

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII • EXAMINATION – SUMMER • 2014****Subject Code: 172006****Date: 31-05-2014****Subject Name: CAD for Mechatronics****Time: 02:30 pm - 05:00 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)** Figure 1 depicts an assembly of two bar elements made of different materials. Determine the nodal displacements and element stresses. Element 1 area $A_1=750\text{mm}^2$, $L_1=500\text{mm}$ and $E_1=70\times 10^3\text{ N/mm}^2$ and Element 2 $A_2=500\text{mm}^2$, $L_2=500\text{mm}$ and $E_2=200\times 10^3\text{ N/mm}^2$ **07**

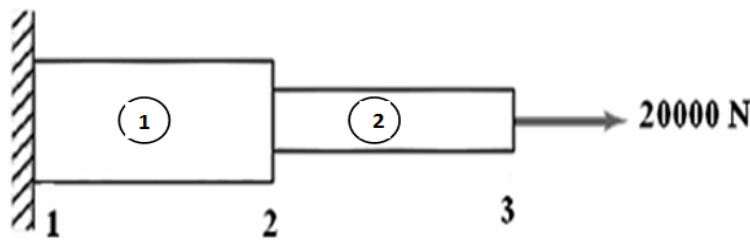


Figure 1. (All dimensions are in mm)

- (b)** Using the minimum potential energy approach or Direct stiffness method, obtain the stiffness matrix for the spring system shown in the figure 2. The vertical members at nodes 2 and 3 are to be considered rigid. Solve for the nodal displacements and the reaction force (at node 1) if $k_1 = 4\text{ N/mm}$, $k_2 = 6\text{ N/mm}$, $k_3 = 3\text{ N/mm}$, $F_2 = 30\text{ N}$, $F_3 = 0$ and $F_4 = 50\text{ N}$. **07**

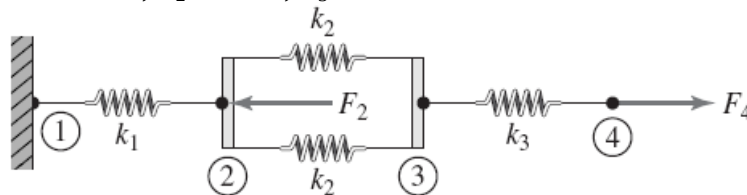


Figure 2. (All dimensions are in mm)

- Q.2 (a)** Evaluate the LED and LCD displays in terms of their characteristic features for CAD applications. **07**
- (b)** Explain Modern industries prefer Computer Aided Design over conventional design approach. **07**

OR

- (b)** (i) List some uses for wireframe models. What are the limitations of a wireframe model? **07**
- (ii) List engineering applications of surface models, for which wireframe models cannot be used. What are different types of surfaces?

- Q.3 (a)** Differentiate between Surface model and Solid models. State the engineering applications of each one. **07**
- (b)** What is computer aided design? Discuss the reasons for implementing CAD. **07**

OR

- Q.3 (a)** Prove that if the first segment of Bezier curve is formed by P_0, P_1, P_2 and P_3 and second segment is formed by P_3, P_4, P_5, P_6 and P_7 , then three points P_2, P_3 and P_4 must be collinear and satisfy the relationship: $3(P_3 - P_2) = 4(P_4 - P_3)$ **07**
- (b)** Explain sweep, octree and B-rep techniques used for solid modeling. **07**

- Q.4 (a)** (i) Differentiate between a bar element and a truss element. **07**
(ii) State the properties of global stiffness matrix.
(b) Describe the general steps involved in a finite element analysis. **07**

OR

- Q.4 (a)** A three element truss shown in figure 4 has modulus of elasticity $E = 200 \text{ GPa}$. The area of each element is 50 mm^2 . The length of element $L_1 = 1000 \text{ mm}$ and $L_3 = 1000 \text{ mm}$. The load at node 2 is applied $P_2 = 100 \text{ N}$ are applied as shown. Determine the nodal displacements at node 2. **07**

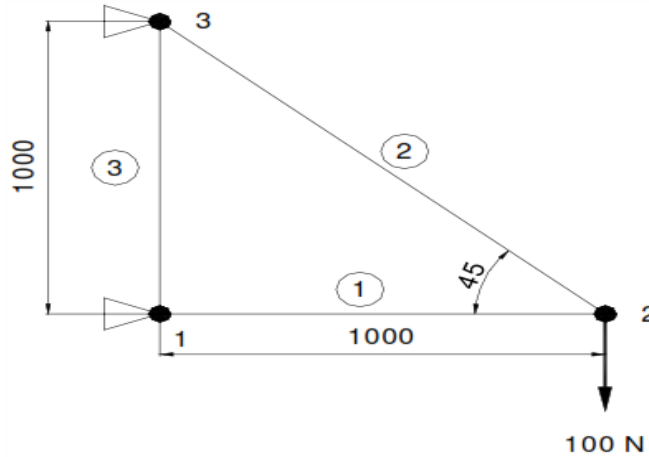


Figure 4. (All dimensions are in mm)

- (b)** Derive the orthographic projection matrices for the Top view and Right Hand side view of a 3D model. **07**
- Q.5 (a)** For the cubic Bezier curve $P(u)$ $[0 \leq u \leq 1]$ defined by the control points $P_0 (0, 0)$, $P_1 (1, 0)$, $P_2 (0, 1)$ and $P_3 (2, 2)$ **07**
(i) Draw the control polygon, and the convex hull,
(ii) Draw a rough sketch of the curve, and calculate the position of the curve point P at $u=1/3$, $u=1/2$ and $u=2/3$.
(iii) Prove that the curve passes through the first and last points only.
(b) Develop from fundamentals the transformation matrix for rotating an object in the ZX-plane. **07**

OR

- Q.5 (a)** A triangle ABC has vertices $A(20,20)$, $B(30,40)$ and $C(20,40)$. This triangle is to be reflected about a line joining point $P(10,10)$ and $Q(40,20)$. Determine the new coordinates of the vertices. **07**
(b) A monochrome display has a resolution of 800×600 with a refresh rate of 75 Hz non-interlaced. Find the bitmap size and the no. of simultaneous gray levels that can be displayed. **07**
If the display is to be upgraded to display 256 gray levels simultaneously, find the bitmap size.
