Enrolment No./Seat No_____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE- SEMESTER–VI EXAMINATION – WINTER 2025**

**Subject Code:3161903 Date:17-11-2025**

**Subject Name:Computer Aided Design**

**Time:02:30 PM TO 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.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | What are the main stages of a typical product cycle? | **03** |
| | **(b)** | With proper sketch explain Interactive Computer Graphics. | **04** |
| | **(c)** | Draw line segment joining (20, 10) and (25, 14) using Bresenham line generation algorithm. | **07** |
| **Q.2** | **(a)** | Explain types of surfaces in brief. | **03** |
| | **(b)** | Differentiate between Constructive Solid Geometry and B-Representation. | **04** |
| | **(c)** | Describe the properties of Bezier curves, such as endpoints, control points, and curve shape. | **07** |
| | | **OR** | |
| | **(c)** | Based on Bezier curve definition, derive the equation of three point Bezier curve defined by the following control points.<br>(-1,0), (0,2), and (1,0). | **07** |
| **Q.3** | **(a)** | Explain Homogeneous Coordinate system? | **03** |
| | **(b)** | Differentiate between the Scaling and Shearing transformation. | **04** |
| | **(c)** | Obtain the mirror reflection of the triangle formed by vertices A (0, 3), B (2, 0), C (3, 2) about the line passing through the points (1, 3) and (-1,-1). | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Write the transformation matrix for 2D Rotation, Reflection and Shearing Transformation. | **03** |
| | **(b)** | Find the 3x3 homogeneous co-ordinate transformation matrix for each of the following:<br>i. Shift an image to the right by 3 units.<br>ii. Shift the image up by 2 units and down 1 units.<br>iii. Move the image down 2/3 units and left 4 units. | **04** |
| | **(c)** | Prove that the multiplication of three dimensional transformation matrices for each of the following sequence of operations is commutative:<br>(a) Two successive rotations about any one of the coordinate axis.<br>(b) Two successive translations.<br>(c) Two successive scaling. | **07** |
| **Q.4** | **(a)** | Define Finite Element Analysis (FEA) and explain its application in engineering. | **03** |
| | **(b)** | Explain the purpose of each step in the FEA process. | **04** |
| | **(c)** | Consider the bar shown in given Fig. 1 An axial load P = 200 x 103 N is applied as shown. Determine the nodal displacements Using the penalty approach for handling boundary conditions | **07** |

| | | | |
|---|---|---|---|
| **Q.4** | **(a)** | List the basic steps involved in solving a problem using FEA. | **03** |
| | **(b)** | What is discretization? How it is done in FEM. | **04** |
| | **(c)** | Explain in detail the General procedure of Finite Element Method | **07** |
| **Q.5** | **(a)** | Explain optimization in the context of engineering. | **03** |
| | **(b)** | Discuss Euler-Bernoulli beam theory. | **04** |
| | **(c)** | Describe the purpose of optimization techniques in engineering design. Explain the difference between constrained and unconstrained optimization. | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | Define engineering optimization and explain its importance in the design of machine elements. | **03** |
| | **(b)** | Explain how the stiffness matrix is derived from the strain-displacement matrix for structural problems. | **04** |
| | **(c)** | What is Johnson's method used for in engineering design? Define the key steps involved in Johnson's method. | **07** |

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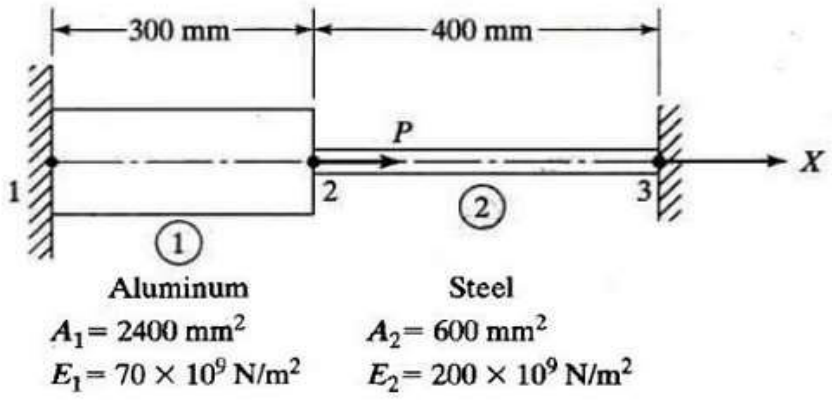


Fig: 1 {Que: 4 (c)}

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# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE- SEMESTER–VI (NEW) EXAMINATION – WINTER 2024**

**Subject Code:3161903 Date:25-11-2024**

**Subject Name:Computer Aided Design**

**Time:02:30 PM TO 05:00 PM Total Marks:70**

**Instructions:**

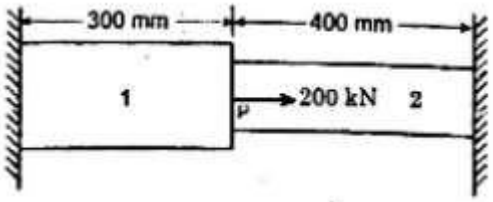
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | |
|---|---|---|---|
| **Q.1** | **(a)** | Clearly distinguish between conventional design and CAD. | **03** |
| | **(b)** | Explain different coordinate systems available in a CAD software. | **04** |
| | **(c)** | Write Breshnham's algorithm for line having slope less than 45°. | **07** |
| **Q.2** | **(a)** | State the role of graphics standards in CAD. List various graphics standards with their full name | **03** |
| | **(b)** | (i) List various data exchange formats. (ii) Explain GKS standard. | **04** |
| | **(c)** | Explain Hermit cubic spine curve with neat sketch. Also write its characteristics and obtain the parametric equation for the same. | **07** |
| | | **OR** | |
| | **(c)** | The coordinates of four control points P0, P1, P2 and P3, relative to WCS are: (3,3,0), (3,4,0), (4,4,0) and (4,3,0) respectively. Find the equation of the Bezier curve and determine the coordinates of points on curve for u = 0, 0.25, 0.5, 0.75 and 1.0. | **07** |
| **Q.3** | **(a)** | Briefly discuss about B-spline curve. | **03** |
| | **(b)** | Differentiate between wireframe modeling and solid modeling technique for CAD. | **04** |
| | **(c)** | The three vertices of triangle PQR are: P(50,20), Q(110,20) and R(80,60). Determine the coordinates of the vertices for the new reflected triangle, if it is to be reflected about:<br>(i) X-axis and (ii) line y=x | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Prepare the detailed specification for a CAD workstation. | **03** |
| | **(b)** | Explain properties of Bezier curve. | **04** |
| | **(c)** | A rectangle is formed by four points: A(25,25), B(25,125), C(75,125), and D(75,25). Calculate the coordinates of transformed rectangle if:<br>(i) It is changed by scaling factors Sx = 0.4 and Sy = 0.6<br>(ii) The center remains at same position after scaling and scaling factor is 1.5 | **07** |
| **Q.4** | **(a)** | What is Geometric Transformation? | **03** |
| | **(b)** | Explain with suitable example, transformation matrix in homogeneous coordinate system. | **04** |
| | **(c)** | What is feature based modeling? Discuss various steps involved in creation of models using features. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Give step by step procedure of Finite Element Analysis | **03** |
| | **(b)** | Explain with neat sketch octree encoding technique used in solid modeling. | **04** |
| | **(c)** | Discuss applications of optimization in engineering. | **07** |

**Q.5** **(a)** What is discretization in finite element analysis? **03**

**(b)** Explain the following with reference to optimization: i) Objective function ii) Constraints **04**

**(c)** Consider a bar as shown in below figure. An axial load of 200KN is applied at point P. Take A1=2400 mm2 , E1=70GPa, A2=600 mm2 and E2=200GPa. Calculate the following (i) The nodal displacement (ii) Stresses in each element (iii) Reactions at supports **07**

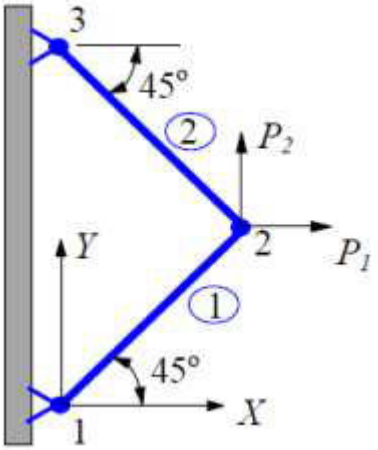



**OR**

**Q.5** **(a)** State the properties of the global stiffness matrix **03**

**(b)** Explain concept of plane stress and plane strain with examples. **04**

**(c)** A simple plane truss is made of two identical bars (with E, A and L) and loaded as shown in below figure. Find 1) Displacement of node 2 2) Stress in each bar **07**

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# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VI (NEW) EXAMINATION – WINTER 2023**

**Subject Code:3161903 Date:05-12-2023**

**Subject Name: Computer Aided Design**

**Time:02:30 PM TO 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.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | List various graphics standard used for graphics data exchange in CAD. | **03** |
| | **(b)** | Compare conventional design with Computer Aided Design. | **04** |
| | **(c)** | What is meant by a scan conversion? Explain Bresenham's line drawing algorithm. | **07** |
| **Q.2** | **(a)** | List the advantages and limitations of surface modeling. | **03** |
| | **(b)** | Explain analytic curves and synthetic curves with example. | **04** |
| | **(c)** | Derive general parametric equation for Hermits cubic spline curve in matrix form. | **07** |
| | | **OR** | |
| | **(c)** | A cubic spline is represented by the following equation: $P(u) = C_3u^3 + C_2u^2 + C_1u + C_0$ where $0 \leq u \leq 1$ where $C_3, C_2, C_1, C_0$ are the polynomial coefficients. Determine the four control points of an identical Bezier curve in terms of these polynomial coefficients. | **07** |
| **Q.3** | **(a)** | Write 2D transformation matrix for Scaling, Rotation and Translation. | **03** |
| | **(b)** | Explain Projections of geometric models. | **04** |
| | **(c)** | A Triangle PQR has its vertices at P (0,0), Q (4,0) and R (2,3). It is to be translated by 4 units in X direction, and 2 units in Y direction, then it is to be rotated in anticlockwise direction about the new position of point R through 90 degree. Find the new position of the triangle. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Write engineering application of Finite Element Analysis. | **03** |
| | **(b)** | Explain homogenous coordinate transformation with its advantages. | **04** |
| | **(c)** | The end points of a line are (2, 3) and (10, 8). Find the intermediate raster locations of the line using DDA algorithm. | **07** |
| **Q.4** | **(a)** | State the difference between Plane truss and Space truss. | **03** |
| | **(b)** | Write step by step general procedure for FEA. | **04** |

**(c)** Consider the bar as shown in figure 1 below. find: a) Nodal Displacement, using global stiffness matrix. b) Elemental Stresses. c) Support Reaction. **07**

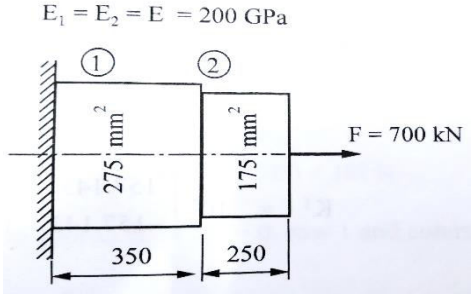


Figure 1

**OR**

**Q.4** **(a)** Discuss applications of optimization in engineering. **03**

**(b)** Explain Plain Stresses and Plain Strains in FEA. **04**

**(c)** For the Loading as shown in figure 2, with the penalty approach determine the displacements and support reaction. Assume modulus of elasticity as 80 X $10^3$ N/$mm^2$. **07**

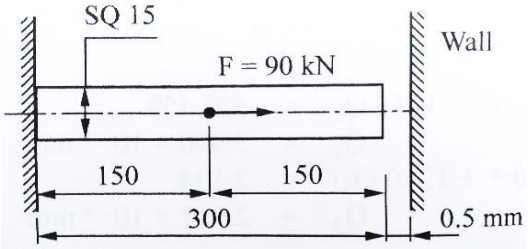


Figure 2

**Q.5** **(a)** Explain Penalty approach to solve FEA problem. **03**

**(b)** Discuss the properties of global stiffness matrix. **04**

**(c)** Explain Johnson's method of optimum design with an example **07**

**OR**

**Q.5** **(a)** What do you understand by geometry and topology in solid modelling? **03**

**(b)** What do you mean by thermal effects of temperature? How is it included in calculation for 1-D elements? **04**

**(c)** What are different representation schemes for solid models? Compare CSG and B-rep techniques of solid modeling **07**

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# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VI(NEW) EXAMINATION – WINTER 2022**

**Subject Code:3161903 Date:14-12-2022**

**Subject Name:Computer Aided Design**

**Time:02:30 PM TO 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.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | Marks |
|---|---|---|---|
| **Q.1** | **(a)** | State the usage of CAD tools in various stages of design process. | **03** |
| | **(b)** | What do you mean by Computer Aided Design (CAD)? Discuss reasons for implementing CAD in industry. | **04** |
| | **(c)** | What is meant by a scan conversion? Explain Bresenham's circle drawing algorithm | **07** |
| **Q.2** | **(a)** | Write equations of following curves in parametric form: (1) Line (2) Circle (3) Ellipse | **03** |
| | **(b)** | Write the differences between (i) Raster scan and Vector scan displays (ii) Analytic curves and Synthetic curves | **04** |
| | **(c)** | Distinguish between B-Rep and C-Rep of Solid modeling techniques. | **07** |
| | | **OR** | |
| | **(c)** | A Bezier curve is to be constructed using control points $P_0(35,30)$, $P_1(25,0)$, $P_2(15,25)$ and $P_3(5,10)$. The Bezier curve is anchored at $P_0$ and $P_3$. Find the equation of the Bezier curve and plot the curve for u=0, 0.2, 04, 06, 0.8 and 1. | **07** |
| **Q.3** | **(a)** | Explain the Geometric Transformation. | **03** |
| | **(b)** | List the advantages and limitations of surface modeling. | **04** |
| | **(c)** | A rectangle ABCD has vertices A (10,20), B (40,20), C (40,40) and D (10,40). This rectangle is to be sheared in such a way that coordinates of vertices C and D changes to C'(50,40) and D'(20,40), with A and B remaining unchanged. Write down the necessary transformation. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | What is homogenous coordinate system? Explain its importance in CAD. | **03** |
| | **(b)** | Compare wireframe, surface and solid modeling techniques. | **04** |
| | **(c)** | A triangle ABC with vertices A (0,0), B(4,0) and C(2,3) is translated through 4 and 2 units along X and Y direction respectively and then rotated through $90^o$ in counter clock wise direction about the new position of point C. Find the (1) New concatenated transformation matrix and (2) The new position of triangle. | **07** |
| **Q.4** | **(a)** | Give step by step procedure of Finite Element Analysis | **03** |
| | **(b)** | Write matrices for 2D scaling, 2D translation, 2D rotation and mirroring about Y axis for object in 2D space using homogeneous coordinates. | **04** |
| | **(c)** | Explain the following with reference to optimization: i) Objective function ii) Constraints | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | State the application of Finite Element Analysis | **03** |
| | **(b)** | Briefly explain the Graphic exchange standard. | **04** |

**(c)** Discuss applications of optimization in engineering. **07**

**Q.5** **(a)** Discuss in brief the elements used in FEA **03**

**(b)** Discuss the shape functions in natural coordinate system. **04**

**(c)** An axial load F=20000N is applied as shown in figure 1 on the bar. **07**
Find out following using finite element method.

(a) Nodal displacement.
(b) Stress in each section.
(c) Reaction forces.

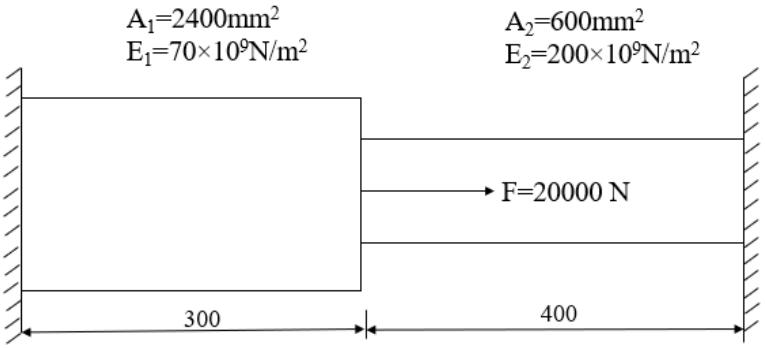


**Figure 1**

**OR**

**Q.5** **(a)** Discuss the properties of global stiffness matrix. **03**

**(b)** Discuss the elimination approach used in FEA. **04**

**(c)** The arrangement of the truss element is shown in figure 2. **07**
Find out following using finite element method.

(a) Nodal displacement.
(b) Stress in each section.
(c) Reaction forces.

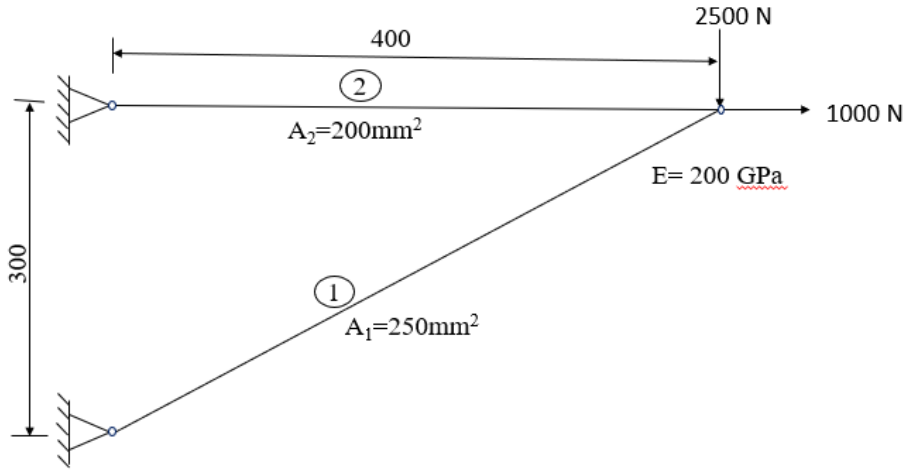


**Figure 2**

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