ECE 6380: Problem Set #1

1. Modify the FEM MATLAB code from Note #1 to produce a formulation that imposes a Dirichlet boundary condition at the left end of the domain

$$E_y^{total}\Big|_{x=a} = K_a$$

and a zero or homogeneous Neumann boundary condition of the form

$$\left.\frac{dE_y^{total}}{dx}\right|_{x=b} = 0$$

at the right end of the domain. Using $K_a = 1$, generate results for a sequence of meshes for a free-space region of dimension 1.0 wavelengths (show plots of the E-field magnitude to establish that the results are reasonably converged). Comment on the convergence.

2. Use extrapolation to improve the results in Table 5, assuming an $O(\Delta^2)$ rate. (Hint: You may find it easiest to create a short MATLAB code to do this.). Provide a table of the extrapolated values (magnitude and phase).

3. Consider a more general total-field FEM formulation that allows the cells in the model to be variable in size. The input data file will contain a non-uniform set of $\{x\}$ coordinates in this case. Derive the general Z_{mn} entries and *RHS* entries for such a case. (Hint: Perform the integration over one cell at a time, using a variable such as Δ_L or Δ_R to denote the cell dimensions for the cells to the left and right of a given node.)