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**ME40064: System Modelling & Simulation**
**ME50344: Engineering Systems Simulation**

**Tutorial 4: Applying Boundary Conditions and Solving the Finite Element Matrix System**

1. a. For the following finite element global matrix system:

$$\begin{bmatrix} 2 & -2 & 0 & 0 & 0 \\ -2 & 4 & -2 & 0 & 0 \\ 0 & -2 & 4 & -2 & 0 \\ 0 & 0 & -2 & 4 & -2 \\ 0 & 0 & 0 & -2 & 2 \end{bmatrix} \begin{bmatrix} C_0 \\ C_1 \\ C_2 \\ C_3 \\ C_4 \end{bmatrix} = \begin{bmatrix} 0.1000 \\ 0.2000 \\ 0.2000 \\ 0.2000 \\ 0.1000 \end{bmatrix}$$

which has been calculated for the domain x= [0,1], apply the following Dirichlet boundary conditions (BCs):

c = 0 at x = 0
c = 1 at x = 1.

Write down the modified matrix and/or right hand side vector.

b. Now input the modified matrix and vector as variables in Matlab and use them to solve the matrix system to obtain the solution vector for **c**. Plot this solution and save the figure to file.

2. a. For the same original matrix system as in Q1, now apply the following boundary conditions. At x=0, the Dirichlet condition c = 0, still exists but now at x=1, there is a Neumann boundary condition equal to -1. Write down the modified matrix and/or right hand side vector for these BCs.

b. Again input the modified matrix and vector into Matlab and solve the system to obtain the solution vector for **c.** Plot this solution and save the figure to file.

c. How has this changed the solution and why?

3. a. If you only set a Dirichlet BC at one end of the domain, what boundary condition would have been implicitly specified at the other end? What would that boundary condition represent physically?