

## PHYSICS PAPER-C

(Electricity and Magnetism-I)

Time : 3 Hours

Max. Marks : 44

- Note:
- (1) Do *five* questions, selecting *two* questions from each Unit. Unit III is compulsory.
  - (2) The paper will be evaluated out of 44 marks and the score obtained will be halved.
  - (3) Put correct serial no. of each question attempted.
  - (4) Use of non-programmable scientific calculator is allowed.

### Unit-I

- (a) State and prove Gauss's divergence theorem.  
(b) Define gradient of a scalar field. Give its physical interpretation. 6,3
- (a) Derive an expression for electric field due to an electric dipole at a point on its axial line.  
(b) A particle of charge 3 mC and mass 20 g is projected with velocity  $5\hat{i} - 12\hat{j}$  m/s in uniform electric field of  $80\hat{j}$  N/C. Find speed of the charge after 2 sec. 6,3
- (a) State and prove Stokes's theorem. What is its importance ?  
(b) A cube of side 5 cm is given charge of  $6 \mu\text{C}$ . Assuming that the charge is distributed uniformly on all the faces of the cube, find the surface charge density. 6,3

## Unit-II

4. Derive an expression for electric potential at a far off point due to an arbitrary charge distribution. Show that it is the sum of potentials due to a monopole, a dipole, quadrupole etc. 8½

5. (a) Show that in an electrostatic field  $\vec{E}$ , the potential difference between

two point A and B is given by 
$$N_B - N_A = \int_A^B \vec{E} : \vec{dr}$$

Using this relation, define electric potential at a point.

- (b) Electric potential  $V$  at any point in space is given by  $V = 4x^2$ . Find the electric field. Will the electric field be uniform? 4½, 4
6. (a) Derive Gauss's law in differential form for dielectrics.
- (b) Define atomic polarizability. On which factors does it depend. Give its S.D. Units. 4½, 4

## Unit-III

7. Attempt any six parts :

- (i) What is a conservative field? Give example.
- (ii) What is a solenoidal field? Give example.
- (iii) What is an equipotential surface? What will be its shape for a point charge?
- (iv) Define electric susceptibility.
- (v) Is the potential difference more basic than potential?
- (vi) What is the source of electric field in a dielectric?
- (vii) Distinguish between a free charge and a bound charge.  $6 \times 1\frac{1}{2} = 9$