(b) What is the purpose of Illumination model? Discuss the perspective of different light sources.

7 + 5 = 12

9. (a) How does Z-buffer algorithm determine hidden surfaces? In this algorithm how two different polygons with same Z value are rendered on screen?

(b) Explain the Quadtree and Octree data structures with reference to the mechanism of recursive hierarchical subdivision methods.

(4 + 3) + 5 = 12

MCA/4TH SEM/MCAP 2203/2018

COMPUTER GRAPHICS
(MCAP 2203)

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) Consider a system with a 8 inch by 10 inch video screen that can display 10 pixels per inch. If a colour lookup table with 32 positions is used with this system, what is the smallest possible size for the frame buffer?
(a) 8 KB (b) 4 KB (c) 6 KB (d) 5 KB.

(ii) Consider the line segment that starts at (5, 14) and ends at (21, 2). With the DDA algorithm, what will be the amount added to the secondary component each time through the loop?
(a) -1/2 (b) -3/4 (c) 3/4 (d) -4/3.

(iii) Pixel phasing is a technique for
(a) shading (b) shadowing
(c) hidden line removal (d) anti aliasing.

(iv) Consider two points A (0, 1) and B (5, 6). Let P (u) =(x (u), y (u)) be a parametric line function. Which one is 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.

(v) 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) $(M / 2)^2$.

(vi) When the point P (3,2,4) is translated by translation components (2,1,4), the transformed point is given by
(a) (3, 2, 6) (b) (1, 2, 0) (c) (3, 2, 0) (d) (5, 3, 8).

(vii) In Cohen-Sutherland line clipping, a line with end point codes 0000 & 0100 is
(a) partially visible (b) completely visible
(c) completely invisible (d) of inconclusive visibility.

(viii) The 2D reflection matrix with respect to y = -x is given below:

$$\begin{bmatrix} 0 & p \\ q & 0 \end{bmatrix}$$

Determine p & q.
(a) p = 1, q = 1 (b) p = 1, q = -1
(c) p = -1, q = 1 (d) p = -1, q = -1.

(ix) For a Bezier curve, which of the following properties guarantees that if a line is drawn through the curve, the number of intersections with the curve will be less than or equal to the number of intersections with the control polygon?
(a) Coordinate System Independence (b) Convex-Hull
(c) Symmetry (d) Variation Diminishing.

(x) The CMY coordinates of a colour that at (0.2, 1, 0.4) in the RGB space is
(a) (0.8, 1, 0.4) (b) (0.8, 0, 0.4) (c) (0.2, 0, 0.6) (d) (0.8, 0, 0.6).

Group - B

2. (a) Define the following terms with reference to CRT display: fluorescence, phosphorescence, persistence of phosphor, Critical Fusion Frequency.

(b) Differentiate between raster-scan display and random-scan display.

(c) Compare and contrast boundary fill and flood fill algorithms.

4 + 4 + 4 = 12

3. (a) Describe Midpoint circle drawing algorithm with necessary mathematical derivations.

(b) Find out the pixels plotted when a straight line segment is drawn from (20, 15) to (15, 5) using midpoint line drawing algorithm.

7 + 5 = 12

Group - C

4. (a) What is meant by extra edge problem in Sutherland-Hodgman polygon clipping algorithm? State how to rectify this problem.

(b) A straight line segment from P(-6,-1) to Q(-1,4) is to be clipped against a rectangular window ABCD whose sides are represented by the following equations: AB is y=0, BC is x=8, CD is y=4 and DA is x=0. Find out the clipped portion of PQ using Cyrus-Beck algorithm.

(2 + 3) + 7 = 12

5. (a) A triangle is defined by the following matrix.

$$\begin{matrix} 2 & 4 & 4 \\ 2 & 2 & 4 \end{matrix}$$

Find the transformed coordinates after each of the following transformation is performed independently on the above triangle:
(i) 90^0 rotation about origin. (ii) Reflection about y = -x.

(b) Obtain the overall transformation matrix for a 2D viewing transformation from a WINDOW with its corner coordinates from (xw_{min}, yw_{min}) to (xw_{max}, yw_{max}) to a VIEWPORT with corner coordinates from (xv_{min}, yv_{min}) to (xv_{max}, yv_{max}).

(c) What is the condition for a line being trivially rejected according to Cohen-Sutherland line clipping algorithm? What is the drawback of this algorithm?

4 + 4 + (2 + 2) = 12

Group - D

6. (a) What is meant by vanishing point? Describe one, two and three principal vanishing point perspectives.

(b) Find the matrix for reflection with respect to the plane passing through the origin and having normal vector with direction **N = i + j + k.**

(2 + 6) + 4 = 12

7. (a) Differentiate between interpolating curves and approximating curves.

(b) Find the equation of the Bezier Curve passing through (0, 0) and (-3, 2) and controlled by (7, 5) and (3, 0).

(c) Mention four control handles used to influence the shape of B-spline curves.

2 + 6 + 4 = 12

Group - E

8. (a) Find out the reflection vector using Phong Model.