

T.E Electrical V CBGS
E.M.F & Wave

11.5.16
QP Code : 31040

(3 Hours)

[Total Marks: 80

- N.B.: (1) Question No.1 is compulsory.
(2) Answer any three from remaining five questions.
(3) Figures to the right indicate full marks.
(4) Assume the data if it is necessary.
(5) Vector notation must be used wherever necessary.

Q.1) Attempt any four of the following:- (05-Marks each)

- (a) Express the following vector in Cartesian co-ordinate system
 $\vec{A} = 2 \cos \theta \hat{a}_r + 3r \hat{a}_\theta - 4 \hat{a}_z$ [20]
- (b) Discuss the various practical applications of electrostatic fields.
- (c) A \vec{H} due to a current source is given by, $\vec{H} = [y \cos(ax)] \hat{a}_x + [y + e^x] \hat{a}_z$. Describe the current density over the yz plane.
- (d) "Magnetic field has non-existence of monopole" Justify the statement.
- (e) Explain estimation and control of electric stress. [20]

Q.2)

- (a) Derivation of E due to uniform volume charge density ρ_v C/m³. Distributed in a sphere of radius 'a' centred at origin. [10]
- (b) The flux density within the cylindrical volume bounded by $r = 4$ m, $z = 0$ m and $z = 5$ m, is given by $\vec{D} = 30 e^{-r} \hat{a}_r - 2z \hat{a}_z$ C/m². What is the total outward flux crossing the surface of cylinder? [10]

Q.3)

- (a) A current sheet $\vec{K} = 10 \hat{a}_z$ A/m lies in $x=4$ m plane and a second sheet $\vec{K} = -8 \hat{a}_z$ A/m is at $x=-5$ m plane. Find \vec{H} at points (i) $P(1, 1, 1)$ and (ii) $Q(0, -3, 10)$ [20]
- (b) In the region $0 < r < 0.5$ m in cylindrical co-ordinates system, the current density is $\vec{J} = 4.5 e^{-2r} \hat{a}_z$ A/m² and $J = 0$ elsewhere. Use Ampere's Circuital Law to find H in all regions. [10]

Q.4)

- (a) Derive the Poission's and Laplace equation. And determine whether the following potential fields satisfied Laplace equation or not? [20]
- (i) $V = 4x^2 + 3y - 4z^2$ (ii) $V = r \sin \phi + z$ [10]

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- (b) Consider an interface in the Y-Z plane. The region $x < 0$ is medium-1 with $\mu_{r1} = 4.5$ and magnetic field, $\vec{H} = 4\hat{a}_x + 3\hat{a}_y - 6\hat{a}_z$ A/m. The region $x > 0$ is medium-2 with $\mu_{r2} = 6$. Find \vec{H}_2 and \vec{B}_2 in medium-2 and also calculate the angles made by the \vec{H}_2 with the normal to the interface. [10]

Q.5)

- (a) Show that following field vectors, in the free space,

$$\vec{E} = E_0 \cos(\omega t - \beta z) \hat{a}_x$$

$$\vec{H} = \frac{E_0}{\eta} \cos(\omega t - \beta z) \hat{a}_y$$

Can satisfy all Maxwell's equations provided that

$$\beta = \pm \omega \sqrt{\mu_0 \epsilon_0} \text{ and } \eta = \pm \sqrt{\frac{\mu_0}{\epsilon_0}} \quad [10]$$

- (b) State the Maxwell's equations for time varying fields in integral and point forms. Also explain the physical significance of each equation. [10]

Q.6)

- (a) Derive and explanation of the plane electromagnetic wave equation in free space and definition of wave velocity intrinsic impedance. [10]

- (b) A 9375 MHz uniform plane wave is propagating in polystyrene. If the amplitude of the electric field intensity is 20 V/m and the material is assume to be lossless. Find (i) the phase constant, (ii) the wavelength (in the polystyrene), (iii) the velocity of propagation, (iv) the intrinsic impedance, (v) the propagation constant, (vi) the amplitude of the magnitude field intensity. [10]