

26

Pg 1/3

Q.P. Code : 3269

(3 Hours)

[Total Marks : 80

- N.B. : (1) Question No. 1 is compulsory.
 (2) Attempt **any three** questions out of **remaining five** questions.
 (3) Figures to the right indicate full marks.
 (4) **Assume** suitable **data** if necessary.

1. Solve any **four**.

10

- (a) A live charge on the X axis has its one end at the origin and the other end at 2.4m. The charge density of the line is defined by $\rho_l = 2e^{-0.4x} \mu\text{C/m}$. Find the flux out of a closed surfaced enclosing the line charge.
- (b) Given $v = 10 \frac{\sin\theta \cos\phi}{r^2}$, find the field intensity at (2.5m, -60° , 45°).
- (c) The inner radius, outer radius and axial depth of a toroid of rectangular cross section are $a = 30$ cm, $b = 40$ cm and $c = 15$ cm respectively. It has a uniformly distributed coil of 1000 turns. The relative permeability of the core material is 950. Find the external inductance of the exciting coil of the toroid neglect leakage.
- (d) If the magnetic field $\vec{H} = (3x \cos\beta + 6y \sin\alpha) \vec{a}_z$. Find the current density \vec{j} if fields are invariant with time.
- (e) A copper conductor having a 0.8 mm diameter and length 2cm carries a current of 20A. Find the electric field intensity, the voltage drop and resistance for 2cm length. Assume conductivity of copper as $5.8 \times 10^7 \text{ s/m}$.
- (f) Define poisson's and Laplace equation for magnetic field.

10

2. (a) Show that the \vec{E} due to infinite sheet of charge at a point is independent of the distance of that point from the plane containing the charge.
- (b) If $\vec{G} = 10e^{-2z}(r\vec{a}_r + \vec{a}_z)$, determine the flux going out of the entire surface of the cylinder $r = 1$, $0 \leq z \leq 1$. Confirm the result using divergence theorem.

10

[TURN OVER

Q.P. Code : 3269

2

3. (a) The plane interface between two dielectric regions is described by $S = 3x + 5y + 6z = 30$. The relative permittivity of Region 1, that is towards the origin from the interface, is $\epsilon_{r1} = 4.2$, and the relative permittivity of Region 2, that is away from the origin from the interface is $\epsilon_{r2} = 2.6$. The electric field intensity at the interface is Region 1 is $E_1 = \overline{ax} + 2\overline{ay} + 3\overline{az}$. Find the electric field intensity at interface is Region 2. 10
- (b) What is an electric dipole? Derive the expression of \overline{E} and v due to an electric dipole. 10
4. (a) In the cylindrical region $0 < r < 0.5m$, the current density is $\overline{J} = 4.5e^{-2az} \overline{az} A/m^2$ and $J = 0$ else where. Use Ampere's law to find \overline{H} . 10
- (b) Give the general set of Maxwell's equations for static fields and harmonically time varying fields. 10
5. (a) A lossy dielectric has $\mu = 4 \times \pi \times 10^{-9} H/m$ and $\epsilon = 10^{-8}/36\pi F/m$, $\sigma = 2 \times 10^{-8} S/m$. The electric field $\overline{E} = 200 \sin \omega t \overline{az} V/m$ exists at a certain point in the dielectric.
- (i) At what frequency will the conduction current density and displacement current densities have equal magnitudes?
 - (ii) At this frequency calculate the instantaneous displacement current density.
 - (iii) What is the phase angle between the conduction current and the displacement current?
- (b) In free space $\overline{D} = D_m \sin(\omega t + Bz) \overline{ax}$ using Maxwell equation show that 10
- $$\overline{B} = \frac{-\omega \mu_0 D_m}{\beta} \sin(\omega t + Bz) \overline{ay}$$

[TURN OVER

Q.P. Code : 3269

3

6. (a) Derive an expression of wave equation in terms of an electric and magnetic field. 10

(b) A wave propagating in a lossless dielectric has components. 10

$$\vec{E} = 500 \cos(10^7 t - B_z) \vec{a}_x \text{ v/m and}$$

$$\vec{H} = 1.1 \cos(10^7 t - B_z) \vec{a}_y \text{ A/m}$$

If the wave is travelling at $v = 1.5 \times 10^8 \text{ m/s}$. Find μ_r , ϵ_r , β , λ and η .
