YAKUBU NATHAN BALA
17/ENG04/076
ELECT.
EEE 316 ASSIGNMENT

Q4.)

(a) In reference $\frac{\partial^2 E_y}{\partial x^2} = (j\omega\mu\sigma - \omega^2\mu\varepsilon) = \gamma^2 E_y$

$$\frac{\partial^2 E_y}{\partial x^2} = \gamma^2 E_y$$

$$\gamma = \alpha + j\beta$$

$$E_y = E_0 e^{-\gamma} = E_0 e^{-\gamma x} e^{-j\beta x}$$

~~From $\sqrt{j} = 1$~~

$$\frac{\partial^2 E_y}{\partial x^2} = j\omega\mu\sigma E_y = \gamma^2 E_y$$

From $\sqrt{j} = \frac{1+j}{\sqrt{2}}$

Then, $\gamma = \sqrt{\frac{\omega\mu\sigma}{2}} + j\sqrt{\frac{\omega\mu\varepsilon}{2}}$

$\therefore \alpha = \sqrt{\frac{\omega\mu\varepsilon}{2}}$ and $\beta = \sqrt{\frac{\omega\mu\sigma}{2}}$

$$E_y = E_0 e^{-\sqrt{\frac{\omega\mu\varepsilon}{2}} x} \cdot e^{-j\sqrt{\frac{\omega\mu\varepsilon}{2}} x}$$

$$= E_y = E_0 e^{-x/\delta} \cdot e^{-jx/\delta}$$

The amplitude of the wave rapidly decreases and exponentially as it passes through a conducting medium by a factor of $e^{-x/\delta}$

(b) Skindepth is a measure of how closely electric current flow along the surface of a ~~material~~ material.

$$\delta = \sqrt{\frac{2}{\omega\mu\varepsilon}} \qquad \omega = 2\pi f$$

$$\delta = \sqrt{\frac{1}{\pi f \mu\varepsilon}}$$

(c) $f = 10\,MHz = 1 \times 10^7\,Hz$

$\sigma = 5.8 \times 10^7\,S/m$

$\mu_r = 1$

$\mu_0 = 1.257 \times 10^{-6}$

$\mu = \mu_0 \times \mu_r$

$= 1 \times 1.257 \times 10^{-6}$

1.257×10^{-6}

$$\delta = \text{Skin depth} = \sqrt{\frac{1}{\pi f \mu \sigma}}$$

$$= \frac{1}{\sqrt{\pi \times 1\times10^{7} \times 1.257\times10^{-6} \times 5.8\times10^{7}}}$$

$$\delta = 2.09 \times 10^{-6}\ m.$$

Q7.)

(a) $a = 3mm$, $b = 10mm$, $Z_0 = 8.85\times10^{-12}\ F/m$; $\mu_0 = 1.257\times10^{-6}\ H/m$

Capacitance ~~Parameter~~

$$C = \frac{2\pi\varepsilon_0}{\log_e b/a}$$

$$C = \frac{2\pi \times 8.85\times10^{-12}}{\log_e 0.01/0.003}$$

$$C = \frac{2\pi \times 8.85\times10^{-12}}{\log_e 28.03}$$

$$C = 3.84\times10^{-11}\ F/m.$$

(b) Inductance Parameter

$$L = \frac{\mu_0}{2\pi} \log_e b/a$$

$$L = \frac{1.257\times10^{-6}}{2\pi} \log_e \frac{0.1}{0.003}$$

$$L = \frac{1.257\times10^{-6}}{2\pi} \cdot \log_e 28.03$$

$$L = 2.90\times10^{-7}\ H/m.$$

(c) The Characteristic impedance

$$Z_0 = \sqrt{\frac{L}{C}}$$

$$Z_0 = \sqrt{\frac{2.90\times10^{-7}}{3.84\times10^{-11}}}$$

$$Z_0 = 86.90\ \Omega$$

(d) Phase Velocity, V_p

$$V_p = \frac{1}{\sqrt{LC}}$$

$$V_p = \frac{1}{\sqrt{(2.90\times10^{-7}) \times (3.84\times10^{-11})}}$$

$$V_p = 29.10\times10^{7}\ V.$$