Homework 1.

There are three options to choose from. The first one is research of topics not covered in OPTI-583, while the other two are computational and will require a small amount of code writing (with optional use of a template provided by the instructor)

Option A: Modeling media in Maxwell solvers

In the context of finite-difference Maxwell solvers, we have only talked about modeling "numerical vacuum" in the class, i.e. a medium without physical dispersion. Look in the literature, textbooks, or online sources of your choice to find out how one can model transparent media with frequency-dependent index of refraction. Write a brief report to summarize your findings.

Option B: Mapping numerical dispersion in 1D Maxwell

Implement and demonstrate the method for mapping the dispersion relation of the 1D Maxwell solver based on the propagation of "white noise." Your task is to re-create the method we have discussed in the class:

1. You can choose to start from a bare-bone 1D Maxwell solver template or write your own simple solver.

2. Propagate the initial condition in the form of white noise for a sufficient number of integration steps, saving the sequence of spatial profiles of the electric field into a two dimensional array (Location$\times$Time).

3. Fourier transform in both dimensions and identify the resulting features that show the dispersion relation of the numerical scheme used.

Submit your program together with a brief report.

Option C: Absorbing boundary in 1D Maxwell

Implement absorbing boundary conditions (Mur ABC, as discussed in the class) into the 1D Maxwell solver, demonstrate their function on both sides of the domain, and estimate the amplitude reflection coefficient of the domain edge.

You can use the provided Maxwell solver template as your point of departure, or write your own. A C-language program is provided with this assignment package for illustration and/or "inspiration."

Submit your program together with a brief report.