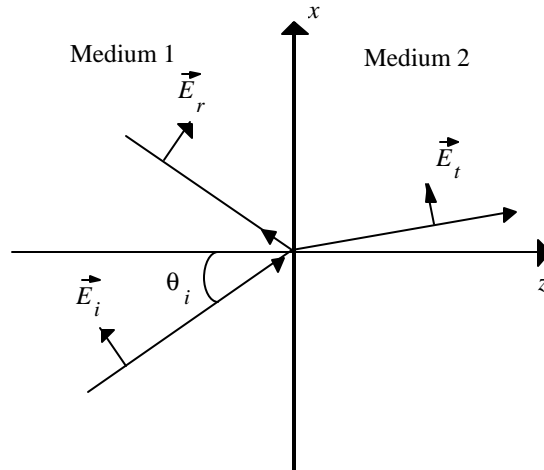


Sample Questinos: Exam #2

1. For the case of oblique incidence of a uniform plane wave with perpendicular polarization on a plane boundary with $\mathbf{e}_1 = \mathbf{e}_0$, $\mathbf{e}_2 = 2.25\mathbf{e}_0$, $\mathbf{m}_1 = \mathbf{m}_2 = \mathbf{m}_0$, shown below, assume $H_{i0} = 0.053$ A/m, $f = 100$ MHz, and $\theta_i = 30^\circ$.



- (a) Find the reflection and transmission coefficients.
- (b) Write the instantaneous expressions for $\vec{E}_t(x, z; t)$ and $\vec{H}_t(x, z; t)$.
2. Find the maximum amplitude of the source current I_0 with which a dipole antenna of total length of 17cm has to be excited at a frequency of 900 MHz in order to produce an electric field of 1 mV/m at a distance of 3.2 km broadside to the dipole antenna. What is the half-power angle relative to broadside of the dipole?
3. Aluminum has $\epsilon = \epsilon_0$, $\mu = \mu_0$ and $\sigma = 3.54 \times 10^7$ S/m. If an antenna for VHF (100 MHz) reception is made of wood coated with a layer of aluminum and if its thickness is 5 times greater than the skin depth of the aluminum that frequency, determine the thickness of the aluminum layer. Is ordinary aluminum foil (1/1000 inch thick) thick enough for this purpose?
4. Water vapor in the atmosphere has a molecular absorption band near 22 GHz which causes the power P in a \hat{z} -propagating wave to be attenuated as $P = P_0 e^{-\frac{z}{1000}}$, where z is in meters.
- (a) If we characterize the permittivity of the atmosphere as $\mathbf{e}_{eff} = \mathbf{e}_0 - j\mathbf{e}''$, what is \mathbf{e}'' ?
- (b) If the permittivity is characterized by \mathbf{e}_0 and the medium is assumed to have a bulk conductivity \mathbf{s} , what is \mathbf{s} ?

5. A plane wave in air with $\vec{E} = \hat{y}10e^{-j(3x+4z)}$ [V/m] is incident upon the planar surface of a dielectric material with $\epsilon = 4\epsilon_0$ occupying the half-space $z > 0$. Assume $\mu = 1$.

Determine:

- (a) The polarization of the incident wave.
- (b) The angle of incidence.?
- (c) The average power density carried by the wave in the dielectric medium.

6. A plane wave in air with $\vec{E} = \hat{y}10e^{-j(3x+4z)}$ [V/m] is incident upon the planar surface of a dielectric material with $\epsilon = 4\epsilon_0$ occupying the half-space $z > 0$. Assume $\mu = 1$.

Determine: