

BACHELOR OF COMPUTER SCIENCE & ENGG. EXAMINATION, 2025 (3rd YEAR , 1st SEMESTER)

COMPUTER GRAPHICS

Time: Three Hours

Full Marks: 100

Read the Following Instructions Carefully:

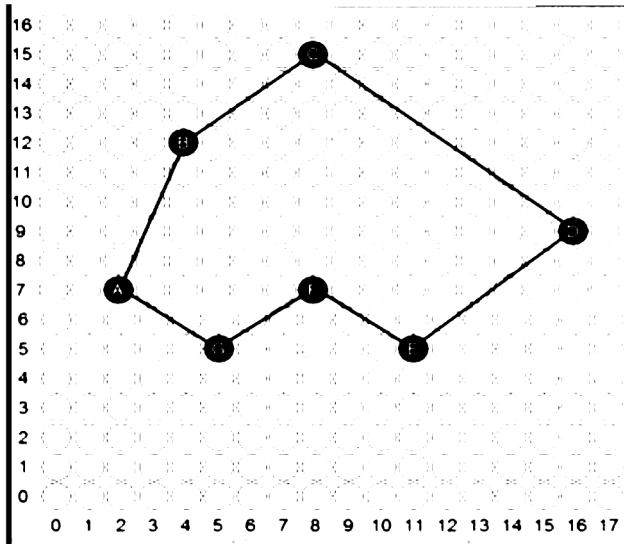
Let R be the last two digits of your Exam Roll No. and let R_1 and R_2 be the two digits in your Exam Roll No. For example, If your Exam Roll No. is 23, then, $R = 23$, $R_1 = 2$ and $R_2 = 3$; $R_1 + R_2 = 5$. If your Roll No. is 05, then, $R = 5$, $R_1 = 0$ and $R_2 = 5$; $R_1 + R_2 = 5$.

Answer ANY Four Questions

1. Derive the decision parameters for Bresenham's midpoint ellipse drawing algorithm. Given input ellipse parameters $r_x = 5$, and $r_y = 6 + R_1$, centred at origin, derive the steps in the midpoint ellipse algorithm by determining raster positions along the ellipse path in the first quadrant. 25

- 2 a) Derive the decision parameters for Bresenham's line drawing algorithm. Digitize a line from $(R_1, 12)$ to $(15, R_2)$ on a raster screen using Bresenham's straight-line Algorithm (compute upto 10 points). 20
 b) What is an inside-outside test? Check if the point (R_1, R_2) is inside the concave polygon defined by vertices $(1, 1), (6, 3), (4, 6), (1, 5), (2, 3), (1, 1)$. 5

3. a) 15



Explain Scan-line polygon filling algorithm in brief. Considering the above figure, generate the intersection points and the inside points for row numbers, 5-9.

- b) Consider the figure shown in 3(a), generate the transformation matrix for rotating an object comprising of the vertices $\{A, B, F, G\}$ by 30° in clockwise direction, with respect to the vertex A. 10

[Turn over

$$\begin{bmatrix} & 2 \\ & \end{bmatrix}$$

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4. a) QA unit square is transformed by a 2×2 transformation matrix. The resulting position vectors are 5

$$\begin{pmatrix} 0 & 2 & 8 & 6 \\ 0 & 3 & 4 & 1 \end{pmatrix}$$

What is the transformation matrix?

Hint:

Let the unit square have coordinates (x, y) , $(x + 1, y)$, $(x + 1, y + 1)$, $(x, y + 1)$ and let the transformation matrix be

$$\begin{pmatrix} a & c \\ b & d \end{pmatrix}$$

- b) Prove that if rotation angle is θ the transformation matrix formed when multiplied by the transformation matrix formed when angle is $-\theta$ is equal to identity matrix. 5
- c) Let ABCD be the rectangular window with A(0,0), B(10,0), C(10,10), D(0,10). Use Cohen-Sutherland Line-clipping algorithm to clip a line XY, such that X(-5, R_1) and Y(15, R_2). 10
- d) Write the inside-outside rules used in Weiler-Atherton Polygon Clipping algorithm. 5

5. Derive the equation of a cubic Bezier curve and generate the intermediate points on the curve for the following control points ($\Delta u = 0.20$). 25
- $\{(1, 4 + R_1), (3, 7), (7, 1), (11, 5)\}$

6. a) Derive the formulation for diffuse and specular reflections from multiple light sources, with RGB color considerations. 10
- b) Briefly discuss Phong surface rendering model. Then, discuss its advantages and disadvantages with respect to the Gouraud model. 10
- c) Briefly discuss the Painter's algorithm for hidden surface removal 5