Problem #1: RCWA Implementation

Write a MATLAB program to implement rigorous coupled-wave analysis to analyze the triangular grating device described in Lecture 22. Follow the implementation outline exactly. Write your entire model in a single MATLAB script file, but call `convmat()` to construct the convolution matrices and call `star()` to combine scattering matrices. While the device only contains two layers, write your RCWA so that the code can handle any number of layers.

Using this code, do the following:

1. To verify your code, duplicate all of the data in the RCWA benchmarking documents. Confirm that all your data matches, but you do not need to provide it in this homework.
2. Using 21×21 spatial harmonics, confirm you get R = 9.77% and T = 90.23%.

Use the following header for your program:

```
% Homework #11, Problem 1
% EE 5337 - COMPUTATIONAL ELECTROMAGNETICS
%
% This MATLAB program performs fully three-dimensional
% rigorous coupled-wave analysis of a triangular grating.

% INITIALIZE MATLAB
close all;
clc;
clear all;

% UNITS
meters      = 1;
centimeters = 1e-2 * meters;
millimeters = 1e-3 * meters;

% OPEN FIGURE WINDOW
fig = figure('Color','w');

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% DASHBOARD
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% SOURCE PARAMETERS
lam0 = 2 * centimeters;         %free space wavelength
theta = 0*degrees;              %elevation angle of incidence
phi   = 0*degrees;              %azimuthal angle of incidence
te    = 1;                      %complex amplitude of TE polarization
tm    = 0;                      %complex amplitude of TM polarization

% DEVICE PARAMETERS
ur1 = 1.0;                      %permeability in reflection region
er1 = 2.0;                      %permittivity in reflection region
ur2 = 1.0;                      %permeability in transmission region
er2 = 9.0;                      %permittivity in transmission region
urd = 1.0;                      %permeability of device
erd = 6.0;                      %permittivity of device
Lx  = 1.75 * centimeters;       %period along x
Ly  = 1.5 * centimeters;        %period along y
d1  = 0.5 * centimeters;        %thickness of layer 1
d2  = 0.3 * centimeters;        %thickness of layer 2
w   = 0.8*Ly;                   %length of one side of triangle

% RCWA PARAMETERS
Nx = 1024;                      %number of point along x in real-space grid
Ny = round(Nx*Ly/Lx);           %number of point along y in real-space grid
PQ = 21 * [1 1];                %number of spatial harmonics along x and y
```

Problem #2: Simulate a Second Case

Model the same grating with $\varepsilon_{r,\text{trn}} = 1.0$ and the electric field linearly polarized along the x-axis. Report the total reflectance R and transmittance T from this new device. You will be graded heavily on your accuracy*!*