

Enoch Izuchukwu

17/ENG04/019

ELECT/ELECT ENGR

ELECTROMAG ASSIGN.

Q3)

$$\frac{\partial^2 E_y}{\partial x^2} = C(\omega\mu_0 - \omega^2\mu\epsilon)E_y$$

a) E_y = Electric field in electromagnetic wave (V/m)

ω = radian freq (rad/s)

μ = permeability of medium (H/m)

ϵ = permittivity of medium (F/m)

J = Conductivity of medium (S/m)

b) The expression of $v_p = \frac{1}{\sqrt{\mu\epsilon}}$

c) when medium is lossless $\mu_r = 1$ $\epsilon_r = 1$

$$v_p = \frac{1}{\sqrt{\mu\epsilon}} = \frac{1}{\sqrt{\mu_0\mu_r\epsilon_0\epsilon_r}}$$

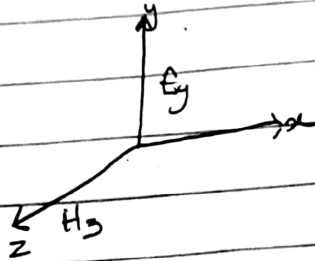
$$= \frac{1}{\sqrt{8.854 \times 10^{-12} \times 1 \times 4\pi \times 10^{-7} \times 1}}$$

$$= 2.99 \times 10^8 \text{ m/s}$$

$$Z_0 = \sqrt{\frac{\mu}{\epsilon}} = \sqrt{\frac{\mu_0\mu_r}{\epsilon_0\epsilon_r}} = \sqrt{\frac{1 \times 4\pi \times 10^{-7}}{1 \times 8.854 \times 10^{-12}}}$$

$$Z_0 = \underline{\underline{376.73 \Omega}}$$

d) The magnetic field is lined up in the z direction because the electric field is always perpendicular to the magnetic field & both fields are directed in right angles to the direction of propagation of the wave (i.e. x direction). Electromagnetic waves are a type of transverse wave.



Q7)

$$a = 3\text{mm} = 0.003\text{m} \quad b = 10\text{mm} = 0.01\text{m} \quad \epsilon_0 = 8.854 \times 10^{-12} \text{ F/m}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$$

$$a) C = \frac{2\pi\epsilon_0}{\log_e \frac{b}{a}} = \frac{2\pi \times 8.854 \times 10^{-12}}{\log_e \frac{0.01}{0.003}}$$

$$\therefore C = 4.62 \times 10^{-11} \text{ F/m}$$

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

$$L = \frac{4\pi \times 10^{-7}}{2\pi} \times \log_e \frac{0.01}{0.003}$$

$$L = 2.408 \times 10^{-7} \text{ H/m}$$

$$c) Z_0 = \sqrt{\frac{L}{C}} = \sqrt{\frac{2.4 \times 10^{-7}}{4.62 \times 10^{-11}}} = 2.998 \times 10^8 \text{ m/s} \quad 72.195 \Omega$$

$$d) v_p = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{2.408 \times 10^{-7} \times 4.62 \times 10^{-11}}}$$

$$v_p = 2.998 \times 10^8 \text{ m/s}$$