DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
UNIVERSITY OF BARISHAL

FINAL EXAMINATION-2023
Course Title: Computer Graphics
Course Code: CSE-4109
4th Year, 1st Semester, Session: 2019-20

Time: 3 hours **Marks:** 60

Answer any Five (5) Questions from the followings.

1. An important algorithm to draw an ellipse is Midpoint algorithm. Using the algorithm, we can find points of four quadrants to draw a complete ellipse. Figure 1 shows an ellipse which is given by the equation: $\left(\frac{x}{a}\right)^2 + \left(\frac{y}{b}\right)^2 = 1$ with the center (0,0) and the radii a and b.

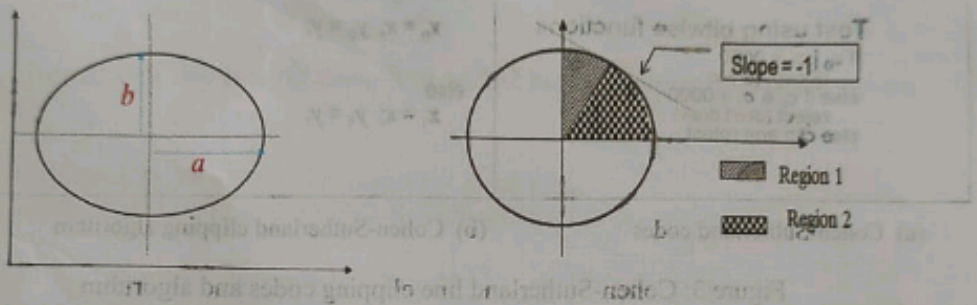


Figure 1: Illustration of an ellipse

a) Demonstrate the calculation to find the decision parameter P for regions 1 and 2 as shown in Figure 1. 7

b) Determine the next five points from the initial point (x0,y0) = (0,b) for the first quadrant where radii a=20 and b = 10. Use Table 1 as a guideline to find the next five points. 5

Table 1: Guideline to find the points

K	P_k	(x_{k+1}, y_{k+1})
0		
1		
2		
3		
4		
5		

2. Figure 2 shows a viewing (clipping) window with coordinates where a line joining the point p0(x0, y0) and point p1(x1, y1) is required to be clipped. Figure 3 shows Cohen-Sutherland line clipping codes and algorithm to find the intersection points that form the line after clipping.

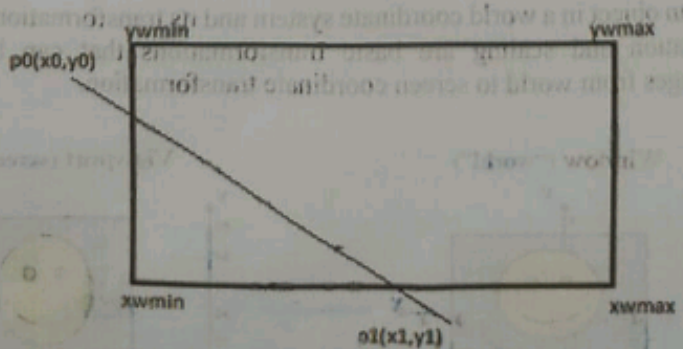
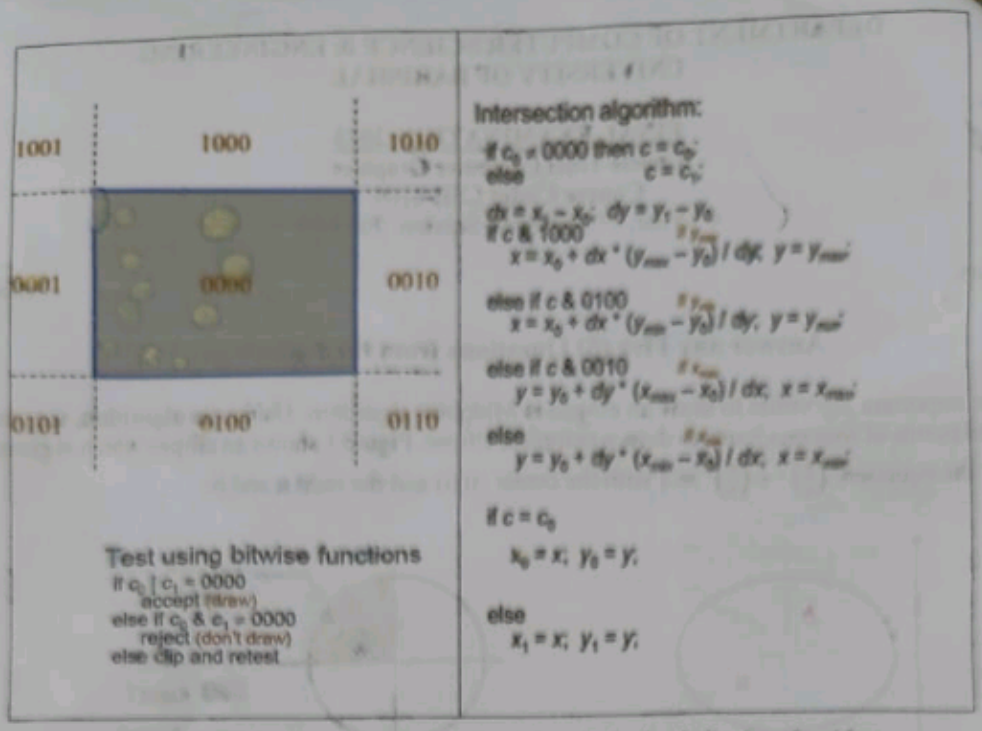


Figure 2: Viewing area and a line to be clipped



(a) Cohen-Sutherland codes (b) Cohen-Sutherland clipping algorithm

Figure 3: Cohen-Sutherland line clipping codes and algorithm

a) Demonstrate the process to find the intersection points that form the line after the clipping using the Cohen-Sutherland algorithm with xwmin = 0, xwmax = 120, ywmin = 0, ywmin = 120, x0 = -15, y0 = -25, x1 = 120 and y1 = 110. 10

b) Analyze how the viewing-coordinate reference frame can be established? 2

3. a) Define shades, tints and tones. 3
b) Define color gamut. Discuss CIE chromaticity diagram in short and how can we get color gamut from CIE diagram. 6
c) Why HSV color model have more appeal to a user rather than RGB model. 3

4. a) Analyze the differences between geometric transformations and coordinate transformation. 4
b) For scaling an object, is it necessary to have a fixed point? 4
c) Explain with example: (a) how to convert standard 3D coordinates, (x; y; z), to homogeneous coordinates, and (b) how to convert homogeneous coordinates to standard 3D coordinates. 4

5. Figure 4 shows an object in a world coordinate system and its transformation in a screen system. Translation, rotation and scaling are basic transformations that can be implemented to accomplish changes from world to screen coordinate transformation.

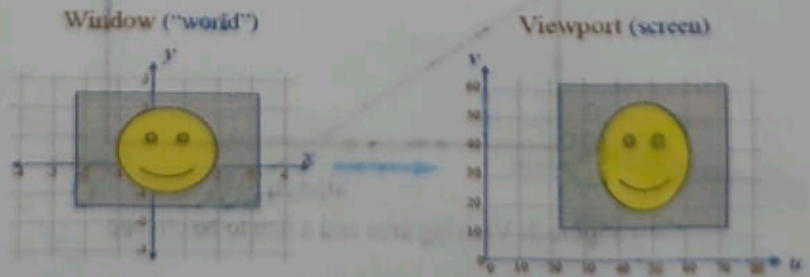


Figure 4: Transformation of a 2D object from world to screen coordinate

a) Derive world-to-screen transform vector for a generic coordinate (x, y). 5
b) Suppose that xmin = -4, ymin = -4, xmax = 2 and ymax = 1 for the world coordinate system and umin = 30, vmin = 10, umax = 80 and vmax = 30 for the screen coordinate system. Simplify your vector obtained from the world-to-screen transform vector with the information. 5
c) Analyze the term "Viewing Transformation" using a suitable figure. 2

Analyze the cause of peak response for RGB colors in our human visual system. 6

b) Differentiate the terms with suitable figure: i) Foreshortening, ii) Vanishing Points, iii) View Confusion, and iv) Topological distortion. 4

c) Demonstrate the Gouraud Surface Rendering Algorithm with suitable figure(s).

7. a) A line passing through the points p1 = (1, 3, 2) and p2 = (2, 4, 3) that shows in Figure 5. Translate the line to the origin by setting p1 to (0, 0, 0). Then rotate the line with θ=45° about y axis. 7

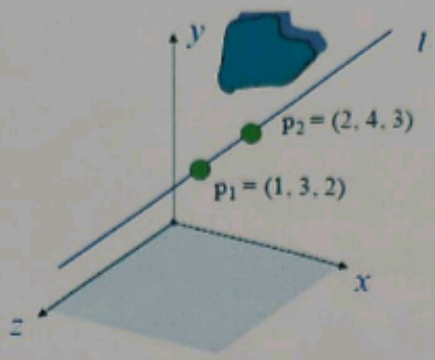


Figure 5: A line passing through p1 and p2 in 3D Cartesian coordinate system

b) Explain the necessities of lighting for computer graphics? 2

c) Distinguish three properties of chromatic light: Brightness, Hue, and Saturation. 3

8. a) Distinguish the differences between Gouraud and Phong Surface Rendering. 3

b) A perspective transformation is determined by prescribing a center of projection and a view plane. In Figure 6, the object point P is located in world coordinates at (x, y, z). The problem is to determine the image point coordinates P/(x/, y/ ,z/), as described in Figure 6. 9

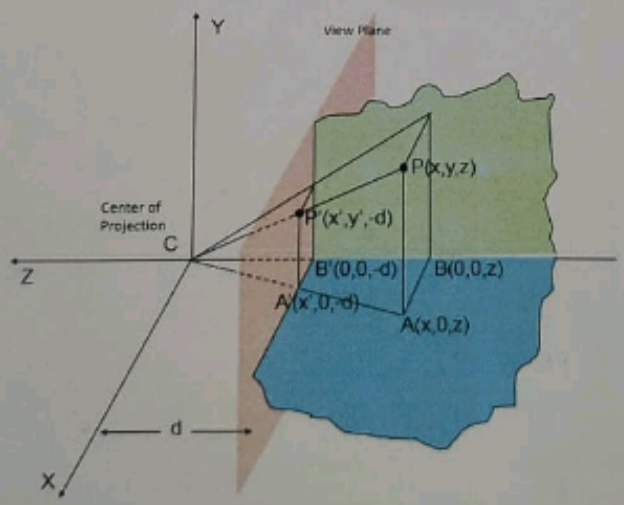


Figure 6: Perspective Projection

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