Dr. Pankaj Kumar

Jaypee University of Information Technology, Waknaghat

T 3 Examination – December 2018

M. Tech. 1st Semester (Structural Engineering) & B. Tech. 7th Semester (Civil Engineering)

Course Code: *13M1WCE131* Max. Marks: 35

Course Name: *Finite Element Methods*

Course Credit: *03* Max. Time: 120 *Minutes*

Note: All questions are compulsory. Carrying of mobile phone during examination will be treated as case of unfair means. Assume any missing data.

Q.1 Analyse the space truss shown in Figure1. The truss is composed of four nodes, whoses coordinates (in meters) are shown in figure, and three elements, whose cross-sectional areas are all 0.0001 m^2. The modulus of Elasticity E=210 GPa for all the elements. A load of 20 kN is applied at node 1 in the global x-direction. Node 2-4 are pin supported and thus constrained from movement in the x, y and Z directions. [5]

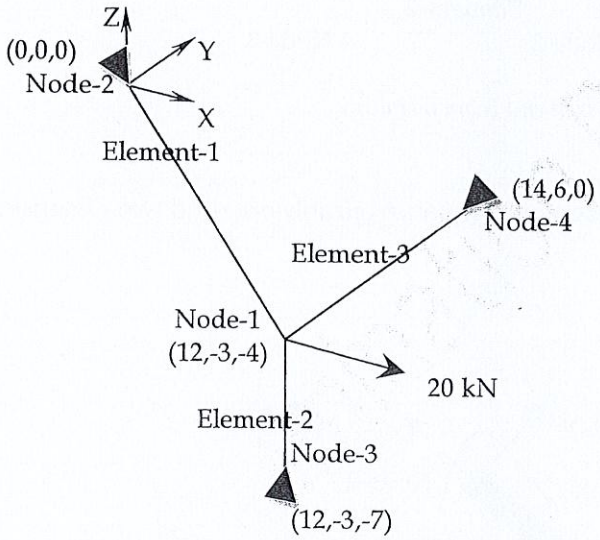
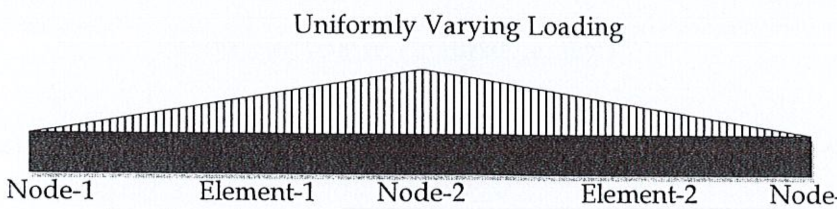


Figure 1: Space truss assembly

Q.2 Compare displacement and axial stress obtained from the finite element solution and exact solution for a bar element. (Assume minimum two elements in a bar element). The schematic view of bar element is shown in Figure 2. [7]



Span Length-2L, Cross section area of bar is A, and Elastic modulus is E.
Fixed at Node-1 and 2. (Assume suitable data if required).

Figure 2: Bar member subjected to uniformly varying loading

Q.3. (a) Write the statement for the Euler-Bernouli Beam Theory and Timoshenko Beam Theory with the engineering application.

(b) Develop a beam stiffness matrix including bending deformation only.

(c) Plot the shape function for the same (beam). [3+3+3]

Q.4. Determine the displacement and rotation under the force and moment located at the centre of the beam shown in Figure 3. The beam has been discredited into the two elements, as shown in Figure. The beam is fixed at both ends. A downward force of 10 kN and an applied moment of 20 kN-m act at the centre of the beam. Elastic modulus E is 210 GPa and Moment of Inertia is 0.0004 m^4 throughout the beam length. Also plot the nodal forces and moments, which are acting on each element. [7]

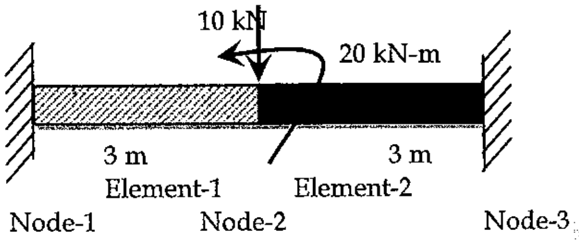


Figure 3: Fixed end beam member

Q.5 Develop a global elemental stiffness matrix for an arbitrarily oriented two dimensional beam element shown in Figure 4. [5]

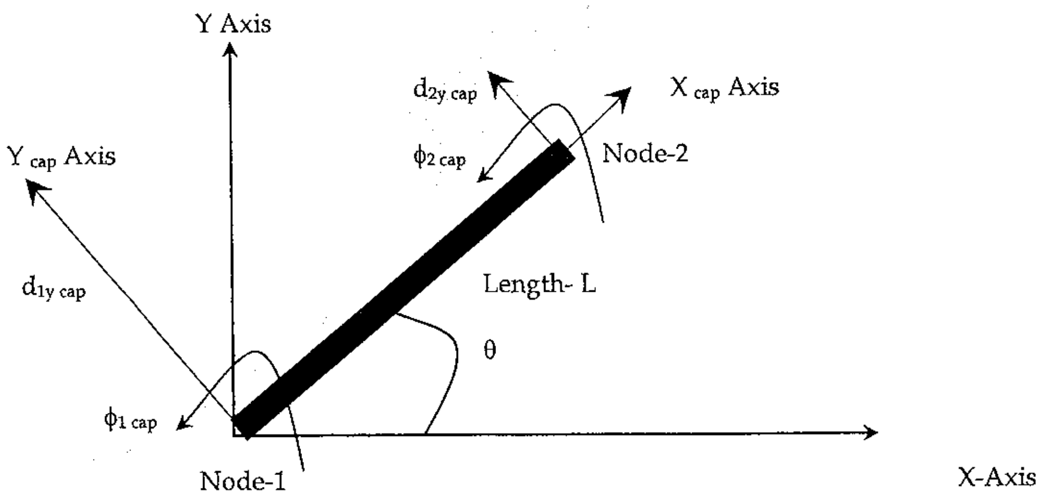


Figure 4: Arbitrarily oriented beam element

Q.6 Define Constant stress and constant strain element and explain the use to analyse a structural engineering problem. [2]