

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination November 2018

B. Tech. (ME/CSE/CSE-IBM) Engineering, Semester V

Roll No.....

COURSE CODE: ID504

Time: 3 hours

Max. Marks: 80

COURSE TITLE: FINITE ELEMENT ANALYSIS

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

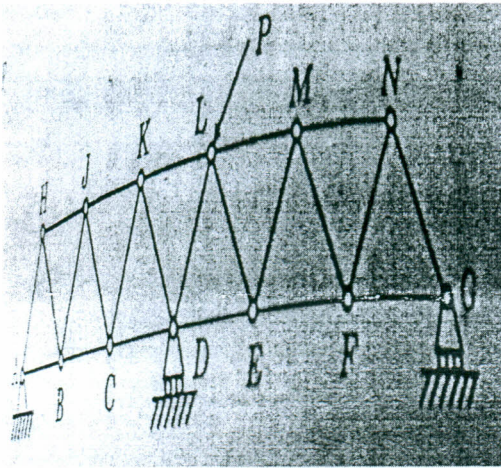
- i. The FEA software is:
(a) ANSYS (b) COSMOS (c) both (a) and (b) (d) None of these
- ii. The expression of shape function N and displacement u for one dimensional bar element
(a) $U = N_1 u_1 + N_2 u_2$ (b) $U = N_1 u_1 - N_2 u_2$ (c) $U = N_1 u_1 / N_2 u_2$ (d) None of these
- iii. The area coordinates are
(a) $L_1 = A_1/A, L_2 = A_2/A, L_3 = A_3/A$ (b) $L_1 = A_1/A, L_2 = A_2/2A, L_3 = A_3/3A$
(c) $L_1 = A_1/3A, L_2 = A_2/3A, L_3 = A_3/3A$ (d) None of these
- iv. One dimensional elements are:
(a) Rectangular (b) Hexahedral (c) Beam (d) None of these
- v. The shape function has unit value at
(a) one nodal point (b) each nodal point (c) both (a) and (b) (d) None of these
- vi. The characteristics of the shape functions is/are []
(a) the shape function has unit value at one nodal point and zero value at the other nodes
(b) the sum of the shape function is equal to one
(c) a & b
(d) none
- vii. Any point in a structure can have maximum of DOF
(a) 2 (b) 3 (c) 4 (d) 6
- viii. What are the types of loading acting on the structure?
(a) Body force (f) (b) Point load (P) (c) both (a) and (b) (d) None of these
- ix. What is the classification of co-ordinates?
- x. Give the stiffness matrix equation for an axisymmetric triangular element.

Q.2 Short answer type questions (4 questions @ 2.5 marks)

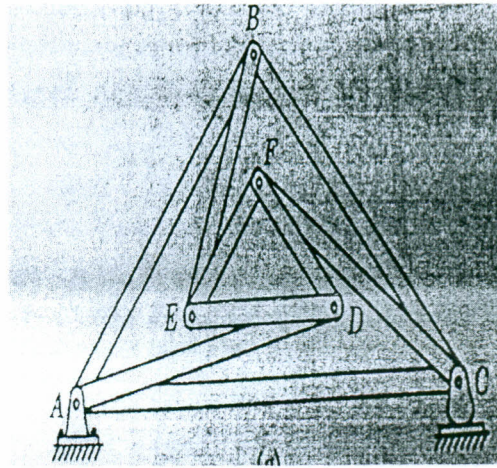
10

- Q.2A What is meant by finite element, nodes and joints? Explain with figures.
- Q.2B State the three phases of finite element method with examples.
- Q.2C Define shape function. What are the characteristic of shape function?
- Q.2D What are the types of boundary conditions?

- Q.3A Write the general steps involving in finite element analysis. 05
- Q.3B Write the conditions of symmetry and anti-symmetry. Consider any plane having eight nodes and five elements then write the conditions of symmetry and anti-symmetry. 05
- Q.4A Explain Constant Strain Triangle (CST). Also, determine the shape functions for the CST. Then, use polynomial functions. 05
- Q.4B What is polynomial type of interpolation functions are mostly used in FEM? Also, describe DOF. 05
- Q.5A During discretization, mention the places where it is necessary to place a node and why. Justify your answer. 05
- Q.5B Classify each of the trusses in following figures as determinate and indeterminate. Also, specify the degree of indeterminacy. 05



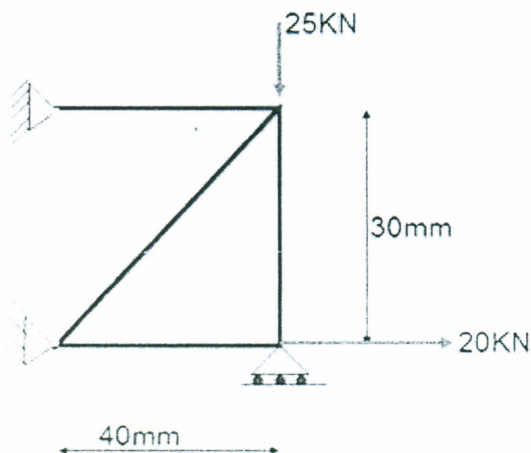
(a)



(b)

- Q.6A Consider the truss structure presented in the following figure:

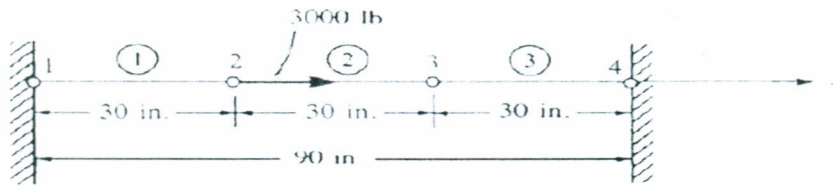
05



$$E = 29.5 \times 10^6 \text{ N/mm}^2 \quad A = 1 \text{ mm}^2$$

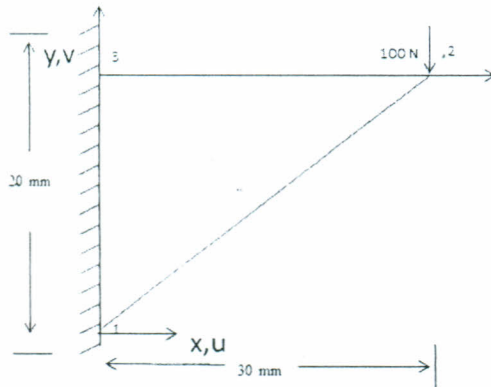
Determine the unknown displacements and reaction forces.

- Q.7 Consider the following three-bar system shown below. Assume for elements 1 and 2: $A = 1 \text{ in}^2$ and $E = 30 (10^6) \text{ psi}$ and for element 3: $A = 2 \text{ in}^2$ and $E = 15 (10^6) \text{ psi}$. 10



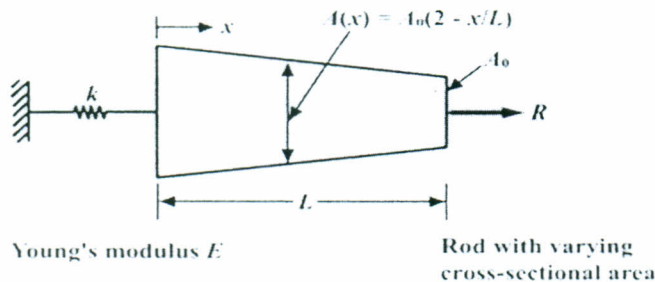
Determine: (a) the global stiffness matrix, (b) the displacement of nodes 2 and 3, and (c) the reactions at nodes 1 and 4.

- Q.8 Calculate displacements and stress in a triangular plate, fixed along one edge and subject to concentrated load at its free end. Assume $E=70,000 \text{ MPa}$, $t=10\text{mm}$ and $\nu=0.3$. 15



OR

- Q.8 (a) Establish the differential equation of equilibrium of the problem shown in the figure below and the (geometric and force) boundary conditions. 8



- (b) Determine the shape functions for the five-node rectangular element shown in the figure below.

