

Problem #1: `tmm1d()` Function

Convert your previous `tmm1d` code from Homework #4 into a generic MATLAB function that implements the transfer matrix method (TMM) based on scattering matrices. Your function should not overwrite any of your input arguments.

Use the following header for your function.

```
function DAT = tmm1d(DEV, SRC)
% TMM1D      One-Dimensional Transfer Matrix Method
%
% DAT = tmm1d(DEV, SRC);
%
% Homework #5, Problem #3
% EE 5337 - COMPUTATIONAL ELECTROMAGNETICS
%
% INPUT ARGUMENTS
% =====
% DEV        Device Parameters
%
%   .er1     relative permittivity in reflection region
%   .ur1     relative permeability in reflection region
%   .er2     relative permittivity in transmission region
%   .ur2     relative permeability in transmission region
%
%   .ER      array containing permittivity of each layer in unit cell
%   .UR      array containing permeability of each layer in unit cell
%   .L       array containing thickness of each layer in unit cell
%   .NP      number of unit cells to cascade
%
% SRC        Source Parameters
%
%   .lam0    free space wavelength
%
%   .theta   elevation angle of incidence (radians)
%   .phi     azimuthal angle of incidence (radians)
%
%   .ate     amplitude of TE polarization
%   .atm     amplitude of TM polarization
%
% OUTPUT ARGUMENTS
% =====
% DAT        Output Data
%
%   .REF     Reflectance
%   .TRN     Transmittance
```

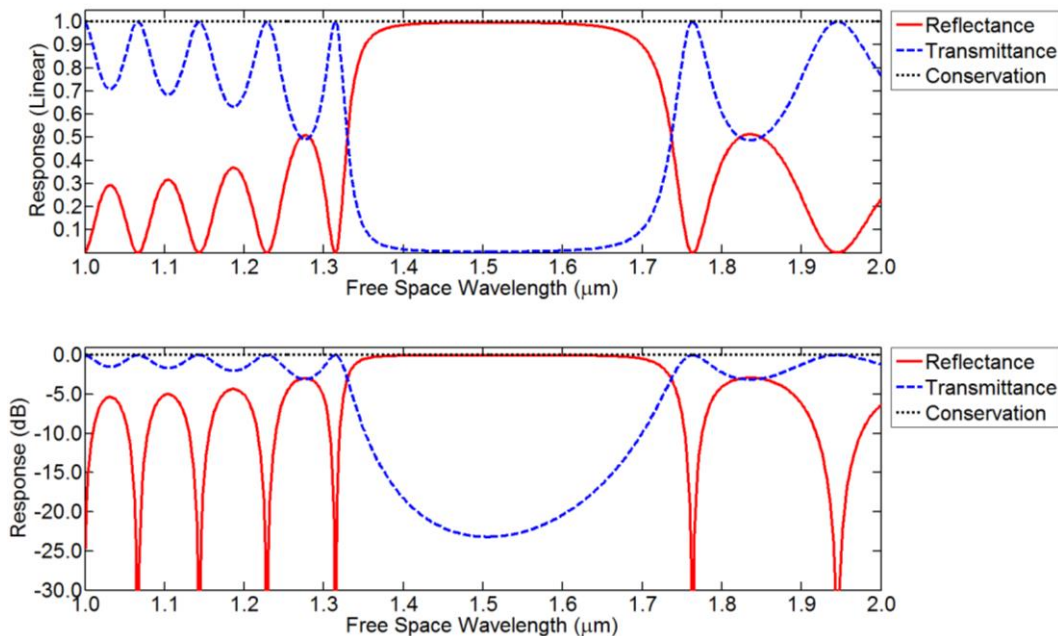
It is recommended to benchmark your `tmm1d()` function by reproducing at least some of the results from Homework #4.

Problem #2: Bragg Grating Wavelength Sweep

A Bragg grating is a device composed of alternating layers of dielectric so as to form a band stop filter. That is, it will reflect strongly over some band of frequencies. For this homework, layer 1 has a refractive index of 1.5 and a thickness of 250 nm. Layer 2 has a refractive index of 2.1 and a thickness of 180 nm. Layer 1 and Layer 2 together form one period of the grating. The overall Bragg grating resides in air and has 10 periods total as illustrated below.



Write a MATLAB program that simulates this Bragg grating for light at normal incidence (i.e. $\theta = 0^\circ$). Your program will perform a parameter sweep and use `tmm1d()` inside the main loop to do this. Calculate the reflectance and transmittance of the Bragg grating as a function of wavelength from 1.0 μm up to 2.0 μm . Use just enough points in your sweep to resolve the response with smooth lines. Generate two plots, one on a linear scale and the other on a decibel scale. Plot reflectance, transmittance, and conservation of power in each plot. Be sure your diagrams are clear and professional. Your results should look something like the following. Try to meet or exceed the quality of these diagrams in your homework.



Problem #3: Bragg Grating Angle of Incidence Sweep

The same Bragg grating is operated at a fixed wavelength of $1.3 \mu\text{m}$ and illuminated with left-hand circularly polarized light. Write a second MATLAB program to calculate the reflectance and transmittance as a function of angle of incidence θ from -89° to $+89^\circ$. Keep the azimuthal angle set to zero, $\phi = 0^\circ$. Your results should look something like the following. Try to meet or exceed the quality of these diagrams in your homework.

