47 TE - sem - V - OBG3 - Electrical - EFW 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) [20]

(a) Express the following vector in Cartesian co-ordinate system
$\overline{A} = 2\cos\theta\ \hat{a}_r + 3\,r\,\hat{a}_\theta - 4\,\hat{a}_z$

(b) Discuss the various practical applications of electrostatic fileds.

(c) A $\overline{H}$ due to a current source is given by, $\overline{H} = [\,y\cos(\alpha x)]\,\hat{a}_x + [\,y + e^x\,]\hat{a}_z$. Describe the current density over the yz plane.

(d) "Magnetic field has non-existance of monopole" Justify the statement.

(e) Explain estimation and control of electric stress.

Q.2) [20]

(a) Derivation of E due to uniform volume charge density $\rho_v\ c/m^3$. 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 $\overline{D} = 30\,e^{-r}\ \hat{a}_r - 2\,z\,\hat{a}_z\ c/m^2$. What is the total outward flux crossing the surface of cylinder? [10]

Q.3) [20]

(a) A current sheet $\overline{K} = 10\,\hat{a}_z\ A/m$ lies in x=4 m plane and a second sheet $\overline{K} = -8\,\hat{a}_z\ A/m$ is at x=-5 m plane. Find $\overline{H}$ at points $(i)\ P(1,1,1)\ and\ (ii)\ Q(0,-3,10)$ [10]

(b) In the region $0 < r < 0.5\ m$ in cylindrical co-ordinates system, the current density is $\overline{J} = 4.5\,e^{-2r}\,\hat{a}_z\ A/m^2$ and $J = 0$ eleswhere. Use Ampere's Circuital Law to find H in all regions. [10]

Q.4) [20]

(a) Derive the Poission's and Laplace equation. And determine whether the following potential fields satisfied Laplace equation or not?
(i) $V = 4x^2 + 3y - 4z^2$ (ii) $V = r\sin\varphi + z$ [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, $\bar{H} = 4\,\hat{a}_x + 3\,\hat{a}_y - 6\,\hat{a}_z\ A/m$. The region $x > 0$ is medium-2 with $\mu_{r2} = 6$. Find $\bar{H}_2$ and $\bar{B}_2$ in medium-2 and also calculate the angles made by the $\bar{H}_2$ with the normal to the interface. [10]

Q.5) [20]

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

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

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

Can satisfy all Maxwell's equations provided that

$\beta = \pm\,\omega\sqrt{\mu_0\,\varepsilon_0}$ and $\eta = \pm\sqrt{\frac{\mu_0}{\varepsilon_0}}$ [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) [20]

(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]

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