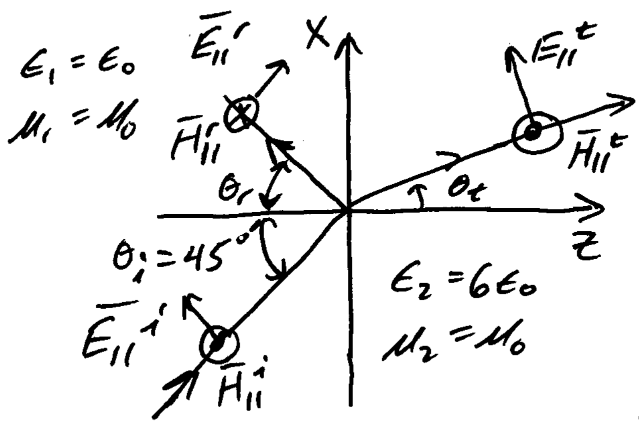
Example- A UPW in air (ε_0, μ_0, $z < 0$) is obliquely incident on a glass half-space ($6\varepsilon_0$, μ_0, $z > 0$) at an angle of 45°. The 800 MHz incident magnetic field is oriented in the y-direction and has a field strength of 0.4 mA/m at $z = 0$. Analyze and determine the various associated fields, power densities, and other related quantities.



$$\eta_1 = \eta_0 = \underline{376.7303\ \Omega}$$

$$\beta_1 = \omega\sqrt{\mu_0\epsilon_0} = \frac{2\pi\, 800\times10^6}{2.9979\times10^8} = \underline{16.76676\ \frac{\text{rad}}{\text{m}}}$$

$$\eta_2 = \eta_0/\sqrt{\epsilon_{r2}} = \frac{376.7303}{\sqrt{6}} = \underline{153.7995\ \Omega}$$

$$\beta_2 = \omega\sqrt{\mu_0 6\epsilon_0} = 2\pi\,(800\times10^6)\sqrt{4\pi\times10^{-7}(6)\,8.854187 8\times10^{-12}}$$

$$\underline{\beta_2 = 41.070007\ \frac{\text{rad}}{\text{m}}}$$

Per (5.24a), $\underline{\theta_r = \theta_i = 45°}$

Per (5-24b), $\beta_1 \sin\theta_i = \beta_2 \sin\theta_t$

$$16.76676 \sin 45° = 41.07 \sin\theta_t$$

$$\hookrightarrow \theta_t = \sin^{-1}\left(\frac{16.76676 \sin 45°}{41.07001}\right) = \sin^{-1}(0.288675)$$

$$= 16.778655° \Rightarrow \underline{\theta_t = 16.7787°}$$

Per (5-24c), $$\Gamma_{\parallel}^b = \frac{-\eta_1\cos\theta_i + \eta_2\cos\theta_t}{\eta_1\cos\theta_i + \eta_2\cos\theta_t}$$

$$\Gamma_{\parallel}^{b} = \frac{-376.7303\cos 45^\circ + 153.7995\cos 16.7787^\circ}{376.7303\cos 45^\circ + 153.7995\cos 16.7787^\circ} = \frac{-124.432}{413.64}$$

$$\Gamma_{\parallel}^{b} = -0.28802$$

$$T_{\parallel}^{b} = \frac{2\eta_2\cos\theta_i}{\eta_1\cos\theta_i + \eta_2\cos\theta_t} = \frac{2(153.7995)\cos 45^\circ}{413.64}$$

$$T_{\parallel}^{b} = 0.52583$$

Per (5-20d), $H_{\parallel}^{i} = \frac{E_0}{\eta_1} \Rightarrow E_0 = 376.7303(0.4\times 10^{-3})$

$$E_0 = 0.150692 \text{ V/m}$$

(5-20b) $\bar{H}_{\parallel}^{i} = \hat{a}_y\, 0.4\, e^{-j16.767(0.707x+0.707z)}\ (\text{mA/m})$

(5-20a) $\bar{E}_{\parallel}^{i} = (0.707\hat{a}_x - 0.707\hat{a}_z)\,0.1507\, e^{-j16.767(0.707x+0.707z)}\ (\text{V/m})$

(5-21a) $\bar{E}_{\parallel}^{r} = (0.707\hat{a}_x + 0.707\hat{a}_z)\,0.1507(-0.288)\, e^{-j16.767(0.707x-0.707z)}$

$$\bar{E}_{\parallel}^{r} = (0.707\hat{a}_x + 0.707\hat{a}_z)(-43.402)\, e^{-16.767(0.707x-0.707z)}\ \left(\frac{\text{mV}}{\text{m}}\right)$$

(5-21b) $\bar{H}_{\parallel}^{r} = -\hat{a}_y \frac{-43.402\times 10^{-3}}{376.7307} e^{-j16.767(0.707x-0.707z)}$

$$\bar{H}_{\parallel}^{r} = +\hat{a}_y\, 0.1152\, e^{-j16.767(0.707x-0.707z)}\ (\text{mA/m})$$

(S-22a) $$\bar{E}_{\parallel}^{t} = (\hat{a}_x \cos 16.779^\circ - \hat{a}_z \sin 16.779^\circ)(0.526)(0.1507)\, e^{-j41.07(x \sin 16.8^\circ + z \cos 16.8^\circ)}$$

$$\bar{E}_{\parallel}^{t} = (0.9574\,\hat{a}_x - 0.2887\,\hat{a}_z)(79.268)\, e^{-j41.07(0.2887x + 0.9574z)} \left(\frac{mV}{m}\right)$$

(S-22b) $$\bar{H}_{\parallel}^{t} = \hat{a}_y \frac{0.52583(0.150692)}{153.7995}\, e^{-j41.07(0.2887x + 0.9574z)}$$

$$\bar{H}_{\parallel}^{t} = \hat{a}_y\, 0.5152\, e^{-41.07(0.2887x + 0.9574z)} \left(\frac{mA}{m}\right)$$

(S-26a) $$\Gamma_{\parallel}(z) = \Gamma_{\parallel}^{b}\, e^{j2\beta_1 z \cos\theta_i}$$

$$= -0.28802\, e^{j2(16.76676)\cos 45^\circ z}$$

$$\Gamma_{\parallel}(z) = -0.28802^{\,j23.7118z} \qquad z \le 0$$

(S-26) $$\bar{E}_{\parallel}^{1} = \hat{a}_x \cos 45^\circ (0.1507)\, e^{-j16.767(0.707x + 0.707z)}\left[1 + \Gamma_{\parallel}(z)\right]$$

$$- \hat{a}_z \sin 45^\circ (0.1507)\, e^{-j16.767(0.707x + 0.707z)}\left[1 - \Gamma_{\parallel}(z)\right]$$

$$\bar{E}_{\parallel}^{1} = \hat{a}_x\, 0.10656\, e^{-j16.767(0.707x + 0.707z)}\left[1 + \Gamma_{\parallel}(z)\right]$$

$$- \hat{a}_z\, 0.10656\, e^{-j16.767(0.707x + 0.707z)}\left[1 - \Gamma_{\parallel}(z)\right] \left(\frac{V}{m}\right)$$

$$z \le 0$$