$$[X] = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$ (6)

12. (a) Explain CMY color model in graphics system. (4)

    (b) What do you mean by hidden surfaces? Explain Z-Buffer algorithm for visible surface determination. (6)

13. (a) What is Morphing? Morph a triangle into a square by equalizing the vertex count. (4)

    (b) Consider two Bezier curve segments defined by control points $P_0(20,20)$, $P_1(40,50)$, $P_2(60,20)$ and $P_3(80,20)$. Another curve segment is defined by $Q_0(a,b)$, $Q_1(c,d)$, Q_2 and Q_3. Find the point Q_0 and Q_1 such that two curve join smoothly and C^1 continuity exists between them. (6)

14. (a) What is dithering? What are its advantages over halftoning? (4)

    (b) Derive the basis matrix for Hermite curve. (6)

[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1353 **A**

Unique Paper Code : 32341602

Name of the Paper : Computer Graphics

Name of the Course : **B.Sc. (H) Computer Sc.**

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **Section A** is compulsory.
3. Attempt any **four** questions from **Section B**.
4. Parts of a question must be answered together.

SECTION A

1. (a) Show that the composition of two rotations is additive.

$$R(\alpha) \times R(\beta) = R(\alpha+\beta)$$ (2)

(b) Suppose an RGB raster system is to be designed using an 8 inch x 10 inch screen with a resolution of 100 pixels per inch in each direction. 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? Also find the aspect ratio of the raster system. (3)

2. (a) Construct a translation matrix to translate a Point P from position (h, k) to the origin. (2)

(b) Discuss briefly the steps involved in design of animation sequence. (3)

3. (a) Is RGB colour model additive? Justify your answer. (2)

(b) Define Projection. Give any two differences between parallel and perspective projections. (3)

4. (a) Write any two properties of Bezier curve. (2)

(b) Consider a triangle ABC with A(0,0), B(5,0) and C(0,5). Give transformation matrix after shearing triangle ABC by 3 units along Y-axis and 4 units along X-axis. Use homogeneous coordinates. (3)

$$T = \begin{bmatrix} 6 & 4 \\ 2 & 4 \end{bmatrix}$$

Find the area of transformed triangle. (4)

(b) Consider a line AB with position vectors of end point as [A] = [1 2] and [B] = [3 4]. The transformation matrix is given as $[T] = \begin{bmatrix} 2 & 4 \\ 6 & 2 \end{bmatrix}$.

Calculate the transformed line A'B'. Also prove that the midpoint of original line AB yield same results for the midpoint of transformed line A'B'. (6)

11. (a) Consider a square ABCD with coordinates as A(0,0), B(0,4), C(4,4) and D(4,0). Let the centre of the square be at coordinate P(2,2). Apply 2-D transformation to reduce the square ABCD to half of its size, with centre fixed at point P. (4)

(b) Perform a 3-point perspective projection onto the x=0 plane on a unit cube with centre of projections at $x_c = -10$, $y_c = -10$ and $z_c = -10$. Also, give the vanishing points. Consider the coordinates of the unit cube as follows :

5. (a) What is the condition for trivial acceptance of a line segment AB with A(0,4) and B(8,4) in Cohen Sutherland Line Clipping Algorithm using rectangular window coordinates as A(0,0), B(8,0), C(8,8) and D(0,8)? (2)

(b) Using Bresenham's line drawing algorithm find out the list of the rasterized pixels for the line from (20,10) to (25,14). (3)

6. (a) What is Specular reflection? (2)

(b) What are the steps in an Area-Subdivision method for Visible Surface determination? Is it an object-space method or image-space method? (3)

7. (a) What is interlacing? Discuss its significance in raster graphics. (2)

(b) Show that a 2D reflection through the x-axis, followed by a 2D reflection through the line y=x, is equivalent to a pure rotation about the origin. (3)

SECTION B

8. (a) Prove that two scaling transformations are commutative.

Write 3X3 2-D transformation matrix for each of the following transformations respectively :

(i) Enlarge the object by three times.

(ii) Translate the object by 3 units in x direction. (4)

(b) Using mid-point circle drawing algorithm find out the pixel positions lying in the first quadrant of the circle with centre at (0,0) and radius of 8 units. (6)

9. (a) Describe Phong interpolation shading method for polygon rendering. Give any two advantages of this method. (4)

(b) Using Sutherland Hodgman Polygon Clipping Algorithm, clip the polygon ABC with coordinates A(100,150), B(200,250) and C(300,200) against the clipping window with coordinates P(150,150), Q(150,200), R(200,200) and S(200,150). (6)

10. (a) A triangle is defined by vertices (2,0), (0,2), (−2,0). It is transformed by 2x2 transformation matrix