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) Which of the following is the process of digitizing a given picture definition into a set of pixel-intensity for storage in the frame buffer?
(a) Scan conversion (b) True colour system
(c) Encoding (d) Rasterization.

(ii) Raster images are also known as
(a) bitmap images. (b) vector images.
(c) clip art images. (d) multimedia images.

(iii) Consider a window that is bounded by these lines: y = 0; x = 0; y = 3 and x = 5. If clipped against this window, the line segment joining the (-1, 0) and (4, 5) will connect the points will be:
(a) (0, 1) and (3, 2) (b) (0, 1) and (4, 3)
(c) (0, 1) and (3, 3) (d) (0, 1) and (2, 3).

(iv) Parametric equation of a straight line segment from P0 to P1 (where 0<=t<=1) is,
(a) P(t)= P0 + (P1 + P0)t (b) P(t)= P0 - (P1 + P0)t
(c) P(t)= P0 - (P1 - P0)t (d) P(t)= P0 + (P1 - P0)t

(v) Which of the following operations can be used to zoom in or out around any axis on a three-dimensional object from its original position?
(a) Rotation (b) Shearing
(c) Scaling (d) Translation.

(vi) If we rotate a point P (2, 5) by 60° about a pivot point (1, 2). The new transformed point P' would be
(a) (– 4, 1) (b) (1, – 4) (c) (-1, 4) (d) (1, 4).

(vii) If _____ is increased then discrete samples are also increased.
(a) sampling rate (b) oscillation rate
(c) sampling frequency (d) sampling ratio

(viii) Which of the following is defined as the sampling of object characteristics at a high resolution and displaying the result at a lower resolution?
(a) Anti-aliasing (b) Super-sampling or Post-filtering
(c) Post-filtering (d) Super-sampling.

(ix) Consider two points A (0, 1) and B (5, 6). Let P (u) =(x (u), y (u)) be a parametric line function. What is a parametric equation of the line segment joining the points A and B?
(a) x(u)=u, y(u)=5u+1 (b) x(u)=5u, y(u)=5u+1
(c) x(u)=5u, y(u)=u+1 (d) x(u)=5u, y(u)=5u.

(x) Entropy encoding, focuses on how the information is _____
(a) Copied (b) Enabled
(c) Encoded (d) Represented.

Group - B

2. (a) Explain the term *grey axis* in connection with the CMY colour space. Use suitable diagram. *[(CO1)(Understand/LOCQ)]*

(b) For a straight line, two end points are (2, -3) and (14, -7). Using DDA algorithm if the line is processed from left end point, what is the third calculated pixel? *[(CO1) (Analyze/IOCQ)]*

(c) Distinguish between 1080p and 1080i resolution. *[(CO1) (Analyze/IOCQ)]*

(d) A circle centred at origin is generated using midpoint circle algorithm in the second octant starting from the point (0, r). Three decision parameters $\mathbf{d_3}$, $\mathbf{d_4}$, $\mathbf{d_5}$ are **-3**, **8** and **5** respectively. Find out the value of $\mathbf{(x_5, y_5)}$. *[(CO1) (Apply/IOCQ)]*

3 + 3 + 3 + 3 = 12

3. (a) Explain three major adverse side effects of scan conversion? *[(CO1) (Understand/LOCQ)]*

(b) When eight-way symmetry is used to obtain a full circle from pixel coordinates generated for the 0^0 to 45^0 octant, identify the locations where overstrike occurs? Give the drawbacks of overstrike. *[(CO1) (Apply/IOCQ)]*

(c) Compare and contrast the boundary fill algorithm and flood fill algorithm. *[(CO1) (Understand/LOCQ)]*

4 + 4 + 4 = 12

Group - C

4. (a) Prove that a uniform scaling ($s_x = s_y$) and a rotation form a commutative pair of operations but that, in general, scaling and rotation are not commutative operations. *[(CO2) (Apply/IOCQ)]*

(b) Show that the transformation matrix for a reflection about the line y = -x, is equivalent to a reflection relative to the y axis followed by a counter clockwise rotation of 90^0. *[(CO2) (Analyze/IOCQ)]*

(c) Mention the series of 2D affine transformations required to create an animation effect of Windmill Rotation with three triangular shaped blades.
[(CO2) (Analyze/IOCQ)]

4 + 4 + 4 = 12

5. (a) What is the condition for a line being trivially rejected according to Cohen-Sutherland line clipping algorithm? *[(CO3) (Understand/LOCQ)]*

(b) Clip a straight line C (-1, 5) D (3, 8) using midpoint subdivision line clipping algorithm against a standard rectangular window whose bottom left and top right corners are (-3, 1) and (2, 10), respectively with error tolerance level 0.1.
[(CO3) (Apply/IOCQ)]

(c) Apply Sutherland-Hodgeman clipping algorithm to the following 2D polygon. Use the clipping sequence as Top **->** Bottom **->** Left **->** Right and give the full list of vertices produced after each stage. Any new vertices created by the clipping should be labelled on the diagram. Mention any drawback, if present in this approach. *[(CO3) (Apply/IOCQ)]*

2 + 5 + (4 + 1) = 12

Group - D

6. (a) State the difference between interpolated and approximated curves.
[(CO4) (Remember/LOCQ)]

(b) A cubic Bezier curve is defined by the control points P_0 (10, 10), P_1 (20, 30), P_2 (30, -10), P_3 (50, 50). Another cubic Bezier curve is defined by the control points Q_0, Q_1, Q_2, Q_3. Determine the values of Q_0, Q1, Q_2 and Q_3 so that the two curve segments join smoothly. *[(CO4) (Apply/IOCQ)]*

(c) Find the expression for the tangents on Bezier curves. *[(CO4) (Remember/LOCQ)]*

3 + 6 + 3 = 12

7. (a) Explain the equation $I_{spec} = I_i k_s \cos^{ns} \alpha$ for specular reflection in Phong model.
[(CO5) (Understand/LOCQ)]

(b) Compare between local and global illumination models with emphasis on the attenuation factors. *[(CO5) (Analyze/IOCQ)]*

(c) "Cyclic overlapping hinder Painter's algorithm" - Explain the statement with suitable diagram. *[(CO5) (Analyze/IOCQ)]*

4 + 4 + 4 = 12

Group - E

8. (a) Explain the terms Period and Frequency in terms of an audio signal. Use suitable diagram for your explanation. *[(CO6) (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. *[(CO6) (Create/HOCQ)]*

6 + 6 = 12

9. (a) Explain the zero suppression run length encoding with suitable example. *[(CO6) (Analyze/IOCQ)]*

(b) Distinguish between anchor and link in context with hypertext. *[(CO6) (Remember/LOCQ)]*

(c) Explain different frames of MPEG compression technique. *[(CO6) (Understand/LOCQ)]*

4 + 2 + 6= 12

Cognition Level	*LOCQ*	*IOCQ*	*HOCQ*
Percentage distribution	*38.54*	*55.20*	*6.25*

Course Outcome (CO):

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

MCAP2261.1: Visualize the application areas of computer graphics in the development of real world applications.

MCAP2261.2: Develop the concept of affine transformation in 2D & 3D.

MCAP2261.3: Apply different viewing and clipping techniques for geometric shapes and surfaces.

MCAP2261.4: Compare between polygonal curves and surfaces which has graphical impact.

MCAP2261.5: Detect visible surfaces and apply different illumination and shading techniques.

MCAP2261.6: Characterize multimedia document architecture, importance of synchronization and specific applications of multimedia

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