy between linear motion and rotational motion
		• Circular motion with uniform angular velocity in a horizontal plane
			Student will be able to;
			• expresses angular displacement, angular velocity, and angular acceleration in SI units.
			• describes rotational motion using time period and frequency.
			• solve problems using equations of rotational motion..
			• explain that the moment of inertia is the measure of rotational inertia.
			• demonstrates that moment of inertia depends on mass, axis of rotation and mass distribution.
			• predicts the motion of a rotating body by determining the torque acting on it.
			• solves numerical problems associated with moment of inertia, torque and angular momentum
			• gives examples related to principle of conservation of angular momentum.
			• conduct simple activities to demonstrate the principle of conservation of angular momentum.
			• analyzes situations in which an object moves round a circle at uniform speed.
			• calculates the centripetal acceleration of
				15

		• Frequency • Period • Tangential velocity • Centripetal acceleration • Centripetal force	an object moving round a horizontal circular path at a uniform speed. • identifies centripetal forces of various circular motions. • relates the centripetal acceleration of such an object to the forces acting on it. • carries out calculations related to rotational motion and circular motion. • compares angular and linear motions.	
	2.8 Uses the principles and laws related to flowing fluids in scientific work and daily pursuits.	• Fluid-dynamics • Streamline flow and turbulent flow • Equation of continuity for a steady, stream line flow • Bernoulli's principle (derivation not necessary) • Applications of Bernoulli's principle	**Student will be able to;** • distinguishes between streamline and turbulent flow. • uses the equation of continuity for a steady streamline flow. • states the conditions under which Bernoulli's principle is valid. • applies Bernoulli's principle to solve problems. • conducts simple activities to demonstrate Bernolli's principle.	08

Unit 3 - Oscillations and Waves **(100 periods)**

Competency	Competency Level	Content	Learning outcomes	No. of Periods
3. Uses the concepts and principles related to waves to broaden the range of sensitivity of human.	3.1 Analyzes oscillations on the basis of physics.	• Oscillations • Simple harmonic motion • Physical quantities related to simple harmonic motion • Amplitude • Frequency • Period • Energy • Definition of S. H. M • Characteristic equation of the simple harmonic motion $a = -\omega^2 x$ • Simple harmonic motion as a projection of a uniform circular motion • Phase • Phase difference • Equation of displacement (Only for oscillations starting with $x = 0$ and $t = 0$) $x = A \sin \omega t$ • Displacement – time graph corresponding to simple harmonic motion • Small oscillations of a simple pendulum • Period $T = 2\pi\sqrt{\frac{l}{g}}$	**Student will be able to;** • describes the conditions necessary for simple harmonic motion. • defines simple harmonic motion. • recognizes and uses $a = -\omega^2 x$ as the characteristic equation of simple harmonic motion. • relates the motion of an oscillating object to the forces acting on it. • describes the interchange between kinetic and potential energy during simple harmonic motion. • illustrates the S.H.M. as a projection of a circular motion. • identifies the state of the motion of a particle in S.H.M. using the phase. • uses phase difference to illustrate of motion of two S.H.M.s • finds the displacement of an oscillating particle starting from center position. • uses the displacement – time graph of the particle to explain the S.H.M. • investigates the motion of an oscillator using experimental and graphical methods. • describes with graphical illustrations, the changes in displacement, velocity and acceleration of simple harmonic motion. • determines the gravitational acceleration using simple pendulum • determines the spring constant of a light helical spring	15

		• **Determination of gravitational acceleration by using simple pendulum** • Small oscillations of a mass suspended by a light helical spring. • Period $T = 2\pi\sqrt{\frac{m}{k}}$ • **Determination of the spring constant of a light helical spring** • Free oscillations • Damped oscillations • Forced oscillations and Resonance	• distinguishes free, damped and forced oscillations. • describes practical examples of forced oscillations and resonance. • realizes that there are some instances in which resonance is useful and other instances in which resonance should be avoided. • demonstrates forced oscillations and resonance using Barton's pendulum.	

	3.2 Investigates various types of wave – motions and their uses.	• Mechanical waves
		  • Transverse waves
		  • Longitudinal waves
		• Graphical representation of a wave
		• Physical quantities related to waves
		  • Frequency – f
		  • Wavelength – λ
		  • Speed - v
		  • Amplitude – A
		• Speed of waves $v = f\lambda$
			Student will be able to;
			• demonstrates wave motion using slinky
			• describes wave motion in terms of S.H.M. of particles.
			• understands and uses the terms displacement, amplitude, phase difference, period, frequency, wavelength and speed of a wave.
			• distinguishes between longitudinal and transverse waves.
			• represents the wave motion graphically and identify points in same phase (in phase) and different phase (out of phase).
			• identifies wavelength using points of the same phase.
			• deduce $v = f\lambda$ from the definitions of speed, frequency and wavelength
			• solves problems related to wave motion.
				08

	3.3 Investigates the uses of waves on the basis of their properties	• Properties of waves
		  • Reflection
		    • Rigid reflection
		    • Soft reflection
		  • Refraction
		  • Diffraction
		  • Polarization
		  • Principle of superposition of waves
		    • Interference
		    • Stationary waves
		    • Beats
		      • $f_b = \|f_1 - f_2\|$ (derivation is not necessary)
		    • Comparison of stationary waves and progressive waves
			Student will be able to;
			• conducts simple activities to demonstrate the properties of waves by using ripple tank and a string/ slinky
			• states reflection, refraction, interference and diffraction as common properties of waves.
			• describes change of velocity, wavelength and direction in different media to describe the effects of refraction.
			• carries out numerical calculations on refraction.
			• states the principle of superposition of waves.
			• graphically represents the principle of superposition of waves.
			• uses the principle of superposition of waves to explain the occurrence of interference, stationary waves and beats qualitatively.
			• demonstrates stationary waves using string vibrator
			• demonstrates beats using CRO and tuning forks.
			• carries out numerical calculations on beats and stationary waves.
			• explains diffraction, interference and polarization qualitatively.
				15

	3.4 Uses the modes of vibration of strings by manipulating variables.	• Stationary waves in strings
		  • Stationary waves in a stretched string
		  • Speed of transverse waves $v = \sqrt{\frac{T}{m}}$
		  • Modes of vibrations in a stretched string
		    • Fundamental tone $f_0 = \frac{1}{2l}\sqrt{\frac{T}{m}}$
			Student will be able to;
			• explains the numerical patterns of resonant frequencies for stationary waves on strings
			• carries out calculations on stationary wave patterns on strings.
			• describes seismic waves, Earth quakes, Richter scale and formation of tsunami qualitatively.
			• finds the frequency of a tuning fork using sonometer.
				12

Competency	Competency Level	Content	Learning outcomes	No. of Periods
		• Overtones and harmonics • **Sonometer** • **Determination of the frequency of a tuning fork by changing the tension of the string** • **Verification of the relationship between the vibrating length and frequency** • Speed of longitudinal wave $v = \sqrt{\frac{E}{\rho}}$ • Seismic waves, Earth quakes, Richter scale and Tsunami	• prepares a report to explain earthquake and Tsunami.	
	3.5 Uses the vibrations in air columns by manipulating the variables.	• Waves in gases • Speed of sound in air $v = \sqrt{\frac{\gamma P}{\rho}}$ • $v = \sqrt{\frac{\gamma RT}{M}}$ • Factors affecting the speed of sound in air • Modes of vibrations in an air column • Closed tube • Open tube • **Determination of the speed of sound in air using a closed tube** • **by using one tuning fork**	**Student will be able to;** • describes the factors affecting the speed of sound in air. • explains the numerical patterns of resonant frequencies for stationary waves in tubes. • designs experiments to determine the speed of sound in air and the end correction of the tube using one tuning fork and set of tuning forks. • carries out calculations on stationary waves in resonant tubes	10

		• **by using a set of tuning forks (graphical method)**		

	3.6 Inquires about the uses of Doppler effect.	• Doppler effect
		  • Equations for apparent frequency
		    • Only the observer is moving
		    • Only the source is moving
		    • Both observer and source are moving along the same line
		    • Sonic boom
			Student will be able to;
			• conducts simple activities to demonstrate the Doppler effect.
			• describes phenomena related to change in apparent frequency using Doppler effect
			• applies the Doppler effect to sound with appropriate calculations.
			• describe Sonic boom qualitatively.
			• explains the applications and explanations related to Doppler effect.
				05

	3.7 Produces and propagates sound by considering characteristics of sound.	• Nature of sound
		  • Characteristics of sound
		    • Pitch
		    • Loudness
		    • Quality of sound
		  • Limits of hearing
		    • Threshold of hearing
		    • Threshold of pain
		  • Intensity and intensity level of sound (decibel)
		  • Graph of intensity level versus the frequency for human ear
			Student will be able to;
			• describes the characteristic properties of sound.
			• uses the graph of intensity level verses the frequency for human ear to explain various situations.
			• conducts activities to demonstrate characteristics of sound
			• carries out numerical calculations related to intensity level (decibel) and intensity.
			• introduces ultrasonic and infrasonic qualitatively.
			• states the uses of ultrasonic and infrasonic
			• uses the knowledge of properties of sound in day-to-day activities.
			• explains the importance of having proper sound levels.
				05

Competency	Competency Level	Content	Learning outcomes	No. of Periods
	3.8 Inquires about electromagnetic waves.	• Electromagnetic waves • Electromagnetic spectrum • Properties of electromagnetic waves • Uses of electromagnetic waves • LASER • Principle • Properties • Uses	**Student will be able to;** • states that electromagnetic waves generate due to the acceleration or deceleration of charge particles. • describes the properties of electromagnetic waves • describes the applications of electromagnetic waves in each of the main wavelength ranges. • explains the principle of LASER • identifies the properties and uses of LASER beams.	05
	3.9 Applies the principles of refraction of light for daily pursuits.	• Geometrical optics • Refraction • Laws of refraction • Refractive index • Absolute refractive index • Relative refractive index • Relationship between refractive indices • Relationship between real depth and apparent depth • Apparent displacement $d = t\left(1 - \frac{1}{n}\right)$ • **Determination of the refractive index of glass using a travelling microscope** • Critical angle • Relationship between the critical	**Student will be able to;** • designs experiments to determine images formed due to refraction. • carries out calculations on refraction at plane boundaries and total internal reflection. • finds the refractive index of glass using travelling microscope. • finds the relationship between incident angle and the angle of deviation. • designs an experiment to find the refractive index using critical angle method. • derives the relationship between prism angle, refractive index and the angel of minimum deviation. • uses spectrometer to find the angle of minimum deviation and the angle of a prism. • finds the images formed by lenses using no parallax method	15

		angle and the relative refractive index $n = \frac{1}{\sin C}$ • Total internal reflection • Refraction through a prism • **Experimental investigation of deviation of a light ray through a prism** • Deviation • $d - i$ graph • Minimum deviation • Relationship between prism angle, reflective index and the angle of minimum deviation. • **Determination of the refractive index of material of prism by critical angle method** • **Spectrometer** • **Main adjustments** • **Determination of the angle of a prism** • **Finding the angle of minimum deviation** • Refraction through thin lenses • Real and virtual images of convex and concave lenses • Lens formula with Cartesian sign convention • Linear magnification • **Determination of focal length of convex lenses and concave lenses** • Power of a lens • Combination of thin lenses in contact	• constructs images formed by lenses using ray diagrams • derives lens formula by geometrical method using Cartesian sign convention. • carries out numerical calculations to solve problems for lenses and lens combination • uses the power of a lens as Converging(+),Diverging(-) • conducts experimentation to determine the focal length of convex lenses and concave lenses	

Competency	Competency Level	Content	Learning outcomes	No. of Periods
	3.10 Applies the knowledge of images formed by lenses for the correction of defects of vision appropriately.	• Human eye • Formation of an image • Visual angle • Defects of vision and correction • Short sight • Long sight • Presbyopia	**Student will be able to;** • describes optical system of human eye. • explains the formation of image on eye. • describes defects of vision and sight corrections using ray diagrams. • carries out sight correction calculations. • describes Presbyopia qualitatively.	04
	3.11 Applies the knowledge of the images formed by lenses in using the optical instruments appropriately.	• Optical instruments • Simple microscope • Normal adjustment • Magnifying power (Angular magnification) • Compound microscope • Normal adjustment • Magnifying power (Angular magnification) • image at infinity • Astronomical telescope • Normal adjustment • Magnifying power (Angular magnification) • image at near point	**Student will be able to;** • uses simple/ compound microscope and astronomical telescope properly. • sketches ray diagrams to explain how a simple and compound microscope work and carry out related calculations. • sketches ray diagrams to explain how astronomical telescopes work • carries out related calculations.	06

Unit 4 - Thermal Physics (60 periods)

Competency	Competency Level	Content	Learning outcomes	No. of Periods

4. Uses the knowledge of heat to fulfill human needs and for scientific work productively.	4.1 Measures temperature correctly by selecting appropriate thermometer according to the need.	• Temperature
		  • Thermal equilibrium
		  • Zeroth law of thermodynamics
		  • Thermometric properties
		  • Expression for temperature based on two fixed points
		  $\theta = \frac{x_\theta - x_L}{x_H - x_L}(\theta_H - \theta_L) + \theta_L$
		  • Celsius scale
		  $\theta = \frac{x_\theta - x_L}{x_H - x_L} \times 100°C$
		  • Absolute scale (Thermodynamic scale)
		  • Absolute zero
		  • Triple point of water
		  • Expression for absolute temperature based on triple point of water
		  $T = \frac{X_T}{X_{tr}} \times 273.16$
		  • Relationship between Celsius and absolute temperatures
		  $T = \theta + 273.15$
		  • Thermometers
		    • Mercury/ alcohol in glass thermometer
		    • Thermister
		    • Thermocouple
			Student will be able to;
			• states that (thermal) energy is transferred from a region of higher temperature to a region of lower temperature.
			• states zeroth law of thermodynamics
			• understands that regions of equal temperature are in thermal equilibrium.
			• understands that there is an absolute scale of temperature that does not depend on the property of any particular substance (i.e. the thermodynamic scale and the concept of absolute zero)
			• explains the different temperature scales and different types of thermometers.
			• relates and uses Kelvin and Celsius temperature scales.
			• identifies thermister as a temperature senor.
			• identifies thermocouple as a thermometer.
				08

Competency	Competency Level	Content	Learning outcomes	No. of Periods

	4.2 Inquires about the instances where the expansion of solids and liquids are used.	• Thermal expansion
		  • Expansion of solids
		    • Linear expansion
		    • Area expansion
		    • Volume expansion
		• Relationship between linear, area and volume expansivities
		• Volume expansion of liquids
		  • Real expansion
		  • Apparent expansion
		  • $\gamma_{real} = \gamma_{apparent} + 3\alpha$ (Derivation not necessary)
		  • Variation of density with temperature
		• Anomalous expansion of water
			Student will be able to;
			• carries out numerical calculations to solve problems related to thermal expansion of solids and liquids.
			• explains the variation of density of liquids due to thermal expansion of liquids.
			• explains phenomena related to anomalous expansion of water.
			• uses the knowledge of expansion of solids and liquids in day to day activities.
			• Gives examples for uses and disadvantages of solids and liquids.
				06

	4.3 Investigates the behavior of gases	• Gas laws
		  • Boyle's law
		    • **Determination of the atmospheric pressure using quill tube**
		  • Charles's law
		    • **Investigation of relationship between volume and temperature at constant pressure**
		  • Pressure law
		    • **Investigation of relationship between pressure and temperature at constant volume**
		• Ideal gas equation $pV = nRT$
		• Dolton's law of partial pressure
			Student will be able to;
			• conducts experiments to observe the behavior of gases
			• conducts an experiment to find the atmospheric pressure
			• uses gas laws to explain the behavior of gases.
			• analyzes the behavior of gases using ideal gas equation.
			• carries out numerical calculations to solve problems using gas laws.
				06

Competency	Competency Level	Content	Learning outcomes	No. of Periods

	4.4 Inquires about the pressure exerted by a gas on its container using kinetic theory of gases.	• Kinetic theory of gases
		  • Elementary assumptions of the kinetic theory
		  • $pV = \frac{1}{3}Nm\overline{c^2}$
		(Derivation is not necessary)
		  • Expression for mean translational kinetic energy of air an molecule, $E = \frac{3}{2}kT$
			Student will be able to;
			• states the basic assumptions of the kinetic theory of gases.
			• explains how molecular movement causes the pressure exerted by a gas.
			• relates temperature to the mean kinetic energy of molecules of a gas.
			• explains the distribution of molecular speeds at different temperatures
			• carries out calculations using the kinetic theory equation
			• appreciates the kinetic theory of gases in explaining the behavior of gasses based on microscopic behavior of gas molecules.
				04

	4.5 Quantifies the amount of heat exchange among the objects using the specific heat capacity of substances.	• Heat exchange
		  • Heat capacity
		  • Specific heat capacity of solids and liquids
		  • Molar heat capacities of gases
		  • **Determination of specific heat capacities of solids by the method of mixtures**
		  • Newton's law of cooling
		  • **Determination of specific heat capacities of a liquid by the method of cooling**
			Student will be able to;
			• defines heat capacity of solids and liquids.
			• defines principle molar heat capacities of gases.
			• conducts experiments to find specific heat capacity of solids and liquids.
			• carries out calculations considering heat exchange.
			• uses Newton's law of cooling to carry out calculations on heat loss.
				10

<table>
<tr>
<td></td>
<td>4.6 Inquires about the productive use of the heat exchange during the change in state of matter.</td>
<td>• Change of state
• State of matter
• Qualitative molecular account of the difference between solids, liquids and gases
• Simple explanation of the molecular processes in fusion and boiling
• Fusion (melting)
• Specific latent heat of fusion
• Determination of specific latent heat of fusion of ice (method of mixtures)
• Vaporization at Boiling
• Specific latent heat of vaporization
• Determination of specific latent heat of vaporization of water (method of mixtures)
• Effect of pressure on boiling point and melting point</td>
<td>Student will be able to;
• states that melting and boiling take place without a change in temperature.
• defines specific latent heat of vaporization and specific latent heat of fusion.
• explains that specific latent heat of vaporization is higher than specific latent heat of fusion for the same substance.
• carries out numerical calculations of the latent heat of substance.
• identifies fusion and vaporization using the graph of temperature vs. time.
• conducts experiments to determine latent heat of fusion of ice and latent heat of vaporization of water.
• states the effect of pressure on boiling point and melting point.
• describes qualitatively physical process associated with the change of state.</td>
<td>08</td>
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Competency	Competency Level	Content	Learning outcomes	No. of Periods

	4.7 Relates the effect of water vapour on weather.	• Vapour and humidity
		  • Evaporation
		  • Comparison of evaporation and vaporization (boiling)
		  • Vapour pressure and saturated vapour pressure
		  • Variation of vapour pressure with temperature
		  • Variation of vapour pressure with volume
		  • Dew point
		  • Absolute humidity
		  • Relative humidity
		    • **Determination of relative humidity using polished calorimeter**
			Student will be able to;
			• differentiates evaporation and boiling
			• explains the behavior of unsaturated and saturated water vapour.
			• illustrates graphically the variation of saturated vapour pressure and unsaturated vapour pressure with temperature and with volume.
			• explains the humidity refers to the moisture (amount of water vapour present) in the atmosphere.
			• carries out numerical calculations to solve problems on relative humidity, absolute humidity and dew point.
			• correlates the boiling point and saturated vapour pressure
			• realizes that hygrometers are available to find relative humidity
			• conducts experiment of find Relative Humidity
				08

	4.8 Uses laws of thermodynamics to analyze the various thermodynamic processes.	• Thermodynamics
		  • Explanation of heat as a state of transfer of energy
		  • Internal energy
		  • First law of thermodynamics $\Delta Q = \Delta U + \Delta W$
		  • Special instances where the first law of thermodynamics is applicable
		    • Constant pressure processes
		    • Constant volume processes
		    • Isothermal processes
		    • Adiabatic processes
		    • Cyclic processes
		    • Pressure – volume curves for above processes
			Student will be able to;
			• relates a rise in temperature of a body to an increase in its internal energy.
			• explains the first law of thermodynamics.
			• uses the first law of thermodynamics to explain the changes of a gas.
			• conducts simple activities to demonstrate isothermal adiabatic , constant pressure and constant volume processes.
			• carries out numerical calculations using the first law of thermodynamics.
				04

Competency	Competency Level	Content	Learning outcomes	No. of Periods
	4.9 Designs daily and scientific work by considering the methods and amount of transfer of heat.	• Transfer of heat • Conduction • Thermal conductivity • Equation for the rate of conduction of heat • Temperature variation of lagged & non lagged uniform rods. • Determination of thermal conductivity of a metal • **Searle's method** • Convection • Radiation	**Student will be able to;** • describes heat transfer mechanisms indicating conduction, convection and radiation. • carries out numerical calculations related to thermal conduction. • illustrates temperature distribution of lagged and non lagged uniform rods graphically. • explains convection and radiation qualitatively. • conducts an experiment to determine thermal conductivity.	06

Unit 5 - Gravitational Field **(20 periods)**

Competency	Competency Level	Content	Learning outcomes	No. of Periods

5. Uses laws and principles of gravitation to be productive in daily pursuits and scientific work.	5.1 Analyses the effect of gravitational force on objects using Newton's law of gravitation.	• Gravitational force field
		  • Gravitational force
		  • Gravitational force between two masses
		    • Newton's law of universal gravitation
		  • Gravitational field
		  • Gravitational field intensity
		  • Field intensity at a point away from a point mass
		  • Field intensity at a point outside a spherical mass
		  • Graphical representation of the variation of field intensity
		  • Gravitational potential
		  • Expression for gravitational potential at a point distance *r* from a point mass $m, V = -\frac{Gm}{r}$ (derivation is not necessary)
		  • Potential energy of a mass in a gravitational field
		  • Graphical representation of the variation of potential with distance
		  • Expression for the energy of a mass *m* moving on a circular path of radius *r* taking centre as the centre of a spherical mass *M* (Energy equation)
			Student will be able to;
			• uses Newton's law to calculate the gravitational force between two masses
			• states that all masses create gravitational field
			• understands that gravitational field as a field of force.
			• explains the concept of gravitational field 'as actions at a distance'.
			• uses the concept of gravitational field to calculate the force exert on a mass in a gravitational field
			• defines gravitational field intensity.
			• uses Newton's law of gravitation to find gravitational field intensity at a point due to a point mass and spherical mass (away from the sphere).
			• defines gravitational potential at a point.
			• calculates gravitational potential at a point in a gravitational field.
			• uses the expression for the potential energy of a mass in a gravitational field.
			• represents graphically the variation of gravitational field intensity and gravitational potential with the distance from a point mass and outside a spherical mass.
			• uses the energy equation to determine the total energy of a particle moving along circular path around an isolated mass.
				08

Competency	Competency Level	Content	Learning outcomes	No. of Periods
	5.2 Inquires about the instances of using the knowledge on Earth's gravitational field to fulfill human activities.	• Earth's gravitational field ◦ Gravitational field intensity near the Earth surface ◦ Relationship between the acceleration due to gravity and gravitational field intensity ◦ Earth satellites ◦ Geostationary satellites ◦ Escape velocity	**Student will be able to;** • uses knowledge obtained regarding gravitational fields to deduce corresponding relationships in Earth's gravitational field. • derive the expression (mgh) for gravitational potential energy. • Find physical quantities related to satellite motion, describing conditions for such motions. • carries out calculations related to satellite motion in circular orbits. • appreciates the uses of satellites. • derives an expression for escape velocity.	12

Unit 6 - Electric Field (60 periods)

Competency	Competency Level	Content	Learning outcomes	No. of Periods

6. Uses laws and principles of electrostatic field for scientific work and daily pursuits effectively.	6.1 Uses the laws related to electrostatic force appropriately to find the distribution and magnitude of electrostatic field produced by various charged objects.	• Electrostatic force
		  • Force electro static force between two charges
		    • Coulomb's law
		  • Electric field intensity
		  • Electric field lines
		    • Around a point charge
		    • Around two point charges
		    • Between two charged parallel plates
		  • Field intensity of a point due to a point charge
		  • Graphical representation of the variation of field intensity
			Student will be able to;
			• uses coulomb's law to calculate the electro static force between two charge
			• states that all charges create electric fields
			• uses the concept of electric field to explain how a force exerts on a charge in an electric field
			• defines electric field intensity.
			• uses the equation $F_E = EQ$ to find the force on a charge placed in an electrostatic (electric) field.
			• uses the concept of electric field lines to illustrate the electric field
			• draws Electric field lines in various electric fields.
			• calculates the field intensity at a point in an electric field using Coulomb's law.
			• graphically represents the variation of electric field intensity with the distance from a point charge.
				15

	6.2 Quantifies the electrostatic field using the flux model.	• Flux model
		  • Electric flux
		  • Gauss's theorem
		  • Finding electrostatic field intensities using Gauss's theorem
		    • Around a point charge
		    • Near an infinite charge plate
			Student will be able to;
			• explains the flux model using suitable examples
			• applies the Gauss's theorem to find electrostatic field intensity.
			• represents graphically the variation of field intensity with distance from the centre of the sphere.
				15

Competency	Competency Level	Content	Learning outcomes	No. of Periods

		• Around a charged conducting sphere
		  • Outside the sphere
		  • On the surface of the sphere
		  • Inside the sphere
		• Field intensity at a distance *r* from an infinitely long charged thin wire
			• calculates electric field intensity due to different charged objects using relevant expressions.	

	6.3 Quantifies the potential energy of charges placed in an electrostatic field.	• Electric potential
		  • Definition of potential at a point in an electrostatic field
		  • Potential at a point due to a point charge, $V = \frac{1}{4\pi\varepsilon}\frac{Q}{r}$ (derivation is not necessary)
		  • Potential at a point due to distribution of point charges
		  • Potential difference between two points
		  • Work done in moving a charge across a potential difference
		  • Potential energy of a charge in an electric field
		  • Potential energy of a system with two charges
		  • Potential gradient
		  • Relationship between potential gradient and electric field intensity
		  • Equipotential surfaces
		  • Equipotential surfaces in different
			Student will be able to;
			• defines electric potential.
			• finds the electric potential at a point due to a point charge and distribution of point charges.
			• illustrates graphically the variation of electric potential with the distance from the centre of conducting sphere.
			• finds electric potential energy of a charge in an electric field.
			• defines potential difference between two points in an electric field.
			• defines electron volt as a unit of energy.
			• expresses the relation between potential gradient and electric field intensity.
			• carries out numerical calculations to solve problems related to electric potential and potential energy.
			• draws equipotential surfaces in different fields.
				15

		fields • Near a point charge • Near like point, charges Near unlike point charges		

	6.4 Uses capacitors appropriately in electrical circuits.	• Electric capacitance
		  • Definition of capacitance
		  • Parallel plate capacitor
		  • Derivation of the equation $c = \frac{k\varepsilon_0 A}{d}$
		  • Capacitance of a spherical conductor (spherical capacitors are not included)
		  • Combination of capacitors
		    • Series combination
		    • Parallel combination
		  • Energy stored in a charged capacitor
		  • Derivation of expression for energy
		• Distribution of charges on conductors having different shapes
		  • Point discharge (corona discharge)
			Student will be able to;
			• defines the capacitance of a parallel plate capacitor.
			• derives the expression for capacitance of a parallel plate capacitor and a conducting sphere.
			• obtains the equivalent capacitance of capacitors in series and capacitors in parallel.
			• derives expressions for energy stored in a charged capacitor.
			• solves problems related to capacitors.
			• Interpret the charge distribution of conductors having different shapes using diagrams.
				15

Unit 7 – Magnetic fields (40 periods)

Competency	Competency Level	Content	Learning outcomes	No. of Periods
7. Uses the effects of interrelations hips between electricity and magnetism for scientific work and daily pursuits.	7.1 Manipulates the variables to control the force acting on a current carrying conductor and moving charge placed in a magnetic field.	• Magnetic force • Force acting on a current carrying conductor placed in a magnetic field • Expression for the magnitude of force • Magnetic flux density • Fleming's left hand rule • Force acting on a charge moving in a magnetic field • Magnitude of the force • Direction of the force • Hall effect • Qualitative explanation • Derivation of an expression for Hall voltage	**Student will be able to;** • states that moving charges or current carrying conductor creates magnetic field • demonstrates the nature of electromagnetic force using current balance • defines magnetic flux density. • expresses the magnetic force in terms of magnetic flux density, current and the length of the conductor. • uses the expression for force acting on a moving charge in a magnetic field. • finds the direction of the above magnetic force by Fleming's left hand rule. • solves problems related to magnetic force and magnetic flux density. • explains Hall effect. • solves problems related to Hall effect. • gives examples for the applications of Hall effect	10
	7.2 Constructs magnetic fields by manipulating variables for the needs.	• Magnetic force field • Biot –Savart law • Maxwell's corkscrew rule • Magnetic flux density near a current carrying infinitely long straight conductor (derivation is not necessary) • Magnetic flux density at the centre of a current carrying circular coil	**Student will be able to;** • interprets Biot-Savart law by relevant expression • derives the expression for magnetic flux density at the centre of a current carrying circular coil. • mentions the expressions for magnetic flux density outside an infinitely long straight conductor and along the axis of a long solenoid carrying currents.	15

Competency	Competency Level	Content	Learning outcomes	No. of Periods
		• Magnetic flux density along the axis of a current carrying long solenoid (derivation is not necessary) • Magnitude of the force between two current carrying infinitely long parallel conductors • Definition of Ampere	• derives the expression for the force between two parallel infinitely long current carrying conductors. • solves problems related to magnetic flux density of current carrying infinitely long straight conductor, circular coil and long solenoid. • defines "Ampere"	

	7.3 Inquires the rotational effect due to the inter-relationship of electricity and magnetism.	• Torque acting on a current loop
		    • Rectangular coil placed in a uniform magnetic field
		    • Rectangular coil placed in a radial magnetic field
		    • Moving coil galvanometer
		        • Expression for deflection
		        • Factors affecting the current sensitivity
		    • Direct current motor
			Student will be able to;
			• derives expressions for torque acting on a current carrying rectangular coil placed in a uniform magnetic field.
			• deduces the expression for the torque acting on a current carrying rectangular coil placed in a radial magnetic field.
			• solves problems related to torque acting on a current loop.
			• explains the structure and the function of moving coil galvanometer.
			• derives an expression for the deflection of the moving coil galvanometer
			• describes current sensitivity of the moving coil galvanometer.
			• describes the structure and function of a direct current motor with one armature coil.
				15

Unit 8 - Current Electricity **(70 periods)**

Competency	Competency Level	Content	Learning outcomes	No. of Periods

8. Uses the laws principles and effects of current electricity productively and appropriately.	8.1 Manipulates the physical quantities related to current electricity wherever appropriate.	• Fundamental concepts
		  • Electric charges and electric current $I = \frac{Q}{t}$
		  • Mechanism of conduction of electricity through a metallic conductor
		  • Expression for the relationship between current and drift velocity
		  • Current density
		  • Potential difference
		  • Resistance and resistivity $R = \rho\frac{l}{A}$
		  • Variation of resistance with temperature
		    • Temperature coefficient of resistance
		  • Superconductivity
		    • Behavior of superconductors
		    • Super conducting materials
		    • Properties of superconductors
		    • Uses of superconductors
		  • Combination of resistors
		    • Series combination
		    • Parallel combination
		    • Ohm's law
		      • Conditions for validity of Ohm's law
			Student will be able to;
			• defines electric current as the rate of flow of charges.
			• explains the mechanism of conduction of electric current through a metallic conductor.
			• derives an expression for the relationship between current and drift velocity.
			• deduces an expression for current density.
			• defines resistance, and resistivity.
			• explains variation of resistance with temperature of conductors and insulators.
			• appreciates the properties of superconductors.
			• explains the behavior of ohmic and non-ohmic conductors using. I- V Curves.
			• uses potential divider circuit to obtain variable voltages
			• finds equivalent resistance of simple networks
			• solves problems using ohms law
				10

		• I-V curves • Ohmic conductors • Non-ohmic conductors • Potential divider circuit		
	8.2 Quantifies the energy and power in direct current (dc) circuits.	• Energy and power • Expression for energy dissipated due to flow of charges $W = QV$ and $W = VIt$ • Expression for power (rate of dissipation of energy) $P = VI$ • Obtaining $P = I^2 R$, $P = \frac{V^2}{R}$ and $W = I^2Rt$, $W = \frac{V^2}{R}t$ • Application of $P = VI$ and $W = VIt$ for any electrical appliance Application of $P = I^2 R$, $P = \frac{V^2}{R}$, $W = I^2Rt$ and $W = \frac{V^2}{R}t$ for appliances producing heat only (Joule heating)	**Student will be able to;** • conduct simple activities to demonstrate that energy dissipates through any electrical apparatus when current flows. • expresses formulae for energy dissipation due to flow of charges. • expresses formulae for rate of dissipation of energy. • applies $W = VIt$ and $P = VI$ for any electrical appliance. • uses $P = I^2 R$, $P = \frac{V^2}{R}$, $W = I^2Rt$ and $W = \frac{V^2}{R}t$ to find the dissipation of heat for passive resistors.	05
	8.3 Inquires the power supply of an electric circuit quantitatively	• Electromotive force • Formation of potential difference between plates of a simple cell	**Student will be able to;** • explain the formation of e.m.f. using simple cell. • describe the energy transformation in different types of sources of electromotive force (emf). • define electromotive force (e.m.f.) in terms of the energy transformation in a source	10

Competency	Competency Level	Content	Learning outcomes	No. of Periods

		• Transformation of different forms of energy in various sources of Electromotive force
		• Definition of electromotive force
		• Introduction of internal resistance
		• Application of the law of conservation of energy to a circuit having a source of electromotive force
		• Expression $V = E - Ir$ for the potential difference between the terminals of a cell in a closed circuit
		• **Determination of electromotive force and internal resistance of a cell (graphical method)**
		• Combination of sources of electromotive force
		  • Series connection
		  • Parallel connection of identical sources
		• Graphical representation of the relationship between resistance and power dissipation of a resistor
		• Condition for maximum power transfer (derivation is not necessary)
			Student will be able to;
			• expresses that rate of energy supply from the source as the product EI.
			• expresses the voltage difference across a source of emf with internal resistance in a closed circuit.
			• understands the effects of the internal resistance of an electric source of on the terminal potential difference.
			• expresses the effective emf of combination of series cell and identical parallel cells.
			• explains the condition for maximum power transfer using graph of power versus resistance.
			• conducts an experiment to determine electromotive force and internal resistance of a cell.	

	8.4 Uses the laws and principles related to current electricity for designing circuits.	• Electric circuits
		  • Kirchhoff's laws
		    • First law (conservation of charges)
		    • Second law (conservation of energy)
			Student will be able to;
			• explains Kirchhoff's first law on the basis of conservation of charge.
			• describes Kirchhoff's second law as one form of conservation of energy.
			• applies Kirchhoff's laws to electrical networks to solve problems.
				05

Competency	Competency Level	Content	Learning outcomes	No. of Periods

	8.5 Selects suitable instruments according to the quantity to be measured and uses electrical measuring instruments accurately and protectively.	• Electrical measuring instruments based on moving coil galvanometer
		• Ammeter
		  • Arrangement
		  • Properties of an ideal ammeter
		  • Changing the range of an ammeter
		• Voltmeter
		  • Arrangement
		  • Properties of an ideal voltmeter
		  • Changing the range of a voltmeter
		• Ohm – meter
			Student will be able to;
			• describe the construction of ammeter, voltmeter and ohm - meter.
			• uses ammeters and voltmeters correctly and protectively according to the needs.
			• solves numerical problems on conversion of moving coil galvanometer to ammeter and voltmeter.
			• Conduct activities to use multimeter correctly according to the appropriate situations.
				04

	8.6 Uses Wheatstone bridge	• Wheatstone bridge
		• Relationship between resistances for balanced condition.
		• Meter bridge
		  • facts to be considered in using meter bridge.
		  • **Uses of meter bridge**
		    • **Finding temperature coefficient of resistance**
			Student will be able to;
			• derives relationship among resistances of a balanced Wheatstone bridge.
			• uses Wheatstone bridge relationship to find equivalent resistance of simple networks.
			• uses meter bridge accurately to find the temperature coefficient of resistnace.
			• explains the facts to be considered in using metre bridge.
			• carries out numerical calculations to solve problems using Wheatstone bridge
				06

Competency	Competency Level	Content	Learning outcomes	No. of Periods
	8.7 Uses potentiometer by setting up the circuit appropriately.	• Potentiometer • Principle of potentiometer • Calibration of potentiometer • Facts to be considered in using potentiometer • **Uses of potentiometer** • **Comparison of electromotive forces** • **Comparison of resistances** • **Determination of internal resistance of a cell** • Advantages and disadvantage of using potentiometer	**Student will be able to** • explains the facts to be considered in using potentiometer. • describes the principle of potentiometer. • uses potentiometer to compare electromotive forces and to compare resistances. • uses potentiometer to determine internal resistance. • compares advantages and disadvantage of using potentiometer • solves problems related to potentiometer.	10
	8.8 Uses the laws and rules in electromagnetic induction for technical needs.	• Electromagnetic induction • Magnetic flux and flux linkage • Laws of electromagnetic induction • Faraday's law • Lenz's law • **Demonstrating the laws of electromagnetic induction** • Electromotive force induced in a straight rod moving in a uniform magnetic field • Expression for induced electromotive force • Fleming's right hand rule	**Student will be able to;** • demonstrates the laws of electromagnetic induction. • derives expressions for induced electromotive force of a rod moving/ rotating in magnetic field • derives expressions for induced electromotive force of a disc rotating in magnetic field • derives expressions for maximum value of induced electromotive force of a rectangular coil rotating in a magnetic field. • describes the structure of the alternating current generator. • expresses graphically the variation of e. m. f. of	20

		• Electromotive force induced in a rod rotating in a magnetic field
		• Electromotive force induced in a disc rotating in a magnetic field
		• Electromotive force induced in a rectangular coil rotating in a magnetic field and expression for maximum value
		• Alternating current generator
		  • Arrangement
		  • Graphical representation of the variation of electromotive force with time
		  • Introduction to alternating current and voltage
		  • r.m.s value and peak value of current and voltage.
		  • Average power in watts in a resistive circuits.
		• Eddy currents and their uses
		• Back e.m.f. of an electric motor
		• Demonstration of back e. m. f. of electric motor
		• Effect of the back e.m.f. on the armature current
		• Controlling the initial current /starter swich
		• Transformers
		  • Structure
		  • Relationship between the number of turns and the voltages of primary and secondary coils for ideal transformers.
			alternating current generator.
			• Explain the formation of back e. m. f.
			• explains the purpose of starter switch.
			• explains the structure and function of a transformer.
			• carries out calculations related to transformers.
			• explains elements of alternating current.
			• States the relationship between r. m. s. value and peak value of the voltage of the voltage and current.
			• explains transmission of electric power qualitatively.
			• carries out numerical calculations to solve related problems.	

		• Step-down and step-up transformers
		• Input and output power of the transformer
		• The product *VI*, as input / output power of a transformer
		  • Energy loss in a transformer
		    • Loss due to Joule heating
		    • Loss due to eddy current
		    • Method to minimize energy loss.
		    • Uses of transformers
		  • Transmission of electric power		

Unit 9 - Electronics **(40 periods)**

Competency	Competency Level	Content	Learning outcomes	No. of Periods

9. Uses electronic circuits to fulfill human needs efficiently.	9.1 Inquires about the principle of action of a semiconductor diode.	• Semiconductors
		  • Intrinsic semiconductors
		  • Extrinsic semiconductors
		    • n – type
		    • p- type
		• Junction diode
		  • p-n junction
		    • Depletion layer
		    • Forward bias
		    • Reverse bias
		  • Characteristic curves of a diode
		    • I-V curve of ideal diode
		    • **I-V curve of a practical diode**
		  • Diode as a rectifier
		    • Half wave rectification
		    • Full wave rectification
		    • Smoothing
		  • **Demonstration of rectification using CRO**
		    • Diode as a switch
		    • Types of diodes
		      • Zener diode
		        • Voltage regulation using Zener diode
		      • Light emitting diode(LED)
		      • Photo diode
		• Solar power
			Student will be able to;
			• identifies pure silicon and germanium as intrinsic semiconductors.
			• describes extrinsic semiconductors.
			• explains the formation of depletion region and voltage barrier of a p – n junction.
			• represents graphically the characteristic of a practical diode and ideal diode.
			• explains the action of diode in forward bias and reverse bias conditions.
			• Design an experiment to obtain I – V curve of a practical diode.
			• explains with relevant diagrams the uses of diode as a rectifier.
			• explains the action of a diode as a switch.
			• Solves numerical problems related to diodes.
			• conducts simple activities to demonstrate rectification and switching.
			• explains voltage regulation of zener diode.
			• explains qualitatively the action of LED and photo diode.
				10

Competency	Competency Level	Content	Learning outcomes	No. of Periods
	9.2 Uses the action of transistor for practical needs.	• Transistor • Bipolar transistor • Structure and circuit symbol of npn and pnp transistors • npn transistor circuits • Action of a transistor • Circuit configuration • Common – base • Common – emitter • Common – collector • Action of a transistor • **Investigating the characteristics of common emitter configuration of a transistor** • Input characteristic • Transfer characteristic • Output characteristic • Biasing a transistor • Common emitter transistor amplifier • Current amplification • Voltage amplification • Common emitter transistor switch • Unipolar transistor (JFET) • Structure of p-channel and n-channel JFET • Action of n-channel JFET • characteristic	**Student will be able to;** • explains the structure of npn and pnp transistors. • describes the action of a npn transistor with respect to electrons and holes. • describes with appropriate diagrams, the common base, common emitter and common collector configuration of a transistor. • conduct experiments to interpret graphically the input, output and transfer characteristics of common emitter configuration of a transistor. • explains the biasing of npn transistors with suitable diagrams. • describes the action and uses of a transistor in common emitter configuration as a current amplifier and as a voltage amplifier. • solves problems related to transistors. • describes the action of a transistor as a switch. • explains the structure, action and characteristics of a n-channel and p-channel JFET. • explains voltage amplification of a n-channel JFET using characteristic curer.	14

Competency	Competency Level	Content	Learning outcomes	No. of Periods
	9.3 Investigates on the uses of operational amplifier.	• Operational amplifier • Operational amplifier as an integrated circuit (IC) • Identification of pins • Action of operational amplifier • Characteristics of the open loop state • Uses of operational amplifier as a voltage amplifier • Close loop state • Golden rules I and II • Inverting amplifier • Non-inverting amplifier • Use of operational amplifier as a voltage comparator/ switch	**Student will be able to;** • identifies the pin numbers of operational amplifier • describes the open loop characteristic of an operational amplifier. • expresses the voltage gain of open loop state. • states the properties of operational amplifier. • explains the purpose of negative feedback and the effects on the gain of an operational amplifier. • interprets graphically and with suitable circuit diagrams the action of inverting and non-inverting operational amplifier. • states the Golden rules I and II regarding an operational amplifier in operating in linear region • derives an expression for the voltage gain of inverting and non - inverting amplifiers • explains the use of operational amplifier as a voltage comparator. • solves problems related to operational amplifier.	06
	9.4 Uses logic gates to control the action of digital circuits.	• Digital electronics • Boolean expressions and truth tables of logic gates • AND gate • OR gate • NOT gate • NAND gate • NOR gate • EXOR gate	**Student will be able to;** • writes Boolean expressions and truth tables for AND, OR, NOT, NAND, NOR, Ex-OR, and Ex-NOR logic gates. • develops logic expressions for simple digital logic circuits having two or three inputs. • converts given logic expressions into logic circuits. • designs simple logic circuits to suit given conditions.	10

		• EXNOR gate
		• **Investigating the truth tables of basic logic gates**
		• Logic expressions for simple digital circuits (maximum of three inputs)
		• Converting a given logic expression to a logic gate circuit
		• Logic expression for a truth table
		• Designing simple logic circuits
		• Electronic memory
		    • Single memory element with NOR gates
		    • Basic SR flip-flop (Bistable)
			• explains basic feature of memory element using NOR gates
			• explains the action of SR flip-flop using a truth table.	

Unit 10 - Mechanical Properties of Matter (40 periods)

Competency	Competency Level	Content	Learning outcomes	No. of Periods

10 Applies the knowledge on mechanical properties of matter quantitatively in scientific activities and daily pursuits.	10.1 Selects relevant materials for day-today needs in life using the knowledge about elasticity.	• Elasticity of solids
		  • Tension and extension
		  • Load-extension graph
		  • Hooke's law
		  • Tensile stress
		  • Tensile strain
		  • Young modulus
		  • **Determination of Young modulus of a metal using a wire**
		  • Stress-strain graph
		  • Energy stored in a stretched string
			Student will be able to;
			• conducts an experiment to investigate the relationship between tension and extension of a string or spring.
			• states Hook's law
			• defines the terms stress, strain and Young modulus
			• explains the behavior of materials using stress-strain graph
			• determines the Youngs modulus of a metal wire
			• gives an expression for energy stored in a string / a spring under a stress
			• carries out numerical calculations to solve problems related to elasticity.
				10

	10.2 Uses the knowledge on viscosity in scientific work and daily pursuits.	• Viscosity
		  • Viscous force
		  • Coefficient of viscosity
		  $F=A\eta\,(v_1-v_2)/d$
		  • Poiseuille's equation for a fluid flow
		  • Conditions of validity
		  • Correctness of the equation through dimensional analysis
		  • **Determination of coefficient of viscosity by using Poiseuille's formula**
		• Motion of an object through viscous media
		  • Forces acting on a spherical object
		  • Terminal velocity
		  • Stokes' law
			Student will be able to;
			• demonstrate the differences of flowing of various liquids using simple activities.
			• describe viscosity in terms of tangential stress and velocity gradient for a liquid flow.
			• defines coefficient of viscosity.
			• uses the expression for viscose force to solve problem
			• expresses Poiseuille's for a liquid flow.
			• conducts experiment to determine coefficient of viscosity of water by capillary flow method.
			• explains terminal velocity using v – t graph of a body moving through a viscous media.
			• solves simple numerical problems related to viscosity.
				15

Competency	Competency Level	Content	Learning outcomes	No. of Periods
		• Correctness of formula through dimensional analysis • Derivation of expressions for terminal velocity • Object moving upwards • Object moving downwards		
	10.3 Uses the knowledge on surface tension to explain the natural phenomena and to fulfill the daily pursuits.	• Surface tension • Definition of surface tension • Angle of contact • Relationship between nature of the liquid meniscus and the angle of contact • Free surface energy • Expression for the work done in increasing the surface area of a liquid film isothermally • Relationship between surface energy and surface tension • Expression for pressure difference across a spherical meniscus • Capillary rise • Expression for capillary rise • **Determination of surface tension** • **Using a microscope slide** • **Capillary rise method** • **Jaegar's method**	**Student will be able to;** • demonstrates the behavior of free surface of a liquid using simple activities • explains the behavior of free surface of a liquid using inter-molecular forces • defines surface tension • obtain the relationship between surface energy and surface tension. • describes the angle of contact with the help of diagrams. • derives an expression for pressure difference across spherical meniscus in terms of surface tension and the radius of the meniscus. • explains capillary rise using surface tension phenomena. • derives an expression for capillary rise in terms of surface tension, angle of contact and radius of the meniscus. • conducts experiments to determine surface tension by using microscope slide method, capillary rise method and Jaeger's method • solves problems related to surface tension.	15

Unit 11 - Matter and Radiation **(30 periods)**

Competency	Competency Level	Content	Learning outcomes	No. of Periods
11 Inquires the Modern theories in physics.	11.1 Applies the quantum theories to explain the intensity distribution of black body radiation.	• Quantum nature of radiation • Black body radiation • Stefan's law • Modification of the Stefan's law for non-black bodies • Intensity distribution of black body radiation • Wien's displacement law • Failure of the classical physics to explain the distribution of intensity of radiation • Planck's hypotheses	**Student will be able to;** • explains thermal radiation of bodies at various temperatures using activities and examples • explain the black body radiation. • describes the intensity distribution of blackbody radiation using the graph of intensity Vs wave length for various temperatures. • relate the temperature and intensity of black body radiation using Stefan's law. • use the modification of the Stefan's law for non-black body radiation. • use Wien's displacement law for relevant instances. • describe the failure of classical physics in explaining the black body radiation. • explain Plank's hypothesis using the appropriate terms. • accepts the quantum nature of radiation. • accept that plank's theory can be used to explain black body radiation.	08
	11.2 Applies the quantum theories to explain the photoelectric effect.	• Photoelectric effect • Threshold frequency • I-V graphs • Stopping potential • Graph of frequency against stopping potential • Graphs for different metals	**Student will be able to;** • explains the phenomenon of photoelectric effect using photoelectric effect experiment. • identifies the threshold frequency (or cutoff frequency) • explain the stopping potential	08

Competency	Competency Level	Content	Learning outcomes	No. of Periods
		• Failure of the classical physics to explain photoelectric effect • Hypotheses put forward by Einstein to explain the photoelectric effect Explaining photoelectric effect considering energy quanta (photon) • Work function • Einstein's photoelectric effect equation • Relationship between work function and threshold frequency • Relationship between stopping potential and maximum kinetic energy	• accepts that classical physics cannot be used to explain the results of the photoelectric effect. • states Einstein's hypotheses • explains the photoelectric effect using photon theory. • explains Einstein's photoelectric equation by introducing its terms. • relates threshold frequency to the work function. • relates stopping potential to the maximum kinetic energy. • solves numerical calculation using photo electric equation • explains why the maximum kinetic energy is independent of intensity, whereas the photoelectric current is proportional to intensity. • states that the photoelectric effect provides evidence for a particulate nature of electromagnetic waves.	

	11.3 Inquires about wave particle duality	• Wave nature of matter
		  • de Broglie wavelength for matter waves
		  • Evidences about wave nature of matter
		  • Principle of electron microscope
			Student will be able to;
			• gives evidence about wave nature of matter.
			• accept that any particle of a specific momentum has an associated wavelength called the de Broglie wavelength.
			• applies the de Broglie hypothesis for determination of the de Broglie wavelength of matter waves associated with a moving particle.
			• explains the principle of electron microscope.
				02

	11.4 Uses X – rays to fulfill human needs.	• X – rays
		  • Production of X – rays
		  • Properties of X – rays
		  • Uses of X – rays
			Student will be able to;
			• explains the discovery of X-rays
			• describes the method of production of X-rays
			• explains the properties of X-rays
			• explains qualitatively how X-rays can be used in different fields (medical, industrial, et.).
				02

	11.5 Inquires about radioactivity to fulfill human needs.	• Radioactivity
		  • Natural radioactive decay
		    • Emission of α- particles
		    • Emission of β- particles
		    • Emission of γ-rays
		  • Radioactive disintegration law
		    • Graphical representation
		    • Decay constant
		    • Activity
		    • Half life
		  • Uses of radioactivity
		    • Radioactive dating (C+14)
		    • In medicine, engineering and agriculture
		• Health hazards of radiation and safety precautions
		    • Measurement of quantity of radiation
		      • Radiation dose (Gy)
		      • RBE (Relative Biological Effectiveness) / Q (Quality Factor)
		      • Effective dose (Sv)
		    • Health hazards
		      • time of expose
		      • Area of the body which exposed to radiation
		    • Safety precaution
			Student will be able to;
			• explains the natural radioactivity and its properties.
			• describes the radioactive decay, the radioactive disintegration law and the graph.
			• explains the decay constant, activity and half-life time.
			• explains the use of radioactivity in medicine, engineering, agriculture and radioactive dating.
			• explains the background radiation, the health hazards and safety precautions.
			• Carry out numerical calculations to solve problems related to radioactivity.
				06

Competency	Competency Level	Content	Learning outcomes	No. of Periods

	11.6 Inquires about the nuclear energy and its uses	• Atomic nucleus
		  • Stability of nucleus
		  • Unified atomic mass unit
		  • Mass defect
		  • Einstein's mass – energy equation
		  • Binding energy
		  • Graphical representation between atomic number and binding energy of a nucleon
		  • Comparison of energy released in chemical reaction and nuclear reaction
		• Nuclear energy
		  • Nuclear fission
		    • Action of an atomic bomb
		    • Action of a nuclear power station
		    • Nuclear fusion
		      • Conditions necessary for fusion reaction
		      • Fusion reaction inside the sun
		      • Attempt of using fusion reaction for producing energy
			Student will be able to;
			• identifies the atomic structure, the nucleus, the isotopes, nuclear notation and the atomic mass unit.
			• compares the energy released in chemical reactions and nuclear reactions.
			• explains the nuclear fission and the process of chain reaction which may be controlled (nuclear power) or uncontrolled (atomic bomb)
			• explains the nuclear fusion, its process, fusion reaction inside the sun/in other stars, and the production of elements.
				04

4.0 Teaching - Learning Strategies

Global trend in present day education is to introduce competency based curricula which promote collaborative learning through student-centred activities where learning predominates over teaching. It is intended for the students to actively participate in activities which enhance the development of individual, social and mental skills. Emphasis is laid on the following aspects.

- Allow the students to acquire hands on experience.
- Direct students to acquire knowledge and information through reliable sources wherever necessary.

5.0 School policy and programmes

- The teacher has the liberty to follow any suitable teaching learning method to achieve the relevant learning outcomes.
- It is expected that the theoretical components of each unit will be dealt with the relevant practical components, **which are given in italics**.
- Capacity of students should be enhanced through extra-curricular activities, extensive use of supplementary reading materials and learning teaching aids such as Computer Assisted Learning (CAL) software.
- With a view to extending learning beyond the classroom activities and to highlight the students' special abilities, it is expected to involve students in co-curricular activities such as;
    - setting up school societies or clubs to pursue various aspects of chemistry
    - field trips to places where applications of chemistry can be observed and preparation of reports subsequently
    - organizing school exhibitions and competitions
    - organizing guest lectures on relevant topics by resource persons
    - producing school publications
    - organizing events such as debates, science days, etc.

- School management is responsible in providing services such as lab equipments, computer facilities, etc. and assistance within the school and from outside resources.
- In order to develop school policy and programmes it would be desirable to form a committee comprising relevant teachers and students.
- Most importantly, the school should serve as a role model to be followed by the students.
- School will develop its annual programmes, consisting of a variety of activities for achieving policy goals. In determining the activities to be undertaken during a particular year, the school will need to identify priorities and consider feasibility in relation to time and resource constraints.

6.0 Assessment and Evaluation

Assessment and Evaluation should conform to the standards set by the Department of Examinations. However, school-based assessment should also be part and parcel as it paves way to give direct feedback to learners.