

Study Material

Text Book

Elements of Electromagnetics, 6th Ed.
Matthew N. O. Sadiku
Oxford University Press

Study Numerical Analysis of Slab Waveguides

Read “Notes – Slab waveguide analysis”
http://emlab.utep.edu/ee4386_5301_CompMethEE.htm

MATLAB Code

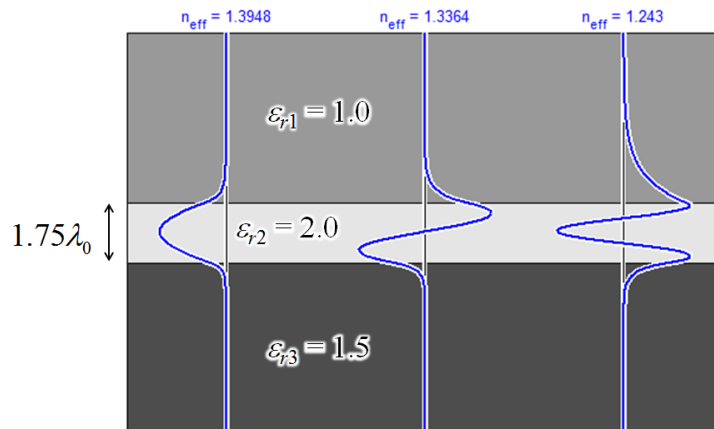
Problem #1

Write a MATLAB function that calculates the modes of slab waveguides. The function should have the following header which dictates the input and output variables.

```
function [NEFF,Ay,xa] = slab(a,er1,er2,er3)
% SLAB      Slab Waveguide Analysis
%
% [NEFF,Ay,xa] = slab(a,er1,er2,er3);
%
% This program analyzes a dielectric slab waveguide. The function
% has the following input arguments:
%
% a --> width of the core (in wavelengths)
% er1 --> dielectric constant of superstrate
% er2 --> dielectric constant of core
% er3 --> dielectric constant of substrate
%
% The function has the following output arguments:
%
% NEFF --> Array containing the effective refractive indices
% Ay --> Matrix who's columns are the modes
% xa --> Coordinates of the points along the x-axis
```

Problem #2

Write a MATLAB program that calls `slab()` to simulate the following slab waveguide and then plots the guided modes. The modes should be provided in order of their effective refractive index and labeled. Duplicate these results to benchmark your code.



Waveguide Analysis

Problem #3

Starting with Problem #2, plot the 4th and 5th modes in addition to the 1st, 2nd, and 3rd modes and explain the results.

Problem #4

Given that $a = 1.75$ cm in Problem #2, calculate the range of frequencies over which the slab waveguide in Problem #2 is single mode.

Problem #5

Plot the effective refractive index of the slab waveguide in Problem #4 over the full range of frequencies that the guide is single mode.

Problem #6

If $\epsilon_{r3} = 1.0$ in Problem #4, what is the new cutoff frequency of the slab waveguide?