Wednesday, February 5, 2020 11:58

Uniform plane waves - free space

↳ assumptions lead to $\frac{\partial^2 E_x}{\partial z^2} = \mu_0 \epsilon_0 \frac{\partial^2 E_x}{\partial t^2}$

$$E_x(z,t) = E^+ \cos(\omega t \overset{\to +z}{-} \beta_0 z + \phi^+) + E^- \cos(\omega t \overset{\to -z}{+} \beta_0 z + \phi^-)$$

↳ initial conditions

$\omega = 2\pi f$

$T = \frac{1}{f}$

↳ phase constant

$\beta_0 = \frac{2\pi}{\lambda}$

$= \omega\sqrt{\mu_0 \epsilon_0}$

→ direction of propagation

→ phase velocity: $v_p = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$ (u)

↳ $\nabla \times \vec{E}_s = -j\omega\mu_0 \vec{H}_s \Rightarrow$

$$H_y(z,t) = \frac{E^+}{\eta_0}\cos(\omega t - \beta_0 z + \phi^+) - \frac{E^-}{\eta_0}\cos(\omega t + \beta_0 z + \phi^-)$$

$\eta_0 = \sqrt{\frac{\mu_0}{\epsilon_0}} = 377\Omega$