TEST-1

"Fluidity in nature: Computational Interpretations"

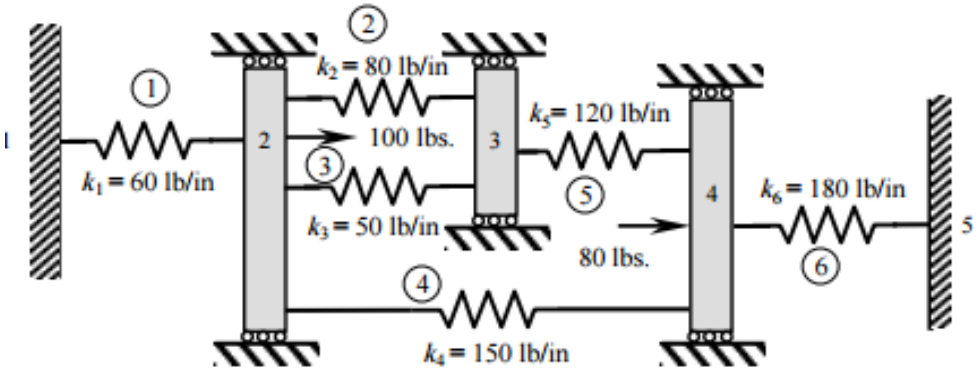
Max marks: 25

1. We wish to use the finite element method to solve the problem described by the following differential equation.

$$-\frac{d}{dx}\left(a\frac{du}{dx}\right)+\frac{d^2}{dx^2}\left(b\frac{d^2u}{dx^2}\right)+cu-x^2=0 \quad for \quad 0<x<1$$

Write down the expression for stiffness matrix (K_{ij}) and force vector (F_i) in integral form for the above mentioned differential equation. What should be the nature of interpolation function for this problem? **(5 marks)**

2. Consider the spring assemblage shown in the figure. Determine the displacement of the rigid block and forces in the spring assuming that the rigid block is required to remain vertical (i.e., no tilting from its vertical position). Use boundary conditions to write the condensed equations for the unknown displacement and forces. **(10 marks)**



3. What are the characteristics of shape functions or interpolation functions used in finite element analysis? Why polynomials are generally used as shape functions? **(5 marks)**

4. Write down the shape functions for a one dimensional quadratic element in terms of local co-ordinates (say the element length is he) and show that these shape functions satisfy the kronecker-delta property. **(5 marks)**