Aims

1. To enable candidates to acquire knowledge and to develop an understanding of the terms, facts, concepts, definitions, and fundamental laws, principles and processes in the field of physics.

2. To develop the ability to apply the knowledge and understanding of physics to unfamiliar situations.

3. To develop a scientific attitude through the study of physical sciences.

4. To develop skills in,

   (a) The practical aspects of handling apparatus, recording observations and

   (b) Drawing diagrams, graphs, etc.

5. To develop an appreciation of the contribution of physics towards scientific and technological developments and towards human happiness.

6. To develop an interest in the world of physical sciences.

There will be two papers in the subject.

Paper I Theory: 3 hours (70 marks)
Paper II Practical: 3 hours (20 marks)
Project work: 10 marks
Practical file: 3 marks

PAPER I: THEORY 70 Marks

Paper I shall be of 3 hours duration and be divided into two parts.

Part 1 (20 marks)
This part will consist of compulsory short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.

Part 2 (50 marks)
This part will be divided into three Sections A, B and C. There shall be three questions in Section A (each carrying 9 marks) and candidates are required to answer two questions from this Section. There shall be three questions in Section B (each carrying 8 marks) and candidates are required to answer two questions from this Section. There shall be three questions in Section C (each carrying 8 marks) and candidates are required to answer two questions from this Section. Therefore, candidates are expected to answer six questions in Part 2.

Note
Unless otherwise specified, only S. I. units are to be used while teaching and learning, as well as for answering questions.

SECTION A

Electrostatics

1. Coulomb's law, S.I. unit of charge; permittivity of free space.

2. Concept of electric field $E = F/q_0$; Gauss' theorem and its applications.

3. Electric dipole; electric field at a point on the axis and perpendicular bisector of a dipole; electric dipole moment; torque on a dipole in a uniform electric field.

4. Electric lines of force.

5. Electric potential and potential energy; potential due to a point charge and due to a dipole; potential energy of an electric dipole in an electric field.

6. Capacitance of a conductor C = Q/V, the farad; capacitance of a parallel-plate capacitor; capacitance in series and parallel combinations; energy $U = \frac{1}{2}CV2 = \frac{1}{2}QV = \frac{1}{2}\frac{Q^2}{C}$

7. Dielectrics (elementary ideas only); permittivity and relative permittivity of a dielectric ($\varepsilon r = \varepsilon/\varepsilon 0$). Effects on pd, charge and capacitance.

Current electricity

1. Steady currents; sources of current, simple cells, secondary cells.

2. Potential difference as the power supplied divided by the current; Ohm's law and its limitations; Combinations of resistors in series and parallel; Electric energy and power.

3. Mechanism of flow of current in metals, drift velocity of charges. Resistance and resistivity and their relation to drift velocity of electrons; description of resistivity and conductivity based on electron theory; effect of temperature on resistance, colour coding of resistance.

4. Electromotive force in a cell; internal resistance and back emf. Combination of cells in series and parallel.

5. Kirchhoff's laws and their simple applications to circuits with resistors and sources of emf; Wheatstone bridge, metre-bridge and potentiometer; use for comparison of emf and determination of internal resistance of sources of current; use of resistors (shunts and multipliers) in ammeters and voltmeters.

6. Heating effect of a current (Joule's law).

7. Thermoelectricity; See beck and Peltier effects; measurement of thermo emf, its variation with temperature. Peltier effect.

Magnetism

1. Magnetic field B r, definition from magnetic force on a moving charge; magnetic field lines. Superposition of magnetic fields; magnetic field and magnetic flux density; the earth's magnetic field; Magnetic field of a magnetic dipole; tangent law.

2. Properties of dia, para and ferromagnetic substances; susceptibility and relative permeability

Electromagnetism

1. Oersted's experiment; Biot-Savart law, the tesla; magnetic field near a long straight wire, at the centre of a circular loop, and at a point on the axis of a circular coil carrying current and a

solenoid. Amperes circuital law and its application to obtain magnetic field due to a long straight wire; tangent galvanometer.

2. Force on a moving charge in a magnetic field; force on a current carrying conductor kept in a magnetic field; force between two parallel current carrying wires; definition of the ampere based on the force between two current carrying wires. Cyclotron (simple idea).

3. A current loop as a magnetic dipole; magnetic dipole moment; torque on a current loop; moving coil galvanometer.

4. Electromagnetic induction, magnetic flux and induced emf; Faraday's law and Lenz's law; transformers; eddy currents.

5. Mutual and self inductance: the Henry Growth and decay of current in LR circuit (dc) (graphical approach), time constant.

6. Simple a.c. and d.c. generators.

7. Comparison of a.c. with d.c.

Alternating current circuits

1. Change of voltage and current with time, the phase difference; peak and rms values of voltage and current; their relation in sinusoidal case.

2. Variation of voltage and current in a.c. circuits consisting of only resistors, only inductors and only capacitors (phasor representation), phase lag and phase lead.

3. The LCR series circuit: phasor diagram, expression for V or I; phase lag/lead; impedance of a series LCR circuit (arrived at by phasor diagram); special cases for RL and RC circuits.

4. Power P associated with LCR circuit = 1/2V0I0 =VrmsIrms; power absorbed and power dissipated; choke coil (choke and starter); electrical resonance; oscillations in an LC circuit ($\omega = 1/\sqrt{LC}$).

SECTION B

Wave optics

1. Complete electromagnetic spectrum from radio waves to gamma rays; transverse nature of electromagnetic waves, Huygen's principle; laws of reflection and refraction from Huygen's principle. Speed of light.

2. Conditions for interference of light, interference of monochromatic light by double slit; measurement of wave length. Fresnel’s biprism.

3. Single slit Fraunhoffer diffraction (elementary explanation).

4. Plane polarised electromagnetic wave (elementary idea), polarisation of light by reflection and refraction, Brewster's law; polaroids.

Ray optics and optical instruments

1. Refraction of light at a plane interface (Snell's law); total internal reflection and critical angle; total reflecting prisms and optical fibres.

2. Refraction through a prism, minimum deviation and derivation of relation between n, A and δ_{min}.

3. Refraction at a single spherical surface (relation between n_1, n_2, u, v and R); refraction through thin lens (lens maker's formula and formula relating u, v, f, n, R_1 and R_2); combined focal length of two thin lenses in contact. Combination of lenses [Silvering of lens excluded].

4. Dispersion; dispersive power; production of pure spectrum; spectrometer and its setting (experimental uses and procedures included); absorption and emission spectra; spherical and chromatic aberration; derivation of condition for achromatic combination of two thin lenses in contact and not of prism.

5. Simple microscope; Compound microscope and their magnifying power.

6. Simple astronomical telescope (refracting and reflecting), magnifying power and resolving power of a simple astronomical telescope.

SECTION C

Electrons and Photons

1. Cathode rays: measurement of e/m for electrons; principle of cathode ray oscillograph.Millikan’s oil drop experiment.

2. Photo electric effect, quantization of radiation; Einstein's equation; threshold frequency; work function; energy and momentum of photon. Determination of Plank's Constant from photo electric effect.

3. Wave particle duality, De Broglie equation, phenomenon of electron diffraction informative only).

Atoms

1. Charge and size of molecules (a-particle scattering); atomic structure; Bohr's postulates, Bohr's quantization condition; radii of Bohr orbits for hydrogen atom; energy of the hydrogen atom in the nth state; line spectra of hydrogen and calculation of E and f for different lines.

2. Production of X-rays; maximum frequency for a given tube potential. Characteristic and continuous X-rays. Mosley’s law.

Nuclei

1. Atomic masses; unified atomic mass unit u and its value in MeV; the neutron; composition and size of nucleus; mass defect and binding energy.

2. Radioactivity: nature and radioactive decay law, half-life, mean life and decay constant. Nuclear reactions.

Nuclear energy

1. Energy - mass equivalence.

2. Nuclear fission; chain reaction; principle of operation of a nuclear reactor.

3. Nuclear fusion; thermonuclear fusion as the source of the sun's energy.

Semiconductor devices

1. Energy bands in solids; energy band diagrams for distinction between conductors, insulators, semi-conductors-intrinsic and extrinsic; electrons and holes in semiconductors.

2. Junction diode; depletion region; forward and reverse biasing current – voltage characteristics; pn diode as a half wave and afull wave rectifier; solar cell, LED and photodiode. Zener diode and voltage regulation.

3. The junction transistor; npn and pnp transistors; current gain in a transistor; transistor common emitter) amplifier (only circuit diagram and qualitative treatment) and oscillator.

4. Elementary idea of discreet and integrated circuits, analogue and digital circuits. Logic gates (symbols; working with truth tables; applications and uses) - NOT, OR, AND, NOR, NAND.