GUJARAT TECHNOLOGICAL UNIVERSITY BE - SEMESTER-VII • EXAMINATION – SUMMER • 2014

Subject Code: 172006

Subject Name: CAD for Mechatronics

Time: 02:30 pm - 05:00 pm

Date: 31-05-2014

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. 07 Determine the nodal displacements and element stresses. Element 1 area $A_1=750$ mm², $L_1 = 500$ mm and $E_1 = 70 \times 10^3$ N/mm² and Element 2 $A_2=500$ mm², $L_2 = 500$ mm and $E_2 = 200 \times 10^3$ N/mm²



Figure 1. (All dimensions are in mm)

(b) Using the minimum potential energy approach or Direct stiffness method, 07 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 $k_1 = 4$ N/mm, $k_2 = 6$ N/mm, $k_3 = 3$ N/mm, $F_2 = 30$ N, $F_3 = 0$ and F4 = 50N.



Figure 2. (All dimensions are in mm)

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

OR

- (b) (i) List some uses for wireframe models. What are the limitations of a 07 wireframe model?
 - (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 07 applications of each one.
 - (b) What is computer aided design? Discuss the reasons for implementing CAD. 07OR
- **Q.3** (a) Prove that if the first segment of Bezier curve is formed by P_0 , P_1 , P_2 and P_3 **07** 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: $3(P_3-P_2)=4(P_4-P_3)$
 - (b) Explain sweep, octree and B-rep techniques used for solid modeling.

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

OR

Q.4 (a) A three element truss shown in figure 4 has modulus of elasticity E= 200 GPa. 07 The area of each element is 50 mm². The length of element $L_1= 1000$ mm and $L_3=1000$ mm. The load at node 2 is applied $P_2 = 100N$ are applied as shown. Determine the nodal displacements at node 2.



Figure 4. (All dimensions are in mm)

- (b) Derive the orthographic projection matrices for the Top view and Right Hand 07 side view of a 3D model.
- **Q.5** (a) For the cubic Bezier curve $P(u) [0 \le u \le 1]$ defined by the control points P0 07 (0, 0), P1 (1, 0), P2 (0, 1) and P3 (2, 2)
 - (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 07 the ZX-plane.

OR

- Q.5 (a) A triangle ABC has vertices A(20,20), B(30,40) and C(20,40). This triangle is 07 to be reflected about a line joining point P(10,10) and Q(40,20). Determine the new coordinates of the vertices.
 - (b) A monochrome display has a resolution of 800x600 with a refresh rate of 75Hz
 07 non-interlaced. Find the bitmap size and the no. of simultaneous gray levels that can be displayed.

If the display is to be upgraded to display 256 gray levels simultaneously, find the bitmap size.

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