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**. 20

(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 $\rho\ell = 2e^{-0.4x}\mu c/m$. Find the flux out of a closed surfaced enclosing the line charge.

(b) Given $v = 10\frac{\sin\theta\cos\varphi}{r^2}$, 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 = 15cm respectively. It has a uniformly distributed coil of 1000 turns. The relative pormeability of the core material is 950. Find the external inductance of the exciting coil of te toroid neglect leakege.

(d) If the magnetic field $\bar{H} = (3x\cos\beta + 6y\sin\alpha)\bar{a}z$. Find the cutrrent destiny $\bar{j}$ 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 5.8×10^{7} s/m.

(f) Define poisson's and Laplace equation for magnetic field.

10

2. (a) Show that the $\bar{E}$ due to infinite sheet of charge at a point is independent of the distance of that point from the plane containing the charge. 10

(b) If $\bar{G} = 10e^{-2z}(r\bar{a}r + \bar{a}z)$, determine the flux goint out of the entire surface of the cylinder $r = 1$, $0 \le z \le 1$. Confirm the result using divergence theorem.

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3. (a) The plane interface between two dielectric regions is described by $S = 3x + 5y + 6z = 30$. The relative permitivity of Region 1, that is towards the origin from the interface, is $\in r_1 = 4.2$, and the relative permitivity of Region 2, that is away from the origin from the interface is $\in r_2 = 2.6$. 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 $\overline{J} = 4.5e^{-2}\overline{az}\ A/m^2$ and $J = 0$ else where. Use Ampere's law to find $\overline{H}$.

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(b) Give the general set of Maxwell's equations for static fields and harmonically time verying fields.

10

5. (a) A lossy dielectric has $\mu = 4 \times \pi \times 10^{-9}$ H/m and $E = 10^{-8}/36\pi$ F/m, $6 = 2 \times 10^{-8}$ S/m. The electric field $\overline{E} = 200\sin wt\,\overline{az}\ V/m$ 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?

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(b) In free space $\overline{D} = Dm\sin(wt + B_z)\overline{ax}$ using Maxwell equation show that $\overline{B} = \frac{-\omega\mu 0 Dm}{\beta} \sin(\omega\omega + Bz)\,\overline{ay}$.

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

$\overline{E} = 500\cos(10^7 t - B_z)\,\overline{ax}$ v/m and

$\overline{H} = 1.1\cos(10^7 t - B_z)\,\overline{ay}$ A/m

If the wave is travelling at v =1.5x 10^8m/s. Find μr, εr, β, λ and η.
