1. In free-space, \( \vec{H} = 0.1 \cos(2 \times 10^8 t - \beta x) \hat{y} \text{ A/m.} \)

(a) Calculate \( \beta, \lambda, \) and \( T \) and the time \( t \) it takes the wave to travel a distance of \( \frac{\lambda}{8} \).

(c) Sketch the wave at time \( t \) above.

(d) Determine the direction of propagation.

2. In air, a uniform plane wave is oriented in the z-direction and propagates along \( \hat{x} \). Assume that \( \vec{E} \) is sinusoidal with adjacent minimum and maximum values of \( \pm 0.01 \text{ V/m} \) occurring at \( x = 20 \text{ m} \) and \( x = 170 \text{ m} \), respectively, when \( t = 0 \) and that \( \vec{E}(0, 0) = 0 \). Find the instantaneous expression for \( \vec{E} \). Also, calculate \( \vec{E} \) at \( x = 100 \text{ m}, t = 2 \mu s. \)

3. Problem 5.10 (text).

4. Problem 5.26 (text).

5. A plane wave having \( \vec{E} = 0.5 e^{-z/3} \sin(10^8 t - \beta z) \hat{z} \text{ V/m} \) propagates through a medium with \( \varepsilon_r = 8, \mu_r = 2. \) Determine \( \beta \), the loss tangent, wave impedance, wave velocity, and the associated \( \vec{H} \) field.

6. A plane wave traveling in the +y direction in a lossy medium \( (\varepsilon_r = 4, \mu_r = 1, \sigma = 10^{-2} \text{ S/m}) \) has \( \vec{E} = 30 \cos(10^9 \pi t + \pi/4) \hat{z} \text{ V/m} \) at \( y = 0 \). Find

(a) \( \vec{E} \) at \( y = 1 \text{ m}, t = 2 \text{ ns}; \)

(b) The distance traveled by the wave to have a phase shift of 10°;

(c) The distance traveled by the wave to have its amplitude reduced by 40%;

(d) \( \vec{H} \) at \( y = 2 \text{ m}, t = 2 \text{ ns}. \)

7. The amplitude of a wave traveling through a lossy nonmagnetic medium reduces by 18% every meter. If the wave operates at 10 MHz and the electric field leads the magnetic field by 24°, calculate the propagation constant, the wavelength, the skin depth, and the conductivity of the medium.

**Reading Assignment:** Chapter 5