

PHYSICS PAPER-C

(Electricity and Magnetism—I)

Time Allowed : Three Hours

Maximum Marks : 45

Note : Attempt five questions in all, selecting two questions from each Unit I and II. Unit III (Q. No. 7) is compulsory. The use of non-programmable calculators are allowed. Log tables can be asked.

UNIT-I

1. (a) State and prove Stoke's theorem. Give its importance.
(b) What is physical significance of curl of a vector field ? 6,3
2. (a) Derive an expression for electric field due to electric dipole at a point on its equatorial line.
(b) A charge q_0 experiences force of $(42\hat{i} + 35\hat{j})$ N when placed in an electric field of $(18\hat{i} \times 15\hat{j}) \times 10^6$ NC⁻¹. Find the charge q_0 . 6,3
3. (a) Deduce Gauss's law in differential form.
(b) A sphere of radius 20 cm is uniformly charged and, has volume charge density 4.3×10^{-10} C/m³. Find electric field at a point on the surface of sphere. 6,3

UNIT-II

4. (a) What is a conservative field ? Give an example of such a field. Show that curl of such a field is zero.
(b) The electric potential in space is given by $V = 3x + 4y - 7z$. Obtain the expression for potential gradient and electric intensity. 6,3
5. (a) Derive an expression for the electric potential at any point due to linear quadrupole.
(b) Derive Laplace's equation. 6,3
6. (a) A charge is situated at a distance d from the infinite conducting sheet maintained at zero potential in x - y plane. The source lies in the region $z > 0$. Using method of images, find electric field at any point in the region $z > 0$.
(b) What is atomic Polarizability ? Show that :

$$\vec{P} = \alpha E_0$$

6,3

UNIT-III

7. Attempt any *six* points :

- (i) If vector field is divergenceless, can it be expressed as the curl of another vector field ?
- (ii) Define Coulomb.
- (iii) What is volume charge distribution ?
- (iv) State the condition under which it can be written as $\phi = EA$.
- (v) What is equipotential surface ?
- (vi) What is electric susceptibility ?
- (vii) What is unit of Atomic Polarizability ?

$1\frac{1}{2} \times 6 = 9$