Con. 6754-13. **LJ-11251**

(3 Hours) **[Total Marks :100**

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

1. Solve any **four** :- **20**
   (a) Two point charges, $Q_1 = 1.6\ \mu c$ and $Q_2 = -2.2\ \mu c$ are located at P_1(0.5m, -0.8 m, 1.2 m) and P_2(-0.7 m, 1.5 m, 0.7 m) respectively, in a medium of relative permittivity 2.6 calculate the electric force on Q_1.
   (b) The current density over the cross-section of a conductor of radius 5 mm is $j = (4 \times 10^6)\, e^{-200r}\, \overline{az}\ A/m^2$ in cylindrical coordinates. Calculate current carried by the conductor.
   (c) Derive integral and differential forms of Faraday's Law.
   (d) Prove that the electric flux passing through any closed surface is equal to the total charge enclosed by that surface.
   (e) Define electric dipole and derive expression for electrical potential due to electric dipole.
   (f) Explain Bio+- savart law in magnetic field.

2. (a) Two oppositely charged lines are parallel to the Z axis of cylindrical co-ordinates. The line with positive charge is at P_1(0.5 m, 60°) and the line with negative charge is at P_2(0.8 m, 150°). Find the field intensity at P(1.5 m, 90°) in free space. The charge density in each line is 0.075 pc/m. **10**
   (b) Evaluate both sides of divergence theorem in the cylindrical region defined by r = 3.0 m and 1.0 m ≤ z ≤ 6.0 m if electric flux density in the region. **10**

   $D = ae^{-r}\, \overline{ar} + \frac{b}{z}\, \overline{az}$ where a and b are constants.

3. (a) Derive the expression for magnetic field intensity due to a finite wire carring a current I. **10**
   (b) The common boundary surface of two dielectric regions is on the x-y plane. the relative mermittivity of region 1 (z > 0) are 1.1 and 6.0 respectively. The field intensity at the boundary in region 1 is $\overline{E_1} = 0.5\, \overline{ax} - 1.2\, \overline{ay} + 1.5\, \overline{az}$ v/m . Calculate the magnitudes of field intensities on two sides of the boundary and the angles which they make with normal to the interface. **10**

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4. (a) Two parallel conducting disks are separated by a distance 5 mm at Z = 0 and Z = 5 mm. If V = 0 at Z = 0 and V = 100 at Z = 5 mm. Find charge densities on the disks. **10**

   (b) Find work done moving point charge Q = 0.5 μc from origin to $\left(2, \frac{\pi}{4}, \frac{\pi}{2}\right)$ in field **10**

$$\overline{E} = 5e^{-r/4}\,\overline{ar} + \frac{10}{r \sin\theta}\,\overline{a\theta} \text{ v/m}$$

5. (a) Two identical circular loops of 1m radius are situated side by side on a common axis. The distance between the loops is 1m. If both loops carry a current of 1A in the same direction. Find $\overline{B}$ (i) at the centre of one loop (ii) at a point midway between the loops on their common axis. **10**

   (b) Given that $\overline{E} = Em \sin(at - Bz)\overline{ay}$ in free space find $\overline{D}, \overline{B}$ and $\overline{H}$. **10**

6. (a) Starting from Maxwell equations derive equation of electromagnetic wave in dielectric medium. **10**

   (b) A 9375 MHz uniform plane wave is propagating in a medium having relative permittivity Er = 2.56. If magnitude of $\overline{E}$ = 20 v/m and the material assumed to be lossless. Find - **10**

   (i) the phase constant
   (ii) the wavelength
   (iii) velocity of propagation
   (iv) the intrinsic impedance
   (v) The propagation constant
   (vi) The amplitude of the magnetic field intensity.

7. (a) Define Poynting vector. Derive the integral form of Poynting vector and explain significance of each term. **10**

   (b) Derive Maxwell's equations in integral and point form for time varying fields. **10**
