C10-R3: COMPUTER GRAPHICS & ANIMATION

NOTE:

1. Answer question 1 and any FOUR questions from 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) Describe how the Cyrus-back algorithm determines whether a point on a line is inside, on or outside a window?

b) Define the
   i) one-point perspective transformation
   ii) two-point perspective transformation and
   iii) three-point perspective transformation. Can multiple faces of an object be revealed using the perspective projections?

c) What are hidden surface problems? How z-buffer algorithm handles them?

d) Give any one technique to determine the direction of the reflection vector in implementing an illumination model.

e) Discuss the generation of Solid Objects using sweep method.

f) Why do we consider a mathematical spline model using cubic polynomials? Whether Bezier curves are better than the routine curve fitting techniques for ab initio design of curves?

g) How far a fixed angle representation avoids the invalid representation problem? What is gimbal lock? State the Euler angle representation.

(7x4)

2.

a) Using Cyrus-back algorithm determine whether the line from P(6, -2) to Q(10, 1) will be visible, partially visible or invisible when clipped to the rectangular window as shown below:

b) An object is to be rotated 60 degree clockwise about an line passing through the origin and a point (3, 5, 4). Find the sequence of transformations required to perform this task.

(10+8)
3. a) What are the methods for degree raising of B-spline curves?
Consider an open third-order B-spline curve initially defined by four polygon vertices
A(0,0), B(1,1), C(2,1), D(3,0). Subdivide the curve applying Oslo algorithm while
maintaining a open uniform knot vector.
b) Calculate the five third order B-spline basis functions using the knot vector \( X = [0 0 0 1 1 3 3 3] \) which contains an interior repeated knot value.

4. a) Consider the rectangle with corners as \( P(10,5,10), Q(10,25,10), R(25,25,10), S(25,5,10) \)
and the triangle \( ABC \) penetrating the rectangle from the behind where \( A=(15, 15, 15), B=(25, 25, 5 \) and \( C=(30, 10, 5) \). Assume the observer is located at infinity on the
positive z-axis. If the ray is considered through the pixel at \( (20, 15) \), find the visible
portion of the scene illustrating each step of the ray-tracing algorithm.
b) Find the general form of an oblique projection onto the xy plane.

5. a) Explain how Octrees can be used to represent curved objects. Give algorithms for union
and intersection of object representation using Octrees.
b) Explain phong’s shading model. Give its advantages and disadvantages over Gouraud’s
model.

6. a) What are different techniques used for implementing key frame based animation?
Discuss the advantages and disadvantages of them.
b) Describe the two-pass procedure to interpolate the image grids and forming an in
between grid while interpolating one image into another.

7. a) Explain and compare the Particle System and Flocking System techniques for
animation?
b) What are the main forces at work in keeping a bunch of boids behaving like a flock.
Discuss each of them briefly.