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Paper Code : IT-604B

COMPUTER GRAPHICS

Time Allotted : 3 Hours   Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own

words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

$$10 \times 1 = 10$$

i) Sometimes lines appear broken or show staircase effect on the screen as

a) the screen is not really flat

b) there are numerical errors in calculations

c) the line drawing algorithm allows only specific pixels to be put on

d) the algorithm is not efficient for slanting lines.

ii) If a point (x, y) is reflected about an axis which is normal to the XY plane and passing through the origin, the reflected point (X, Y) is

a) $(x, -y)$ b) $(-x, y)$

c) $(-x, -y)$ d) (y, x).

iii) Which filling algorithm fits the most for filling objects with multicolour boundaries ?

a) Flood fill algo   b) Boundary fill algo

c) Scan line fill algo   d) None of these.

iv) Raster scan display means that the screen is scanned

a) top to bottom and right to left

b) left to right and top to bottom

c) bottom to top and left to right

d) bottom to top and right to left.

v) A rectangle has been drawn on the screen. It is desired to carry out a Zoom-in process to double the size of the rectangle. This process would involve

a) only scaling

b) scaling and translation

c) scaling and rotation

d) translation, scaling and translation back.

vi) Bresenham's algorithm deals with

   a) floating point numbers only

   b) integers only

   c) both (a) and (b)

   d) none of these.

vii) A Bezier curve should pass through

   a) all the control points

   b) first and second control points

   c) first and last control points

   d) none of these.

viii) The transformation which will result in invalid operation in 2D graphics is

a) $\begin{bmatrix} 1 & -1 & 0 \\ -1 & -1 & 0 \\ 0 & -1 & 1 \end{bmatrix}$
b) $\begin{bmatrix} 0 & 0 & 0 \\ -1 & 0 & 0 \\ 0 & -1 & 1 \end{bmatrix}$

c) $\begin{bmatrix} 0 & 0 & 0 \\ 0 & -1 & 0 \\ -1 & 1 & 1 \end{bmatrix}$
d) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & -1 & 0 \end{bmatrix}$.

ix) Sutherland-Hodgeman algorithm works well for

   a) Concave polygon   b) Convex polygon

   c) Smooth curves   d) Line segment.

x) Reflection about the X axis is equivalent t reflection about the line $y = x$ and

   a) counter-clockwise rotation of 90 degrees

   b) counter-clockwise rotation of 45 degrees

   c) clockwise rotation of 90 degrees

   d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. What is homogeneous co-ordinate system ? What is 2D affine transformation ? Discuss 2D transformations in homogeneous co-ordinate system. $1 + 1 + 3$

3. Write mid-point circle drawing algorithm.   5

4. Describe parallel and perspective projections. Obtain the transformation matrix for standard perspective transformation where X-Y plane is the view plane and centre of projection is on Z-axis at (0, 0, -d).   5

5. What do you mean by hidden surface removal ? Distinguish between object-space and image-space methods for hidden surface removal. $2 + 3$

6. Compare and contrast between Constant shading, Gourad shading and Phong shading.   5

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Describe World Coordinate System (WCS), Physical Device Coordinate System (PDCS), Normalized Device Coordinate System (NDCS) and Viewing transformation.

    b) What is aspect ratio ? What is its significance in viewing transformation ?

    c) Find the normalization transformation that maps a window whose lower left corner is at (1, 1) and upper right corner is t (3, 5), onto a viewport that is the entire normalized device screen. $6 + 3 + 6$

8. a) Describe Sutherland Cohen Line clipping algorithm.   4

    b) Use the Cohen-Sutherland line clipping algorithm to clip the following lines against a window A (100, 10), B (160, 10), C (160, 40) and D (100, 40).

    i)   P1 (120, 5) and P2 (180, 30)

    ii) p3 (120, 20) and p4 (140, 80) $3 + 3$

    c) Write Sutherland-Hodgeman polygon clipping algorithm.   5

9. a) State the properties of Bezier curves. How Bezier surfaces can be drawn ?

    b) Let P and Q be two bezier curve segments of degree 2 defined by the control points as follows :

    P1 (-1, 0) P2 (-1, 1) P3(0, 1)

    Q1 (0,1) Q2 (1, 1) Q3 (1, 0)

    Draw a rough sketch of both the curves. Do the curves join without any break ? If the answer is yes, are the curves joined smoothly ? Justify your answer.

    By choosing Q1 (0, 1), Q2 (2, 2), Q3 (2, 0) again draw both the Bezier curves. $5 + 10$

10. a) Magnify the triangle with vertices A(0, 0), B(1, 1), C(5, 2) to twice its size while keeping C(5, 2) fixed.

    b) Reflect the diamond shaped polygon whose vertice are A(-1, 0), B(0, -2), C(1, 0) and D (0, 2) about th line $y = x + 2$

    c) Describe rotation about any arbitrary axis in 3D and obtain the necessary transformation matrix.

    $4 + 4 +$

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11. Write short notes on any *three* of the following :   3 × 5

    a)   Z buffer algorithm

    b)   Scan line polygon fill algorithm.

    c)   Bresenham line drawing algorithm

    d)   Painter's algorithm.

    e)   Phong's shading model.