1. $f = 3\ GHz$

$$\underline{H} = 10^{-3}(\hat{x} + j\hat{y})\, e^{jK_0 z}$$

$$K_0 = \omega\sqrt{\mu\varepsilon} = 2\pi f\sqrt{\mu_0\varepsilon_0} = \frac{2\pi f}{c_0} = \frac{2\pi \cdot 3\times10^9}{3\times10^8} = 20\pi$$

$$K_0 z = -\vec{K}\cdot\vec{r} = -\|\vec{K}\| \cdot \hat{m}\cdot\vec{r} \Rightarrow \hat{m} = -z$$

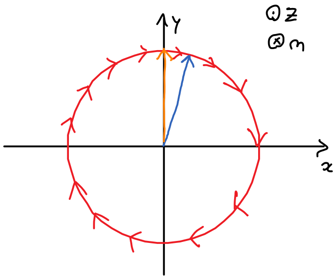
$\hat{x}\times(-\hat{z}) = \hat{y}$

$\hat{y}\times(-\hat{z}) = \hat{x}$

$$\underline{E} = Z_0\,\underline{H}\times\hat{m} = Z_0\cdot 10^{-3}(\hat{y} - j\hat{x})\, e^{jK_0 z}$$

2. $\vec{E}(t,z) = Re\{\underline{E}\, e^{j\omega t}\} = Z_0 10^{-3}\cos(\omega t + K_0 z)\,\hat{y} + Z_0 10^{-3}\cos(\omega t + K_0 z - \frac{\pi}{2})\,\hat{x}$

- $\vec{E}(t,z)\big|_{t=0,\ z=0} \Rightarrow$ componente $\hat{y}$: $Z_0 10^{-3}$; componente $\hat{x}$: 0
- $\vec{E}(t,z)\big|_{t=0^+,\ z=0} \Rightarrow$ componente $\hat{y} < Z_0 10^{-3}$; componente $\hat{x} > 0$



⊙z
⊗m

⊗m e ↻ ⇒ Polarização circular Direita

$e_1\times e_2 = \hat{m}$ e $\hat{y}\times\hat{x} = -\hat{z} \Rightarrow E_1 = E_y$, $E_2 = E_x$

$$P = \frac{E_2}{E_1} = \frac{-j}{1} = -j \Rightarrow \begin{cases} |P| = 1 \\ \angle P = -\frac{\pi}{2} \end{cases} \Rightarrow \text{PCD}$$

3. $\sigma = 0$, $\mu_r = 1$, $\varepsilon_r = 3$, $\theta_i = 45^\circ$, $E^i_{\parallel 0} = 0$

$$\frac{S^r_{av}}{S^i_{av}} = \frac{\cancel{\frac{1}{2}} \cancel{Re\{\frac{1}{Z}\}}\, |\underline{E}^r|^2}{\cancel{\frac{1}{2}} \cancel{Re\{\frac{1}{Z}\}}\, |\underline{E}^i|^2} = \frac{|\underline{E}^r|^2}{|\underline{E}^i|^2} = \frac{|R_\perp|^2}{1^2} = |R_\perp|^2 = \left(\frac{1}{2}\right)^2 = \frac{1}{4} = 0.25 \Rightarrow \underline{25\%}$$

$$R_\perp = \frac{Z_2\cos(\theta_i) - Z_1\cos(\theta_t)}{Z_2\cos(\theta_i) + Z_1\cos(\theta_t)} = \frac{\frac{1}{\sqrt5}\cdot\frac{\sqrt2}{2} - \cos(\theta_t)}{\frac{1}{\sqrt5}\cdot\frac{\sqrt2}{2} + \cos(\theta_t)} = \frac{\frac{1}{\sqrt{10}} - \frac{3}{\sqrt{10}}}{\frac{1}{\sqrt{10}} + \frac{3}{\sqrt{10}}} = \frac{-\frac{2}{\sqrt{10}}}{\frac{4}{\sqrt{10}}} = -\frac{1}{2}$$

$$\frac{1}{\sqrt5}\cdot\frac{\sqrt2}{2} = \frac{1}{\sqrt{10}}$$

$$n_2\sin(\theta_t) = n_1\sin(\theta_i) \Leftrightarrow \sqrt5\sin(\theta_t) = 1\cdot\frac{\sqrt2}{2} \Leftrightarrow \sin(\theta_t) = \frac{1}{\sqrt{10}} \Rightarrow \cos(\theta_t) = \sqrt{1 - \left(\frac{1}{\sqrt{10}}\right)^2} = \sqrt{\frac{9}{10}} = \frac{3}{\sqrt{10}}$$