Department of Computer Science and Engineering
BRAC University

Set A

Examination: Midterm
Duration: 1 hour 25 minutes

Semester: Summer 2025
Full Marks: 30

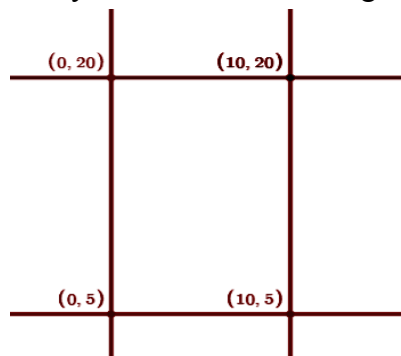## CSE 423: Computer Graphics

Name:	ID:	Section:

[Answer the following questions. Understanding the questions is part of your examination. So, do not ask for any clarification of the questions.]

Question 1 [CO1]

a. The starting point of a line segment is $(-423, -25)$ and the ending point is $(-430, 12)$. Using the DDA algorithm, **compute** the first 3 pixels (including the starting pixel) to be colored for the given line segment. **How** many times will the value of **y** be increased to draw the complete line? **[3 + 1]**

b. Suppose you are positioned at the intersection point of the lines $2x - y - 10 = 0$ and $-2x - 50 = 0$, while your friend stands at the coordinate $(-10, 15)$ on a floor composed of square grid tiles. To reach you, your friend wishes to move step by step along the grid, constrained to adjacent tiles, and aims to follow the straight-line path to your location as closely as possible. Using the Mid-point Line Drawing Algorithm, **determine** the **first six** grid tiles (including the starting tile) that your friend will step on during the approach. Show the calculations in a table. **[6]**

Question 2 [CO2]

a. Meliodas got an email from his faculty that had the following diagram:

He recently learned about line clipping algorithms in his class, so he wanted to test this out for the above clip region. He selected a line with two endpoints, A$(-20, 0)$ and B$(15, 40)$. Meliodas mentioned learning a clipping algorithm, which involved 4-bit Opcodes.

According to Meliodas's mentioned algorithm, *the clipping process applied to endpoint A differs from that applied to endpoint B*. Do you agree with this statement? Briefly **explain** why or why not, based on how his algorithm works. (No calculation needed). **[4]**

b. In a highly restricted military region, a classified research lab is located at the origin $(0, 0)$. To secure the facility, a no-fly perimeter has been established around it.
    This rectangular no-fly zone is defined relative to the lab as follows:
    ● 100 meters to the East of the lab
    ● 100 meters to the West of the lab
    ● 125 meters to the North of the lab
    ● 75 meters to the South of the lab

    A drone is flying in a diagonal path from a location 200 meters West and 200 meters North of the secret lab to a location 250 meters East and 150 meters South of the lab.

    Using the Cyrus-Beck Line Clipping Algorithm, **determine** whether the drone's flight path intrudes into the no-fly zone. If intrusion occurs, **calculate** the entry and exit points of the segment inside the restricted airspace. **[6]**

Question 3 [CO3]

a. **Why** are geometric transformations in computer graphics typically represented using matrices rather than individual functions? **Justify** your answer with relevant reasoning. Also, **discuss** the significance of introducing the homogeneous coordinate system in the representation of geometric transformations. **[2 + 2]**

b. In a 3D gallery setup, a spotlight's position was adjusted through a sequence of transformations to properly illuminate a new painting. The adjustments were applied in this order:
    ● **Rotation:** The point was rotated 90° clockwise about the Z-axis, around the origin.
    ● **Shear:** The rotated point then underwent a shear via $(x + 3y, y, z + 4y)$.
    ● **Translation:** The point was finally translated by $(-4, 2, 5)$.
    After all transformations, the spotlight's **final position** was recorded as $(3, -1, 4)$.

    Using homogeneous coordinate matrices and proper composition of transformations, **determine** the **original** position of the spotlight before any transformation was applied. **[6]**

*************** **The End** ***************