Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (R,S) / (WP), S4 (PT) Exam April 2025 (2019 Scheme)

Course Code: CST304

Course Name: COMPUTER GRAPHICS AND IMAGE PROCESSING

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks. Marks

1	Explain the pixel, resolution and aspect ratio of a display screen.	(3)
2	Describe the beam-penetration technique in CRT displays. How does it contribute to color generation?	(3)
3	List the fundamental types of 3D transformations in computer graphics.	(3)
4	A triangle with vertices A(2, 3), B(5, 4), and C(4, 1) is rotated counter clockwise by 45° about the origin. Determine the new coordinates of the triangle after rotation.	(3)
5	List the steps involved in the Three-Dimensional Viewing Pipeline in computer graphics.	(3)
6	Define Perspective Projection and describe its characteristics. How does it differ from Parallel Projection?	(3)
7	List and explain any three applications of image processing.	(3)
8	Differentiate between Spatial Resolution and Gray Level Resolution in image processing with examples.	(3)
9	What is Power-Law Transformation in image processing? Explain its significance with an example.	(3)
10	What is Contrast Stretching in image processing? Explain its importance in image processing.	(3)

PART B

Answer one full question from each module, each carries 14 marks.

Module I

11	a)	Describe the raster scan display system. How does it generate images on the screen, and what role does refresh rate play in its functioning?	(8)

b) Plot a line using Bresenham's Line Drawing Algorithm for the coordinates (2, 3) to (10, 8). Show the step-by-step calculations and determine the sequence of pixel positions. (6)

OR

12 a) Apply the Digital Differential Analyzer (DDA) Algorithm to draw a line between the points (2,4) and (7,8). Show step-by-step calculations and determine the intermediate pixel positions plotted. (6)

b) Explain the Random Scan Display System in detail. How does it differ from the Raster Scan Display System? (8)

Module II

13 a) Explain the Boundary Fill Algorithm, its working principle, and the step-by-step process. Compare the 4-connected and 8-connected approaches, and explain how the 8-connected approach improves over the 4-connected approach. (8)

b) Consider a triangle with vertices at points A(2, 2), B(5, 2), and C(3, 4). Apply the following transformations in sequence: (6)

i. Translate the triangle by 4 units in the x-direction and 3 units in the y-direction.

ii. Scale the translated triangle by a factor of 1.5 in the x-direction and 0.75 in the y-direction.

Determine the final coordinates of the transformed triangle.

OR

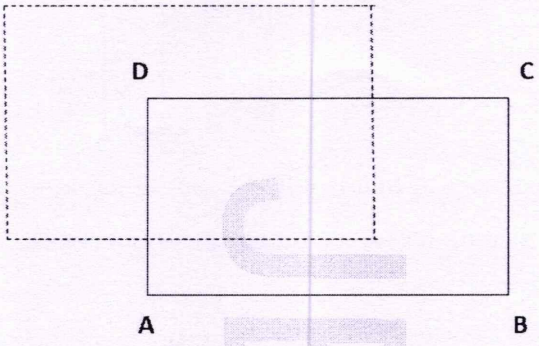
14 a) Compare the Scan Line Algorithm and the Flood Fill Algorithm used for polygon filling in computer graphics. Discuss their working principles, advantages, and limitations. (7)

b) Prove that two successive 2D rotations are additive, while two successive 2D scaling are multiplicative. Derive the transformation matrices for both cases and provide an example to illustrate this property. (7)

Module III

15 a) Explain the Scan Line Visible Surface Detection Algorithm in computer graphics. Describe its working principle. Provide a suitable example to illustrate its application in visible surface detection. (8)

b) Apply the Sutherland-Hodgeman Polygon clipping algorithm to clip the polygon ABCD with respect to a given clipping rectangle. Explain the step-by-step process. (6)



OR

	a)	Consider a window defined by the coordinates (xmin, ymin) = (2, 2) and (xmax, ymax) = (8, 6). A line segment is given with endpoints P1(1, 5) and P2(7, 8). Using the Cohen-Sutherland Line Clipping Algorithm, determine whether the line is completely inside, outside, or partially inside the window. If it is partially inside, compute the clipped coordinates of the line segment.	(6)
16	b)	Explain the Depth Buffer Algorithm used in computer graphics for hidden surface removal. Discuss its operational mechanism and benefits.	(8)

Module IV

	a)	Explain the components of an Image Processing System. Describe each component in detail, highlighting its role in image processing. Illustrate the system with a diagram.	(8)
17	b)	Given a 2D image data f(x) and a mask (filter) weight w(x), perform convolution to compute the output.	(6)

Image Data: f(x)=

0	0	0	0	0
0	0	0	0	0
0	0	2	0	0
0	0	0	0	0
0	0	0	0	0

Mask Data w(x)=

3	2	1
1	1	1
1	2	1

OR

	a)	Explain the basic relationships between pixels in an image. Discuss concepts such as neighbourhood, adjacency, connectivity and distance measures. Illustrate with examples	(7)
18	b)	Explain the fundamental steps in image processing with a detailed description of each step. Illustrate the process with a block diagram.	(7)

Module V

19	a)	Explain Histogram Equalization. Perform Histogram Equalization for the given image.	(6)

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$$\begin{bmatrix} 0 & 2 & 2 & 3 \\ 1 & 2 & 3 & 3 \\ 0 & 1 & 2 & 3 \\ 1 & 1 & 2 & 3 \end{bmatrix}$$

b) Explain the concept of Sharpening Spatial Filtering in image processing. Discuss different sharpening techniques, such as Gradient filter mask and Laplacian filter mask. (8)

OR

20 a) Explain the concept of Edge Detection in image processing. Discuss different edge detection techniques such as Sobel, Prewitt edge detectors. (7)

b) Explain the Region-Based Approach in image segmentation. Discuss the concepts of Region Growing, Region Splitting, and Merging with step-by-step explanations. (7)

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