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) Propose the conversion from YIQ to HSI color model. 
   b) How is Octree used for visible surface detections? 
   c) What are the differences between local and global illumination? 
   d) Describe Ambient Occlusion. 
   e) Describe the 3D rendering pipeline. 
   f) Describe Phong Shading Model. 
   g) What is the use of antialiasing for rendering a 3D scene?  
       (7×4)

2.        
   a) Describe the full procedure for the simulation of particle generation. 
   b) Explain the various types of projections with suitable diagram.  
       (9+9)

3.        
   a) Explain CSG (Constructive Solid Geometry) with example. Also elaborate on a few applications where CSG is commonly used. 
   b) Convert from RGB to YCbCr colour model.  
       (9+9)

4.        
   a) Explain the differences between Z-Buffer Algorithm and the Painter’s Algorithm for detecting hidden surfaces. 
   b) Show that the normalized perspective to parallel transform $NT_p$ preserves the relationships of the original perspective transformation while transforming the normalized perspective view volume into the unit cube.  
       (9+9)

5.        
   a) Derive the 3D Shearing matrix. 
   b) Explain the Ray-object Intersection used in ray tracing algorithm.  
       (9+9)

6.        
   a) Write short notes on:
      i) Hermite Curve, & 
      ii) Text-clipping 
   b) Explain the Visible Surface Ray Tracing Algorithm.  
       (9+9)
7. 
   a) Derive the equation for any cubic spline segment $k$.
   b) A cube with one of its corner cut off (as shown in the figure) is formed by $\phi=30^\circ$ rotation about the y-axis, followed by a $\theta=45^\circ$ rotation about the x-axis and then parallel projected on $z=0$. Find the foreshortening ratios.

   ![Cube with corner cut off](image)

   The position vectors for the cube with one corner removed are:

   $$
   [X] = \begin{bmatrix}
   0 & 0 & 1 & 1 \\
   1 & 0 & 1 & 1 \\
   1 & 0.5 & 1 & 1 \\
   0.5 & 1 & 1 & 1 \\
   0 & 1 & 1 & 1 \\
   0 & 0 & 0 & 1 \\
   1 & 0 & 1 & 1 \\
   1 & 1 & 0 & 1 \\
   0 & 1 & 0 & 1 \\
   1 & 1 & 0.5 & 1 
   \end{bmatrix}
   $$

   (9+9)