T.E. (Electronics) Sem-V CBGS.

Electromagnetic Engg. Q.P. code: 37487

Q1.a) $\frac{\partial \vec{D}}{\partial t} = 20 \cos(1.5\times10^8 t - \beta x)\, \vec{a}_y \ \mu A/m^2.$

$$\vec{D} = \frac{20 \sin(1.5\times10^8 t - \beta x)\, \vec{a}_y}{1.5\times10^8}$$

$$= 0.133 \sin(1.5\times10^8 t - \beta x)\, \vec{a}_y \ pC/m^2.$$

$\beta = \omega\sqrt{\mu\varepsilon} = \omega\sqrt{20\mu_0\varepsilon_0}$

$= 2.236 \ rad/m.$

$$\vec{D} = 0.133 \sin(1.5\times10^8 t - 2.236x)\, \vec{a}_y \ pC/m^2.$$

$$\vec{E} = \vec{D}/5\varepsilon_0 = 3 \sin(1.5\times10^8 t - 2.236x)\, \vec{a}_y \ mV/m$$

Q4 b) $d = 2h\sqrt{\left(\frac{f_{MUF}}{f_c}\right)^2 - 1}$

$$\left(\frac{f_{MUF}}{f_c}\right)^2 = \frac{d^2}{4h^2} + 1$$

$$f_{MUF} = f_c\sqrt{(d^2/4h^2) + 1}$$

$$= 12\times10^6 \sqrt{\left(\frac{6.25}{\frac{250}{400}}\right)^2 + 1}$$

$$\therefore \quad f_{MUF} = 45.95 \ MHz.$$

4c). $U(\theta, \phi) = 4\cos\sec^2\theta$

$\pi/3 < \theta < \pi/2$.
$0 < \phi < \pi$.

$$D = \frac{U_{max}}{U_{avg}}$$

$U_{max} = 4$.

$$U_{avg} = \frac{4}{4\pi} \int_{\phi=0}^{\pi} \int_{\theta=\pi/3}^{\pi/2} \frac{1}{\sin^2\theta} \sin\theta \, d\theta \, d\phi$$

$$= 0.5493$$

$$\therefore \boxed{D = 7.282.}$$