HW 7

Problem 1

> 自由空间中的平面波以波导半空间θ角入射；对于足够大的$\sigma/w\epsilon_0$，通过证明$\theta_t = tan^{-1}k_x/k_{zR}$来证明透射波垂直于边界

$$\frac{sin\theta_i}{sin\theta_t} = \frac{k_t}{k_0}$$

$$tan\theta_t = \frac{k_0 sin\theta_0}{\sqrt{k_t^2 - k_0^2 sin^2\theta_0}} = \frac{k_x}{k_z} = \frac{k_x}{k_{zr}}$$

$$\text{由于}\frac{\sigma}{w\epsilon_0} >> 1$$

$$k_x = \sqrt{\frac{w\epsilon}{2\sigma}}k(i-1)$$

$$k_x^2 + k_z^2 = k^2$$

$$tan\theta_t = \frac{k_x}{\sqrt{k^2 - k_x^2}} = \frac{i-1}{\sqrt{2}\sqrt{\frac{\sigma}{w\epsilon}+i}} = 0$$

Problem 2

$$\text{对于}TE\text{波，}R_{TE} = \frac{1-p_{0t}}{1+p_{0t}}$$

$$T_{TE} = \frac{2}{1+p_{0t}}$$

$$p_0 t = \frac{u_0 k_{tz}}{u_t k_z}$$

$$\text{对于}TM\text{波，}R_{TM} = \frac{1-p_{0t}}{1+p_{0t}}$$

$$T_{TM} = \frac{2}{1+p_{0t}}$$

$$p_{0t} = \frac{\epsilon k_{tz}}{\epsilon_t k_x}$$

$$\text{由于}TE\text{、}TM\text{波入射的是相同介质，得到的}TEM\text{波反射率、透射率相同}$$

Problem 3

$$E_i = (\frac{1}{\sqrt{2}}x + \frac{1}{\sqrt{2}}z + iy)e^{i\frac{1}{\sqrt{2}}k_0x - i\frac{1}{\sqrt{2}}k_0z}$$

$$= (\frac{1}{\sqrt{2}}x + \frac{1}{\sqrt{2}}z + iy)[cos(\frac{1}{\sqrt{2}}k_0(x-z)) + isin(\frac{1}{\sqrt{2}}k_0(x-z))]$$

$$E_x = \frac{1}{\sqrt{2}}[cos(\frac{1}{\sqrt{2}}k_0(x-z)) + isin(\frac{1}{\sqrt{2}}k_0(x-z))]x$$

$$E_y = \frac{1}{\sqrt{2}}[cos(\frac{1}{\sqrt{2}}k_0(x-z)) + isin(\frac{1}{\sqrt{2}}k_0(x-z))]iy$$

由于入射方向是z方向，电场方向在x，z平面内，入射波是TM波，

对于TM波，$E_r = R^{TM}E_i$

$$R_{TM} = \frac{1-p_{0t}}{1+p_{0t}}, T_{TM} = \frac{2}{1+p_{0t}}, p_{0t} = \frac{\epsilon k_{tz}}{\epsilon_t k_x}$$

由于是从$+z$入射到$-z$方向，入射波是左旋的

又由于$(\frac{1}{\sqrt{2}})^2 + (\frac{1}{\sqrt{2}})^2 = 1$.入射波是圆极化波

=> 反射波是右旋圆极化波