

1. In a brief statement, explain on the basis of the boundary conditions why it is necessary that $\Gamma = -1$ at the boundary of a dielectric and a perfect conductor.
2. A 1-GHz TEM wave whose E -field is confined to the \hat{x} direction (i.e. the wave is linearly polarized) is travelling in air in the \hat{z} direction. It is normally incident on a thick copper plate whose surface lies in the $z = 0$ plane. The wave amplitude is 12 mV/m, and for the copper take $\mu_R = 1$, $\epsilon_R = 1$ and $\sigma = 5.8 \times 10^7 \text{ U/m}$. (a) Show that to a good approximation, the reflection coefficient is -1. (b) Using this and the fact that the incident field is time-harmonic, determine the phasor and time-varying forms of both the total electric and magnetic fields in the air. (c) Make a sketch of the total fields in the air at $t = 0.125 \text{ ns}$.
3. A beam of visible light of wavelength $0.6 \mu\text{m}$ is normally incident from air onto a flat glass plate whose surface is in the $z = 0$ plane. The relative permittivity for the glass is 2.25 and $\mu_R = 1$. Determine (a) the standing wave ratio and (b) the fraction of the incident power which is transmitted into the glass.
4. A uniform plane wave in air partially reflects from the surface of a material whose properties are unknown. Measurements of the E -field in front of the surface yield a 1.5 m spacing between maxima, with the first maximum occurring 0.75 m from the interface. The standing wave ratio is found to be 5. Using the fact that an E -field minimum is found at the boundary (i.e. at $z = 0$) whenever $\theta_\Gamma = \pi$, determine the intrinsic impedance, η_2 , of the unknown material.
5. Two half-spaces have the following properties: In region 1 $x < 0$, and this region is a perfect dielectric with $\mu_1 = 2 \mu\text{H/m}$ and $\epsilon_1 = 200 \text{ pF/m}$. In region 2 where $x > 0$, $\mu_2 = 2 \mu\text{H/m}$, $\epsilon_2 = 200 \text{ pF/m}$ and $\sigma_2 = 1.2 \text{ U/m}$. The wave incident on the $x = 0$ boundary plane is given by

$$\vec{E}_i = 1000e^{-\alpha_1 x} \cos(\omega t - \beta_1 x) \hat{y} \text{ V/m}$$

where $\omega = 10^{10} \text{ rad/s}$. Determine (a) the phasor form, \vec{E}_1 , of the total field in region 1; (b) the phasor form \vec{E}_2 of the transmitted wave; and (c) the time-varying form, \vec{H}_2 , of the magnetic field in region 2.

6. Problem number 13.9, p.476 of text.
7. Problem number 11.2, p.388 of text.
8. Problem number 11.3, p.388 of text.
9. Problem number 11.6, p.389 of text.