

Seat No.: \_\_\_\_\_

Enrolment No. \_\_\_\_\_

**GUJARAT TECHNOLOGICAL UNIVERSITY**

**BE - SEMESTER-VI (NEW) - EXAMINATION – SUMMER 2017**

**Subject Code: 2161903**

**Date: 08/05/2017**

**Subject Name: Computer Aided Design**

**Time: 10:30 AM to 01:00 PM**

**Total Marks: 70**

**Instructions:**

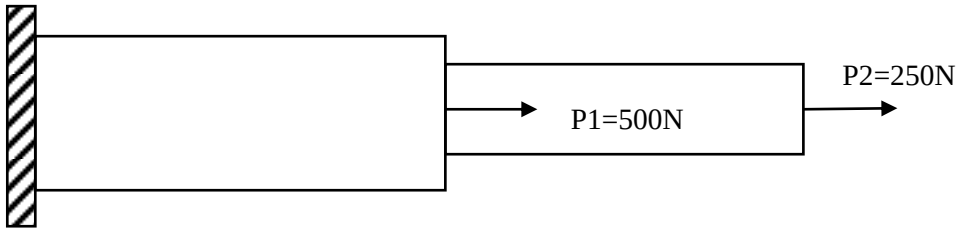
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

|            |                                                                                                                                                                                                                                                                                                                       | MARKS     |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>Q.1</b> | <b>Short Questions</b>                                                                                                                                                                                                                                                                                                | <b>14</b> |
| 1          | DVST stands for _____<br>a. Digital View Storing Table    b. Direct Visual Storage Tube<br>c. Direct View Storage Tube    d. Digital View Storage Tube                                                                                                                                                                |           |
| 2          | A _____ modeler defines model without mass properties.<br>a. wireframe    b. primitive    c. B-rep    d. CSG                                                                                                                                                                                                          |           |
| 3          | What is persistence?                                                                                                                                                                                                                                                                                                  |           |
| 4          | A triangle has vertices at A (2, 3), B (4, 3), and C (3, 6). Which transformation would produce an image with vertices A' (3, - 2), B' (3, - 4), C' (6, - 3)?<br>a. a reflection over the x-axis    b. a reflection over the y-axis<br>c. a rotation 90° clockwise at origin    d. a rotation 90° counterclockwise at |           |
| 5          | B-rep and C-Rep are the methods of _____<br>a. Solid modeling    b. Surface modeling<br>c. Wire frame modeling    d. 2D modeling                                                                                                                                                                                      |           |
| 6          | The degree of Bezier curve with n control points is:<br>a. (n+1)    b. (n-1)    c. (n+2)    d. (n-2)                                                                                                                                                                                                                  |           |
| 7          | C <sup>1</sup> continuity refers to<br>a. Common tangent    b. Common curvature<br>c. Common normal    d. Common point                                                                                                                                                                                                |           |
| 8          | The rectangle portion of the interface window that defines where the image will actually appear are called<br>a) Transformation viewing    b) View port<br>c) Clipping window    d) Screen coordinate system                                                                                                          |           |
| 9          | State limitations of wire-frame modeling.                                                                                                                                                                                                                                                                             |           |
| 10         | State any two advantages of homogeneous coordinate transformations.                                                                                                                                                                                                                                                   |           |
| 11         | Write two characteristics of any shape functions.                                                                                                                                                                                                                                                                     |           |
| 12         | What is a difference between bar elements and beam elements?                                                                                                                                                                                                                                                          |           |
| 13         | What are the type of loading acting on structure?                                                                                                                                                                                                                                                                     |           |
| 14         | Name any three FEM software.                                                                                                                                                                                                                                                                                          |           |
| <b>Q.2</b> | <b>(a)</b> State the various stages for a design process, in which various CAD tools can be used to improve productivity.                                                                                                                                                                                             | <b>03</b> |
|            | <b>(b)</b> For the position vectors P <sub>1</sub> [3 7] and P <sub>2</sub> [8 9], determine the parametric representation of line segment between them. Also determine the slope                                                                                                                                     | <b>04</b> |
|            | <b>(c)</b> Write steps required to plot a line whose slope is between 45° & 90°, using Bresenham's algorithm.                                                                                                                                                                                                         | <b>07</b> |
|            | <b>OR</b>                                                                                                                                                                                                                                                                                                             |           |
|            | <b>(c)</b> Determine the pixels for a straight line connecting two points (2, 7) and (15,                                                                                                                                                                                                                             | <b>07</b> |

- 10) using Bresenham's algorithm.
- Q.3 (a)** State the properties of Hermite Cubic Splines. How these curves are differing from Bezier curves? **03**
- (b)** A point P is translated by (4,6,0) rotated about x-axis by 45° CCW and then rotated about z- axis by 30° CCW. Obtain the concatenated homogeneous transformation matrix and final coordinates of a point P. **04**
- (c)** Differentiate between surface and solid modelling. **07**  
State the limitations and applications of each of these modelling techniques.

**OR**

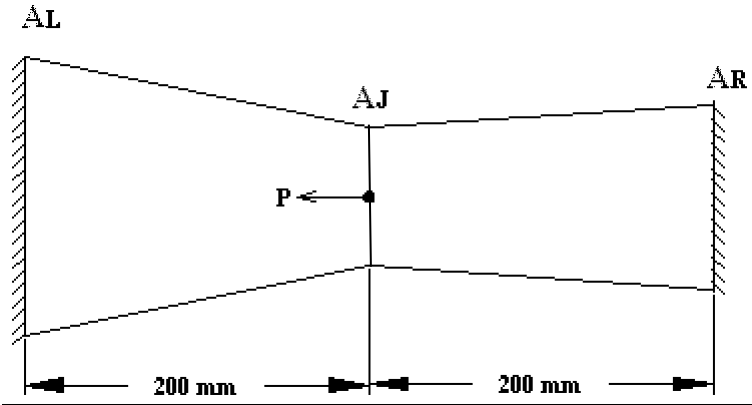
- Q.3 (a)** Derive the orthographic projection matrices for the Top view and Right Hand side view of a 3D model. **03**
- (b)** Find reflection matrix, when the axis of reflection is given by the equation  $y=5x$ . **04**
- (c)** The vertices of a Bezier polygon are  $A_0 [2, 2]$ ,  $A_1 [3, 4]$ ,  $A_2 [3, 4]$  and  $A_3 [5, 4]$ . Determine 4 points on the Bezier curve. **07**
- Q.4 (a)** Draw a sketch of following elements showing nodes:  
(1) Quadrilateral (2) Six noded triangular (3) Tetrahedral **03**
- (b)** Consider the bar shown in figure-1 below. Determine the nodal displacement and element stresses. **04**



$A_1 = 250 \text{ mm}^2$   
 $E_1 = 200 \text{ GPa}$   
 $L_1 = 250 \text{ mm}$

$A_2 = 150 \text{ mm}^2$   
 $E_2 = 70 \text{ GPa}$   
 $L_2 = 250 \text{ mm}$

- (c)** Formulate the finite element model using 1D-bar element for the system shown in figure-2 below. Area at the junction shown below is  $A_J = 250 \text{ mm}^2$ , at the left end is equal to  $A_L = 750 \text{ mm}^2$  and at the right end is equal to  $A_R = 500 \text{ mm}^2$ . Length up to junction from any end is 200 mm. Load  $P = 500 \text{ kN}$  is acting at the junction. Young's modulus of elasticity  $E = 200 \text{ GPa}$ . The temperature of the system is raised by 40°C. Co-efficient of thermal expansion is  $11 \times 10^{-6}$  per °C. Assemble the stiffness matrix & force vector. **07**



**OR**

- Q.4 (a)** What do you mean by Iso-parametric representations? **03**
- (b)** Find the nodal displacements and elemental stresses for the axially loaded stepped bar as shown in figure-3 below using Penalty approach. **04**  
 $E = 200 \text{ GPa}$ ,  $A_1 = 200 \text{ mm}^2$ ,  $A_2 = 180 \text{ mm}^2$  and  $\Delta x = 0.1 \text{ mm}$ .

- (c) A thin plate as shown in figure-4 has a uniform thickness of 10 mm and modulus of elasticity is 200 GPa. The plate is subjected to a point load  $P = 500$  N as shown in figure. Model the problem with two elements and find stresses in each element.

07

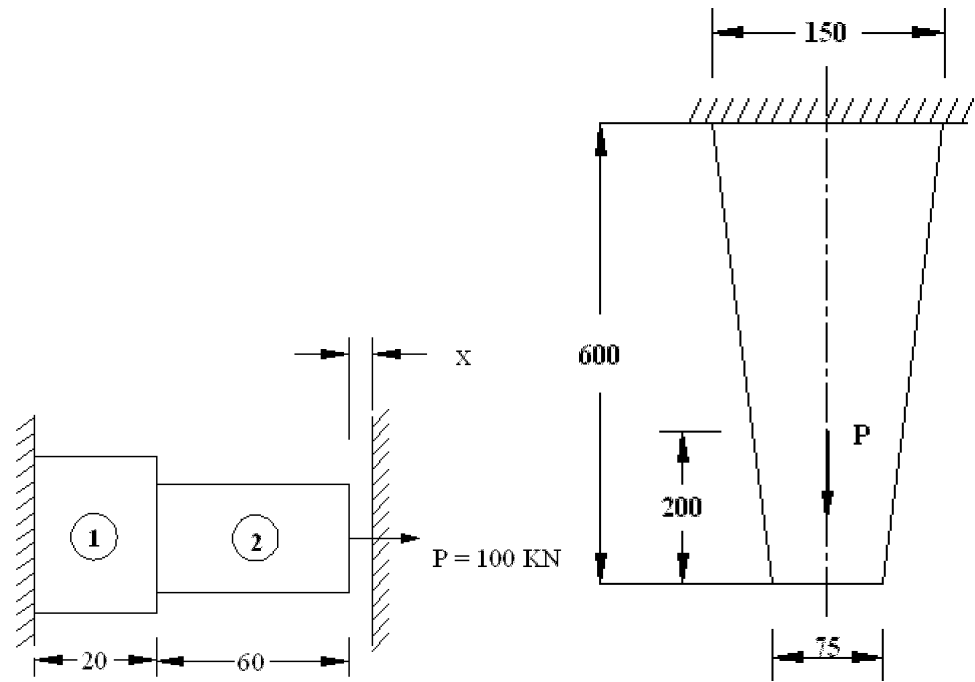
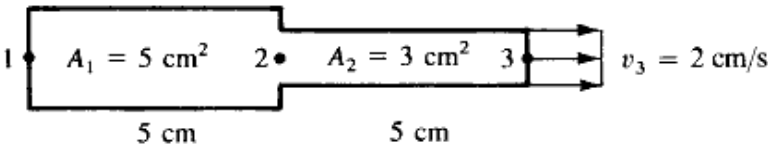


Figure -3 (Q-4b)

Figure -4 (Q-4c)

- Q.5 (a) Discuss quadratic shape functions and their uses. 03
- (b) i. State the applications of FEA in the field of engineering. 04
- ii. Write the properties of global stiffness matrix.
- (c) For the one dimensional fluid flow problem as shown in figure 5 with velocity known at right end, determine velocities at nodes 1 and 2. Let  $K_{xx}=2\text{cm/s}$  07



OR

- Q.5 (a) Write the general steps to be followed in FEA to solve a structural problems. 03
- (b) Evaluate the shape functions  $N_1$ ,  $N_2$  and  $N_3$  at the interior point P for the triangular element as shown in figure 6. 04
- (c) A three element truss as shown in figure 7 has modulus of elasticity  $E = 200$  GPa. The area of each element is  $50\text{ mm}^2$ . The length  $L_1 = 1000\text{ mm}$  and  $L_2 = 750\text{ mm}$ . The load  $P_1 = 25\text{ kN}$  and  $P_2 = 30\text{ kN}$  are applied as shown. Determine the nodal displacements, reaction forces and elemental stresses. 07

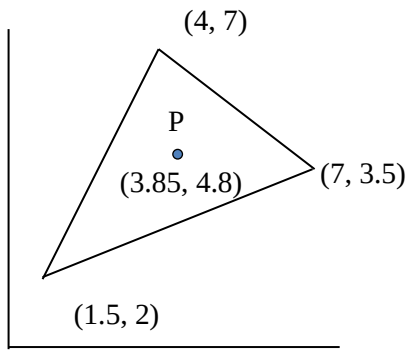


Figure 6 (Q-5b)

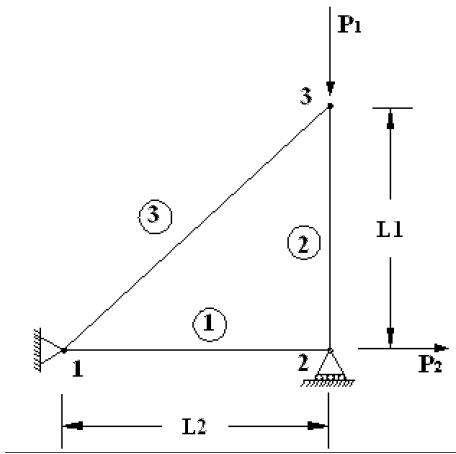


Figure 7 (Q-5c)

\*\*\*\*\*