Cairo University
Faculty of Computers & Information
Information Technology Department

Final Exam
Spring 2011
Time: 2 hours

## Computer Graphics (IT322)

**ATTEMPT ALL QUESTIONS**

## Question 1

[a] Distinguish between simple DDA and Bresenham's algorithm for line generation.

[b] Write an algorithm to draw a circle given its centre point and radius.

[c] Trace the mid-point line drawing algorithm for drawing the line with end points (8, 9), (10, 2). Summarize your traces by supplying the following information:

| Formulas you used to compute the decision variable d | | |
|---|---|---|
| Initial decision: $d_{initial} =$ | | |
| Change in decision when d<0: $d_1 =$ | | |
| Change in decision when d>0: $d_2 =$ | | |
| Traces | | |
| X | Y | Decision variables |
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## Question 2

] Describe an algorithm for clipping a line with end points $(x_1, y_1)$ and $(x_2, y_2)$ against a circle with radius R entred about $(x_c, y_c)$

] Using steps followed in Cohen-Sutherland algorithm, determine the intersection of the line segment ith end points (0, -1) and (3, 2) with a rectangular window with corner points (0, 2) and (3, 0).

] Draw the active linked list updates (at y=4, 5, 6, 7, 8) of the general polygon filling algorithm when ling a polygon with vertices (2, 4), (7, 4), (1, 8), (8, 6).

## Question 3

Derive the transformation matrix needed to rotate an object an angle $\theta$ about the origin on an elliptic h with radii **a** and **b** where the major and minor axes of the ellipse coincide with the principle axis.

ht: start with the ellipse parametric equations:

$$x = a \cos \varphi$$

$$y = b \sin \varphi$$

[b] Write a homogeneous transformation matrix (or product of matrices) to:

- Rotate an object about the y axis with a rotation angle of 30° clockwise.
- Scale an object with respect to a fixed point (a, b) where the scaling factors in x and y directions are $\alpha$ and $\beta$ respectively
- Shear an object with a shear factor of 2 in the direction of the vector (3, 4)
- Transform Figure 1 into Figure 2 as shown below. Note that the transformation is a rigid transformation (i.e. composition of translation and rotation).
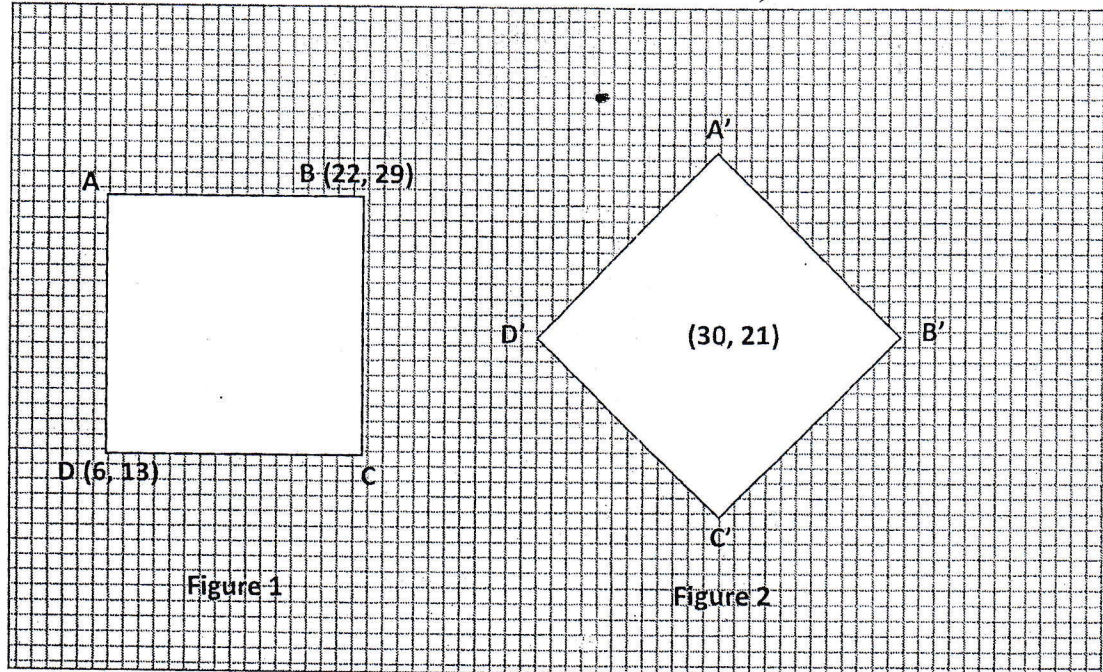


- Map the cuboid with opposite corner vertices: (3, 7, 2) and (10, 20, 8) to a cube with unit side length centred about the origin
- Map the ellipse:

$$\frac{(x-7)^2}{25} + \frac{(y-4)^2}{49} = 1$$

to a circle of radius 10 centred about (5, 9)

[c] Find the orthogonal projection of the point (6, 2, 3) on the plane passing through the points (1, -3, 5), (2, 4, 1) and (0, 1, 0)

## Question 4

[a] Write an algorithm to compute the camera view matrix from the following parameters:

- Center of projection (COP), Center point (CP) and Viewer's up direction (VUP)

[b] Compute the parallel and perspective projection of the point (5, 3 , 4) on the camera view plane given that: COP = (-2, -1, 1), CP = (0, 0, 0)  VUP= (3, 0, 4) and distance (D) from COP to view plane is 4

[c] Write an algorithm to compute the matrix of rotation about a general axis (a, b, c) passing through the origin.