ALCCS

Code: CS40 **Subject: COMPUTER GRAPHICS**
Time: 3 Hours **SEPTEMBER 2010** **Max. Marks: 100**

NOTE:

- **Question 1 is compulsory and carries 28 marks. Answer any FOUR questions from the rest. Marks are indicated against each question.**
- **Parts of a question should be answered at the same place.**
- **All calculations should be up to three places of decimals.**

Q.1 a. What do you understand by vanishing points? Indicate how do you calculate the vanishing point when viewing a 3D object.

b. Indicate very briefly the scan line seed fill algorithm.

c. Consider a clipping window A (10, 10), B (40, 10), C (40, 20), D (10, 20). Using outcodes of end points of the line P (50, 0) – Q (70, 30), show that the line is trivially invisible.

d. Consider a triangle A (a,b), B(c,d), C(e,f) drawn on the XY plane. Find the transformation matrix to perform 90^{o} clockwise rotation transformation about the point A? Also find the coordinates of the rotation of B and C?

e. Given the control points P1(0,10), P2(30,40), P3(80,10), P4(60,40), draw a rough sketch of a cubic Bezier curve, and draw the convex hull of the curve. You don't have to do any calculations.

f. Explain briefly the floating Horizon method for hidden surface removal.

g. A light source of intensity I is throwing light on an object at distance D. Write an expression for the diffuse reflection from the object. Define any constants that appear in your expression. **(7 × 4)**

Q.2 a. It is desired to draw a line in the first quadrant, with slope m = 2. Derive the Bresenham's integer line drawing algorithm to indicate the coordinates of the line that will be displayed, as the line moves from $P(x_1 , y_1)$ to $Q(x_2 , y_2)$, given that
$x_2 > x_1$ and $y_2 > y_1$.

b. Compare Gouraud shading with Phong shading in terms of their implementation and the difference in appearances in displaying an object on the screen. **(10+8)**

Q.3 a. Consider a clipping window A (0, 0), B (30, 0), C (30, 20), D (0, 20). Use Cyrus Beck algorithm to determine the portion of line P (25, 40) – Q (50, 10) clipped by this window. Make the complete Cyrus Beck table and show all calculations.

b. Explain the Binary space partitioning method for hidden surface removal. **(10+8)**

Q.4 a. Derive the parametric form of the cubic Bezier curve. Show that the last point on the curve coincides with the last control point, and that the starting slope of the curve is fixed by the position of the first two control points.

b. Consider the rectangular object shown in Fig. 1. Note that the Z-axis is coming towards the observer from the origin of the axes. Work out the transformation matrix to rotate the object clockwise around Y-axis by 30^{o} and to translate it by

10 units along the Z-axis, such that the new coordinate of point O is (0, 0, – 10). **(10+8)**

Q.5 a. Derive the transformation matrix to obtain an isometric view of the object shown in Fig. 1.

b. Describe antialiasing in computer graphics. **(10+8)**

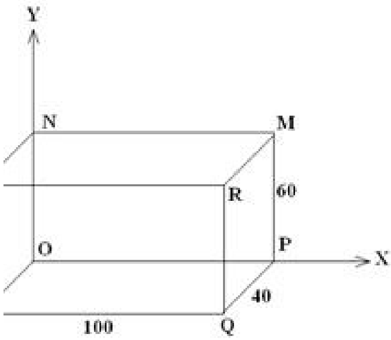

Fig. 1

Q.6 a. The object shown in Fig 1 is pushed back 40 units along z axis till the face SRQT falls on the XY plane. It is then pushed to left along x axis by 50 units such that new coordinate of T is (–50, 0, 0). Work out the transformation matrix for the perspective view that will be generated from a centre of projection at (0, 0, 25). Calculate the screen positions of points S, R, N and M as viewed from this position.

b. Taking the Koch curve as an example show how the fractal dimensions are calculated for self similar fractals. **(12+6)**

Q.7 a. Describe the transformation matrix to obtain the top view and the right side view of the object shown in Fig 1.

b. Given 4 control points P1 (40, 40), P2 (10, 40), P3 (60, 60), P4 (60, 0), draw a rough sketch of a periodic cubic B-spline curve. Calculate the position of the last point on the curve. Given another control point P5(80,20), show that the starting point of the B-spline curve corresponding to control points P2, P3, P4, P5 is same as the last point of the first curve. The characteristic basis matrix for a periodic cubic B-spline curve is given by **(6+12)**

$$(1/6)\begin{pmatrix} -1 & 3 & -3 & 1 \\ 3 & -6 & 3 & 0 \\ -3 & 0 & 3 & 0 \\ 1 & 4 & 1 & 0 \end{pmatrix}$$