Department of Computer Science and Engineering
BRAC University

Set A

Examination: Midterm | Semester: Spring 2025
Duration: 1 hour 25 minutes | 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. Matt wants to play Red Dead Redemption 2, requiring ***144 FPS*** on his pc, which uses a ***32-bit* color depth per pixel** for the frame buffer. A frame size in the buffer is ***14,745,600 bytes***. **Calculate** the GPU's minimum rendering speed (pixels per millisecond) to achieve this FPS. **[4]**

b. A robotic painter is positioned at an unknown location on a digital canvas where the line $4x + 9y + 128 = 0$ intersects the ***x*-axis**. The task for the painter is to draw a straight line from **this starting point** to the point **(-48, -17)**. Using the **Midpoint Line Drawing Algorithm**, **compute** the first 6 (including the starting point) pixels of the line segment the painter needs to use and **show** each step. **[6]**

Question 2 [CO3]

a. Let's say the viewing region is a rectangle bounded by the points (0,0) and (100, 200).
The bits in the region code are defined as follows:

Bit 3	**Bit 2**	**Bit 1**	**Bit 0**
Above	Below	Right	Left

i. Leonard remembers that the number of iterations may vary in the **Cohen-Sutherland Line Clipping Algorithm**. Can you help him come up with an example line segment where the algorithm takes the **maximum number of iterations possible** in the given scenario? **State** the endpoints of your line segment and **draw** a rough illustration of your example. **[4]**

ii. Sheldon looks at Leonard's example and says that he can reduce the number of iterations just by changing the **definition of the bits in the region code**. **State** the new region code definition (Sequence of Bits) that Sheldon has in mind. **[1]**

b. A security camera monitors a restricted zone in a warehouse, recording movements only within (2, 2) to (8, 6). A drone follows a linear flight path from (3, 1) to (10, 7). Using the **Cyrus-Beck Line Clipping Algorithm**, **compute** the values of parameter t at which the drone enters and exits the detection area. **Find** the coordinates of the visible portion of the flight path. **[5]**

Question 3 [CO2]

a. **Why** is scaling not considered a ***Euclidean*** transformation? Can all Euclidean transformations be written in the form of matrix multiplication? **State** your reasons. **[2 + 2]**

b. A robot is positioned at (2, 0, 3) with the endpoint of its hand at (2, -2, 1). The robot wants to grab a fruit located at (12, 5, 13). To achieve this, it performs the following transformations **sequentially** on its **hand's endpoint**:

1. **Rotation**: The hand's endpoint is rotated **90° counter-clockwise** around the ***X*-axis**, using the **robot's position as the center of rotation**.
2. **Scaling**: The hand's endpoint is **scaled uniformly** by a factor of ***S***.
3. **Translation**: The robot **itself** is translated by (10, 0, 15), bringing the hand's endpoint to the fruit's position.

Find the value of ***S*** that ensures the hand's endpoint aligns with the fruit (hand's endpoint will be the same as fruit's location). **Show** your calculations using composition of transformations. **[6]**

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