Name:

I.D. Number:

KEY

Consider a uniform plane wave propagating in a lossy medium with a relative permittivity of 1.00. The intrinsic impedance $\eta = 377\exp(j\,37.761^\circ)\,\Omega$. Calculate the relative permeability of the medium.

[Hint: $\eta = \sqrt{\dfrac{\mu}{\varepsilon}}\dfrac{e^{j\frac{1}{2}\tan^{-1}(\frac{\sigma}{\omega\varepsilon})}}{[1+(\frac{\sigma}{\omega\varepsilon})^2]^{\frac{1}{4}}}$]

$$377\,e^{j\,37.761^\circ} = 377\sqrt{\frac{\mu_r}{\varepsilon_r}}\,\frac{e^{j\frac{1}{2}\tan^{-1}(\frac{\sigma}{\omega\varepsilon})}}{\left[1+\left(\frac{\sigma}{\omega\varepsilon}\right)^2\right]^{1/4}}$$

$\therefore \ \frac{1}{2}\tan^{-1}\left(\frac{\sigma}{\omega\varepsilon}\right) = 37.761^\circ \implies \frac{\sigma}{\omega\varepsilon} = 3.873$

$\oint \quad 1 = \sqrt{\frac{\mu_r}{1}}\,\frac{1}{\left[1+(3.873)^2\right]^{1/4}}$

$\Downarrow$

$\mu_r = 4$