COURSE CODE: 17B11EC411   MAX. MARKS: 25

COURSE NAME: Electromagnetic Engineering

COURSE CREDITS: 4   MAX. TIME: 1 Hr. 30 Min

Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.

1. For Silver, $\sigma = 6.1 \times 10^7\, S/m$, $\mu_r = \varepsilon_r = 1$, determine the frequency at which the plane wave penetration depth is 2mm. [CO-3; 2 Marks]

2. Which of the following media may be treated as conducting at 8 MHz?

   (a) Wet marshy soil ($\varepsilon = 15\varepsilon_0, \mu = \mu_0, \sigma = 10^{-2}\, S/m$)

   (b) Intrinsic Germanium ($\varepsilon = 16\varepsilon_0, \mu = \mu_0, \sigma = 0.025\, S/m$)

   (c) Sea Water ($\varepsilon = 81\varepsilon_0, \mu = \mu_0, \sigma = 25\, S/m$)   [CO-2,3; 2 Marks]

3. Suppose $E(y,t) = E_{01}\cos(\omega t - \beta y)a_x + E_{02}\cos(\omega t - \beta y + \varphi)a_y$ V/m. Determine the polarization of wave at $\varphi = 0$, $\varphi = \frac{\pi}{2}$ and $\varphi = \pi$. [CO-2; 2 Marks]

4. Write the Maxwell's equations(differential and integral forms) in final form for a linear, homogeneous and isotropic medium. [CO-2; 2 Marks]

5. What is the significance of Poynting theorem? Derive the expressions for instantaneous and average Poynting vector. [CO-2; 4 Marks]

6. In certain region, $J = (2ya_x + xza_y + z^3 a_z)\sin 10^4 t$ A/m^2. Find ρ_v using continuity equation if $\rho_v(x, y, 0, t) = 0$ [CO-3; 2 Marks]

7. Two extensive homogeneous isotropic dielectrics meet on plane $z = 0$. For, $z > 0\ \varepsilon_{r1} = 4$ and for $z < 0\ \varepsilon_{r2} = 3$. A uniform field $E_1 = 5a_x - 2a_y + 3a_z$ V/m exists for $z \geq 0$ find:

   (a) E_2 for $z \leq 0$

   (b) The angles E_1 and E_2 makes with the interface.

   (c) The Energy density (J/m^3) in both the dielectrics.

   (d) The Energy within a cube of side 2 m centered at (3,4,-5) [CO-3; 4 Marks]

8. Express Vector:

$$B = \frac{10}{r}a_r + r\cos\theta a_\theta + a\varphi$$

In Cartesian and cylindrical Co-ordinates and Find $B(-3,4,0)$ and $B(5,\frac{\pi}{2},-2)$

[CO-1; 4 Marks]

9. If $\mu_1 = 2\mu_0$ for medium 1 $(0 < \varphi < \pi)$ and $\mu_2 = 5\mu_0$ for region 2 $(\pi < \varphi < 2\pi)$ and

$B_2 = 10a_\rho + 15a\varphi - 20a_z mWb/m^2$. Calculate:

(a) B_1

(b) The energy density in two media.   [CO-3; 3 Marks]