**AE-675/AE-675A: Introduction to Finite Element Methods**

**Assignment No. 2**

1. Develop the weak form and the finite element model of the following differential equations over an element:

Where are known functions of position . Ensure that the element coefficient matrix is symmetric. What is the nature of the interpolation function for the problem?

1. Construct the weak form and the finite element model of the differential equation

over the typical element . Here are the known functions of , and is the dependent variable. The natural boundary condition should not involve the function . What type of interpolation function can be used for ?

1. Construct the weak form and the associated finite element model of the equation

such that the natural boundary condition of the type

is included in the weak form. Here are known functions of , while and are constants.

1. Evaluate the following coefficient matrices and source vector using the linear Lagrange interpolations functions:

are constants.

1. Use the finite element method to solve the differential equation

For the (Drichlet) boundary conditions and . Use a uniform mesh of three linear elements, and compare the finite element solution with the exact solution for .

1. Solve the differential equation in in problem 5 for the (mixed) boundary conditions

Use three linear elements.

1. Find the three- element finite element solution to the stepped- bar problem (axial deformation of a bar). See Fig. for the geometry and data.



1. The equation governing the axial deformation of an elastic bar in the presence of applied mechanical loads f and P and a temperature change T is

where is the thermal expansion coefficient, E the modulus of elasticity, and A the cross- sectional area. Using three linear finite elements, determine the axial displacements in a non- uniform rod of length 30in, fixed at the left end and subjected to an axial force of ad a temperature change of . Take .

1. Analyse the stepped bar with its right end supported by a linear axial spring (see Fig.). The boundary condition at in is



1. Determine the axial deformation of a non- uniform bar, , under its own weight ( per unit length). Use two linear elements. The bar is fixed at .
2. Determine the axial deformation of a varying cross- section member (see Fig.) under its own weight. Use one quadratic element.

