Exam. Code : 103201
Subject Code : 1305

B.A./B.Sc. Ist Semester

PHYSICS

Paper—B (Electricity & Magnetism)

Time Allowed—3 Hours] [Maximum Marks—35

Note :—There are **FIVE** sections A, B, C, D & E. Section A is compulsory. Attempt **ONE** question from each section. **All** questions carry equal marks.

SECTION—A

1. (a) What do you understand by solenoidal vector ?

   (b) What is meant by the term 'test charge' and 'source charge'?

   (c) What is equipotential surface ? Can two equipotential surfaces interact ?

   (d) What is the significance of negative sign in the equation $\vec{E} = -\vec{\nabla} \cup$?

   (e) What is the nature of current versus potential difference graph for ohmic and non-ohmic resistor ?

(f) What is gyromagnetic orbital ratio ?

(g) How can a magnet be demagnetised completely ?

7×1=7

SECTION—B

2. (a) State and prove Gauss's divergence theorem.

(b) A point charge q = 17.7 μc is located at the centre of cube of side 3 cm. Find the electric flux through the whole cube and each face of the cube.

4+3

3. (a) Define curl of a vector field. Give its physical interpretation.

(b) Determine the relation between Coulomb and Stat-coulomb. 4+3

SECTION—C

4. (a) Find the electric potential at a point due to a point charge at the origin.

(b) If the electric potential in a region is represented by V = 2x + 3y – 4z, obtain the expressions for potential gradient and electric field strength.

4+3

5. (a) Prove that electric potential at a point due to a dipole varies inversely as the square of the distance of the point from the dipole.

(b) Establish relation between Volt and Stat-Volt.

5+2

SECTION—D

6. (a) Define the terms current and current density. Derive the relation between current density and drift velocity.

   (b) A copper wire carrying current of 2A has area of cross section 0.01 cm^2. If the number of free electrons in copper is $8.0\times10^{28}/m^3$, calculate the drift velocity of electrons. 5+2

7. (a) What is meant by invariance of charge ? Give evidence in support of the same.

   (b) Prove that $\left|\vec{J}\right| = \sigma\left|\vec{E}\right|$ is equivalent to the Ohm's law. 5+2

SECTION—E

8. Show that transformation laws for transforming electric field from one inertial frame of reference to another are given by $E'_{11} = E_{11}, E'_{\perp} = rE\perp$ where $r = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$ 7

9. (a) Define intensity of magnetisation and magnetic induction.

Prove that $B = \mu_0(H+M)$ and $\mu_r = (1+\chi_m)$

where symbols have their usual meanings.

(b) What are free and bound currents ? Establish a relation $\vec{\nabla} \times \vec{H} = \vec{J}_f$ 4+3