

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-VII Examination-Nov/Dec.-2011

Subject code: 172006

Date: 29/11/2011

Subject Name: Computer Aided Design for Mechatronics

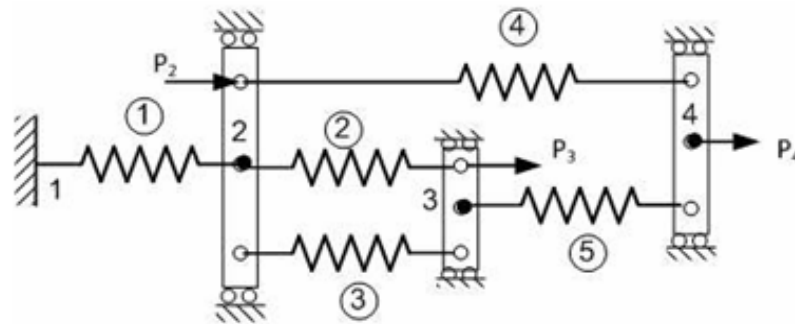
Time: 10.30 am-01.00 pm

Total marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** Using minimum potential energy method or Direct stiffness method, Find the nodal displacements and deflection of the spring assemblage shown in fig 1. **07**



$$k_1 = k_2 = k_3 = 10 \text{ N/mm}, k_4 = 30 \text{ KN/mm}, k_5 = 40 \text{ KN/mm}$$

$$P_2 = 2 \text{ KN}, P_3 = 1.5 \text{ KN}, P_4 = 2.5 \text{ KN}$$

Fig 1.

- (b)** Solve and compare for the axial displacement and stress in the tapered bar shown in fig. 2 using one, two and three constant area elements. Evaluate the area at the center of each element length. Use that area for each element. Let $A_0 = 200 \text{ mm}^2$, $L = 300 \text{ mm}$, $E = 200 \times 10^9 \text{ N/m}^2$ and $P = 200 \text{ KN}$. **07**

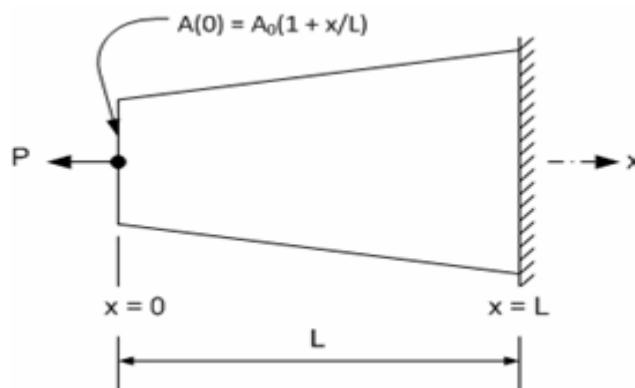


Fig. 2

- Q.2 (a)** Explain the product life cycle with CAD/CAM. And also state the advantage and limitation of CAD. **07**
- (b)** Differentiate between surface and solid modeling. State the limitations and applications of each of these modeling techniques. **07**

OR

- (b) (i) Explain the three most popular graphic standards are GKS, PHIGS and IGES. Write the full form of these acronyms. 04
(ii) Why Flat Panel Displays (LCDs) are gaining popularity with laptop computers and other portable computers? 03

- Q.3 (a) Derive the equation for a Hermite cubic spline segment. Also derive the relationship for blending two segments of Hermite cubic spline. 07
(b) Bezier curve is defined by four control points in sequence (3, 0, 1), (4, 0, 4), (8, 0, 4) and (10, 0, 1). Find the equation of the curve. Evaluate the function for $u=0, 0.2, 0.4, 0.6, 0.8$ and 1.0 and plot the curve. 07

OR

- Q.3 (a) Derive the equation for a 3rd order Bezier curve segment. Also derive the relationship for blending two segments of 3rd order Bezier curve. 07
(b) Determine the displacement and stress in a bar of uniform cross section due to self weight only, when held as shown in fig.3. Use three terms (second order) polynomial for Rayleigh-Ritz method. If Area of cross-section is 100 mm^2 , $E = 200 \text{ GPa}$, material density is 7800 kg/m^3 and length is 1 meter determine the displacement and stress at a point on the rod which is 200 mm away from the fixed end. 07

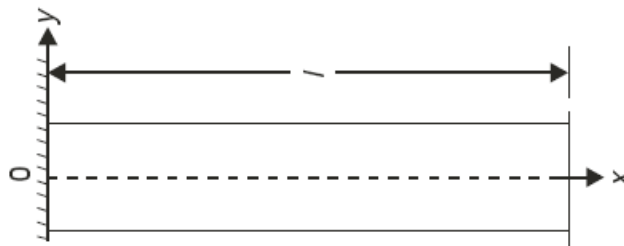


Fig.3

- Q.4 (a) (i) State the applications of FEA in the field of engineering. 03
(ii) Write the general steps to be followed in FEA. 04
(b) A three element truss shown in fig. 4 has modulus of elasticity $E=200 \times 10^3 \text{ N/m}^2$. The area of each element is 300 mm^2 . The length $L_1= 600 \text{ mm}$ and $L_2=800 \text{ mm}$. The load $P_1=10000\text{N}$ and $P_2 = 30000\text{N}$ are applied as shown. Determine the nodal displacements, elemental stresses. 07

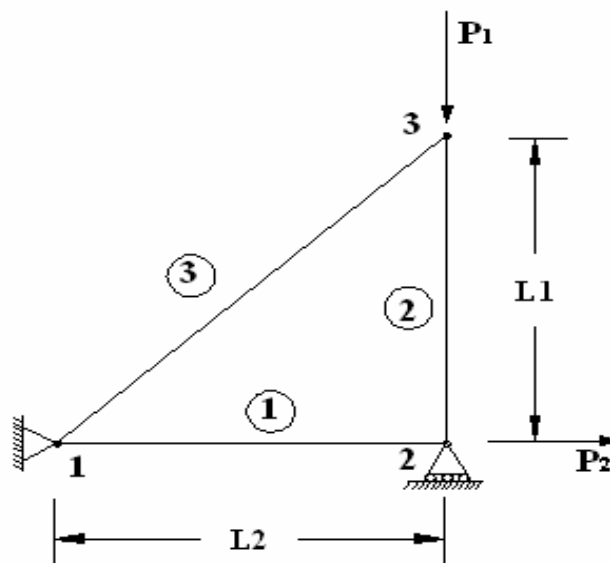


Fig. 4

OR

- Q.4 (a) (i) Write the properties of global stiffness matrix. 04
(ii) Differentiate between a bar element and a truss element 03

- (b) The plane truss shown in fig.5 is composed of members having a square 15mm x 15mm cross section and modulus of elasticity $E=69\text{GPa}$. 07
- Assemble the global stiffness matrix.
 - Compute the nodal displacement in the global coordinate system for the loads shown.
 - Compute the axial stress in each element.

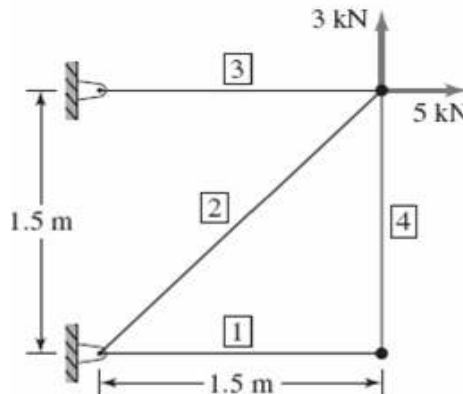


Fig.5

- Q.5** (a) Determine the new vertex positions if a triangle ABC having coordinates A(15,15), B(18,12) and C(15,20) undergoes following transformations: 07
- Rotated by 90° clockwise about the vertex A.
 - Scaled by 0.5 in X direction and 2 in Y direction about vertex C.
 - If it is mirrored about line $y=4x+12$.
- (b) (i) Determine the pixels to be plotted when a line is to be drawn from the position (7, 3) to (1, 1) using DDA algorithm. 04
- (ii) Explain the working of laser printer which is used as an output device in CAD. 03

OR

- Q.5** (a) The concatenated transformation of the graphics element consists of the following operation : 07
- The rotation through 120° about Z-axis.
 - The translation through 10 and -20 units along X and Y directions respectively
 - The rotation through 30° about X- axis
- Write the homogenous transformation matrices for the above operation and develop the concatenated transformation matrix, the operations are done above sequence.
- What will be the result if the sequence of operation reverses?
- (b) (i) With neat sketches, explain the various Boolean operations used in CSG solid modeling. 04
- (ii) Explain the Ruled surface, Tabulated surface and Bezier surface used in surface modeling. 03
