

ANSWER ANY FIVE QUESTIONS ALL QUESTIONS CARRY EQUAL MARKS

1. (a) State and explain Coulomb's law of electrostatic field in vector form.
- (b) It is required to hold four equal point charges to each in equilibrium at the corners of a square. Find the point charge, which will do this if placed at the center of the square.
2. Obtain an expression for the energy stored in a capacitor. An air field capacitor consists of two parallel square plates of 50cm side is charged to potential difference of 250V when the plates are 1mm apart. Find the work done in separating the plates from 1 to 3mm. Assume perfect insulation.
3. (a) Define and explain the significance of vector magnetic potential.
- (b) If the vector potential  $A = 5(x^2+y^2+z^2)-1$  i Wb/m, find flux density B and current density J
4. (a) Why the Maxwell's equations are four only? Give the word statements of Maxwell's field equations.
- (b) Show that  $\nabla \cdot J = -\partial \rho / \partial t$ .
- (c) The conduction current density in a lossy dielectric is given by  $J_c = 0.02 \sin(109t)$  A/m<sup>2</sup>. Find the displacement current density, if  $\sigma = 103$  mho/m and  $\epsilon_r = 6.5$ .
5. (a) Prove that the velocity of an electromagnetic wave decreases as the conductivity of a medium increases?
- (b) Using Maxwell's equations show that  $\nabla \cdot D = 0$  in a conducting medium assuming sinusoidal time variations.
6. (a) What is wave polarization? Explain the different types of polarization with analytical treatment.
- (b) A 100 V/m plane wave of frequency 300 MHz travels in an infinite, loss less medium having  $\mu_r = 1$ ,  $\epsilon_r = 9$ ,  $\sigma = 0$  mhos/m.. write the complete time domain expressions for the E and H field vectors.
7. (a) In free space  $E(z, t) = 50 \cos(\omega t - \beta z) \hat{x}$  v/m. find the total power passing through a rectangular area, of sides 90mm and 45mm, in the  $z=0$  plane.
- (b) In a non magnetic material,  $H = 30 \cos(2\pi 10^8 t - 6x) \hat{y}$  m A/m. find the pointing vector and the time average power crossing the surface  $x=1$ ,  $0 < y < z$ ,  $0 < z < 3$  m.
8. (a) Discuss the significance and applications of Poynting Theorem.
- (b) Explain the utility of Poynting vector. If the peak poynting vector in free space is  $10 \text{ W/m}^2$  find the amplitudes of electric and magnetic fields.

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