Problem #1 – Revised Formulation of 1D FDTD

Revise your 1D-FDTD formulation document to include the following additions:

- Total-field/scattered-field source formulation
- Efficient Fourier transforms
- Calculation of reflectance and transmittance
- Block diagram or outline summarizing the calculations and the order they should be implemented

Derive the necessary equations for the above items and formulate the equations necessary to be implemented in MATLAB. Show and explain each step in the formulation in as much detail as possible.

Problem #2 – Revise Implementation of 1D FDTD

Revise your 1D-FDTD MATLAB code for the E_y/H_x mode to include the following additions:

- Total-field/scattered-field source that emerges from the center of the grid
- Calculation of reflectance and transmittance using efficient Fourier transforms from DC up to 1 GHz in steps of 100 MHz.
- Plot the fields in real-time during the simulation using the `draw1d()` function.
- Plot the reflectance and transmittance in real-time during the simulation using the standard `plot()` command.
- In your homework, provide a single final plot of transmittance, reflectance, and energy conservation after the simulation finishes and make the plot look professional.
- Follow your block diagram exactly.

Follow the exact algorithm you described in Problem #1 and use the exact equations you derived. You may continue to use the following parameters or revise any of these as you see fit.

$$N_z = 180 \qquad \Delta z = 0.02 \text{ m} \qquad \varepsilon_r(z) = 1.0$$
$$\text{STEPS} = 2000 \qquad \mu_r(z) = 1.0$$

Hint: Inside the main FDTD loop, follow your plots commands with `drawnow`. This will make sure the graphics are updated each iteration.