

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-6 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

Subject Name & Code:

COMPUTER AIDED DESIGN (3161903)

Unit 1: Introduction

(A typical product cycle, CAD tools, Input/Output devices, Graphics Displays, Coordinate Systems, Line and Curve generation algorithms, Graphics exchange standards and Database management systems.)

Repeated Questions:

1. **List/Explain Bresenham's line generation algorithm.** (S23 - Q2c, 07 marks) (S24 - Q1c, N/A marks) (W23 - Q1c, N/A marks) (S22 - Q2c, 07 marks) (W25 - Q1c, 07 marks) (W24 - Q1c, 07 marks)
2. **Differentiate between Raster Scan and Vector Scan Displays.** (S24 - Q2b, N/A marks) (S22 - Q1b-i, 04 marks)
3. **Differentiate between Analytic curves and Synthetic curves.** (S24 - Q2b, N/A marks) (S22 - Q1b-ii, 04 marks)
4. **What is scan conversion? Explain Bresenham's line/circle drawing algorithm.** (W22 - Q1c, 07 marks) (W23 - Q1c, N/A marks)
5. **List graphics standards used for graphics data exchange in CAD / State the role of graphics standards in CAD. List various graphics standards.** (W23 - Q1a, N/A marks) (S22 - Q2a, 03 marks) (W24 - Q2a, 03 marks)
6. **What is CAD? Explain its capabilities/reasons for implementing CAD.** (W22 - Q1b, 04 marks) (S22 - Q1a, 03 marks) (W25 - Q1a, 03 marks)
7. **Differentiate between Conventional design and Computer Aided Design.** (W23 - Q1b, N/A marks) (W24 - Q1a, 03 marks)
8. **List the steps/procedure of Finite Element Analysis.** (S23 - Q1a, 03 marks) (W22 - Q4a, 03 marks) (W24 - Q4a, 03 marks)

Other Important Questions:

1. **What are the main stages of a typical product cycle?** (W25 - Q1a, 03 marks)
 2. **With proper sketch explain Interactive Computer Graphics.** (W25 - Q1b, 04 marks)
 3. **Compute frame buffer size and number of colors for a given raster system resolution and bits per pixel.** (S24 - Q1a, N/A marks)
 4. **Define drawing entities and utilities and give their examples.** (S24 - Q1b, N/A marks)
 5. **List commercially available CAD softwares and write features of CATIA and ANSYS Software.** (S23 - Q1b, 04 marks)
 6. **Write specifications of a CAD Workstation.** (S23 - Q2a, 03 marks) (W24 - Q3a OR, 03 marks)
 7. **Explain organization of Raster scan system with display processor.** (S23 - Q2b, 04 marks)
 8. **What is persistence? Explain the effect of persistence on CRT?** (S25 - Q1b, 04 marks)
 9. **Explain different coordinate systems available in a CAD software.** (W24 - Q1b, 04 marks)
 10. **List various data exchange formats. Explain GKS standard.** (W24 - Q2b, 04 marks)
 11. **Explain the steps involved to solve a static structural problem using finite element method.** (S22 - Q1c, 07 marks)
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Unit 2: Curves and Surfaces

(Parametric representation of lines, circles, conics; Synthetic Curves: Cubic Spline, Bezier, B-Spline, NURBS; Various types of surfaces.)

Repeated Questions:

1. **Explain/Derive/Write the parametric equation and list characteristics of Bezier curves.** (W25 - Q2c, 07 marks) (S23 - Q3c, 07 marks) (S24 - Q2c OR, N/A marks) (W22 - Q2c OR, 07 marks) (S25 - Q2c, 07 marks) (W24 - Q3b, 04 marks)
2. **Differentiate between/Compare Analytical (analytic) and Synthetic curves.** (S23 - Q3b, 04 marks) (W23 - Q2b, N/A marks)
3. **Explain/Describe properties of Bezier curves (endpoints, control points, curve shape).** (W25 - Q2c, 07 marks) (S25 - Q2c, 07 marks)
4. **Derive/Explain Hermite Cubic spline curve (parametric equation).** (S23 - Q3c OR, 07 marks) (S24 - Q2c, N/A marks) (S22 - Q3c, 07 marks)
5. **Explain Hermite cubic spline curve with neat sketch, its characteristics and parametric equation.** (W24 - Q2c, 07 marks)
6. **Compare Hermite Cubic spline Curve, Bezier Curve and B-Spline Curve.** (S23 - Q3a OR, 03 marks)
7. **List/Explain advantages of Parametric representation and disadvantages of Non-Parametric representation.** (S24 - Q2a, N/A marks)
8. **Write equations of lines, circle, ellipse in parametric form.** (W22 - Q2a, N/A marks)

Other Important Questions:

1. **Explain types of surfaces in brief.** (W25 - Q2a, 03 marks)
2. **Based on Bezier curve definition, derive the equation of three point Bezier curve defined by given control points.** (W25 - Q2c OR, 07 marks)
3. **Write a note on Explicit non-parametric representation.** (S23 - Q3a, 03 marks)
4. **The end points and tangent vectors for a cubic spline are given. Determine the parametric equation and tangent vector. Plot the curve.** (S24 - Q2c, N/A marks)
5. **Find the equation of a Bezier curve for given control points and determine coordinates at specific parameter (u) values.** (W22 - Q2c OR, 07 marks) (W24 - Q2c OR, N/A marks)
6. **A Bezier curve is constructed using four control points. Find the equation and plot for given u values.** (W22 - Q2c OR, 07 marks)
7. **Sketch any two analytical surfaces and two synthetic surfaces.** (S24 - Q2b, N/A marks)
8. **Briefly discuss B-spline curve.** (W24 - Q3a, 03 marks)
9. **List advantages of B-spline curve.** (S24 - Q2c OR, N/A marks)
10. **Explain the following surface entities: (i) Surface of revolution (ii) Tabulated surface.** (S22 - Q4b, 04 marks)

Unit 3: Mathematical Representation of Solids & Geometric Transformations

(Geometry & Topology, Wireframe/Surface/Solid models, Half-spaces, Boolean operations, Representation schemes (B-rep, CSG, Sweep, etc.), Homogeneous transformations, Translation, Scaling, Reflection, Rotation, Shearing, Projections.)

Repeated Questions:

1. **Differentiate between/Compare Constructive Solid Geometry (CSG) and B-Representation (B-Rep).** (W25 - Q2b, 04 marks) (S23 - Q4a, 03 marks) (S25 - Q2a, 03 marks)
2. **Explain Homogeneous Coordinate system and its importance/advantages.** (W25 - Q3a, 03 marks) (W22 - Q3a OR, 03 marks) (S25 - Q3a OR, 03 marks)
3. **Write/Explain transformation matrices (Rotation, Reflection, Shearing, etc.) in 2D/3D using homogeneous coordinates.** (W25 - Q3a OR, 03 marks) (W22 - Q4b, 04 marks) (S24 - Q5a, 03 marks)
4. **Differentiate between/Compare Scaling and Shearing transformation.** (W25 - Q3b, 04 marks)
5. **Find the new coordinates of a shape (triangle/rectangle) after applying a series of transformations (translation, rotation, scaling, reflection).** (S24 - Q3c OR, N/A marks) (W22 - Q3c OR, 07 marks) (W23 - Q3c, N/A marks) (W24 - Q3c OR, N/A marks)
6. **Obtain the mirror reflection of a triangle/polygon about a given line.** (W25 - Q3c, 07 marks) (S25 - Q3c, 07 marks) (S22 - Q4c, N/A marks)
7. **Prove that two successive rotations/translations/scaling are commutative.** (W25 - Q3c OR, 07 marks)
8. **Prove that differential scaling and rotation are not commutative, but uniform scaling and rotation are commutative.** (S23 - Q4c, 07 marks)
9. **What do you understand by geometry and topology in solid modelling?** (S23 - Q1c, 07 marks) (W23 - Q5a OR, 03 marks)
10. **Explain Boolean operations for Constructive Solid Geometry (CSG).** (S23 - Q4b, 04 marks) (S25 - Q2b, 04 marks)
11. **Compare Wireframe, Surface and Solid modeling techniques.** (W22 - Q3b OR, 04 marks)
12. **Explain Feature based modeling.** (S24 - Q5c, N/A marks) (W24 - Q4c, 07 marks)
13. **List methods of geometric modeling. Explain Wire frame modeling.** (S23 - Q3b OR, 04 marks)

Other Important Questions:

1. **Explain Geometric Transformation.** (W22 - Q3a, 03 marks) (W24 - Q4a, 03 marks)
2. **Explain concatenated transformation matrix.** (S23 - Q4a OR, 03 marks)
3. **For a given point, find the transformed point after translation and rotation.** (S23 - Q4b OR, 04 marks)
4. **Derive the equation for transformation by Reflection for all its types.** (S23 - Q4c OR, 07 marks)
5. **Write 3x3 transformation matrices for a given sequence of effects (scale then translate, etc.).** (S24 - Q3c, N/A marks)
6. **Explain primitive instancing with neat sketch.** (S24 - Q3a, N/A marks)
7. **Short note: CSG / B-rep.** (S24 - Q3b, N/A marks) (S24 - Q3b OR, N/A marks)
8. **Explain cell decomposition with neat sketch.** (S24 - Q3a OR, N/A marks)
9. **Explain scaling and its effect on objects in 2D and 3D space.** (S25 - Q3a, 03 marks)
10. **Show that the composition of two rotations is additive.** (S25 - Q3b, 04 marks)
11. **A point is rotated and then translated. Find the new location.** (S25 - Q3b OR, 04 marks)
12. **Explain octree encoding technique used in solid modeling.** (W24 - Q4b OR, 04 marks)
13. **Differentiate between wireframe modeling and solid modeling.** (W24 - Q3b, 04 marks)
14. **Explain with suitable example, transformation matrix in homogeneous coordinate system.** (W24 - Q4b, 04 marks)
15. **Derive the expression of top view of an orthographic projection.** (S22 - Q3b, 04 marks)
16. **Explain projections of geometric models.** (W23 - Q3b, N/A marks)

Unit 4: Finite Element Analysis & Engineering Optimization

(Stress-strain relations, Plane stress/strain, Basic FEA procedure, 1-D Analysis, Shape functions, Stiffness matrix, Elimination & Penalty approaches, Trusses, Beams, Introduction to optimization, Johnson's method.)

Repeated Questions:

1. **Define Finite Element Analysis (FEA) and explain its application/significance in engineering.** (W25 - Q4a, 03 marks) (S25 - Q4a, 03 marks)
2. **Explain the Penalty approach for handling boundary conditions in FEA with an example.** (W25 - Q4c, 07 marks) (S25 - Q4b, 04 marks) (S22 - Q5b OR, 04 marks) (W23 - Q5a, 03 marks)
3. **Determine nodal displacements, stresses, and reaction forces for a given 1-D bar/stepped bar/stepped shaft using FEA (using Penalty or Elimination approach).** (W25 - Q4c, 07 marks) (S23 - Q5c, 07 marks) (S23 - Q5c OR, 07 marks) (S24 - Q4c, 07 marks) (S24 - Q4c OR, 07 marks) (W22 - Q5c, 07 marks) (W23 - Q4c, 07 marks) (S22 - Q5c, 07 marks) (S22 - Q5c OR, 07 marks) (S25 - Q4c, 07 marks) (W24 - Q4c OR, 07 marks)
4. **What is discretization? Explain its concept and importance in FEA.** (W25 - Q3b OR, 04 marks) (S24 - Q4a OR, 03 marks) (S25 - Q4a OR, N/A marks)
5. **Explain the General/Basic steps involved in solving a problem using FEA.** (W25 - Q3a OR, 03 marks) (W23 - Q4b, N/A marks)
6. **Explain/Discuss the properties of the global stiffness matrix.** (W22 - Q5a, 03 marks) (W23 - Q5b, 04 marks) (S22 - Q5a OR, 03 marks) (W24 - Q4a OR, 03 marks)
7. **Define/Optimization in the context of engineering and explain its importance/applications.** (W25 - Q5a, 03 marks) (S24 - Q5b, 04 marks) (W23 - Q4a OR, 03 marks) (S25 - Q5a, 03 marks) (W24 - Q4c OR, 07 marks)
8. **Explain Johnson's method of optimum design.** (W25 - Q5c OR, 07 marks) (W23 - Q5c, 07 marks) (S25 - Q5c, N/A marks)
9. **Explain/Differentiate between constrained and unconstrained optimization.** (W25 - Q5c, 07 marks)
10. **Explain the following with reference to optimization: i) Objective function ii) Constraints.** (W22 - Q4c, 07 marks) (W24 - Q4b, 04 marks)
11. **Explain how the stiffness matrix is derived from the strain-displacement matrix.** (W25 - Q5b OR, 04 marks) (S25 - Q5b, 04 marks)
12. **Explain/Differentiate between Plane stress and Plane strain conditions.** (S23 - Q5b, 04 marks) (W23 - Q4b OR, 04 marks) (W24 - Q4b OR, 04 marks)
13. **Explain the elimination approach used in FEA.** (W22 - Q5b, 04 marks)

Other Important Questions:

1. **Explain the purpose of each step in the FEA process.** (W25 - Q4b, 04 marks)
2. **Sketch and name any three 3D elements used in FEA.** (S24 - Q4a, 03 marks)
3. **Explain the statement "FEM is an approximate method".** (S24 - Q4b, 04 marks)
4. **Determine the temperature at a point given nodal temperatures and positions.** (S24 - Q4b OR, 04 marks) (S22 - Q4b OR, 04 marks)
5. **Write down important properties of matrices for concatenation.** (S24 - Q5a, 03 marks)
6. **Using Johnson's method, design a tensile bar for minimum cost from given materials.** (S24 - Q5c, 07 marks)
7. **Discuss Euler-Bernoulli beam theory (limitations/assumptions).** (W25 - Q5b, 04 marks) (S25 - Q5c OR, N/A marks)
8. **Explain shape functions in the natural coordinate system.** (W22 - Q5b, 04 marks)
9. **"Finite element method gives approximately exact solutions." Justify.** (S22 - Q4a OR, 03 marks)
10. **Derive the element stiffness matrix of a truss element.** (S22 - Q4c OR, N/A marks)
11. **Differentiate between Plane truss and Space truss.** (S22 - Q5a, 03 marks) (W23 - Q4a, N/A marks)
12. **Explain 2D and 3D elements used in FEM along with applications.** (S22 - Q5b, 04 marks)

13. **What are different representation schemes for solid models? Compare CSG and B-rep techniques.** (W23 - Q5c, 07 marks)
14. **Explain the three forms of equations used in Johnson's method of optimum design.** (S22 - Q4a, 03 marks)
15. **Explain the role of optimization in improving performance, reliability, and efficiency.** (S25 - Q5a OR, N/A marks)
16. **Discuss the limitations and assumptions of Johnson's method.** (S25 - Q5c OR, N/A marks)
17. **What do you mean by thermal effects of temperature? How is it included in calculation for 1-D elements?** (W23 - Q5b, 04 marks)
