

N.B. (1) Attempt any five questions.

(2) Assume suitable data if necessary and justify the same.

(3) Figures to the right indicate marks.

1. (a) It is required to hold three equal point charges of + Q each in equilibrium at the corners of an equilateral triangle. Calculate the point charge which will do this if placed at the centre of a triangle. 10

(b) A line charge of 2 nc/m lies along y-axis while surface charge densities of 0.1×10^{-9} and -0.1×10^{-9} c/m² exist on the plane $z = 3$ and $z = -4$ m respectively 10

(i) Find \vec{E} at a point (1, -7, 2)

(ii) Find co-ordinates of the point at which \vec{E} is - Ve of the value in (i).

2. (a) Given that $\vec{D} = \left(\frac{10}{3} x^3\right) a_x$ c/m², evaluate both sides of the divergence theorem for the volume of a cube 2 m on the edge, centered at the origin and edges parallel to the axis. 10

(b) Derive an expression for potential and electric field due to dipole and also define the dipole moment. 10

3. (a) Find the value of electric potential at the point at which electric field is zero when point charges of 3 μ c and 7 μ c are located at (0, 0) and (0.5, 0) in the xy plane. 10

(b) The region $y < 0$ contains a dielectric material for which $\epsilon r_1 = 2.5$, while the region $y > 0$ is characterized by $\epsilon r_2 = 4$. Let $\vec{E}_1 = -30a_x + 50a_y + 70a_z$ v/m and find: 10

(i) D_{N2} (ii) D_{t2} (iii) \vec{D}_2 (iv) \vec{P}_2 (v) ρ_2 .

4. (a) Derive the magnetic boundary conditions for the interface between two magnetic materials. 10

(b) Find the vector magnetic field intensity in Cartesian coordinates at P_2 (1.5, 2, 3) caused by a current filament of 24A in the a_z direction on the z-axis and extending from: 10

(i) $z = 0$ to $z = 6$ (ii) $z = 6$ to $z = \infty$ (iii) $z = -\infty$ to $z = \infty$.

5. (a) Derive the expression for voltage and current in terms of sending end voltage and current for a transmission line of length l . 10

Hence prove that $Z_0 = \sqrt{Z_{oc} Z_{sc}}$.

(b) State Maxwell's Equations for static fields. Explain how are they modified for time varying electric and magnetic field. 10

6. (a) If $E_y = E_0 e^{m(x-ct)}$ show that it a wave equation, if m is a real number. 4

(b) An area of 0.65 m² in the $Z = 0$ plane encloses a filamentary conductor. Find the induced voltage if 6

$$\vec{B} = 0.05 \cos 10^3 t \left(\frac{ay + az}{\sqrt{2}} \right) (T).$$

(c) A lossy dielectric has $\mu r = 1$, $\epsilon r = 50$ and $\sigma = 20$ mho/s at 15.9 MHz, EM wave propagating through this medium, find α , β , v and η . 10

7. Write short notes on any four :-

- (a) Uniqueness theorem
- (b) Method of images
- (c) Vector and scalar magnetic potential
- (d) Electric dipole
- (e) Polarization in magnetic material.

20