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 ($\mu = \mu_0, \varepsilon = \varepsilon_0\varepsilon_r$) 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 $\mathscr{P}$

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 ($\varepsilon = 2.65\varepsilon_0$, $\mu = 5.5\mu_0$) 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 ($\mu = 4\mu_0, \varepsilon = \varepsilon_0$) encounters a lossy medium ($\mu = \mu_0, \varepsilon = 4\varepsilon_0, \sigma = 0.1$ 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