

Series 6

Electromagnetic field's propagation

Exercise 1

To eliminate reflections of normally incident plane waves, a dielectric slab of thickness d and relative permittivity ϵ_r2 is to be inserted between two semi-infinite media with relative permittivities $\epsilon_r1 = 1$ and $\epsilon_r3 = 16$. Use the quarter-wave transformer technique to select d and ϵ_r2 . Assume $f = 3$ GHz.

Exercise 2:

Express the normal-incidence reflection coefficient at the boundary between two nonmagnetic, conducting media in terms of their complex permittivities.

Exercise 3:

In the visible part of the electromagnetic spectrum, the index of refraction of water is 1.33. What is the critical angle for light waves generated by an upward-looking underwater light source?

Exercise 4:

A wave in air is incident upon a soil surface at $\theta_i = 50^\circ$. If soil has $\epsilon_r = 4$ and $\mu_r = 1$, determine Γ_\perp , τ_\perp , Γ_\parallel , and τ_\parallel .

Exercise 5

What is the cutoff frequency for the dominant TM mode in a waveguide filled with a material with $\epsilon_r = 4$? The waveguide dimensions are $a = 2$, $b = 5$ cm.