PHYSICS

PREAMBLE

The syllabus is evolved from the Senior Secondary School teaching syllabus and is intended to indicate the scope of the course for Physics examination.

It is structured with the conceptual approach. The broad concepts of matter, position, motion and time; energy; waves; fields; Atomic and Nuclear Physics, electronics are considered and each concept forms a part on which other sub-concepts are further based.

AIMS

The aims of the syllabus are to enable candidates

(1) acquire proper understanding of the basic principles and applications of Physics;

(2) develop scientific skills and attitudes as pre-requisites for further scientific activities;

(3) recognize the usefulness, and limitations of scientific method to appreciate its applicability ion other disciplines and in every life;

(4) develop abilities, attitudes and skills that encourage efficient and safe practice;

(5) develop scientific attitudes such as accuracy, precision, objectivity, integrity, initiative and inventiveness.

ASSESSMENT OBJECTIVES

The following activities appropriate to Physics will be tested:

(1) Acquisition of knowledge and understanding:

Candidates should be able to demonstrate knowledge and understanding of

(a) Scientific phenomena, facts laws, definitions, concepts and theories;

(b) Scientific vocabulary, terminology and conventions (including symbols, quantities and units);

(c) The use of scientific apparatus, including techniques of operation and aspects of safety;

(d) Scientific quantities and their determinations;

(e) Scientific and technological applications with their social economic and environmental implications.

(2) Information Handling and Problem-solving

Candidates should be able, using visual, oral, aural and written (including symbolic, diagrammatic, graphical and numerical) information to

(a) locate select, organize and present information from a variety of sources including everyday experience;

(b) analyse and evaluate information and other data;

(c) use information to identify patterns, report trends and draw inferences;

(d) present reasonable explanations for natural occurrences, patterns and relationships;

(e) make predictions from data.

(3) Experimental and Problem-Solving Techniques

Candidates should be able to

(a) follow instructions;

(b) carry out experimental procedures using apparatus;

(c) make and record observations, measurements and estimates with due regard to precision, accuracy and units;

(d) interpret, evaluate and report on observations and experimental data;

(e) identify problems, plan and carry out investigations, including the selection of techniques, apparatus, measuring devices and materials;

(f) evaluate methods and suggest possible improvements;

(g) state and explain the necessary precautions taken in experiments to obtain accurate results.

SCHEME OF EXAMINATION

There will be **three** papers, Papers 1, 2 and 3, all of which must be taken. Papers 1 and 2 will be a composite paper to be taken at one sitting.

PAPER 1: Will consist of fifty multiple choice questions lasting 1¼ hours and carrying 50 marks.

PAPER 2: Will consist of two sections, Sections A and B lasting1½ hours and carrying 60 marks.

Section A - Will comprise seven short-structured questions. Candidates will be required to answer any five questions for a total of 15 marks.

Section B - Will comprise five essay questions out of which candidates will be required to answer any three for 45 marks.

PAPER 3: Will be a practical test for school candidates or an alternative to practical work paper for private candidates. Each version of the paper will comprise three questions out of which candidates will be required to answer any two in 2¾ hours for 50 marks.

DETAILED SYLLABUS

It is important that candidates are involved in practical activities in covering this syllabus. Candidates will be expected to answer questions on the topics set in the column headed ' TOPIC'. The 'NOTES' are intended to indicate the scope of the questions which will be set but they are not to be considered as an exhaustive list of limitations and illustrations.

NOTE: Questions will be set in S.I. units. However, multiples or sub-multiples of the units may be used.

PART 1
INTERACTION OF MATTER, SPACE & TIME

TOPICS	NOTES
1. Concepts of matter	Simple structure of matter should be discussed. Three physics states of matter, namely solid, liquid and gas should be treated. Evidence of the particle nature of matter e.g. Brownian motion experiment, Kinetic theory of matter. Use of the theory to explain; states of matter (solid, liquid and gas), pressure in a gas, evaporation and boiling; cohesion, adhesion, capillarity. Crystalline and amorphous substances to be compared (Arrangement of atoms in crystalline structure to be described e.g. face centred, body centred.
2. Fundamental and derived quantities and units (a) Fundamental quantities and units	Length, mass, time, electric current luminous intensity, thermodynamic temperature, amount of substance as examples of fundamental quantities and m, kg, s, A, cd, K and mol as their respective units.
(b) Derived quantities and units	Volume, density and speed as derived quantities and m^3, kgm^{-3} and ms^{-1} as their respective units.
3. Position, distance and displacement. (a) Concept of position as a location of point-rectangular coordinates.	Position of objects in space using the X,Y,Z axes should be mentioned.
(b) Measurement of distance	Use of string, metre rule, vernier calipers and

(c) Concept of direction as a way of locating a point –bearing (d) Distinction between distance and displacement.	micrometer screw gauge. Degree of accuracy should be noted. Metre (m) as unit of distance. Use of compass and a protractor. Graphical location and directions by axes to be stressed.

TOPICS	NOTES
4. Mass and weight	Use of lever balance and chemical/beam balance to measure mass and spring balance to measure weight. Mention should be made of electronic/digital balance.
Distinction between mass and weight	Kilogram (kg) as unit of mass and newton (N) as unit of weight.
5. Time	
(a) Concept of time as interval between physical events	The use of heart-beat, sand-clock, ticker-timer, pendulum and stopwatch/clock.
(b) Measurement of time	Second(s) as unit of time.
6. Fluid at rest	
(a) Volume, density and relative density	Experimental determination for solids and liquids.
(b) Pressure in fluids	Concept and definition of pressure. Pascal's principle, application of principle to hydraulic press and car brakes. Dependence of pressure on the depth of a point below a liquid surface. Atmospheric pressure. Simple barometer, manometer, siphon, syringe and pump. Determination of the relative density of liquids with U-tube and Hare's apparatus.
(c) Equilibrium of bodies	Identification of the forces acting on a body partially or completely immersed in a fluid.
(i) Archimedes' principle	Use of the principle to determine the relative densities of solids and liquids.
(ii) Law of flotation	Establishing the conditions for a body to float in

	a fluid. Applications in hydrometer, balloons, boats, ships, submarines etc.

TOPICS	NOTES
7. Motion	
(a) Types of motion: Random, rectilinear, translational, Rotational, circular, orbital, spin, Oscillatory.	Only qualitative treatment is required. Illustration should be given for the various types of motion.
(b) Relative motion	Numerical problems on co-linear motion may be set.
(c) Cause of motion	Force as cause of motion.
(d) Types of force: (i) Contact force (ii) Non-contact force(field force)	Push and pull These are field forces namely; electric and magnetic attractions and repulsions; gravitational pull.
(e) Solid friction	Frictional force between two stationary bodies (static) and between two bodies in relative motion (dynamic). Coefficients of limiting friction and their determinations. Advantages of friction e.g. in locomotion, friction belt, grindstone. Disadvantages of friction e.g reduction of efficiency, wear and tear of machines. Methods of reducing friction; e.g. use of ball bearings, rollers, streamlining and lubrication.
(f) Viscosity (friction in fluids)	Definition and effects. Simple explanation as extension of friction in fluids. Fluid friction and its application in lubrication should be treated qualitatively. Terminal velocity and its determination.
(g) Simple ideas of circular motion	Experiments with a string tied to a stone at one end and whirled around should be carried out to (i) demonstrate motion in a Vertical/horizontal circle.

TOPICS	NOTES

TOPICS	NOTES
	(i) show the difference between angular speed and velocity. (ii) Draw a diagram to illustrate centripetal force. Banking of roads in reducing sideways friction should be qualitatively discussed.
8. Speed and velocity	
(a) Concept of speed as change of distance with time	
(b) Concept of velocity as change of displacement with time	Metre per second (ms^{-1}) as unit of speed/velocity.
(c) Uniform/non-uniform speed/velocity	Ticker-timer or similar devices should be used to determine speed/velocity. Definition of velocity as $\Delta \vec{s} / \Delta t$.
(d) Distance/displacement-time graph	Determination of instantaneous speed/velocity from distance/displacement-time graph and by calculation.
9. Rectilinear acceleration	
(a) Concept of Acceleration/deceleration as increase/decrease in velocity with time.	Unit of acceleration as ms^{-2}
(b) Uniform/non-uniform acceleration	Ticker timer or similar devices should be used to determine acceleration. Definition of acceleration as $\Delta v / \Delta t$.
(c) Velocity-time graph	Determination of acceleration and displacement from velocity-time graph
(d) Equations of motion with constant acceleration; Motion under gravity as a special case.	Use of equations to solve numerical problems.
TOPICS	**NOTES**

10. Scalars and vectors	
(a) Concept of scalars as physical quantities with magnitude and no direction	Mass, distance, speed and time as examples of scalars.
(b) Concept of vectors as physical quantities with both magnitude and direction.	Weight, displacement, velocity and acceleration as examples of vectors.
(c) Vector representation	
(d) Addition of vectors	Use of force board to determine the resultant of two forces.
(e) Resolution of vectors	Obtain the resultant of two velocities analytically and graphically.
(f) Resultant velocity using vector representation.	
11. Equilibrium of forces	Torque/Moment of force. Simple treatment of a couple, e.g. turning of water tap, corkscrew and steering wheel.)
(a) Principle of moments	
(b) Conditions for equilibrium of rigid bodies under the action of parallel and non-parallel forces.	Use of force board to determine resultant and equilibrant forces. Treatment should include resolution of forces into two perpendicular directions and composition of forces Parallelogram of forces. Triangle of forces.
(c) Centre of gravity and stability	Should ne treated experimentally. Treatment should include stable, unstable and neutral equilibra.
12. Simple harmonic motion	Use of a loaded test-tube oscillating vertically in a liquid, simple pendulum, spiral spring and bifilar suspension to demonstrate simple harmonic motion.
(a) Illustration, explanation and definition of simple harmonic motion (S.H.M)	
TOPICS	**NOTES**

(b) Speed and acceleration of S.H.M.	Relate linear and angular speeds, linear and angular accelerations.
(c) Period, frequency and amplitude of a body executing S.H.M.	Experimental determination of 'g' with the simple pendulum and helical spring. The theory of the principles should be treated but derivation of the formula for 'g' is not required
(d) Energy of S.H.M	
(e) Forced vibration and resonance	Simple problems may be set on simple harmonic motion. Mathematical proof of simple harmonic motion in respect of spiral spring, bifilar suspension and loaded test-tube is not required.
13. Newton's laws of motion:	Distinction between inertia mass and weight
(a) First Law: Inertia of rest and inertia of motion	Use of timing devices e.g. ticker-timer to determine the acceleration of a falling body and the relationship when the accelerating force is constant.
(b) Second Law: Force, acceleration, momentum and impulse	Linear momentum and its conservation. Collision of elastic bodies in a straight line. Applications: recoil of a gun, jet and rocket propulsions.
(c) Third Law: Action and reaction	

PART II
ENERGY: Mechanical and Heat

TOPICS	NOTES
14. Energy:	
(a) Forms of energy	Examples of various forms of energy should be mentioned e.g. mechanical (potential and kinetic), heat chemical, electrical, light, sound, nuclear.
(b) World energy resources	Renewable (e.g. solar, wind, tides, hydro, ocean waves) and non-renewable (e.g. petroleum, coal, nuclear, biomass) sources of energy should be discussed briefly.
(c) Conservation of energy.	Statement of the principle of conservation of energy and its use in explaining energy transformations.
15. Work, Energy and Power	
(a) Concept of work as a measure of energy transfer	Unit of energy as the joule (J)
(b) Concept of energy as capability to do work	Unit of energy as the joule (J) while unit of electrical consumption is KWh.
(c) Work done in a gravitational field.	Work done in lifting a body and by falling bodies
(d) Types of mechanical energy	Derivation of P.E and K.E are expected to be known. Identification of types of energy possessed by a body under given conditions.
(i) Potential energy (P.E.)	
(ii) Kinetic energy (K.E)	Verification of the principle.
(e) Conservation of mechanical energy.	

TOPICS	NOTES

(f) Concept of power as time rate of doing work.	Unit of power as the watt (W)
(g) Application of mechanical energy-machines. Levers, pulleys, inclined plane, wedge, screw, wheel and axle, gears.	The force ratio (F.R), mechanical advantage (M.A), velocity ratio (V.R) and efficiency of each machine should be treated. Identification of simple machines that make up a given complicated machine e.g. bicycle. Effects of friction on Machines. Reduction of friction in machines.
16. Heat Energy	
(a) Temperature and its measurement	Concept of temperature as degree of hotness or coldness of a body. Construction and graduation of a simple thermometer. Properties of thermometric liquids. The following thermometer, should be treated: Constant – volume gas thermometer, resistance thermometer, thermocouple, liquid-in-glass thermometer including maximum and minimum thermometer and clinical thermometer, pyrometer should be mentioned. Celsius and Absolute scales of temperature. Kelvin and degree Celsius as units of temperature.
(b) Effects of heat on matter e.g	Use of the Kinetic theory to explain effects of heat.
(i) Rise in temperature (ii) Change of phase state (iii) Expansion (iv) Change of resistance	Mention should be made of the following effects: Change of colour Thermionic emission Change in chemical properties
(c) Thermal expansion – Linear, area and volume expansivities	Qualitative and quantitative treatment Consequences and application of expansions. Expansion in buildings and bridges, bimetallic strips, thermostat, over-head cables causing sagging nd in railway lines causing buckling. Real and apparent expansion of liquids. Anomalous expansion of water.

TOPICS	**NOTES**

(d) Heat transfer – Condition, convention and radiation.	Per Kelvin (K^{-1}) as the unit of expansivity. Use of the kinetic theory to explain the modes of heat transfer. Simple experimental illustrations. Treatment should include the explanation of land and sea breezes, ventilation and application s in cooling devices. The vacuum flask.
(e) The gas laws-Boyle's law Charles' law, pressure law and general gas law	The laws should be verified using simple apparatus. Use of the kinetic theory to explain the laws. Simple problems may be set. Mention should be made of the operation of safety air bags in vehicles.
(f) Measurement of heat energy: (i) Concept of heat capacity (ii) Specific heat capacity.	Use of the method of mixtures and the electrical method to determine the specific heat capacities of solids and liquids. Land and sea breezes related to the specific heat capacity of water and land, $Jkg^{-1} K^{-1}$ as unit of specific heat capacity.
(g) Latent heat (i) Concept of latent heat	Explanation and types of latent heat.
(ii) Melting point and boiling Point	Determination of the melting point of solid and the boiling point of a liquid. Effects of impurities and pressure on melting and boiling points. Application in pressure cooker.
(iii) Specific latent heat of fusion and of vaporization	Use of the method of mixtures and the electrical method to determine the specific latent heats of fusion of ice and of vaporization of steam. Applications in refrigerators and air conditioners. Jkg^{-1} as unit of specific latent heat

TOPICS	NOTES

(h) Evaporation and boiling	Effect of temperature, humidity, surface area and draught on evaporation to be discussed.
(i) Vapour and vapour pressure	Explanation of vapour and vapour pressure. Demonstration of vapour pressure using simple experiments. Saturated vapour pressure and its relation to boiling.
(j) Humidity, relative humidity and dew point	Measurement of dew point and relative humidity. Estimation of humidity of the atmosphere using wet and dry-bulb hygrometer.
(k) Humidity and the weather	Formation of dew, fog and rain.

PART III

WAVES

TOPICS	NOTES
17. Production and propagation of waves	
(a) Production and propagation of mechanical waves	Use of ropes and springs (slinky) to generate mechanical waves
(b) Pulsating system: Energy transmitted with definite speed, frequency and wavelength.	Use of ripple tank to show water waves and to demonstrate energy propagation by waves. Hertz(Hz) as unit of frequency.
(c) Waveform	Description and graphical representation. Amplitude, wave length, frequency and period. Sound and light as wave phenomena.
(d) Mathematical relationship connecting frequency (f), wavelength(λ), period (T) and velocity (v)	$V = f\lambda$ and $T = \frac{1}{f}$ simple problems may be set.
18. Types of waves	
(a) Transverse and longitudinal	Examples to be given
(b) Mathematical representation of	Equation $y = A \sin (wt \pm \frac{2\pi x}{\lambda})$ to be explained Questions on phase difference will not be set.

wave motion. 19. Properties of waves: Reflection, refraction, diffraction, Interference, superposition of progressive waves producing standing stationary waves	Ripple tank should be extensively used to demonstrate these properties with plane and circular waves. Explanation of the properties.
20. Light waves (a) Sources of light	Natural and artificial. Luminous and non-luminous bodies.

TOPICS	NOTES
(b) Rectilinear propagation of light	Formation of shadows and eclipse. Pinhole camera. Simple numerical problems may be set.
(c) Reflection of light at plane surface: plane mirror	Regular and irregular reflections. Verification of laws of reflection. Formation of images. Inclined plane mirrors. Rotation of mirrors. Applications in periscope, sextant and kaleidoscope.
(d) Reflection of light at curved surfaces: concave and convex mirrors	Laws of reflection. Formation of images. Characteristics of images. Use of mirror formulae: $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ and magnification m = $\frac{v}{u}$ to solve numerical problems. (Derivation of formulae is not required) Experimental determination of the focal length of concave mirror. Applications in searchlight, parabolic and driving mirrors, car headlamps etc.
(e) Refraction of light at plane surfaces: rectangular glass prism (block) and triangular prism.	Laws of refraction. Formation of images, real and Apparent depths. Critical angle and total internal reflection. Lateral displacement and angle of deviation. Use of minimum deviation equation:
(f) Refraction of light at curved	$\mu = \frac{\text{Sin}\,(A + D_m)}{2}$

surfaces: Converging and diverging lenses	Sin A/2 (Derivation of the formula is not required) Applications: periscope, prism binoculars, optical fibres. The mirage. Formation of images. Use of lens formulae $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ and magnification $\frac{v}{u}$ tp solve numerical problems.

TOPICS	NOTES
	(derivation of the formulae not required). Experimental determination of the focal length of converging lens. Power of lens in dioptres (D)
(g) Application of lenses in optical instruments.	Simple camera, the human eye, film projector, simple and compound microscopes, terrestrial and astronomical telescopes. Angular magnification. Prism binoculars. The structure and function of the camera and the human eye should be compared. Defects of the human eye and their corrections.
(h) Dispersion of white light by a triangular glass prism.	Production of pure spectrum of a white light. Recombination of the components of the spectrum. Colours of objects. Mixing coloured lights.
21. Electromagnetic waves: Types of radiation in electromagnetic Spectrum	Elementary description and uses of various types of radiation: Radio, infrared, visible light, ultra-violet, X-rays, gamma rays.
22. Sound Waves	
(a) Sources of sound	
(b) Transmission of sound waves	Experiment to show that a material medium is required.
(c) Speed of sound in solid, liquid and	To be compared. Dependence of velocity of sound

air	on temperature and pressure to be considered.
(d) Echoes and reverberation	Use of echoes in mineral exploration, and determination of ocean depth. Thunder and multiple reflections in a large room as examples of reverberation.
(e) Noise and music (f) Characteristics of sound	Pitch, loudness and quality.

TOPICS	NOTES
(g) Vibration in strings	The use of sonometer to demonstrate the dependence of frequency (f) on length (1), tension (T) and mass per unit length (liner density) (m) of string should be treated. Use of the formula: $f_0 = \frac{1}{21}\sqrt{\frac{T}{m}}$ In solving simple numerical problems. Applications in stringed instruments: e.g. guitar, piano, harp and violin.
(h) Forced vibration	Use of resonance boxes and sonometer to illustrate forced vibration.
(i) Resonance (ii) Harmonies and overtones	Use of overtones to explain the quality of a musical note. Applications in percussion instruments: e.g drum, bell, cymbals, xylophone.
(i) Vibration of air in pipe – open and closed pipes	Measurement of velocity of sound in air or frequency of tuning fork using the resonance tube. Use of the relationship v = $f\lambda$ in solving numerical problems. End correction is expected to be mentioned. Applications in wind instruments e.g. organ, flute, trumpet, horn, clarinet and saxophone.

PART IV
FIELDS

TOPICS	NOTES
23. Description property of fields.	
(a) Concept of fields: Gravitational, electric and Magnetic	
(b) Properties of a force field	Use of compass needle and iron filings to show magnetic field lines.
24. Gravitational field	
(a) Acceleration due to gravity, (g)	G as gravitational field intensity should be mentioned, g = F/m.
(b) Gravitational force between two masses:	Masses include protons, electrons and planets
Newton's law of gravitation	Universal gravitational constant (G) Relationship between 'G' and 'g'
(c) Gravitational potential and escape velocity.	Calculation of the escape velocity of a rocket from the earth's gravitational field.
25. Electric Field	
(1) Electrostatics	
(a) Production of electric charges	Production by friction, induction and contact.
(b) Types of distribution of charges	A simple electroscope should be used to detect and compare charges on differently-shaped bodies.
(c) Storage of charges	Application in light conductors.
(d) Electric lines of force	Determination, properties and field patterns of charges.

TOPICS	NOTES

(e) Electric force between point charges: Coulomb's law	Permittivity of a medium.
(f) Concepts of electric field, electric field intensity (potential gradient) and electric potential.	Calculation of electric field intensity and electric potential of simple systems.
(g) Capacitance- Definition, arrangement and application	Factors affecting the capacitance of a parallel-plate capacitor. The farad (F) as unit of capacitance. Capacitors in series and in parallel. Energy stored in a charged capacitor. Uses of capacitors: e.g. in radio and Television. (Derivation of formulae for capacitance is not required)
(2) Current electricity	
(a) Production of electric current from primary and secondary cells	Simple cell and its defects. Daniel cell, Lechanché cell (wet and dry). Lead-acid accumulator. Alkalne-cadium cell. E.m.f. of a cell, the volt (V) as unit of e.m.f.
(b) Potential difference and electric current	Ohm's law and resistance. Verification of Ohm's law. The volt (V), ampere (A) and ohm (Ω) as units of p.d., current and reisistance respectively.
(c) Electric circuit	Series and parallel arrangement of cells and resistors. Lost volt and internal resistance of batteries.
(d) Electric conduction through materials	Ohmic and non ohmic conductors. Examples of ohmic conductors are metals, non-ohmic conductors are semiconductors.
(e) Electric energy and power	Quantitative definition of electrical energy and power. Heating effect of an electric current and its application. Conversion of electrical energy to mechanical energy e.g. electric motors. Conversion of solar energy to electrical and heat energies: e.g. solar cells, solar heaters.

TOPICS	**NOTES**

(f) Shunt and multiplier	Use in conversion of a galvanometer into an ammeter and a voltmeter.
(g) Resistivity and Conductivity	Factors affecting the electrical resistance of a material should be treated. Simple problems may be set.
(h) Measurement of electric current, potential difference, resistance, e.m.f. and internal resistance of a cell.	Principle of operation and use of ammeter, voltmeter, potentiometer. The wheatstone bridge and metre bridge.
26. Magnetic field	
(a) Properties of magnets and magnetic materials.	Practical examples such as soft iron, steel and alloys.
(b) Magnetization and demagnetization.	Temporary and permanent magnets. Comparison of iron and steel as magnetic materials.
(c) Concept of magnetic field	Magnetic flux and magnetic flux density. Magnetic field around a permanent magnet, a current-carrying conductor and a solenoid. Plotting of line of force to locate neutral points Units of magnetic flux and magnetic flux density as weber (Wb) and tesla (T) respectively.
(d) Magnetic force on: (i) a current-carrying conductor placed in a magnetic field; (ii) between two parallel current-carrying conductors	Qualitative treatment only. Applications: electric motor and moving-coil galvanometer.
(e) Use of electromagnets	Examples in electric bell, telephone earpiece etc.
(f) The earth's magnetic field	Mariner's compass. Angles of dip and declination.
(g) Magnetic force on a moving charged particle	Solving simple problems involving the motion of a charged particle in a magnetic field, using $F=qvB \sin \theta$
27. Electromagnetic field	
(a) Concept of electromagnetic field	Identifying the directions of current, magnetic field and force in an electromagnetic field (Fleming's left-hand rule).
TOPICS	**NOTES**

(i) Shunt and multiplier	Use in conversion of a galvanometer into an ammeter and a voltmeter.
(j) Resistivity and Conductivity	Factors affecting the electrical resistance of a material should be treated. Simple problems may be set.
(k) Measurement of electric current, potential difference, resistance, e.m.f. and internal resistance of a cell.	Principle of operation and use of ammeter, voltmeter, potentiometer. The wheatstone bridge and metre bridge.
26. Magnetic field	
(h) Properties of magnets and magnetic materials.	Practical examples such as soft iron, steel and alloys.
(i) Magnetization and demagnetization.	Temporary and permanent magnets. Comparison of iron and steel as magnetic materials.
(j) Concept of magnetic field	Magnetic flux and magnetic flux density. Magnetic field around a permanent magnet, a current-carrying conductor and a solenoid. Plotting of line of force to locate neutral points Units of magnetic flux and magnetic flux density as weber (Wb) and tesla (T) respectively.
(k) Magnetic force on: (i) a current-carrying conductor placed in a magnetic field; (ii) between two parallel current-carrying conductors	Qualitative treatment only. Applications: electric motor and moving-coil galvanometer.
(l) Use of electromagnets	Examples in electric bell, telephone earpiece etc.
(m) The earth's magnetic field	Mariner's compass. Angles of dip and declination.
(n) Magnetic force on a moving charged particle	Solving simple problems involving the motion of a charged particle in a magnetic field, using $F=qvB \sin \theta$
27. Electromagnetic field	
(a) Concept of electromagnetic field	Identifying the directions of current, magnetic field and force in an electromagnetic field (Fleming's left-hand rule).
TOPIC	NOTES

(b) Electromagnetic induction Faraday's law ,Lenz's law and motor-generator effect	 Applications: Generator (d.c.and a.c.) induction coil and transformer. The principles underlying the production of direct and alternating currents should be treated. Equation $E = E_o$ sinwt should be explained.
(c) Inductance	Qualitative explanation of self and mutual inductance. The unit of inductance is henry (H). $(E = \frac{1}{2} LI^2)$ Application in radio,T.V., transformer. (Derivation of formula is not required).
(d) Eddy currents	A method of reducing eddy current losses should be treated. Applications in induction furnace, speedometer, etc.
(e) Power transmission and distribution	Reduction of power losses in high-tension transmission lines. Household wiring system should be discussed.
28. Simple a.c. circuits	
(a) Graphical representation of e.m.f and current in an a.c. circult.	Graphs of equation I – Io sin wt and\E = E_o sinwt should be treated.
(b) Peak and r..m.s. values	Phase relationship between voltage and current in the circuit elements; resistor, inductor and capacitor.
TOPIC	**NOTES**

(c) Series circuit containing resistor, inductor and capacitor	Simple calculations involving a.c. circuit. (Derivation of formulae is not required.)
(d) Reactance and impedance	X_L and X_c should be treated. Simple numerical problems may be set.
(e) Vector diagrams	
(f) Resonance in an a.c, circuit	Applications in tuning of radio and T.V. should be discussed.
(g) Power in an a.c. circuit.	

PART V

ATOMIC AND NUCELAR PHYSICS

TOPICS	NOTES
29. Structure of the atom (a) Models of the atom	Thomson, Rutherford, Bohr and electron-cloud (wave-mechanical) models should be discussed qualitatively. Limitations of each model. Quantization of angular momentum (Bohr)
(b) Energy quantization	Energy levels in the atom. Colour and light frequency. Treatment should include the following: Frank-Hertz experiment, Line spectra from hot bodies, absorption spectra and spectra of discharge lamps.
(c) Photoelectric effect	Explanation of photoelectric effect. Dual nature of light. Work function and threshold frequency. Einstein's photoelectric equation and its explanation. Application in T.V., camera, etc. Simple problems may be set.
(d) Thermionic emission	Explanation and applications.

(e) X-rays 30. Structure of the nucleus (a) Composition of the nucleus	Production of X-rays and structure of X-ray tube. Types, characteristics, properties, uses and hazards of X-rays. Safety precautions Protons and neutrons. Nucleon number (A), proton number (Z), neutron number (N) and the equation: A-Z + N to be treated. Nuclides and their notation. Isotopes.
TOPICS	**NOTES**
(a) Radioactivity – Natural and artificial (b) Nuclear reactions --- Fusion and Fission 31. Wave-particle paradox (a) Electron diffraction (b) Duality of matter	Radioactive elements, radioactive emissions (α,β,γ)and their properties and uses. Detection of radiations by G – M counter, photographic plates, etc. should be mentioned. Radioactive decay, half-life and decay constant. Transformation of elements. Applications of radioactivity in agriculture, medicine, industry, archaeology, etc. Distinction between fusion and fission. Binding energy, mass defect and energy equation: $E= \Delta mc^2$ Nuclear reactors. Atomic bomb. Radiation hazards and safety precautions. Peaceful uses of nuclear reactions. Simple illustration of the dual nature of light.

HARMONISED TOPICS FOR SHORT STRUCTURED QUESTIONS FOR ALL MEMBER COUNTRIES

TOPICS	NOTES
1. Derived quantities and dimensional Analysis	Fundamental quantities and units e.g. Length, mass, time, electric current, luminous intensity e.t.c., m, kg,s, A, cd, e.t.c. as their respective units Derived quantities and units. e.g. volume, density, speed e.t.c. m^3, kgm^{-3}, ms^{-1} e.t.c. as their respective unit Explanation of dimensions in terms of fundamental and derived quantities. Uses of dimensions - to verity dimensional correctness of a given equation - to derive the relationship between quantities - to obtain derived units.
2. Projectile motion concept of projectiles as an object thrown/release into space	Applications of projectiles in warfare, sports etc. Simple problems involving range, maximum height and time of flight may be set.
3. Satellites and rockets	Meaning of a satellite comparison of natural and artificial satellites parking orbits, Geostationary satellites and period of revolution and speed of a satellite. Uses of satellites and rockets
4. Elastic Properties of solid: Hooke's law, Young's modules and work done in springs and string	Behaviour of elastic materials under stress – features of load – extension graph Simple calculations on Hook's law and Young's modulus.
Thermal conductivity: Solar energy collector and Black body Radiation.	Solar energy; solar panel for heat energy supply. Explanation of a blackbody. Variation of intensity of black body radiation with wavelength at different temperatures.
5. Fibre Optics	Explanation of concept of fibre optics. Principle of transmission of light through an optical fibre Applications of fibre optics e.g. local area Networks (LAN) medicine, rensing devices, carrying laser beams e.t.c.
TOPICS	**NOTES**

6. Introduction to LASER	Meaning of LASER Types of LASERS (Solid state, gas, liquid and semi-conductor LASERS Application of LASERS (in Scientific research, communication, medicine military technology, Holograms e.t.c. Dangers involved in using LASERS.
7. Magnetic materials	Uses of magnets and ferromagnetic materials.
8. Electrical Conduction through materials [Electronic]	Distinction between conductors, semiconductors and insulators in term of band theory. Semi conductor materials (silicon and germanium) Meaning of intrinsic semiconductors. (Example of materials silicon and germanium). Charge carriers Doping production of p-type and n-type extrinsic semi conductors. Junction diode – forward and reverse biasing, voltage characteristics. Uses of diodes Half and full wave rectification.
9. Structure of matter	Use of kinetic theory to explain diffusion.
10. Wave – particle paradox	Electron diffraction Duality of matter Simple illustrations of dual nature of light.