## 24.781 COMPUTATIONAL ELECTROMAGNETICS

ASSIGNMENT 3
The Finite Element Method

October 27, 2003   **Due Date: Wednesday, November 12, 2003**

A)   Summarize the variational formulation of the Finite Element Method as applied to Poisson's equation in 2-D closed regions. Show that Galerkin's Method produces the same equations as the variational formulation. Does this equivalence depend on the use of a minimum order of polynomial elements?

B)   Write a general purpose program (or modify an existing one) to implement the FEM in 2-D, for first-order elements. Fully describe the program using excerpts from the code. Run your program on an example of your choice and comment on the accuracy by validating the results. (You can use the analytic solution from Assignment 1 if you wish.)

C)   Modify your program in order to solve for the capaciatnce matrix of the same transmission lines as were given in Assignment 1.
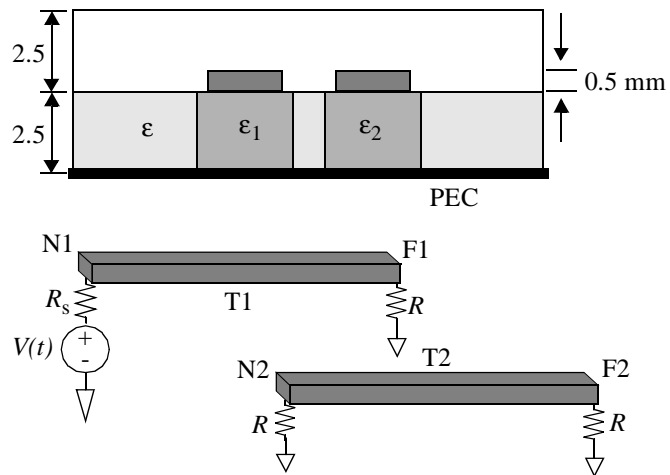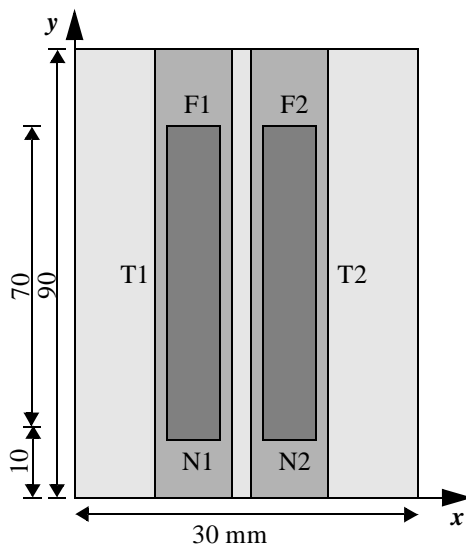
D)   Write a finite-difference time-domain code to solve for the near-end ($V_{N2}(t)$) and far-end ($V_{F2}(t)$) cross-talk. Choose your own transient pulse for $V(t)$. Assume perfect conductors. You will need to determine the inductance matrix as well as the capacitance matrix.