

Homework 2

Electromagnetic Waves

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QUESTIONS

1. In free space, $\vec{H} = 0.2 \cos(\omega t - \beta x) \vec{e}_z$ A/m. Find the total power passing through:

- (a) A square plate of side 10 cm on plane $x + y = 2$
- (b) A circular disk of radius 4 cm on plane $x = 1$

2. The electric field intensity in a dielectric medium ($\mu = \mu_0, \epsilon = \epsilon_0 \epsilon_r$) is given by

$$\vec{E} = 120 \cos(10^9 t + 7x) \vec{e}_z \text{ V/m}$$

Calculate

- (a) The dielectric constant ϵ_r
 - (b) The intrinsic impedance η
 - (c) The velocity of propagation
 - (d) The magnetic field intensity
 - (e) The Poynting vector \mathcal{P}
3. In free space ($z \leq 0$), a plane wave with

$$\vec{H}_i = 5 \cos(10^8 t - \beta z) \vec{e}_x \text{ mA/m}$$

is incident normally on a lossless medium ($\epsilon = 2.65 \epsilon_0, \mu = 5.5 \mu_0$) in region $z \geq 0$. Determine the reflected wave \vec{H}_r, \vec{E}_r and the transmitted wave \vec{H}_t, \vec{E}_t .

4. The plane wave

$$\vec{E} = 50 \sin(\omega t - 5x) \vec{e}_y \text{ V/m}$$

in a lossless medium ($\mu = 4 \mu_0, \epsilon = \epsilon_0$) encounters a lossy medium ($\mu = \mu_0, \epsilon = 4 \epsilon_0, \sigma = 0.1 \text{ S/m}$) normal to the x -axis at $x = 0$. Find

- (a) Γ, τ and standing wave ratio s
- (b) \vec{E}_r, \vec{H}_r
- (c) \vec{E}_t, \vec{H}_t
- (d) The time-average Poynting vectors in both regions