

ECE 222b: Homework #3

Problem 1

Consider a current sheet with current distribution given by $\vec{J}_s = \hat{y}J_0 e^{-jh x}$.

- Find the corresponding electric field for $z > 0$ and < 0
- What is the polarization of the field (TM_z or TE_z)?
- What condition on h would lead to evanescent (non-uniform) plane waves for $z > 0$ or < 0 ?

Problem 2

Consider the same current as in Problem 1 but now it resides a distance a above a dielectric slab of thickness d . Give expressions for the field above the slab.

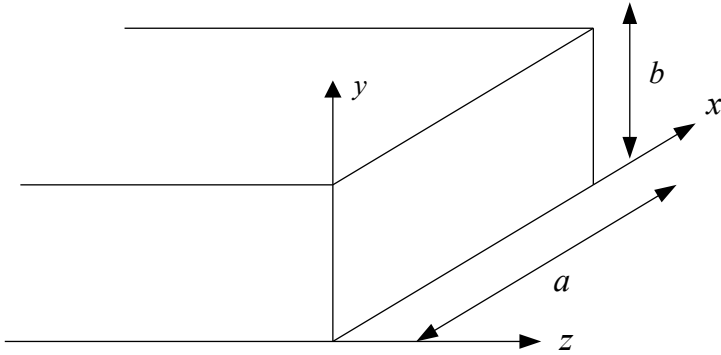


Problem 3

Consider an infinite dielectric slab with permittivity ϵ_2 residing in free space under a normal incidence. Using the reflection coefficient representation via the reflection coefficients through each interface find the resonance frequencies of the slab.

Problem 4

Consider a rectangular waveguide filled with the free space depicted in the figure below. The dimension of the waveguide in the x and y directions are a and b ($a > b$), respectively. In the z direction it occupies the region $-\infty < z < 0$. For a given frequency ω , only one dominant propagating mode exists traveling along z from $-\infty$ in the forward direction. Neglecting the waveguide truncation at $z=0$ (i.e. assuming an infinitely long waveguide), write the expression for the electric and magnetic field in the waveguide, the propagation constant and cutoff frequency of the dominant mode.



Problem 5

Consider a parallel plate waveguide formed by two infinite planar PEC plates at $y=0$ and $y=d$ as shown in the figure below. At the cross-section $z=0$ a current sheet with current $\mathbf{J}_s = \hat{\mathbf{x}}J_s(y)$ is inserted.

- Find the electric and magnetic fields generated by this current in the waveguide
- Write the current distribution that would excite just one lowest order TE_z mode.

