

Learning Objective: EM Wave

Problem 1. Consider the electric field intensity of an electromagnetic wave in a medium of $\epsilon = 4\epsilon_0$ and $\mu = \mu_0$ is given by

$$\mathbf{E} = \hat{\mathbf{x}} \sin(10^{10}t - \beta z) \text{ V/m}$$

- (a) Determine the phasor representation $\tilde{\mathbf{E}}$ of \mathbf{E} .
- (b) Determine the phasor representation $\tilde{\mathbf{H}}$ of \mathbf{E} .
- (c) Determine the phase propagation constant β and phase velocity v_p .

Problem 2. In a parallel plate capacitor, the separation between the plate is 10 cm. The voltage across the capacitor is given by

$$v(t) = \frac{100}{\epsilon_0} \sin(20t) \text{ V.}$$

The material between the plate is characterized by $\epsilon = 2\epsilon_0$.

- (a) Calculate the magnitude of displacement current density.
- (b) Derive the magnitude of wave equation for $\tilde{\mathbf{H}}$ in a medium characterized by constant ϵ and μ , and with \tilde{f}_v and \tilde{J} . Carefully show all your steps leading to the final answer.