Cairo University
Faculty of Computers and Information
Final Exam

Department: Information Technology
Course Name: Computer Graphics **Date: 4/6/2017**
Course Code: IT331 **Duration: 2 hours**
Instructor(s): Prof. Reda A.Wahab **Total Marks: 60**

TRY ALL QUESTIONS

Question 1 [15 marks]

[b] Trace the mid-point line drawing algorithm as it draws the line with end points (12, 10) and (6, 14)
D0=dx-2dy = -14
D1=-2dy
D2=2dx-2dy

[c] Trace the general polygon filling algorithm by drawing the active linked list with each iteration when filling the polygon with the ordered list of vertices (10, 10), (100,10), (10, 18), (90, 16)

Question 2 [15 marks]

[a] Write the conditions under which the line is trivially accepted or rejected in the Cohen Sutherland line clipping algorithm
[b]The Barycentric equation of the triangle with vertices $P_1, P_2, P_3$is:

$$P(t_1, t_2) = t_1 P_1 + t_2 P_2 + (1 - t_1 - t_2) P_3$$
$$0 \leq t_1, t_2 \leq 1$$
$$t_1 + t_2 \leq 1$$

- Write an algorithm to fill-in a triangle based on this equation.
- Write an algorithm to determine whether a given point is inside the triangle.

[c] Write an efficient algorithm to fill an ellipse with axes parallel to the x and y axes.

Question 3 [15 marks]

[a] What is the homogeneous coordinate system and what is its importance in computer graphics. Define the general form of the affine transform in homogeneous space.
[b] Write the transformation matrix and OpenGl code needed to rotate a point 60 degrees clockwise about the y axis.
[c] Write the 2D transformation and OpenGL code to rotate a point 30 degrees in the anticlockwise direction about the point (10, 12)
[d] Write the 2D transformation needed to shear an object in the direction (5, 12) with a shear factor of 4.
[e] Find the affine transformation needed to compute the orthogonal projection of a point on the plane defined by the equation:

$$3x + 4y + z = 10$$

Question 4 [15 marks]

[a]What is the difference between parallel and perspective projection. What are the applications of both.

[b] Derive the Orthogonal and Frustum projection matrices of the OpenGL

[c] Given the following camera and viewport parameters:

Extrinsic Camera Parameters	Center of projection (10, 10, 10) Target point (1,1,0) Viewer's up direction (0, 0, 1)
Intrinsic Camera Parameters (assuming frustum projection)	LEFT=-5 TOP=5, Bottom=-5, TOP=5, NEAR=3, FAR=20
Viewport parameters	Left=10 TOP=20 Width=300 HEIGHT=500

Find:

i. The camera view matrix
ii. The Frustum projection matrix
iii. The Viewport mapping matrix
iv. The image of the triangle with vertices (0, 0, 0), (0,0,5), (5,0,5) on the viewport

Good Luck