

M.Sc. (Physics) (CBCS Pattern) Semester-I  
**PSCPHYT04 Paper-IV - Electrodynamics-I**

P. Pages : 2

Time : Three Hours



**GUG/W/24/11182**

Max. Marks : 80

**Either:**

1. a) Define electric field and obtain its expression for discrete, line, surface and volume charge distribution's. 8
- b) Show that the electric field  $E$  is the gradient of scalar potential  $V$  i.e. 8  
and find the potential inside and outside a spherical shell of radius  $r$  which carries uniform surface charge.

**OR**

- e) State and explain Gauss law Derive its differential form. 4
- f) Derive Poisson and Laplace's equation's. 4
- g) State and explain Coulomb's law in vector form. 4
- h) Derive the equation for electrostatic energy of a continuous charge distribution. 4

**Either:**

2. a) Derive an expression for multipole expansion of potential. 8
- b) State and prove first and second uniqueness theorem. 8

**OR**

- e) Explain the origin of coordinates in multipole expansion's. 4
- f) Find the approximate potential at a point far from the dipole, if a electric dipole consist of two equal and apposite charges separated by a distanced. 4
- g) State and prove Green's theorem. 8

**Either:**

3. a) Derive Ampere's law in differential and integral form. 8
- b) Discuss magnetostatic boundary conditions. 8

**OR**

- e) State and explain Biot-Savart law. 4
- f) Find the magnetic field of a distance from a long straight wire carrying a steady current I. 4
- g) If there are two closed circuits carrying currents  $I_1$  and  $I_2$  then show that the force experienced by these wires due to the magnetic fields set by them are in conformity with Newton's third law. 8

**Either:**

- 4. a) State and prove Poynting theorem. 8
- b) Derive wave equation for E and B by using maxwell's equation. 8

**OR**

- e) Discuss Gauge transformation. 4
- f) Show that  $J_d = \frac{\partial D}{\partial t}$  by using Maxwell's equation in matter, where  $J_d$  is displacement current. 8
- g) Derive the continuity equation. 4

5. Answer **all** the followings:

- a) Discuss electric field, for a point charge. 4
- b) Explain monopole and dipole expansion terms. 4
- c) Deduce Amperes law from Biot-Savart law. 4
- d) Discuss physical significance of Maxwell's equation. 4

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