Time Harmonic Fields

Planar Sinusoidal Wave

$$\boldsymbol{E} = \hat{E}\cos(\omega t - \boldsymbol{k}\cdot\boldsymbol{r} + \phi)\boldsymbol{e}_E \quad \text{instantanious value}$$

$$\boldsymbol{E} = E_0 e^{-j\boldsymbol{k}\cdot\boldsymbol{r}}\boldsymbol{e}_E \quad \text{complex value}$$

$$E_0 = \hat{E}e^{j\phi} \quad \text{top value scale}$$

$$E_0 = \frac{\hat{E}}{\sqrt{2}}e^{j\phi} \quad \text{effective value scale}$$

Propagation Rate

$$v = \frac{1}{\sqrt{\mu_0\mu_r\epsilon_0\epsilon_r}} \quad v = \frac{\omega}{k} \quad k = |\boldsymbol{k}|$$

Wave Impedance Non-Conductive Space

$$\eta = \sqrt{\frac{\mu_r\mu_0}{\epsilon_r\epsilon_0}}$$

Rule of Right-Hand Systems

$$\boldsymbol{e}_k = \boldsymbol{e}_E \times \boldsymbol{e}_H \quad E = \eta H \qquad \boldsymbol{e}_k = \boldsymbol{e}_E \times \boldsymbol{e}_B \quad E = vB$$

Planar Wave in Space with Condctivity

$$\boldsymbol{E} = E_0 e^{\gamma z}\boldsymbol{e}_x$$

Complex Propagation Constant

$$\gamma = \sqrt{j\omega\mu_r\mu_0(\sigma + j\omega\epsilon_r\epsilon_0)} \qquad \gamma = \alpha j\beta$$

Waveinpedance, Space With Given Conductivity

$$\eta = \sqrt{\frac{j\omega\mu_r\mu_0}{\sigma + j\omega\epsilon_r\epsilon_0}}$$

Penetration Depth

$$\delta = \sqrt{\frac{2}{\omega\mu_r\mu_0\sigma}}$$