COMPUTER GRAPHICS AND MULTIMEDIA
(MCAP 2261)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) If P0, P1, P2 and P3 are the control points the Bezier Curve must pass through
(a) P0 and P3 (b) P0 and P1 (c) P1 and P2 (d) P2 and P3.

(ii) Consider the point (2, 5) in the XY plane. Assume that the point is rotated counter-clockwise in the plane by 90 degrees about the origin. What are the coordinates of the resulting point?
(a) (-2, 5) (b) (2, -5) (c) (-2,-5) (d) (-5, 2).

(iii) Consider a raster system with a resolution of 640 by 480. If the display controller refreshes the screen at a rate of 60 frames per second, what is the access time per pixel?
(a) 54.25 ns (b) 64.25 ns (c) 50.45 ns (d) 48.55 ns.

(iv) Let the maximum number of pixels in a line be M. The number of subdivisions at most necessary for using the mid-point subdivision method of clipping is
(a) $\log_2 M$ (b) 2^M (c) M / 2 (d) $(M / 2)^2$

(v) In Cohen-Sutherland line clipping, a line with end point codes 0000 & 0100 is
(a) partially visible (b) completely visible
(c) completely invisible (d) cannot be determined.

(vi) If we want to cut a 512 × 512 sub-image out from the center of an 800 × 600 image, what are the coordinates of the pixel in the large image that is at the lower left corner of the small image?
(a) (144, 144) (b) (150, 150) (c) (800, 512) (d) (512, 600).

(vii) If the axis of rotation is Z-axis, then the direction of positive rotation is
(a) Y to Z. (b) Z to X. (c) X to Y. (d) Y to X.

(viii) The format for storing digital audio in multimedia application is
(a) JPEG (b) MPEG (c) WAV (d) BMP.

(ix) The CMY coordinates of a colour at (0.3,0.4,0.5) in the RGB space is,
(a) (0.7, 0.6, 0.8) (b) (0.3, 0.4, 0.5)
(c) (0.3, 0.6, 0.5) (d) (0.7, 0.6, 0.5).

(x) Which of the following is not an object-space hidden surface removal method?
(a) Painter's algorithm (b) Z-Buffer algorithm
(c) Back face Culling (d) Warnock's algorithm.

Group - B

2. (a) The problem of filling in 4 connected pixels are removed in 8 connected pixels. Outline the reason with suitable diagram. [(CO2)(Evaluate/IOCQ)]
(b) Design a pseudo-code to implement the flood fill algorithm. [(CO2) (Create/HOCQ)]
(c) Find the raster locations which would be chosen by Bresenham's algorithm when scan converting a line from pixel coordinate (1, 1) to (8, 5). [(CO2) (Analyze/IOCQ)]

4 + 4 + 4 = 12

3. (a) Explain the major adverse side effects of scan conversion. [(CO2)(Understand/LOCQ)]
(b) Suppose a RGB raster system is to be designed using an 8 inch × 10 inch screen with a resolution of 100 pixels per inch in each direction.
(i) If we want to store 6 bits per pixel in the frame buffer, how much storage (in bytes) do we need for the frame buffer?
(ii) Suppose it has a non-interlaced 72 Hz refresh with 8% of the scan time required for horizontal retrace and 7% of the frame time required for vertical retrace. What is the time required for a single scan line, including one horizontal retrace? [(CO2)(Apply/IOCQ)]
(c) Implementing the mid-point algorithm find the pixel positions of a circle centered at origin of radius 12 units in the first quadrant. [(CO2)(Apply/IOCQ)]

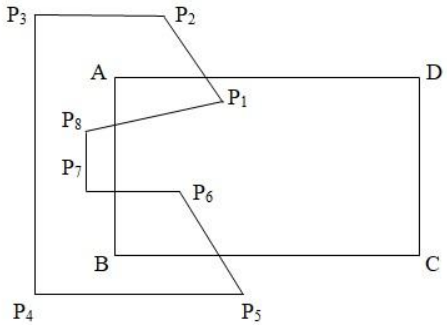
3 + 5 + 4 = 12

Group - C

4. (a) Explain the term 'Affine Transformation' mathematically focussing upon geometric properties. [(CO3)(Understand/LOCQ)]
(b) Implement the reflection of a point (x, y) about an arbitrary line with equation y = mx + c. Derive the corresponding transformation matrix. [(CO3)(Apply/IOCQ)]
(c) Shear a square A(0,0), B(1,0), C(1,1) and D(0,1) with respect to X axis and Y axis, towards both direction with the following shearing co-efficient. $Sh_x = 2$, $Sh_y = 3$. [(CO3)(Apply/IOCQ)]

3 + 5 + 4 = 12

5. (a) Generate the clipped portion applying Weiler-Atherton polygon clipping algorithm to the following
2D polygon $P_1P_2P_3P_4P_5P_6P_7P_8$ with respect to the clipping window ABCD.



[(CO4)(Create/HOCQ)]

(b) Find the normalization transformation which uses the rectangle A(1, 1), B(5, 3), C(4, 5) and D(0, 3) as a window and the normalized device screen as a viewport. [(CO4)(Analyze/IOCQ)]

(c) Consider a line (1, 1) to (7, 3), find its visibility against a rectangle with diagonal (0, 0) to (8, 4) using Cyrus-Beck algorithm. [(CO4)(Analyze/IOCQ)]

4 + 3 + 5 = 12

Group - D

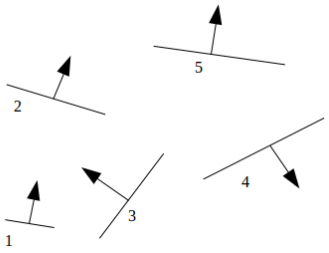
6. (a) Differentiate between Phong Shading and Gouraud Shading. [(CO4)(Analyze/IOCQ)]

(b) Describe piecewise spline curve for (n+1) control points. Differentiate between geometric continuity and parametric continuity. [(CO4)(Analyze/IOCQ)]

(c) Generate a Bezier curve passing through the points $P_1(40,40), P_2(10,40)$and controlled by the points $P_3(60,60), P_4(60,0)$. Also calculate the coordinate of the points on the curve corresponding to the parameter t = 0.2 ; 0.4 ; 0.6 . Calculate a rough sketch of the graph. [(CO4)(Create/HOCQ)]

4 + 4 + 4 = 12

7. (a) Generate the BSP Tree according to the given Planes in the following diagram with indicated surface normals. Then do the traversal of the tree according to the eye position. [(CO4)(Create/HOCQ)]



(b) Explain the type of reflection that creates whitish shiny surface. [(CO4) (Understand/LOCQ)]

(c) Explain the Back Face culling algorithm with suitable diagram. [(CO4) (Understand/LOCQ)]

5 + 3 + 4 = 12

Group - E

8. (a) Explain the terms Period, Pitch and Frequency in terms of an audio signal. [(CO5)(Understand/LOCQ)]

(b) A data stream has only five symbols ABCDE with the following probabilities p(A) = 0.2, p(B) = 0.42, p(C) = 0.06, p(D) = 0.13, p(E) = 0.19. Generate a Huffman tree from this data. [(CO5)(Create/HOCQ)]

6 + 6 = 12

9. (a) Outline the steps mentioning how MIDI sound is synthesized. [(CO6)(Analyze/IOCQ)]

(b) Outline the MPEG compression process. [(CO6)(Analyze/IOCQ)]

(c) Explain one Entropy coding scheme. [(CO5)(Understand/LOCQ)]

4 + 5 + 3 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	22.91	53.12	23.95

Course Outcomes (CO):

After the completion of the course students will be able to:

1. Visualize the application areas of computer graphics concepts in the development of real world applications.
2. Understand the basics of color model and image representation.
3. Develop the concept of affine transformation in 2D & 3D.
4. Analyze the steps to map from real world coordinates to device specific coordinates.
5. Understand Multimedia document architecture, importance of synchronization and specific applications of Multimedia.
6. Identify the individual media ingredients to develop an integrated multimedia project.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question