ROLL NO. _____

Code: CT72 **Subject: COMPUTER GRAPHICS**

ALCCS

Time: 3 Hours **JUNE 2016** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

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.**

Q.1 a. Consider an equilateral triangle. Suppose each side is replaced by the following fractal generator where the 4 segments are of equal length. Name the figure that will be generated by repeating this process number of times. Work out the fractal dimension of this figure.

b. Derive the blending curves for Hermite spline.

c. Work out the visibility of the line $X(-12,32)-Y(36,10)$ in the clipping window A(0,0), B(30,0), C(30,20), D(0,20), making use of the outcodes of the end points of the line.

d. Describe the operations for Constructive Solid Geometry (CSG) modelling.

e. One Bezier curve is specified through control points A1, A2, A3, A4 and the other Bezier curve is specified through B1, B2, B3, B4. Both the curves are 2 dimensional. It is desired the two curves join smoothly. Derive a relationship for smooth join at the joining point A4, B1.

f. What is the difference between perspective projection and parallel projection with respect to projectors and COP?

g. What is the main difference between Gouraud shading with Phong shading methods? Which of the two is better? **(7×4)**

Q.2 a. A box is 130 cm long, 60 cm wide and 50 cm high. It is placed such that one of the vertices is coinciding with the origin of 3D axes. The edges of the box at that vertices are aligned with 3 axes of the coordinate system. Work out the necessary rotations required so that an isometric view of the object can be viewed on the XY plane. **(10)**

b. Describe the scan line seed fill algorithm to generate solid area on the screen. **(8)**

Q.3 a. Using the Bresenham's circle generation algorithm or the midpoint circle algorithm show how to draw an octant of the circle (one eighth of a circle) with centre (0,0) and radius R. The octant starts from the point (O, R) and lies in the first quadrant. **(10)**

b. The characteristic basis matrix for a periodic cubic B-spline curve is given by

$$\frac{1}{6}\begin{bmatrix} -1 & 3 & -3 & 1 \\ 3 & -6 & 3 & 0 \\ -3 & 0 & 3 & 0 \\ 1 & 4 & 1 & 0 \end{bmatrix}$$

Suppose a B-spline curve is drawn with control points A,B,C,D and another B-spline curve is drawn with control points B,C,D,E. Show that the two curves join smoothly (their first derivatives are same at the joining point) **(8)**

Q.4 a. Use Cyrus Beck algorithm to determine if any portion of the line $P(25,40)-Q(50,10)$ gets clipped by the rectangular window $B(30,0), C(30,20), D(0,20), A(0,0)$. Make the complete Cyrus Beck table and show all calculations. **(10)**

b. Explain very briefly the Z Buffer method for hidden surface removal. Show how depths are calculated for a planar Polygon Ax+By+Cz+D=0 whose left edge has slope m. **(8)**

Q.5 a. Draw a smooth sketch of the cubic Bezier curve given the four control points A(30,0), B(0,0), C(50,-10), D(50,-40). **(4)**

b. Given 4 control points P,Q,R and S derive an expression for obtaining points on a Bezier curve. Show that the first point of the curve lies at the point P and that the ending slope of the curve is same as that of the line RS. **(8)**

c. Describe the transformation matrix to obtain the top view and the right side view of an object on the z = 0 plane. **(6)**

Q.6 a. Develop the illumination model which takes into account both diffuse reflection as well as specular reflection for an object lying at a distance of D units from a unit light source. **(6)**

b. Light falls along the z axis on a 3D planar surface with unit normal along $N(n_x, n_y, n_z)$. Using Phong specular reflection model work out the components of the Reflection vector R. **(6)**

c. Show how a cylinder and a cone could be constructed using the method of swept solids. The 3D coordinates of the centre of the base of the cylinder is (30,0,30) and that of the centre of the base of the cone is (100,0,30). Both have base diameter of 40 and height 100. **(6)**

Q.7 a. Work out the transformation matrix to obtain mirror reflection of a point (X,Y) about a line passing through the points (0, 20) and (20, 0). Use this matrix to obtain the coordinates of the reflected points of a triangle P(20,20), Q(15,15), R(20, 30). **(10)**

b. An animation sequence is to be developed to show a car accelerating from stationary position and then moving with constant speed. Show how the accelerations can be simulated for this purpose. **(8)**