General Certificate of Education

(Advanced level)

PHYSICS

Syllabus (Revisited)

For G.C.E. (A/L) Examinations to be held in 2012 and onwards

Department of Science, Health and Physical Education
Faculty of Science and Technology
National Institute of Education

1.0 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.

The following changes have been made in the revisited G.C.E. (Advanced Level) Physics syllabus.

- Unit 12: 'Emerging Scientific Knowledge' has been removed.

- Competency level 1.1
  'How physics is used to understand the evolution of the universe' has been added to the content of 'Introduction to physics' (A brief mention only).

- Competency level 1.4

  ‘Four beam balance’ has been removed from the content of ‘Measuring instruments’.

  ‘Error, fractional error and percentage error of a measurement’ and ‘Influence of relative magnitudes of errors in the final result of an experiment’ have been replaced by ‘Error, fractional error, percentage error of a measurement and their influence on the final result’.

- Competency level 9.2

  Under the ‘Bipolar transistor’, after the introduction of *npn* and *pnp* transistors, only *npn* transistors are discussed.

  Under the ‘Unipolar transistor’, after the introduction of *n*-channel and *p*-channel FETs, only *n*-channel FETs are discussed.

- Competency 11.3

  ‘Derivation of an expression for light photons’ has been removed from the content of ‘Wave nature of matter’.

- Competency level 11.5

  ‘Radiation dose (Gy)’ and ‘Relative Biological Effectiveness (*RBE*) / Quality Factor (*Q*)’ have been mentioned in the content of ‘Health hazards of radiation and safety precautions’ and the order of content has been rearranged.

- The allocated periods are given in page four.

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	22
Unit 02	Mechanics	102
Unit 03	Oscillations and Waves	86
Unit 04	Thermal Physics	46
Unit 05	Gravitational Field	12
Unit 06	Electrostatic Field	30
Unit 07	Current Electricity	42
Unit 08	Electromagnetism	34
Unit 09	Electronics	30
Unit 10	Mechanical Properties of Matter	32
Unit 11	Matter and Radiation	22

Total = 458

Proposed term wise breakdown of the syllabus

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

3.0 Syllabus
3.1 - Grade 12

Unit 1 - Measurement **(22 periods)**

Competency	Competency Level	Content	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 • How physics is connected to daily life and nature • How physics contributed to the development of modern society • How physics is used to understand the evolution of the universe • Explaining simply the subject area of physics • Basic concepts in scientific methodology • How experimental results have influenced the new investigations in physics	04
	1.2 Uses units appropriately in scientific work and daily pursuits.	• Physical quantities and units • Fundamental physical quantities • International system of units (SI units) - *Système International d'Unités* • Basic units • Supplementary units (for measuring angles) • Derived physical quantities and derived units • Physical quantities without units • Multiples and sub multiples of units	02

Competency	Competency Level	Content	No. of Periods

	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 and dimensions of a given quantity
		  • Deriving equations
			02

	1.4 Takes measurements accurately by selecting appropriate instruments to minimize the error.	• Measuring instruments
		  • Principle, least count and zero error of instruments
		  • Metre ruler
		  • Vernier calipers
		  • Micrometer screw gauge
		  • Spherometer
		  • Travelling microscope
		  • Triple beam balance/ Electronic balance
		  • Stop watch/ Digital watch
		  • **Uses of measuring instruments**
		  • Error, fractional error and percentage error of a measurement and their influence on the final result
			08

Competency	Competency Level	Content	No. of Periods

	1.5 Uses vector addition and resolution appropriately.	• Scalars and vectors
		  • Scalar quantities
		  • Vector quantities
		  • Geometrical representation of a vector quantity
		  • Addition and subtraction of vectors
		  • Two vectors in the same line and parallel lines
		  • Two inclined vectors
		  • Parallelogram method
		  • Triangle method
		  • Resolution of vectors
			04

	1.6 Extracts information correctly by graphical representation of experimental data.	• Graphical analysis
		  • Plotting the graph
		  • Values from graphs
		  • Interpretation and prediction of the behaviour of variables using a graph
			02

Unit 2: Mechanics

(102 periods)

Competency	Competency Level	Content	No. of Periods

2. Lays a foundation for analyzing motion around us on the basis of principles of physics.	2.1 Analyzes the linear motion, projectiles and relative motion of bodies.	• Kinematics
		  • Relative motion
		  • Motion in the same direction on parallel paths
		  • Motion in opposite directions on parallel paths
		  • Rectilinear motion under constant acceleration
		  • Use of graphs of motion
		  • *s-t* and *v-t* graphs
		  • Use of equations of motion
		  • Motion on a horizontal plane
		  • Vertical motion under gravity
		  • Motion on a frictionless inclined plane under gravity
		  • Projectiles
			10

	2.2 Uses resultant force and moment of force to control linear motion and rotational motion of a body.	• Resultant of forces
		  • Resultant of two forces
		  • Parallelogram law of forces
		  • Resultant of a system of coplanar forces
		  • Force resolution method
		  • Force polygon method
		• Moment of a force (torque)
		  • Moment of a force about a point
		  • Moment of a couple (of forces)
		  • Resultant of parallel forces and the line of action
		• 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 (concept only)
		• **Determination of weight of a body using the Parallelogram law of forces**
			12

Competency	Competency Level	Content	No. of Periods

	2.3 Manipulates the conditions necessary to keep a body in equilibrium.	• Equilibrium
		  • Conditions for equilibrium
		  • Equilibrium of coplanar forces
		  • Three forces in parallel
		  • Three forces inclined
		  • Triangle of forces
		  • Polygon of forces
		  • Principle of moments
		  • States of equilibrium (Identifying states of equilibrium)
		  • Stable
		  • Unstable
		  • Neutral
		  • **Determination of weight of a body using the principle of moment**
			10

	2.4 Uses Newton's laws of motion to control the states of motion of a body.	• Force and motion
		  • Mass
		  • Inertial mass
		  • Gravitational mass
		  • Inertial and non – inertial frames
		  • Inertial (Fictitious /Pseudo) forces (Introduction only) and non-inertial forces
		  • Newton's first law of motion
		  • Momentum
		  • Newton's second law of motion
		  • Obtaining $F = ma$
		  • Defining the 'newton'
		  • Impulse and impulsive forces
		  • Principle of conservation of linear momentum
		  • Elastic collision and inelastic collision
			16

Competency	Competency Level	Content	No. of Periods

		• Newton's third law of motion
		• Self adjusting forces
		  • Tension
		  • Thrust / compression
		  • Friction
		  • Static friction
		  • Dynamic friction
		• Free body diagrams
		• Applications of Newton's laws	

	2.5 Investigates the concepts related to rotational motion and circular motion.	• Rotational motion
		  • Angular displacement
		  • Angular velocity
		  • Angular acceleration
		  • Frequency of rotation
		  • Motion with uniform angular acceleration
		  • Use of equations of rotational motion
		  • Moment of inertia
		  • Angular momentum
		  • Torque
		  • Relationship between torque, moment of inertia and angular acceleration
		  • Principle of conservation of angular momentum
		  • Analogy between linear motion and rotational motion
		• Uniform circular motion in a horizontal plane
		  • Frequency
		  • Tangential velocity
		  • Period
		  • Centripetal force
		  • Centripetal acceleration
			16

Competency	Competency Level	Content	No. of Periods

	2.6 Consumes and transforms mechanical energy productively.	• Work, energy and power
		  • Work
		  • Work done in linear motion
		  • Work done in rotational motion
		  • Mechanical energy
		  • Kinetic energy
		  • Translational kinetic energy
		  • Rotational kinetic energy
		  • Potential energy
		  • Gravitational potential energy
		  • Elastic potential energy
		  • Power
		  • Principle of conservation of energy
		  • Principle of conservation of mechanical energy
			16

	2.7 Uses the principles and laws related to fluids at rest in scientific work and daily pursuits.	• Hydrostatics
		  • Hydrostatic pressure
		  • **Comparing the relative density of liquids**
		  • **using *U*- tube**
		  • **using Hare's apparatus**
		  • Transmissibility of pressure
		  • Pascal's principle and its applications
		  • Upthrust
		  • Archimedes' principle
		  • Verification theoretically and practically
		  • Floatation
		  • Principle of floatation
		  • **Comparing the density of liquids using the hydrometer**
			14

Competency	Competency Level	Content	No. of Periods

	2.8 Uses the principles and laws related to flowing fluids in scientific work and daily pursuits.	• Fluid-dynamics
		  • Streamline and turbulent flows
		  • Equation of continuity for a steady, stream line flow
		  • Bernoulli's principle (derivation of the equation is not expected)
		  • Applications of Bernoulli's principle
		  • Situations that can be explained by Bernoulli's principle
			08

Unit 3: Oscillations and Waves

(86 periods)

Competency	Competency Level	Content	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
		  • Characteristic equation of the simple harmonic motion $a = -\omega^2 x$
		  • Simple harmonic motion as a projection of a circular motion
		  • Phase of vibration
		  • Phase difference
		  • Equation of displacement $y = A\sin\omega t$
		  • Displacement – time graph corresponding to simple harmonic motion
		  • Small oscillations of a simple pendulum
		  • **Determination of gravitational acceleration by using simple pendulum**
		  • Oscillations of a mass suspended by a light helical spring
		  • **Finding the relationship between the mass and the period of oscillation**
		  • Free vibrations
		  • Damped vibrations
		  • Forced vibrations
		  • Resonance
		  • **Demonstration by Barton's pendulums**
			10

Competency	Competency Level	Content	No. of Periods

	3.2 Investigates various types of wave – motions and their uses.	• Progressive waves
		  • Mechanical waves
		  • **Demonstration of wave motion using slinky/CRO**
		  • Transverse waves
		  • Longitudinal waves
		  • Graphical representation of a wave
		  • Points of the same phase and different phase
		  • Physical quantities related to waves
		  • Speed of waves – v
		  • Wavelength - λ
		  • Frequency – f
		  • Relationship between frequency, wavelength and speed $v = f\lambda$
			08

	3.3 Investigates the uses of waves on the basis of their properties.
	.
		• Properties of waves
		  • **Demonstration of properties of waves by ripple tank**
		  • Reflection
		  • Rigid reflection
		  • Soft reflection
		  • Refraction
		  • Wavelength and speed of waves in different media
		  • Diffraction (qualitatively)
		  • Polarization (qualitatively)
		  • Principle of superposition of waves (graphical representation)
		  • Interference
		  • Stationary waves
		  • Beats
		  • $f_b = f_1 - f_2$ and uses (derivation is not necessary)
		  • Comparison of stationary waves and progressive waves
			10

Competency	Competency Level	Content	No. of Periods

	3.4 Uses the modes of vibration of strings and rods by manipulating variables.	• Stationary waves in strings and rods
		  • Stationary waves in a stretched string
		  • Speed of transverse waves $v = \sqrt{\frac{T}{m}}$
		  • Modes of vibrations in a stretched string
		  • Fundamental tone $f_0 = \frac{1}{2l}\sqrt{\frac{T}{m}}$
		  • Overtones and harmonics
		  • Sonometer
		  • **Finding the frequency of a tuning fork**
		  • **Finding the relationship between vibrating length and frequency**
		  • Longitudinal waves in a rod
		  • Speed of longitudinal waves $v = \sqrt{\frac{E}{\rho}}$
		  • Fundamental vibration
		  • Vibration with one end clamped
		  • Vibration with clamping in the middle
		  • Seismic waves, Richter scale and Tsunami (qualitatively)
			12

Competency	Competency Level	Content	No. of Periods
	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 air column • Closed tube • Open tube • **Determination of the speed of sound in air using a closed tube** • **by one tuning fork** • **by a set of tuning forks (graphical method)**	10
	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 • Applications and explanations of phenomena using Doppler effect • Sonic boom (qualitatively; equations are not necessary)	04

Competency	Competency Level	Content	No. of Periods

	3.7 Produces and propagates sound by considering characteristics of sound.	• Nature of sound
		  • Characteristics of sound
		  • Pitch
		  • Loudness
		  • Quality of sound
		  • Intensity and intensity level of sound (decibel)
		  • Graph of intensity level versus the frequency for human ear
		  • Limits of hearing
		  • Threshold of hearing
		  • Threshold of pain
		  • Ultrasonic and infrasonic (qualitatively)
			08

	3.8 Inquires about electromagnetic waves.	• Electromagnetic waves
		  • Electromagnetic spectrum
		  • Properties of electromagnetic waves
		  • Speed of electromagnetic waves
		  • Uses of electromagnetic waves
		  • LASER beams (production methods are not necessary)
		  • Properties
		  • Uses
			04

Competency	Competency Level	Content	No. of Periods

	3.9 Applies the principles of refraction of light for daily pursuits.	• Geometrical optics
		  • Refraction
		  • Laws of refraction
		  • Refractive index
		  • Relationship between refractive indices
		  • Real depth and apparent depth
		  • Apparent displacement $d = t(1 - 1/n)$
		  • **Finding refractive index using travelling microscope**
		  • Critical angle
		  • Relationship between the critical angle and the refractive index
		  $n = 1/\sin c$
		  • Total internal reflection
		  • Refraction through a prism
		  • **Experimental investigation of deviation through a prism**
		  • Deviation
		  • $d - i$ graph
		  • Minimum deviation
		  • Derivation of $n = \frac{\sin (A+D)/2}{\sin A/2}$ for minimum deviation
		  • **Finding the refractive index of the prism material by critical angle method**
		  • **Spectrometer**
		  • **Main adjustments of the spectrometer**
		  • **Finding the angle of prism**
		  • **Finding the angle of minimum deviation**
			12

Competency	Competency Level	Content	No. of Periods

		• Refraction through lenses
		  • Location of real and virtual images and determination of focal lengths of lenses
		  • **Experimental method**
		  • Ray diagrams
		  • Lens formula
		  • Sign convention
		  • Derivation by geometrical method
		  • Linear magnification
		• Power of a lens (+ converging, - diverging)
		• Combinations of thin lenses in contact	

	3.10 Applies the knowledge of images formed by lenses for the correction of defects of vision appropriately.	• Human eye
		  • Formation of an image
		  • Defects of vision and correction
		  • Short sight (myopia)
		  • Long sight (hypermetropia)
		  • Presbyopia
			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)
		  • Astronomical telescope
		  • Normal adjustment
		  • Magnifying power (Angular magnification)
		• Instances where microscope and telescopes are not in normal adjustment (only the ray diagram)
			04

Unit 4: Thermal Physics

(46 periods)

Competency	Competency Level	Content	No. of Periods

4. Uses the knowledge of heat to fulfil 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
		  • Thermometric substances
		  • 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
		  • Absolute scale (Thermodynamic scale)
		  • Triple point of water
		  • Expression for absolute temperature based on triple point of water
		  $T = \frac{X_T}{X_{tr}} \times 273.16$
		  • Absolute zero
		  • Relationship between Celsius and absolute scales
		  $T = \theta + 273.15$
		  • Thermometers
		  • Liquid - glass thermometers
		  • Mercury-glass thermometer
		  • Thermocouple
		  • Thermistors (Introduction as a temperature sensor)
			04

Competency	Competency Level	Content	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
		  • Expansion of liquids
		  • Real expansion
		  • Apparent expansion
		  • $\gamma_{absolute} = \gamma_{apparent} + 3\alpha$
		  • Variation of density with temperature
		  • Anomalous expansion of water
		  • Uses of expansion of solids and liquids
			06

	4.3 Investigates the behaviour of gases using gas laws.	• Gas laws
		  • Boyle's law
		  • **Finding atmospheric pressure using quill tube**
		  • Charles's law
		  • **Investigation of relationship between gas volume and temperature at constant pressure**
		  • Pressure law
		  • **Investigation of relationship between gas pressure and temperature at constant volume**
		  • Ideal gas equation
		  • Dolton's law of partial pressure
			08

Competency	Competency Level	Content	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 • Explanation of the pressure exerted by a gas • Equation of kinetic theory, $PV = \frac{1}{3}Nm\overline{c^2}$ (Derivation is not necessary) • Distribution of molecular speeds at different temperatures (graphical representation) • Expression for mean translational kinetic energy of air molecule, $E = \frac{3}{2}kT$	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 capacity of gases • **Determination of specific heat capacities of solids and liquids by the method of mixtures** • Newton's law of cooling • **Comparison of specific heat capacities of liquids by the method of cooling**	06

Competency	Competency Level	Content	No. of Periods
	4.6 Inquires about the productive use of the heat exchange during the change in state of matter.	• Changes 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 evaporation • Fusion • State changing curve • Specific latent heat of fusion • **Determination of specific latent heat of fusion of ice (method of mixtures)** • Vapourization • State changing curve • Specific latent heat of vapourization • **Determination of specific latent heat of vapourization of water (method of mixtures)** • Effect of pressure on boiling point and melting point	06
	4.7 Relates the effect of water vapour on weather.	• Vapour and humidity • Evaporation • Comparison of evaporation and vapourization • Vapour pressure and saturated vapour pressure • Variation of vapour pressure with temperature(graphical representation) • Variation of vapour pressure with volume (graphical representation) • Boiling point and saturated vapour pressure • Dew point • Absolute humidity • Relative humidity • **Determination of relative humidity using polished calorimeter**	04

Competency	Competency Level	Content	No. of Periods

	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
		  • Isothermal processes
		  • Adiabatic processes
		  • Constant volume processes
		  • Constant pressure processes
		  • Pressure – volume curves for an ideal gas
		  • Cyclic processes
			04

	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
		  • Determination of thermal conductivity
		  • **Searle's method (for a metal**)
		  • Convection (qualitatively)
		  • Radiation (qualitatively)
			04

3.2 - Grade 13

Unit 5: Gravitational Field

(12 periods)

Competency	Competency Level	Content	No. of Periods
5. Uses laws and principles of gravitational field to be productive in daily pursuits and scientific work.	5.1 Analyses the effect of gravitational field on objects using Newton's law of gravitation.	• Gravitational force field • Action of a force on a mass in the gravitational field • Gravitational field intensity • Newton's law of gravitation • 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 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)	06
	5.2 Inquires about the instances of using the knowledge on Earth's gravitational field to fulfil 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	06

Unit 6: Electrostatic Field (30 periods)

Competency	Competency Level	Content	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 field appropriately to find the distribution and magnitude of electrostatic field produced by various charged objects.	• Electrostatic force
		  • **Investigation of behaviour of charges using the gold leaf electroscope**
		  • Lines of force in various electric fields
		  • Around a point charge
		  • Around two point charges
		  • Between two charged parallel plates
		  • Force on a charge in an electrostatic field
		  • Electric field intensity
		  • Coulomb's law
		  • Field intensity of a point at some distance from a point charge
		  • Graphical representation of the variation of field intensity
			08

	6.2 Quantifies the electrostatic field using the flux model.	• Flux model
		  • Electric flux and lines of flux
		  • Gauss's theorem
		  • Finding electrostatic field intensities using Gauss's theorem
		  • Around a point charge
		  • Near an infinite charge plate
		  • Around a charged conducting sphere
		  • Outside the sphere
		  • On the surface of the sphere
		  • Inside the sphere
		  • Around a non-conducting uniformly charged sphere
		  • Outside the sphere
		  • On the surface of the sphere
		  • Inside the sphere
		  • Graphical representation of the variation of field intensity with the distance from the centre of the sphere
		  • Field intensity at a distance *r* from an infinitely long charged thin wire
			08

Competency	Competency Level	Content	No. of Periods

	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
		  • Potential energy of a charge in an electric field
		  • Potential energy of a system with charge distribution
		  • Work done in moving a charge across a potential difference
		  • Equipotential surfaces
		  • Equipotential surfaces in different fields
		  • Near a point charge
		  • Near like point charges
		  • Near unlike point charges
		  • Potential gradient
		  • Relationship between potential gradient and electric field intensity
			08

Competency	Competency Level	Content	No. of Periods

	6.4 Uses capacitors appropriately in electrical circuits.	• Electric capacity (capacitance)
		  • Definition of capacity
		  • Parallel plate capacitors
		  • 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)
		  • Action of lightning conductor (action of points related to lightning strikes only)
			06

Unit 7: Current Electricity **(42 periods)**

Competency	Competency Level	Content	No. of Periods

7. Uses the laws principles and effects of current electricity productively and appropriately.	7.1 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 drift velocity
		• Current density
		• Potential difference
		• Resistance and resistivity $R = \rho \frac{l}{A}$
		• Conductivity
		• Variation of resistance with temperature (temperature coefficient of resistance)
		• Superconductivity
		  • Behaviour of superconductors
		  • Super conducting materials
		  • Properties of superconductors
		  • Uses of superconductors
		• Combination of resistors
		  • Series connection
		  • Parallel connection
		  • Equivalent resistance of simple networks
		  • Potential divider circuit
		• Ohm's law
		  • Conditions for validity of Ohm's law
		  • *V-I* curves
		  • Ohmic conductors
		  • Non-ohmic conductors
			08

Competency	Competency Level	Content	No. of Periods
	7.2 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 rate of dissipation of energy $P = VI$ • Obtaining $P = I^2R$, $P = \frac{V^2}{R}$ and $W = I^2Rt$, $W = \frac{V^2}{R}t$ • Application of $P = VI$ and $W = VIt$ for any electrical appliance • Application of $P = I^2R$, $P = \frac{V^2}{R}$, $W = I^2Rt$ and $W = \frac{V^2}{R}t$ for appliances producing heat only (Joule heating)	04
	7.3 Inquires the power supply of an electric circuit quantitatively.	• Electromotive force • Formation of potential difference between plates of a simple cell • Direction of conventional electric current • 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)**	06

Competency	Competency Level	Content	No. of Periods

		• Combination of sources of electromotive force
		  • Series connection
		  • Parallel connection of identical sources
		• Graphical representation between resistance and power
		• Condition for maximum power transfer
		(derivation is not necessary)	

	7.4 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)
		• Wheatstone bridge
		  • Relationship between resistances for balanced condition
		  • Metre bridge
		  • Facts to be considered in using metre bridge
		  • **Comparison of resistances**
		  • **Finding temperature coefficient of resistance**
			10

	7.5 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
		  • Arrangement
		• Multi-meter
			04

Competency	Competency Level	Content	No. of Periods

	7.6 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**
		  • **Determination of very small electromotive forces**
		  • Advantages and disadvantage of using potentiometer
			10

Unit 8: Electromagnetism

(34 periods)

Competency	Competency Level	Content	No. of Periods

8. Uses the effects of inter-relationships between electricity and magnetism for scientific work and daily pursuits.	8.1 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
		  • **Demonstrating the nature of electromagnetic force using current balance**
		  • 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
		  • Applications of Hall effect
			10

	8.2 Constructs magnetic fields by manipulating variables for the needs.	• Magnetic force field
		  • Biot –Savart law
		  • 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
		  • Magnetic flux density near 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
			06

Competency	Competency Level	Content	No. of Periods

	8.3 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
			06

	8.4 Uses the laws and rules in electromagnetic induction for technical needs.	• Electromagnetic induction
		  • 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 magnetic field
		  • Expression for induced electromotive force
		  • Fleming's right hand rule
		  • 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
		  • Direct current generator
		  • Arrangement
		  • Graphical representation of the variation of electromotive force with time
		  • Eddy currents and uses
			12

Competency	Competency Level	Content	No. of Periods

		• Back e.m.f. of an electric motor
		• Effect of the back e.m.f. on the armature current
		• Controlling the initial current – starter switch
		• Transformers
		  • Structure
		  • Relationship between the number of turns and the voltages of primary and secondary
		  • Step-down and step-up transformers
		  • 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
		• Uses of transformers
		• Transmission of electric power
		• Elements of alternating current
		  • Sinusoidal voltage and current wave forms from an *ac* source
		  • Peak value and *rms* value
		  • Average power in watts in a resistive circuit	

Unit 9: Electronics **(30 periods)**

Competency	Competency Level	Content	No. of Periods

9. Uses electronic circuits to fulfil human needs efficiently.	9.1 Inquires about the principle of action of a semiconductor diode.	• Junction diode
		  • Intrinsic semiconductors
		  • Extrinsic semiconductors
		  • *n* – type
		  • *p*- type
		  • *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**
		  • Use of diode as a rectifier
		  • Half wave rectification
		  • Full wave rectification
		  • Smoothing
		  • **Demonstration of rectification using CRO**
		  • Diode as a switch
		  • Other types of diodes
		  • Zener diode
		  • Voltage regulation of Zener diode
		  • Light emitting diode(LED)
		  • Photo diode
			06

Competency	Competency Level	Content	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
		  • **Investigating the characteristics of common emitter configuration of a transistor**
		  • Input characteristic
		  • Output characteristic
		  • Transfer characteristic
		  • Biasing a transistor
		  • Common emitter transistor amplifier
		  • Current amplification
		  • Voltage amplification
		  • Common emitter transistor switch
		  • Unipolar transistor
		  • Field effect transistor (FET)
		  • Structure and circuit symbol of *n*-channel and *p*-channel FETs
		  • Action of an *n*-channel FET
		  • Characteristics
		  • Voltage amplification using an FET (qualitatively)
			12

Competency	Competency Level	Content	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 (negative feedback)
		  • Golden rules I and II
		  • Inverting amplifier
		  • Non-inverting amplifier
		  • Use of operational amplifier as a voltage comparator
			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
		  • 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 NAND/NOR gates
		  • Basic SR flip-flop (Bistable)
			06

Unit 10: Mechanical Properties of Matter

(32 periods)

Competency	Competency Level	Content	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- to-day 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's modulus
		  • **Determination of Young's modulus of a metal using a wire**
		  • Stress-strain graph
		  • Energy stored in a stretched string
			10

Competency	Competency Level	Content	No. of Periods

	10.2 Uses the knowledge on viscosity in scientific work and daily pursuits.	• Viscosity
		  • Viscous force
		  • Factors affecting viscous force
		  • Velocity gradient
		  • Tangential stress (*F/A*)
		  • Coefficient of viscosity
		  • Poiseuille's formula for a fluid flow
		  • Conditions of validity
		  • Correctness of the formula through dimensional analysis
		  • **Determination of coefficient of viscosity by using Poiseuille's formula**
		  • Motion of an object through viscous media
		  • Forces acting on an object
		  • Terminal velocity using *v-t* graph
		  • Stokes' law
		  • Condition of validity
		  • Correctness of formula through dimensional analysis
		  • Derivation of expressions for terminal velocity
		  • Object moving upwards
		  • Object moving downwards
		  • Comparison of coefficient of viscosity for different fluids
		  • Variation of viscosity with temperature
		  • Uses of viscosity
			10

Competency	Competency Level	Content	No. of Periods

	10.3 Uses the knowledge on surface tension to explain the natural phenomena and to fulfil the daily pursuits.	• Surface tension
		  • Demonstrating the nature of the free surface of a liquid with examples
		  • Explaining the behaviour of free surface of a liquid using inter-molecular forces
		  • 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**
		  • **using a soap film on a frame**
		  • **capillary rise method**
		  • **Jaegar's method**
			12

Unit 11: Matter and Radiation **(22 periods)**

Competency	Competency Level	Content	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
		  • Graphs between intensity of radiation and wavelength
		  • Wien's displacement law
		  • Failure of the classical physics to explain the distribution of intensity of radiation
		  • Planck's hypotheses
		  • Explaining the black body radiation considering energy quanta and energy levels
			04

	11.2 Applies the quantum theories to explain the photoelectric effect.	• Photoelectric effect
		  • Threshold frequency
		  • *I-V* graph
		  • Stopping potential
		  • Graph of frequency against stopping potential
		  • Graphs for different metals
		  • 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)
		  • Einstein's photoelectric effect equation
		  • Work function
		  • Maximum kinetic energy
		  • Relationship between work function and threshold frequency
		  • Relationship between stopping potential and maximum kinetic energy
			04

Competency	Competency Level	Content	No. of Periods

	11.3 Inquires about wave - particle duality.	• Wave nature of matter
		  • Evidences about wave nature of matter
		  • de Broglie wavelength for matter waves
		  • Principle of electron microscope
			02

	11.4 Uses *X* – rays to fulfil human needs.	• *X* – rays
		  • Production of *X* – rays
		  • Properties of *X* – rays
		  • Uses of *X* – rays
			02

	11.5 Inquires about radioactivity to fulfil 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
		  • 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) and Effective dose (Sv)
			06

Competency	Competency Level	Content	No. of Periods

		• Health hazards
		  • Nature of radiation
		  • Area of the body which exposed to radiation
		  • Effective dose
		• Safety precautions	

	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
			04

4.0 Learning-Teaching Strategies

Global trend in present day education is to introduce competency based curricula which promote collaborative learning through student centered 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 made on the following aspects.

- It is advised to cover the content through 5E- model activities as far as possible.
- The teacher is advised to mention technological applications relevant to each topic.
- 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

1 The teacher has the liberty to follow any suitable teaching learning method to achieve the relevant learning outcomes.

2 It is expected that the theoretical components of each unit will be dealt with the relevant practical components, which are given in bold face letters.

3 Capacity of students should be enhanced through extra curricular activities, extensive use of supplementary reading materials and learning teaching aids including CAL (Computer Aided Learning) software.

4 With a view to extend learning beyond the classroom work 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 Physics.
- field trips to industries and places where principles of Physics are used.
- organising school exhibitions and competitions.
- organising guest lectures on relevant topic by resource persons such as experts or professionals.
- producing school publications.
- organising events such as debates, science days etc.

5 School management is responsible in providing services within the school and from outside resources.
6 In order to develop school policy and programmes, in relation to Physics, it would be desirable to form a committee comprising of suitable teachers and students.
7 Most importantly, the school should serve as the role model to be followed by the students.
8 The 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

It is intended to implement this syllabus in schools with the School Based Assessment (SBA) process. Teachers will prepare creative teaching - learning instruments on the basis of school terms.

The details together with the format and the nature of questions will be introduced by the Department of Examination.