Mandatory Problems on Phasors and Wave Concepts

1. Ulaby Problem 1.4

2. Ulaby Problem 1.8

3. Ulaby Problem 1.13

4. Ulaby Problem 1.26

5. Ulaby Problem 1.27

6. Consider a vector wave that is propagating in a homogeneous dielectric medium with permittivity $\varepsilon = \varepsilon_r \varepsilon_0$ and $\mu = \mu_0$. If the wave has the measured time-dependent electric field given by the expression

$$\vec{E}(x, y, z, t) = |E_0| \sin \left(2\pi \times 10^8 t - \frac{8\pi}{3} x \right) \hat{a}_z$$

a. Determine the frequency of this wave
b. Determine the wave number of this wave
c. Determine the wavelength of this wave
d. Determine the speed of the wave
e. Determine the relative dielectric constant $\varepsilon_r$ of the medium
f. Determine the corresponding phasor $\tilde{E}_\omega(x, y, z)$
g. Determine the phase of the phasor at $x = 0$
7. Consider a vector wave that is propagating in air. If the vector field is given in phasor form as

\[
E_\omega(x, y, z) = (e^{j\pi/4} \hat{a}_x - e^{-j\pi/4} \hat{a}_z)e^{j\pi y}
\]

Determine the following quantities:

a. The wavelength of the plane wave
b. The frequency of the plane wave
c. The corresponding time domain expression
d. The direction of propagation of the wave \( E(x, y, z, t) \)

Optional problems on Phasors and Wave Concepts

*Ulaby: Problems 1.9, 1.15, 1.29*

**Homework Solutions provided: ONLINE**