B.E. INFORMATION TECHNOLOGY 2ND YEAR-2ND SEMESTER EXAMINATION– 2024

Subject: Graphics and Geometric Modeling

Time: 3 hrs.   **Full Marks: 100**

(Note: Answers of all parts of a question should be written together)

CO1 (15)	Q.1 *Answer (a) and any one from (b) and (c):*
	a. Given center point coordinate (15, 10) and radius as 20 unit, generate all points (in the 1st octant) by using Bresenham and Midpoint circle drawing algorithms. Hence compare their respective efficiencies. **8**
	b.
	i. Consider a non-interlaced raster monitor with a resolution of n by m (m scan lines and n pixels per scan line), a refresh rate of r frames per second, a horizontal retrace time of $t_{horizontal}$ and a vertical retrace time of $t_{vertical}$. What is the fraction of the total refresh time per frame spent in retrace of the electron beam?
	ii. Explain with example: efficiency of 8-connected boundary fill algorithm over 4-connected. **3+4**
	c.
	i. Use the midpoint method to derive decision parameters for generating points along a straight-line path with the slope in the range 0 < m < 1. Show that the midpoint decision parameters are the same as those in the Bresenham line algorithm.
	ii. How does aspect ratio affect the performance of CRT? Differentiate between raster scan display and random scan display. **3+(2+2)**
CO2 (25)	Q.2 *Answer (a) and any one from (b) and (c):*
	a.
	i. Determine the Bezier blending functions for five control points. Plot each function and label the max and min values.
	ii. Design a Bezier curve controlled by four control points (2, 2), (3, 4), (5, 4), and (7, 5).
	iii. Find the cubic spline with two end points (1, 1) and (6, 5) and respective tangents (0, 4) and (4, 0). **7+6+6**
	b.
	i. Suppose the knot vector of a B-spline is {0, 0, 0, 1, 2, 3, 3, 3}. Find the possible values of number of control points and degree of the polynomial.
	ii. Obtain no. of segments, no. of control points in each segment, total control points, degree and order of the B-spline curve defined by n=5 and k=3, where symbols carry their usual meaning **3+3**
	c.
	i. Define C^0, C^1, and C^2 continuity used in splines.
	ii. Obtain knot values for n=3 and k=3 where symbols carry their usual meaning. **3+3**
CO3 (25)	Q.4 *Answer (a) and any one from (b) and (c):*
	a.
	i. The lower left-hand and upper right-hand corners of a rectangular clipping window are at (50, 10) and (80, 40) respectively. Using Sutherland-Cohen algorithm, clip the two line segments P_1(35, 10) - P_2(65, 40) and P_3(65, 20) - P_4(95, 10) in the clipping window.
	ii. Derive the three-dimensional transformation matrix for scaling an object by a scaling factor s in a direction defined by the direction cosines α, β, and γ.
	iii. Show that two successive reflections about any line in the xy plane that intersects the coordinate origin is equivalent to a rotation in the xy plane about the origin. **9+3+3**
	b.
	i. A triangle having vertices (0, 3, 3), (3, 3, 0), and (3, 0, 3), is rotated 60^0 around a point (2, 2, 2). Find the new coordinates of the rectangle.
	ii. What is vanishing point and why it is so important? **7+3**
	c.
	i. Vertices of a triangle are (0, 3, 3), (3, 3, 0), and (3, 0, 3). Find the new coordinates of the triangle when it is rotated 60^0 about X, Y, and Z axis (separately).
	ii. What is multi-point perspective and when it is used? **7+3**

CO4 (15)	Q.4 *Answer (a) and any one from (b) and (c):*
	a.
	i. Discuss the differences you might expect to see in the appearance of specular reflections modeled with $(N.H)^{ns}$ compared to specular reflections modeled with $(V.R)^{ns}$.
	ii. How many intensity levels can be displayed with halftone approximations using $n \times n$ pixel grids, where each pixel can be displayed with m different intensities?
	iii. Find out YIQ and CMY color vectors whose equivalent RGB vector is (12, 180, 240). Why HSV model is advantageous than HLS model?
	2+2+(3+2)
	b.
	i. Distinguish between online and offline type of rendering.
	ii. Differentiate between Ray-casting, Ray tracing and Rediosity as techniques of rendering.
	2+4
	c.
	i. Differentiate (with examples) among flat, gouraud and phong shadings.
	ii. How reflected intensity of ambient light, diffusion reflection, and specular reflection are measured?
	3+3
CO5 (13)	Q.5 *Answer any one:*
	a.
	i. Differentiate octree from quadtree. Write the disadvantages of wireframe model.
	ii. Define Generalized Cylinder as a modeling technique. How to use wireframes in content modeling?
	iii. Differentiate between Euclidean dimensions and Fractal dimensions? How to use Ray-casting typically to implement CSG operators? What is firing plane used by ray-casting in CSG?
	4+4+5
	b.
	i. Find the total length after n^{th} order of Koch Curve fractal where number of segments and scaling factor are 5 and 1/4 respectively. Also find the fractal dimension.
	ii. Explain with examples of various feasible set operations in CSG modeling. How is polygon mesh useful in modeling solids? Can rendering be suitable for wireframe models?
	iii. How is scene graph used in 3D modeling? What is the fastest way to insert and move a rectangle object into a linear octree?
	4+5+4
CO6 (7)	Q.6 *Answer any one:*
	a. Why AR is better than VR for artists and creatives? What are the various types of VR and how it is distinguished from AR? Write the use cases of AR and VR in healthcare systems.
	2+2+3
	b. Write the generic steps of morphing. Name some generalized authoring metaphors and write the features of authoring tools. Define snowflake fractals.
	2+3+2

-: Course Outcomes :-

CO1: Describe fundamental terms of computer graphics and input-output devices of Computer Graphics and Explain the algorithms for Raster scan Graphics.

CO2: Illustrate curve and surface representation and drawing algorithms.

CO3: Compute 2D and 3D Geometric transformations and apply viewing algorithms in typical cases.

CO4: Describe color representation and rendering mechanisms of images.

CO5: Describe Object representation and Illustrate Geometric Modeling.

CO6: Discuss various topics of advanced computer graphics such as fractals, animations, morphing etc.