QP Code:CSH41-3 **(Pages: 3)**

Reg No : ..... Name : .....

MAR ATHANASIUS COLLEGE OF ENGINEERING, KOTHAMANGALAM

(Govt. Aided Autonomous Institution)

Fourth Semester B.Tech. Degree Examination, May, 2026

Course Code: B24CSH41

Course Name: ADVANCED TOPICS IN COMPUTER GRAPHICS

Max. Marks: 100 Duration:3 Hours

PART - A: 30 Marks (10 Qns x 3 Marks)

Answer all questions

1. Differentiate between raster scan and random scan display systems.
2. Explain how Touch Panel Technology works in modern display systems.
3. Apply Bresenham's line drawing algorithm to draw the line from (0, 0) to (8, 4). Show the decision parameter table.
4. Explain how the Scan Line Polygon Filling Algorithm handles edge intersections and parity to correctly fill complex polygons.
5. Derive the composite transformation matrix required to reflect a 2-D object about a line L that passes through the point (0, b) and makes an angle θ with the x-axis. Explain the sequence of transformations involved.
6. Translate point (1, 2, 3) by (4, –2, 5) in 3D space.
7. Explain "All-or-none string clipping" and "All-or-none character clipping" method with a suitable example and diagram and also describe how it differs from each other.
8. Explain how Sutherland-Hodgman algorithm handles clipping by processing the polygon against each edge of the clipping window sequentially.
9. Compare Parallel Projection and Perspective Projection in Computer Graphics with respect to projectors, behaviour of parallel lines, size preservation, realism, and applications. Illustrate your answer with suitable diagrams.
10. A scene contains semi-transparent overlapping polygons. Explain step-by-step how A-buffer processes each pixel.

PART - B: 70 Marks (5 Qns x 14 Marks)

Answer any One full question from each module.

Module 1

11. a) Differentiate between Frame Animation and Sprite Animation with suitable examples. Discuss their working principles, advantages, and typical applications in computer graphics and multimedia systems. (7 marks)

b) Compare Computer Generated Animation and Computer Assisted Animation in terms of production process, level of automation, and applications in modern multimedia and film industries. Illustrate your answer with examples. (7 marks)

OR

12. a) Explain the fundamental concepts of video in Multimedia, including Frame Rate, Resolution, Aspect Ratio, and Interlacing. (9 marks)

b) Differentiate between the following in the context of multimedia systems: (i) Analog Sound and Digital Sound (ii) Lossless Audio Formats and Lossy Audio Formats. (5 marks)

Module 2

13. a) Using the Midpoint Circle Algorithm, determine the pixel positions for a circle centered at (2,3) with radius 6. Show step-by-step calculations. (9 marks)

b) Describe how the decision parameter is updated in each iteration of the Midpoint Circle Algorithm. (5 marks)

OR

14. a) Illustrate the Midpoint Ellipse Algorithm by determining the pixel positions for the first quadrant of an ellipse with $r_x = 8$ and $r_y = 6$. Show the calculations for at least the first four points in Region 1. (8 Marks)

b) Compare circle and ellipse generation algorithms in terms of symmetry, decision parameters, and computational complexity. (6 marks)

Module 3

15. (a) Determine the composite matrix for scaling a 2D object by $s_x=0.5$, $s_y=0.5$ relative to its center (x_c, y_c). (7 Marks)

(b) Discuss why matrix concatenation is more computationally efficient for hardware than performing individual transformations on every vertex. (7 Marks)

OR

16. a) Apply fixed-point scaling with $S_x=2$, $S_y=3$ about point (2,1) to point (4,3). Show step-by-step matrix multiplication. (7 marks)

(b) A square has vertices (2, 2), (4, 2), (4, 4) and (2, 4). Apply a scaling factor of s_x=2, s_y=2 with respect to the fixed point (3, 3). (7 Marks)

Module 4

17. a) Explain the Cohen–Sutherland Line Clipping Algorithm used in Computer Graphics. Using this algorithm, clip the line segment with endpoints P1(−1, 5) and P2 (3 , 8) against a rectangular clipping window defined by lower-left corner (0, 0) and upper-right corner (5, 5). Show all intermediate steps, including region codes and intersection calculations. (8 Marks)

b) Describe the Midpoint Subdivision Line Clipping Algorithm. Explain its working with a suitable example or diagram. (6 marks)

OR

18. (a) Explain the Liang - Barskey Line clipping algorithm based on the parametric equation of a line. Derive the conditions for p_k and q_k used to determine if a line is parallel to the clipping boundaries. (8 Marks)

(b) Use the Liang-Barsky algorithm to clip a line with endpoints P_1(20, 10) and P_2(80, 50) against a window defined by $x_{\{min\}}$ = 30, $y_{\{min\}}$ = 20, $x_{\{max\}}$ = 70, $y_{\{max\}}$ = 60. (6 Marks)

Module 5

19. a) Explain the Scan line for visible surface detection. How does it utilize the "Active Edge Table" to determine visibility across a scan line? (8 Marks)

b) Compare back-face detection and depth buffer algorithms with respect to: (i) computational complexity, (ii) memory requirement, (iii) accuracy for concave objects, (iv) handling of intersecting polygons. Give examples where one is preferred over the other. (6 marks)

OR

20. (a) Explain the process of Initializing the Graphic system in C using `initgraph()`. Discuss the roles of the `gd` and `gm` variables. (7 Marks)

b) Write a C program to implement a moving object (e.g., a bouncing ball) across the screen using `delay()` and `cleardevice()`. (7 Marks)

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