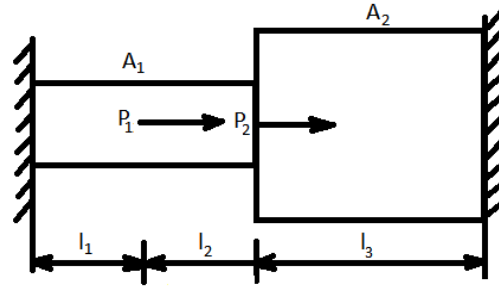# GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VI EXAMINATION – SUMMER 2025

Subject Code: 3161903   **Date: 22-05-2025**

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.**
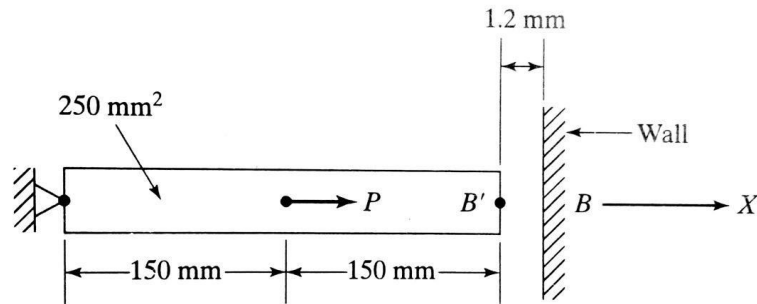4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	What is CAD? Explain its capabilities in Detail	**03**
	(b)	What is persistence? Explain the effect of persistence on CRT ?	**04**
	(c)	Illustrate the Bresenham line generation algorithm by digitizing the line with end points (20,10) and (30,18)	**07**
Q.2	**(a)**	Differentiate between Constructive Solid Geometry and B-Represenrtation.	**03**
	(b)	Describe constructive solid geometry (CSG) and how it represents objects using Boolean operations.	**04**
	(c)	Describe the equations and properties of Bezier curves. How do Bezier curves differ from cubic splines in terms of control and representation?	**07**

OR

	(c)	Given: p0 (1,1): p1(2,3): p2(4,3): p3(3,1) as vertices of Bezier curve determine 3 points on Bezier curve.	**07**
Q.3	**(a)**	Explain scaling and its effect on objects in both 2D and 3D space.	**03**
	(b)	Show that the composition of two rotations is additive by concatenating the matrix representations for $R_{\theta 1}$ and $R_{\theta 2}$ to obtain $R_{\theta 1}\ R_{\theta 2} = R_{(\theta 1 + \theta 2)}$	**04**
	(c)	Reflect the diamond shaped polygon whose vertices are A(-1,0), B(0,-2), C(1,0) and D(0,2) about	**07**

        i.   The horizontal line y =3

        ii.   The vertical line x = 3

        iii.   The line y = x + 3

OR

Q.3	**(a)**	What are the basic advantages of Homogeneous Coordinate system?	**03**
	(b)	A point (3,3) makes a rotating of 45 degree about the origin and then translating in the direction of vector v = 5i + 6j. Find the new location of point P.	**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**
Q.4	**(a)**	Define Finite Element Analysis (FEA) and explain its significance in engineering.	**03**
	(b)	Explain Penalty approach by giving a suitable example.	**04**

(c) Determine the displacement of nodes and elemental stress for the bar as shown in figure. Take A1=400 mm² , A2=500 mm², l_1= l_2=200 mm, l_3=250 mm P_1=P_2=10 kN and E=200 GPa   **07**

OR

Q.4 **(a)** Explain the concept of discretization in FEA and its importance in solving complex engineering problems.   **03**

(b) Give step by step procedure for analyzing any component using FEM.   **04**

(c) In fig a load P=60 x 103 N is applied as shown. Determine the displacement field, stress, and support reactions in the body. Take E= 20 x 103 N/mm2   **07**

Q.5 **(a)** Define 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) Describe the steps involved in applying Johnson's method to determine the safe design parameters for machine elements.   **07**

OR

Q.5 **(a)** Explain the role of optimization in improving the performance, reliability, and efficiency of machine elements.   **03**

(b) Discuss the limitations and assumptions of Euler-Bernoulli beam theory.   **04**

(c) Discuss the assumptions and limitations of Johnson's method.   **07**

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GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2024

Subject Code:3161903   **Date:17-05-2024**
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.
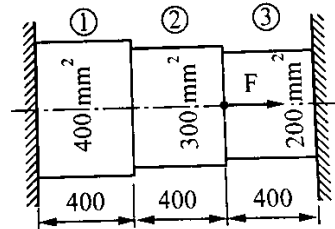4. Simple and non-programmable scientific calculators are allowed.

			MARKS
Q.1	(a)	A raster system has 1024×720 resolution. Compute the size of frame buffer (in Megabytes) to store 32 bits per pixel. For 24-bit display system how many different colours are possible?	03
	(b)	Define drawing entities and utilities and give their examples.	04
	(c)	Determine the pixels for a straight line connecting two points (2, 7) and (15, 10) using Bresenham's algorithm.	07
Q.2	(a)	Write down advantages of Parametric representation and disadvantages of Non-Parametric representation.	03
	(b)	Draw sketch of any two analytical surfaces and two synthetic surfaces.	04
	(c)	The end points of a cubic spline curve are P_0 (2,3) and P_1 (10,1). The tangent vector for end P_0 is given by line joining P_0 and point P_2 (8,6). The tangent vector for end P_1 is given by line joining P_2 and point P_1. Determine the parametric equation of Hermite cubic curve and tangent vector. Also plot the Hermite cubic curve.	07

OR

	(c)	Describe the characteristics of Bezier curve. List advantages of B-spline curve. Differentiate geometry and topology in solid modeling.	07
Q.3	(a)	Explain primitive instancing with neat sketch.	03
	(b)	Short note: CSG	04
	(c)	Write 3x3 transformation matrix for each of the following effects: 1) Scale the image to be twice as large and then translate it 1 unit to the left. 2) Scale x-direction to be half as large and then rotate anticlockwise by 90° about origin. 3) Translate down 0.5 unit, right 0.5 unit and then rotate anticlockwise by 45°.	07

OR

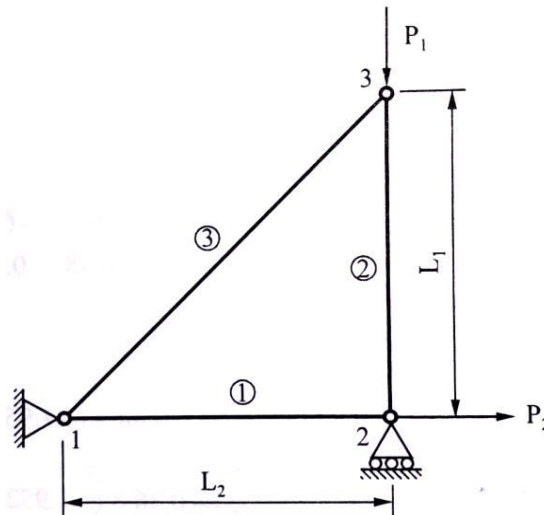|			
Q.3	(a)	Explain cell decomposition with neat sketch.	03
	(b)	Short note: B-rep	04
	(c)	Consider a triangle A (5,5), B (8,5) and C (5,10). Find new vertex positions if: 1) The triangle is scaled 2 times in x-direction and 3 times in y-	07

direction about vertex-A.
2) If it mirrored about a line $y = 2x + 4$.

Q.4 (a) Sketch and name any three 3D elements used in FEA.   03
(b) Explain the statement "FEM is an approximate method" with suitable example.   04
(c) A stepped shaft is shown in the figure below. Determine the stresses, reactions and deflections in each of the sections. Assume uniform material for the complete shaft having a modulus of elasticity as 200 GPa and the axial force F as 35 kN.   07

OR

Q.4 (a) Explain discretization with neat sketch.   03
(b) Determine the temperature at $x = 60$ mm, if the temperature at node-1 $= 150°$ C, node-2 $= 90°$ C and $x_1 = 15$ mm, $x_2 = 80$ mm.   04
(c) A three-bar truss is shown in the figure below. Modulus of elasticity of the material is 3,00,000 N/mm². Area of the bar for the truss is 60 mm² for all the elements. Length $L_1 = 750$ mm and $L_2 = 100$ mm. Load $P_1 = 20$ kN and $P_2 = 25$ kN. Determine nodal displacements, stresses and reaction forces for each element.   07

Q.5 (a) Write down important properties of matrices for concatenation.   03

(b) Draw a neat sketch of any four half-spaces used to represent bounded solids.   04

(c) Using Johnson's method design a tensile bar of length, L = 200 mm to carry a tensile load of 5 kN for minimum cost, out of the following materials: 07

Material	Mass Density (kg/m³)	Material Cost (Rs./N Weight)	Yield Strength (MPa)
Steel	7500	16	130

Al. Alloy	3000	32	50
Ti. Alloy	4800	480	90
Mg. Alloy	2100	32	20

OR

Q.5 (a) Write down matrices for scaling, mirror and shear transformation in the homogeneous coordinate system. 03

(b) Define optimization and write down its engineering applications. 04

(c) What is feature based modeling? Describe any three sketched features and any three pick and place features. 07

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GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2023

Subject Code:3161903   **Date:06-07-2023**

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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	List the steps involved in Finite Element Analysis.	**03**
	(b)	List commercially available CAD softwares and write features of CATIA and ANSYS Software.	**04**
	(c)	What do you understand by geometry and topology in solid modelling? Explain with neat diagram.	**07**
Q.2	**(a)**	Write specifications of CAD Work-station.	**03**
	(b)	Explain with neat diagram organization of Raster scan system with display processor	**04**
	(c)	Write Bresenham's line algorithm for slope ≤1. Draw neat diagram.	**07**
		OR	
	(c)	Generate a straight line connecting two points (21, 11) and (26, 15), using Bresenham's algorithm.	**07**
Q.3	**(a)**	Write a note on Explicit non-parametric representation.	**03**
	(b)	Write comparison between Analytical and Synthetic curves.	**04**
	(c)	Write parametric equation of Bezier Curve and list its characteristics.	**07**
		OR	
Q.3	**(a)**	Compare Hermit Cubic spline Curve, Bezier Curve and B –Spline Curve.	**03**
	(b)	List methods of geometric modeling. Explain Wire frame modeling.	**04**
	(c)	Derive the parametric equation of Hermite Cubic spline.	**07**
Q.4	**(a)**	Compare B-Rep and C-Rep.	**03**
	(b)	Explain Boolean operations for Constructive Solid Geometry.	**04**
	(c)	Prove that differential scaling and rotation are not commutative, but uniform scaling and rotation are commutative.	**07**
		OR	
Q.4	**(a)**	Explain concatenated transformation matrix.	**03**
	(b)	For a given point P(1,3,-5), find: The transformed point P′, if P is translated by d=2i+3j-4k and then rotated by 30° in anti-clock wise direction about the Z-axis.	**04**
	(c)	Derive the equation for transformation by Reflection for all its types.	**07**
Q.5	**(a)**	Explain types of projection with neat diagram.	**03**
	(b)	Explain plain strain and plain stress problem.	**04**
	(c)	A stepped bar is subjected to an axial load of 35 kN, as shown in Figure below. Determine the nodal displacement, reaction forces and stress in each elements, using penalty method.	**07**

Q.5 **(a)** List types of 1D and 2D elements. **03**

(b) Explain shape function. **04**

(c) Consider the stepped bar shown in figure given below. A load of P=200kN **07**
is applied as shown. Determine the nodal displacements, element stress and
support reactions, using elimination approach for boundary conditions.
Take E = 2 x 10^5 N/mm^2.

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GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2022

Subject Code:3161903   **Date:03/06/2022**

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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	List different applications of CAD in mechanical engineering. Discuss the reasons for implementing CAD.	**03**
	(b)	Differentiate between i) Raster Scan and Vector Scan Displays ii) Analytic curves and Synthetic curves	**04**
	(c)	Explain the steps involved to solve static structural problem using finite element method.	**07**
Q.2	**(a)**	State the role of graphics standards in CAD. List various graphics standards with their full name.	**03**
	(b)	What is the need of homogenous transformations? Represent translation, scaling and rotation matrices for 3D transformations in homogenous form.	**04**
	(c)	Explain Bresenham's algorithm for drawing a line with slope m < 1.	**07**

<div align="center">OR</div>

	(c)	Determine the pixels for a straight line connecting two points (5,5) and (15,10) using DDA algorithm.	**07**
Q.3	**(a)**	Explain CSG techniques in solid modeling.	**03**
	(b)	Derive the expression of top view of an orthographic projection.	**04**
	(c)	Explain Bezier curve along with its properties.	**07**

<div align="center">OR</div>

Q.3	**(a)**	The end points for line L_1 are P_1 (5, 7, 9) and P_2(6, 8, 2). Determine (a) the parametric equation of the line (b) tangent vector of the line (c) Length of the line.	**03**
	(b)	Discuss in detail about the applications of optimization in engineering.	**04**
	(c)	Derive from fundamentals the parametric equation for the Hermite Cubic spline. Represent the equation in matrix form.	**07**
Q.4	**(a)**	Explain the three forms of equations used in Johnsons' method of optimum design.	**03**
	(b)	Explain the following surface entities. i) Surface of revolution ii) Tabulated surface	**04**
	(c)	Consider a triangle ABC having coordinates A (1,3), B (-1,4), C (-1,2). Determine the vertices of the triangle after it being reflected about a line $y = 3x + 2$.	**07**

<div align="center">OR</div>

Q.4	**(a)**	"Finite element method gives approximately exact solutions". Justity.	**03**
	(b)	For a system shown in figure 1 below, the temperature at Node 1 is 100^0 c and at Node 2 is 40^0 c. The length of the element is 200 mm. Calculate the	**04**

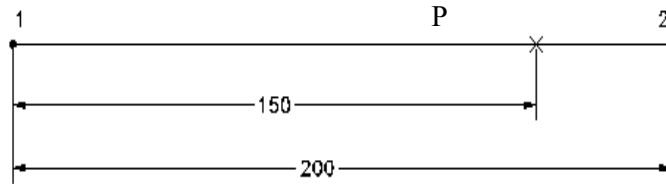temperature at point 'P' situated at 150 mm from Node 1. Assume a linear shape function.

Figure 1

(c)	Derive the element stiffness matrix of a truss element.		**07**
Q.5	**(a)**	Differentiate between Plane truss and Space truss.	**03**
	(b)	Explain 2D and 3D elements used in FEM along with their applications.	**04**
	(c)	For a bar shown in figure 2 below, determine the nodal displacements and stresses in each element. Assume A_1 = 2400 mm², E_1 =70 GPa, A_2 = 600 mm², E_2 = 200 GPa, Take P = 20000 N.	**07**

Figure 2

OR

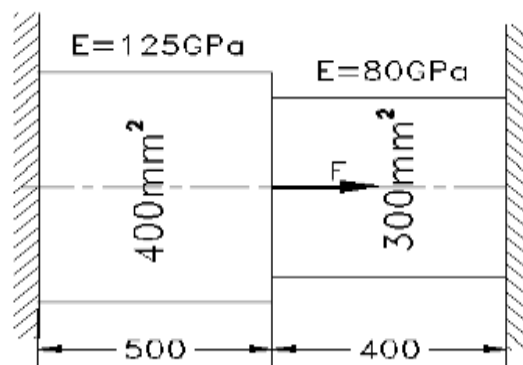|			
Q.5	**(a)**	What are the properties of global stiffness matrix?	**03**
	(b)	Explain Penalty approach for FEA.	**04**
	(c)	For a compound section shown is figure 3 below, determine the nodal displacements and stresses in each element when a force F=1600 N is applied at the change of cross section. Use Penalty approach to solve the problem.	**07**

Figure 3

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