TE - sem - V - CBSGS - [redacted] - EE - EFW

18/11/15

QP Code : 5558

(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) Find the charge enclosed in a cube of having side of 2 m with the edges of the cube parallel to axes x , y , and z while origin is at the centre of the cube. The charge density within the cube is $50\, x^2 \cos\left(\frac{\pi}{2} y\right)\ \mu C/m^3$.

(b) Explain the concept of potential gradient and the relation between electric field and potential.

(c) If the magnetic field $\overline{H} = (3x\cos\beta + 6z\sin\alpha)\,\hat{a}_y$. Find the current density $\overline{J}$ if field are invariant with time.

(d) Discuss the phenomenon of polarization in dielectric medium. Also discuss how it gives rise to bond charge densities.

(e) For a lossy dielectric material having $\mu_r = 1,\ \epsilon_r = 48\ and\ \sigma = 20\ s/m$. Calculate the propagation constant at a frequency of 16 GHz.

Q.2) [20]

(a) Given $\overline{D} = 2rz\ Cos^2\varphi\ \hat{a}_r - rz\sin\varphi\cos\varphi\ \hat{a}_\varphi + r^2Cos^2\varphi\ \hat{a}_z$. Calculate electric flux through the following surfaces.
$(i)\ r = 3\ ,\ 0 \le z \le 5$. $(ii)\ z = 0\ ,\ 0 \le r \le 3$. [10]

(b) Obtain E inside, outside solid sphere. A uniform volume charge density $\rho_v\ c/m^3$, Distributed in a solid sphere of radius 'a' find expression of E everywhere. [10]

Q.3) [20]

(a) Planes $z = 0\ and\ z = 4$ carry a current $\overline{K} = -10\,\hat{a}_x\ A/m$ and $\overline{K} = 10\,\hat{a}_x\ A/m$ respectively. Find $\overline{H}$ at points $(i)\ P(1,1,1)\ and\ (ii)\ Q(0,-3,10)$ [10]

(b) Obtain an expression for magnetic vector potential in the region surrounding an infinitely long straight filamentary current 'I'. [10]

Q.4) [20]

(a) Derive the Poission's and Laplace equation. And the one dimensional Laplace's equation is as $\frac{\partial^2 V}{\partial X^2} = 0$, The boundary conditions are $V = 9\ at\ X = 1\ and\ V = 0\ at\ X = 10$. Find the potential and show the variation of V with respect to X. [10]

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(b) A potential field is given as $V = 100\, e^{-5x} \sin 3y \cos 4z$ *volts*. Let point $P(0.1, \frac{\pi}{12}, \frac{\pi}{24})$ be located at a conductor free space boundary. At point P, find the magnitudes of $(i)\ V$, $(ii)\ \bar{E}$, $(iii)\ E_t$, $(iv) E_N$, $(v)\ \bar{D}$, $(vi)\ D_N$, and $(vii)\ \rho_s$. [10]

Q.5) [20]

(a) Derive the set of Maxwell's equations for static fields and harmonically time varying fields. [10]

(b) Verify whether the following fields

$\bar{E} = (2 \cos x\ \sin t)\, \hat{a}_y$ *and* $\bar{H} = \left(\frac{2}{\mu_0} \cos x \cos t\right) \hat{a}_z$. Satisfy Maxwell's equation in free space. [10]

Q.6) [20]

(a) Formulate the wave equation from Maxwell's equations. Solve it for perfectly conducting media. [10]

(b) The magnetic field intensity of a uniform plane wave in air is 20 A/m along the $\hat{a}_y$ direction. The wave is propagating in the $\hat{a}_z$ direction at a frequency of $2 \times 10^9\ rad/sec$. Find the

(i) Wavelength, (ii) Frequency, (iii) Period, and (iv) Amplitude of $\bar{E}$. [10]
