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18/ENG04/082
ELECT/ELECT
- ELECTROMAG

Q3) $\frac{\gamma^2 E_y}{dx^2} = (jw\mu\sigma - w^2\mu\varepsilon)E_y$

(a) E_y -> electric field in electromagnetic wave (V/m)
w -> radian frequency (rad/s)
μ => permeability of medium (H/m)
ε -> permittivity of medium (F/m)
σ -> conductivity of medium (S/m)

(b) The expression of $V_p = \frac{1}{\sqrt{\mu\varepsilon}}$

(c) When medium is lossless, $\mu_r = 1$, $\varepsilon_r = 1$

$$V_p = \frac{1}{\sqrt{\mu\varepsilon}} = \frac{1}{\sqrt{\mu_o\mu_r\varepsilon_o\varepsilon_r}}$$

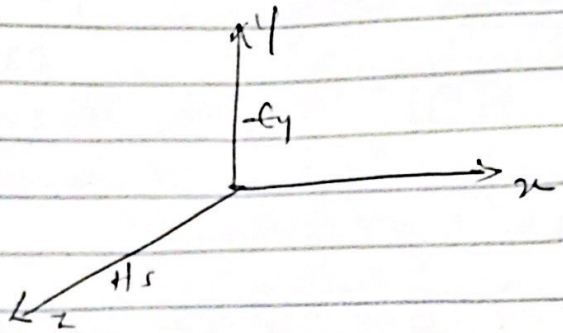
$$= \frac{1}{\sqrt{8.854\times10^{-12}\times1\times4\pi\times10^{-7}\times1}}$$

$$= 2.99\times10^{8}\ ms^{-1}$$

$$Z_o = \sqrt{\frac{\mu}{\varepsilon}} = \sqrt{\frac{\mu_o\mu_r}{\varepsilon_o\varepsilon_r}} = \sqrt{\frac{1\times4\pi\times10^{-7}}{1\times8.854\times10^{-12}}}$$

$$Z_o = 376.73\Omega$$

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 angle to the direction of propagation of the wave (i.e. x direction) Electromagnetic waves are a type of transverse wave



(7) $a = 3mm = 0.003m$ $\epsilon_0 = 8.854 \times 10^{-12} F/m$

$b = 10mm = 0.01m$

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

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

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

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

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

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

(c) $Z_0 = \sqrt{L/C} = \sqrt{\frac{2.4 \times 10^{-7}}{4.62 \times 10^{-11}}} = 72.195\Omega$

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

$V_p = 2.998 \times 10^8 m/s$