Wave transmission – MATLAB project 4
Thin layers coating for wideband matching - eliminating reflections in an air-glass interface:

Project goals:
1. To learn the concept of wide-band and wide spectral-angle matching
2. To learn how an anti-reflecting glass is made
3. To get experience in wide-band calculations in multi-layers transmission lines.

Part I: Quarter wavelength matching layer:
We start with a single quarter wavelength layer which is deposited on the glass.

A. Design a matching layer for normal incidence at the center frequency f_0 of the visible spectrum, between the lowest frequency (red, $\lambda_1 = 800[\text{nm}]$) and the highest frequency (violet; $\lambda_2 = 400[\text{nm}]$). (Note that f_0 is not at $600[\text{nm}]$). Calculate the relative layer's dielectric coefficient ε_T and width d_T.

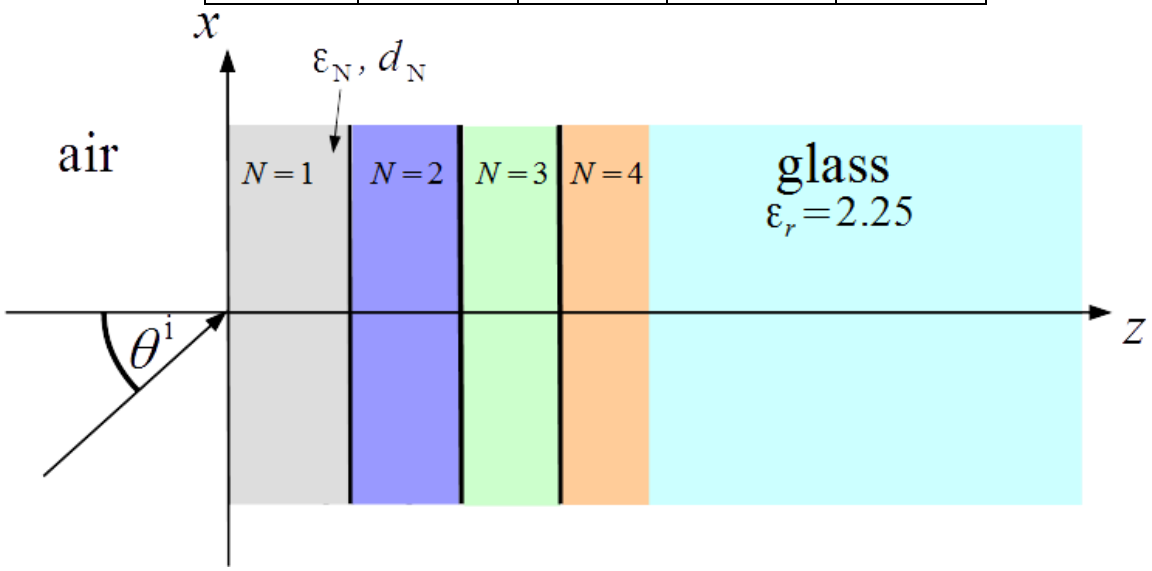
B. Derive the expressions for the reflection coefficient as a function of frequency and angle of incidence. Consider both polarizations.

C. Calculate and plot the absolute value of the reflection coefficient $\Gamma_{\perp\,\parallel}(f,\theta^i)$ for all frequencies in the visible spectrum, for all angles of incidence between $-60^\circ < \theta^i < 60^\circ$, and for both polarizations. Present the results:
   1) On 2D color plots in the (f,θ^i) = (frequency, angle) plane for both polarizations.
   2) As a function of f for $\theta^i = 0$, and as a function of θ^i for $f = f_0$

Part II: Wide-band, multi-layer, quarter wavelength matching:
We now present a wide-band matching by using several quarter-wavelength layers. The design goal is to obtain a reflection coefficient smaller than some specified value Γ_{max} over the specified frequency and angular bandwidth. The values of the desired Γ_{max} and bandwidth determine the number of layers *N*. The matching layers below have been designed using Chebyshev polynomials.

D. Below is a table of the relative dielectric constants for an N-layer adapter where N=2, or 3 or 4. Calculate the widths of the layers (the width of each layer is a quarter wavelength at the center frequency f_0 and for normal incidence). Then, repeat item **C** above for this structure

N	ε_1	ε_2	ε_3	ε_4
2	1.257	1.773	-	-
3	1.131	1.493	1.970	-
4	1.0682	1.301	1.710	2.085



Submission Guidelines
1. The project is performed and *submitted* in *pairs, but students who want it may also do it on their own.*
2. All answers should be explained.
3. Attach your code at the end of the report.