[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 972 **G**

Unique Paper Code : 251405

Name of the Paper : ELHT – 403 : Electromagnetics

Name of the Course : **B.Sc. (H) Electronics**

Semester : IV

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **Five** questions in all, including Question No. 1 which is compulsory.
3. Scientific calculator is allowed.
4. **All** questions carry equal marks.

1. (a) Find the gradient of the following scalar fields :

(i) $V = e^{-z} \sin 2x \cosh y$

(ii) $U = \rho^2 z \cos 2\Phi$

(iii) $W = 10r \sin^2\theta \cos\Phi$

P.T.O.

(b) Two dipoles with dipole moments $-5a_z$ nC/m and $9a_z$ nC/m are located at points (0, 0, −2) and (0, 0, 3), respectively. Find the potential at the origin.

(c) Write the Laplace's equation in Cartesian, cylindrical and spherical co-ordinates.

(d) Write the differential and integral form of four Maxwell's equations and explain their physical significance.

(e) Define (i) Magnetic flux density, (ii) Polarization of dielectric, (iii) Permeability of the material. (5×3)

2. (a) Derive the expression for energy density in electrostatics field. (8)

(b) The point charges −1 nC, 4 nC, and 3 nC located at (0, 0, 0), (0, 0, 1), and (1, 0, 0), respectively. Find the energy in the system. (7)

3. (a) Calculate the induced surface charge density for a given charge +Q placed at a distance *h* from a grounded conducting plane of infinite extent. (8)

(b) Given the potential $V = 10/r^2\ [\sin\theta\cos\Phi]$, Calculate

(i) electric flux density D at $(2, \pi/2, 0)$

(ii) the work done in moving a 10 μC charge from point A(1, 30°, 120°) to B (4, 90°, 60°) (7)

4. (a) Define the capacitance of a capacitor. Derive an expression for the capacitance for a parallel plate capacitor. (7)

(b) Given the potential field $V = 3x^2yz + ky^3z$ V/m

(i) Find k, if potential field satisfies Laplace's equation.

(ii) Find E at (1, 2, 3). (8)

5. (a) Derive and explain the boundary conditions that are applied to magnetostatic fields at an interface between two different media. (7)

(b) Determine the self-inductance of a coaxial cable of inner radius a and outer radius b. (8)

6. (a) Derive the Biot-Savart law and Vector Poisson's equation using Magnetic Vector Potential A. (7)

(b) Calculate the total magnetic flux crossing the surface, $\phi = \pi/2$, $1 \le \rho \le 2$m, $0 \le z \le 5$m. For the magnetic vector potential $A = -\rho^2/4\ a_z$. (8)

7. (a) What do you mean by Displacement current ? Explain why and how Maxwell modified the Ampere's circuital law ? (7)

P.T.O.

(b) A parallel – plate capacitor with plate area of 5 cm^2 and plate separation of 3 mm has a voltage 15 sin 10^3 t volt applied to its plates. Calculate the displacement current assuming $\varepsilon = 2\varepsilon_0$. (8)

Relevant Physical constants :

$\mu_0 = 4\pi \times 10^{-7}$ H/m

$\varepsilon_0 = 8.85 \times 10^{-12}$ F/m

$c = 3 \times 10^8$ m/s

$e = 1.6 \times 10^{-19}$ C

B. Sc
Geology