

## Problem #1: MATLAB Implementation of TMM

Following the block diagram provided in Lecture 2c exactly, write a MATLAB code to implement the transfer matrix method using scattering matrices. The code should start with the header below, which you will need to modify to simulate different cases. Your code must be able to handle the following:

- Any number of layers
- Any value of permittivity and permeability in any layer
- Any polarization and angle of incidence of the applied wave

```
% Homework #3, Problem #1
% EE 5337 - COMPUTATIONAL ELECTROMAGNETICS
%
% This MATLAB program implements the transfer matrix method.

% INITIALIZE MATLAB
close all;
clc;
clear all;

% UNITS
degrees = pi/180;

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% DEFINE SIMULATION PARAMETERS
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% SOURCE PARAMETERS
lam0 = 1;           %free space wavelength
theta = 0 * degrees; %elevation angle
phi = 0 * degrees;  %azimuthal angle
pte = 0;            %amplitude of TE polarization
ptm = 1;            %amplitude of TM polarization

% EXTERNAL MATERIALS
ur1 = 1.0;          %permeability in the reflection region
er1 = 1.0;          %permittivity in the reflection region
ur2 = 1.0;          %permeability in the transmission region
er2 = 1.0;          %permittivity in the transmission region

% DEFINE LAYERS
UR = [ 1 3 1 ];    %array of permeabilities in each layer
ER = [ 3 3 3 ];    %array of permittivities in each layer
L = [ 0.4 0.8 1.3 ]; %array of the thickness of each layer

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% IMPLEMENT TRANSFER MATRIX METHOD
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Reproduce the results from the TMM benchmarking document provided on the course website. You do not need to include those results, just report that you matched them.

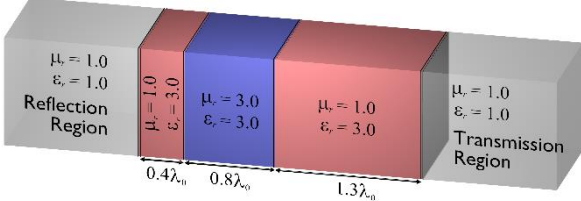
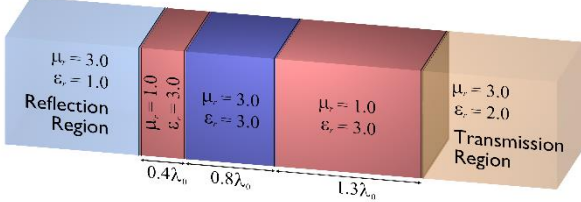
## Problem #2: Benchmark Simulations

Perform the following simulations and record the reflectance, transmittance, and power conservation for the two cases in the table provided. The first case is a wave at normal incidence. The second case is a circularly polarized wave incident at  $\theta=65^\circ$  and  $\phi=35^\circ$ .

#	Device	Case 1: Linear Pol., Normal Incidence			Case 2: Circular Pol., $\theta=65^\circ$ and $\phi=35^\circ$		
		REF	TRN	CON	REF	TRN	CON
1							
2							
3							
4							
5							
6							

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#	Device	Case 1: Linear Pol., Normal Incidence			Case 2: Circular Pol., $\theta=65^\circ$ and $\phi=35^\circ$		
		REF	TRN	CON	REF	TRN	CON
7							
8							

This sequence of simulations is very good practice for testing and benchmarking any new numerical technique. It is always best to simulate simple structures at first and methodically progressing to more complicated structures. This simplifies troubleshooting and is usually the fastest way to get a working code.