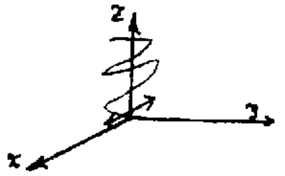
E2.

$$\vec{E} = 50 . \cos(\omega t - \beta z)\,\hat{x} \quad \frac{V}{m} \qquad \text{Free-space}$$



$$\vec{P} = \vec{E} \times \vec{H} \qquad \vec{H} = \frac{k}{\mu\omega}\,\hat{k} \times \vec{E}$$

$$\vec{H} = \frac{\cancel{\epsilon\mu^{1/2}\omega}}{\cancel{\mu\omega}}\,\hat{z} \times \hat{x}\; 50 . \cos(\omega t - \beta z)$$

$$\vec{H} = \left(\frac{\varepsilon_0}{\mu_0}\right)^{1/2} \hat{y}\; 50 . \cos(\omega t - \beta z)\;\frac{V}{m}$$

$$\vec{P} = 50^2 . \cos^2(\omega t - \beta z)\left(\frac{\mu_0}{\varepsilon_0}\right)^{1/2}\hat{z} \quad \underbrace{\left(\frac{V}{m}\right)^2 \frac{1}{\Omega}} \rightarrow \left(\frac{Kg\, m^2}{C . s^2}\frac{1}{m}\right)^2 \frac{C^2 . s}{m^2 kg} \quad \frac{Kg}{s^3}$$

$$\sqrt{\frac{\mu_0}{\varepsilon_0}} = \sqrt{\frac{1.2566 \times 10^{-6}\;\frac{m . kg}{C^2}}{8.85 \times 10^{-12}\;\frac{C^2}{N . m^2}}} \cong 376.81\ \Omega$$

$$\frac{m^2 kg}{s C^2} \leftarrow \frac{m^4 kg^2}{s^2 C^4} = \frac{\frac{m\, kg}{C^2}}{\frac{s^2}{kg . m}\frac{C^2}{m^2}}$$

$$\omega = 2\pi f = \frac{2\pi}{\tau}$$

$$P_{prom} = \left(\int_0^{\tau} \vec{P}\, dt\right)\frac{1}{\tau} = \frac{\omega}{2\pi}\int_0^{2\pi/\omega} \frac{50^2}{(\mu_0/\varepsilon_0)^{1/2}} \cos^2(\omega t - \beta z)\,\hat{z}\; dt$$

$$= \frac{\omega}{2\pi}\frac{50^2}{(\mu_0/\varepsilon_0)^{1/2}}\int_0^{2\pi/\omega} \cos^2(\omega t - \beta z)\,\hat{z}\; dt = \frac{\omega}{2\pi}\left(\frac{50^2}{[\mu_0/\varepsilon_0]^{1/2}}\right)\frac{\pi}{\omega}$$

Es constante, y no depende de z, entonces

$$\text{Potencia} = \int \vec{P}_{AVG} \cdot d\vec{S} = \int P_{AVG}\, dS = P_{AVG}\int dS =$$

$$= P_{AVG} . \underbrace{\pi(2.5\,m)^2}_{\text{área}}$$

$$= \frac{1}{2}\frac{50^2}{376.81} \cdot \frac{kg}{seg^3} \cdot \left[\pi \; 6.25\ m^2\right]$$

$$\text{Potencia} = 65.13\ \frac{kg . m^2}{seg^3} = \boxed{65.13\ \frac{J}{seg}} = 65.13\ \text{Watts}$$

E1.

Onda en un conductor (bueno) $\quad \vec{E} = \vec{E}_0 . e^{i(\beta x - \omega t)} e^{-\beta x}$

La atenuación es $\beta = \left(\frac{\mu \omega \sigma}{2}\right)^{1/2}$. $\mu = \mu_r = \frac{\mu}{\mu_0} = 1$

$$\beta = \left(\frac{\mu_0}{2} \overset{2\pi}{} 100 \times 10^6 \frac{1}{seg} \cdot 58 \times 10^6 \frac{1}{m\Omega}\right)^{1/2}$$

Para un conductor $\quad k_R = k_I \rightarrow \quad k = \beta$

constante de propagación $\rightarrow$ $\cancel{2}\pi . \frac{1.2566 . 10^{-6}}{\cancel{2}} \cancel{\frac{m.kg}{C^2}} \; 100 \times 10^6 \frac{1}{\cancel{s}} . 58 \times 10^6 \cancel{\frac{C^2 seg}{m^2 . kg}} \frac{1}{m}$

$$\boxed{k \cong 151317 \frac{1}{m} = 1.51 \times 10^5 \frac{1}{m}}$$

velocidad de la onda $\quad u = \frac{\omega}{k} = \frac{2\pi . 100 \times 10^6 \; 1/s}{1.51 \times 10^5 \; 1/m} = \boxed{4161 \frac{m}{s}}$

Profundidad pelicular:

$$e^{-\beta x} = e^{-1} \rightarrow \quad \delta = 1/\beta = \beta^{-1}$$

$$\boxed{\delta = 6.6225 . 10^{-6} \, m}$$

La impedancia será:

$$\vec{H} = \frac{k}{\mu\omega}\left(\hat{k} \times \vec{E}\right) \rightarrow \quad |\vec{H}| = \frac{k}{\mu\omega} |\vec{E}|$$

$$|\vec{H}| = \underbrace{\frac{1}{\mu\omega}\left(\frac{\mu\omega\sigma}{2}\right)^{1/2}(1+i)}_{\left(\frac{\sigma}{\cancel{2}\mu\omega}\right)^{1/2} e^{i\pi/4}\sqrt{\cancel{2}}} . |\vec{E}|$$

$$\frac{58 \times 10^6 \; C^2 . seg / m^3 . kg}{\frac{m.kg}{C^2} \; 1.2566 \times 10^{-6} \times 2\pi \times 100 \times 10^6 \frac{1}{seg}} \cong 271.03 \sqrt{\frac{C^4 seg^2}{m^4 kg^2}} \; e^{i\pi/4}$$

$$\eta = \frac{|\vec{E}|}{|\vec{H}|} = \boxed{3.689 . 10^{-3} \frac{1}{\Omega} e^{-i\pi/4}}$$