C10-R3: COMPUTER GRAPHICS AND ANIMATION

NOTE:

1. **Answer question 1 and any FOUR from questions 2 to 7.**
2. **Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours **Total Marks: 100**

1.

a) Write the perspective transformation matrix and show how the vanishing points may be located?

b) Show that the starting slope of a cubic Bezier curve is dictated by the location of first two control points.

c) Discuss briefly the Gouraud shading scheme to render a polygon surface. What are its deficiencies?

d) What is meant by kinematics, inverse kinematics and dynamics of motion specification in animation sequences?

e) How does the Z-buffer algorithm determine which surface is hidden?

f) How is CSG (Constructive solid Geometry) useful in solid modeling?

g) Show the use of velocity curves for carrying out motion control during animation.

(7x4)

2.

a) Consider a rectangle with two diagonally opposite vertices located at (0, 0) and (8, 4). Using Cyrus-back line clipping algorithm, clip the line segment from (6, -2) to (10, 1). Show all the steps and correctly interpret the values of parameter, t obtained.

b) Consider the line segment AB parallel to the z-axis with end points A[3 2 4 1] and B[3 2 8 1]. Perform a perspective projection onto the z = 0 plane from a center of projection at $z_0 = -2$.

(10+8)

3.

a) For a Bezier curve, P(u), of degree 5, suppose the control points are B1(0, 0), B2(2, 2), …, B5(5, -1) and B6(7, 0). Find the remaining control points of the curve which has its second derivative at u=0 and u=1 equal to zero.

b) Explain the concept of visible surface ray tracing. Also give any simple ray tracing algorithm.

c) What are Particle systems? Explain briefly how particles are generated?

(6+6+6)

4.

a) What is Volume rendering? What are the approaches to Volume rendering? Describe any two of them.

b) What is meant by sweep surfaces? Sweep the normalized cubic spline curve segment as defined by P1[0 3 0 1], P2[3 0 0 1], P1′[3 0 0 0], P2′[3 0 0 0] 10 units along the z-axis.

(10+8)

5.

a) How is transparent surface modeled? What is Snell's law?

b) Explain how Octrees can be used to represent curved objects. Give algorithms for union and intersection of object representation using Octrees.

(10+8)

6.

a) i) Describe the technique to determine the self-shadows and the projected shadows for every polygon in the scene for every light source.

ii) Consider a block described by the points $P_1(1,0,3,5)$, $P_2(2,0,3,5)$, $P_3(2,0,5)$, $P_4(1,0,5)$, $P_5(1,3,3,5)$, $P_6(2,3,3,5)$, $P_7(2,3,5)$, and $P_8(1,3,5)$. The block rests on a base plane given by $B_1(0,0,0)$, $B_2(6,0,0)$, $B_3(6,0,6)$, and $B_4(0,0,6)$. The light source is located at infinity along the line connecting $P_2$and P_8. The block and base plane are to be observed from infinity on the positive z-axis, after first being rotated -45 degree about the y-axis followed by a 35 degree rotation about the x-axis. Show that the self-shadowed planes would be produced by determining the self-hidden planes from the position of the light source.

b) What problems are associated with using basic linear interpolation to do 'in-betweening' for key frames?

(12+6)

7.

a) What are the disadvantages of Euler angle representation over the fixed angle representation?

b) What is morphing? Describe the interpolation process for generating an image between the two given images, say L along the way from the source image to the destination image.

c) Give the algorithm to model and animate phenomenon of Water (or Fire or Clouds).

(4+6+8)