[Time: 3 Hours]

NB : 1) **Question 1** is **compulsory**.
2) Attempt any **three** questions from the **remaining** questions.
3) **Assume** suitable **data** wherever applicable.

1 (a) Explain various image representation techniques. 5

(b) Explain parallel and perspective projections 5

(c) Explain the differences between computer graphics and virtual reality 5

(d) Explain any test to determine whether the point is inside or outside of polygon. 5

2 (a) Explain graphics rendering pipeline for virtual reality. 10

(b) Explain Sutherland Hodgeman polygon clipping algorithm. State its drawbacks and explain how it can be solved. 10

3 (a) What is the significance of modeling in virtual reality? Explain any modeling technique. 10

(b) With respect to 3D transformations, describe the steps to be carried out when an object is to be rotated about an axis that is not parallel to any of the coordinate axis. Specify all the required matrices. State your assumptions clearly. 10

4 (a) State mathematical equation for Bezier curve. Find the Bézier curve which starts at $\{x_0, y_0\} = \{2, 2\}$ and ends at $\{x_3, y_3\} = \{4, 1\}$ which has the control points $\{x_1, y_1\} = \{0, 1\}$ and $\{x_2, y_2\} = \{3, -1\}$, respectively. 10

(b) Write a function to fill a region boundary by different colour boundaries using connected approach. Explain the algorithm with example 10

5 (a) Consider a triangle ABC whose coordinates are A (1, 2), B (3, 4), C (5, 2). Perform the following transformations: (Specify the matrices that are used) 10
   i) Translate the given triangle by 3 units in X direction and -2 units in Y direction
   ii) Rotate the given triangle by 30°
   iii) Reflect the given triangle about Y axis
   iv) Scale the given triangle uniformly by 2 units in X and Y direction
   v) Reflect the given triangle about X=Y

(b) Draw a line from (-10, 15) to (-20, 25) using Bresenham's line drawing algorithm. 10

6 Write short note on **(any four)** 20

(a) Fractals

(b) Types of virtual reality systems.

(c) Color models

(d) B-spline curve

(e) Application of virtual reality

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