CSE 4203 | Computer Graphics | Fall 2023 | Quiz - 1 | Marks 20 | **SET A**

Date: 15/5/2024 | Time: 30 minutes

ID:..... Name:..... Section:.....

1. **[6 marks]** Explain how an emissive device works with an example.

2. **[6 marks]** Consider 3 images img1, img2 and img3 (see the image below) overlapping each other where img1 is the foreground of img2 and img2 is the foreground of img3. Both img1 and img2 have an alpha mask α. Determine the pixel values of the resulting output image.

130	20
50	85
230	9

img1

15	20
200	20
110	99

img2

130	20
50	85
230	9

img3

0.2	0.39
0	0.3
0.45	0.5

α

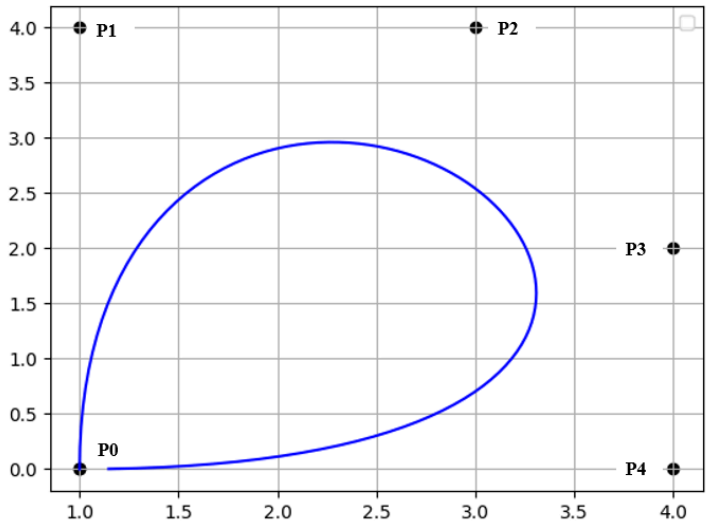
3. **[8 marks]** An uniform quadratic B-Spline curve S is defined by 7 control points P_0 (-3, 1), P_1 (-1, 2), P_2 (1, 3), P_3 (3, 4), P_4 (4, 5), P_5 (6, 7) and P_6 (7, 8). Determine how many curve segments are required. Also, find the point on the last two curve segments for t = 0.3

CSE 4203 | Computer Graphics | Fall 2023 | Quiz - 1 | Marks 20 | **SET B**

Date: 15/5/2024 | Time: 30 minutes

ID:..... Name:..... Section:.....

1. **[6 marks]** Explain why triangles are commonly used as the primary primitive in computer graphics.
2. **[6 marks]** Derive the equation of a Bezier curve of degree 4 using de Casteljau's Algorithm.
3. **[8 marks]** Consider a Bezier curve Q defined by the points P_0, P_1, P_2, P_3 and P_4 (see the image below). Find the mid-point on the curve if the curve is started and ended on the same point.



CSE 4203 | Computer Graphics | Fall 2023 | Quiz - 1 | Marks 20 | **SET C**

Date: 15/5/2024 | Time: 30 minutes

ID:..... Name:..... Section:.....

1. **[6 marks]** State the differences between lossless and lossy compression.

2. **[6 marks]** Consider an image IMG with the pixel values shown in the figure. Each pixel in the image can hold up to 8 bits of data. Find the file size of the image in KB. Also, determine the compression ratio of the image, if the image is compressed by applying run-length compression.

0	0	0	1	1	1	2
0	0	0	0	0	1	1
2	2	2	2	0	1	1
2	2	3	3	3	3	3
3	3	3	3	3	1	1
3	3	3	2	2	0	0

IMG

3. **[8 marks]** Consider a curve S defined by 6 control points P_0 (1, 10), P_1 (3, 15), P_2 (5, 20), P_3 (7, 15), P_4 (9, 13) and P_5 (11, 10). The curve is generated by both uniform quadratic B-spline and open Uniform B-spline curves. Determine the midpoint of the first curve segments for both curves.

CSE 4203 | Computer Graphics | Fall 2023 | Quiz - 1 | Marks 20 | **SET D**

Date: 15/5/2024 | Time: 30 minutes

ID:..... Name:..... Section:.....

1. **[6 marks]** Explain different stages of the graphics pipeline.

2. **[6 marks]** Propose an alpha compositing formula for blending the colors of four objects C_1, C_2, C_3 and C_4. Where C_1 is the foreground of C_2, C_2 is the foreground of C_3 and C_3 is the foreground of C_4 .

3. **[8 marks]** Consider a Bezier curve Q, defined by 6 control points (-3, 3), (-1, 4), (0, 5), (1, 3), P_4 and P_5. Find the control points P_4 and P_5, if $Q(0.5) = [0.68, 3.56]^T$ and $Q(1) = [5, 1]^T$

CSE 4203 | Computer Graphics | Fall 2023 | Quiz - 1 | Marks 20 | **SET E**

Date: 15/5/2024 | Time: 30 minutes

ID:..... Name:..... Section:.....

1. **[6 marks]** State the differences between raster and vector images.

2. **[6 marks]** Consider 2 images IMG1 and IMG2 with the pixel values shown in the figure below. Each pixel in the images can hold up to 8 bits of data. Determine which image has the better compression, if the images are compressed by applying run-length compression. (Show necessary calculations to compare the compression)

0	0	0	1	1
0	0	0	0	0
2	2	2	2	0
2	2	3	3	3
3	3	3	3	3

IMG1

0	1	0	1	0
0	1	0	2	2
2	1	0	2	2
3	1	0	3	3
3	1	0	3	3

IMG2

3. **[8 marks]** Consider a curve S defined by 6 control points P_0 (1, 10), P_1 (3, 15), P_2 (5, 20), P_3 (7, 15), P_4 (9, 13) and P_5 (11, 10). The curve is generated by both uniform quadratic B-spline and open Uniform B-spline curves. Determine the final point of the curve for both techniques.

CSE 4203 | Computer Graphics | Fall 2023 | Quiz - 1 | Marks 20 | **SET F**

Date: 15/5/2024 | Time: 30 minutes

ID:..... Name:..... Section:.....

1. **[6 marks]** State the properties of the Bezier curve.
2. **[6 marks]** Consider 3 images img1, img2 and img3 (see the image below) overlapping each other where img1 is the foreground of img2 and img2 is the foreground of img3. Both img1 and img2 have an alpha mask α. Given the resulting output image is img, find the values of α.

130	20
50	85
230	9

img1

15	20
200	20
110	99

img2

130	20
50	85
230	9

img3

102	20
74	85
201	27

img

3. **[8 marks]** Consider a Bezier curve Q, defined by 6 control points (-3, 3), (-1, 4), (0, 5), (1, 3), P_4 and P_5. Find the control points P_4 and P_5, if $Q(0.5) = [0.9, 3.28]^T$ and $Q(1) = [7, 2]^T$

CSE 4203 | Computer Graphics | Fall 2023 | Quiz - 2 | Marks 20 | **SET A**

Date: 5/6/2024 | Time: 30 minutes

ID:..... Name:..... Section:.....

1. **[8 marks]** Determine the composite transformation matrix to convert a canonical view volume of size 3x3x3 to a viewport of size n_x x n_y.

2. **[12 marks]** Consider a rectangle with vertices A(1,1), B(6,1), C(6,5) and D(1,5). Apply appropriate transformation to the rectangle so that point C and D move 8 units to the right and point A and B remain fixed. You must -

    a. Mention the steps.
    b. Determine the composite transformation matrix.
    c. Calculate and plot the final vertices

CSE 4203 | Computer Graphics | Fall 2023 | Quiz - 2 | Marks 20 | **SET B**

Date: 5/6/2024 | Time: 30 minutes

ID:..... Name:..... Section:.....

1. **[8 marks]** Construct the viewport matrix for a viewport of size m_x x m_y in which the pixel coordinates count down from the top of the image, rather than up from the bottom.

2. **[12 marks]** Consider a line AB in a 3D space, where point A and B are (1, 1, -1) and (9, 7, 2) respectively. Apply appropriate transformations to align the line AB to the z-axis so that point A stays at the origin. Calculate and determine the new point A' and B' after the transformation.

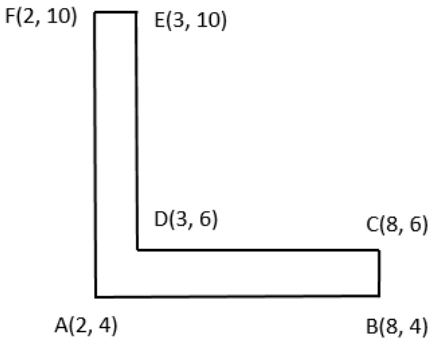
CSE 4203 | Computer Graphics |Fall 2023 | Quiz - 2 | Marks 20 | **SET C**

Date: 5/6/2024 | Time: 30 minutes

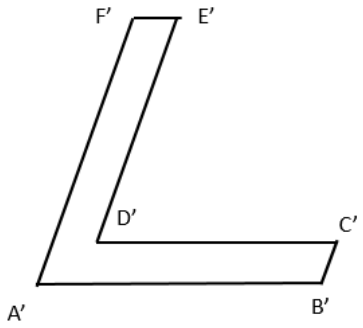
ID:..... Name:..... Section:.....

1. **[8 marks]** Determine the composite transformation matrix to convert an orthographic view volume to a canonical view volume of size 3x3x3.

2. **[12 marks]** Consider a L-shaped object with vertices A(2, 4), B(8, 4), C(8, 6), D(3, 6), E(3, 10) and F(2, 10). Apply appropriate transformations on the object so that the vertices move 3 units to the right while keeping point A and B fixed. (Assume that two edges of the L-shaped object are detachable).



(a) Initial State



(b) Transformed State

CSE 4203 | Computer Graphics |Fall 2023 | Quiz - 2 | Marks 20 | **SET D**

Date: 5/6/2024 | Time: 30 minutes

ID:..... Name:..... Section:.....

1. **[8 marks]** Show that the composite transformation of two rotations $R(\theta_1)$ and $R^{-1}(\theta_2)$ can be obtained with a single rotation of $R(\theta_1 - \theta_2)$.

2. **[12 marks]** Consider a line AB in a 3D space, where point A and B are (2, 1, 1) and (8, 7, 2) respectively. Apply appropriate transformations to align the line AB to the y-axis so that point A stays at the origin. Calculate and determine the new point A' and B' after the transformation.

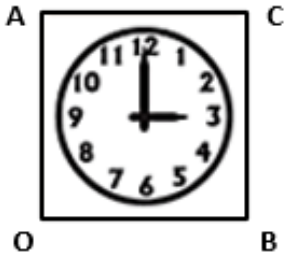
CSE 4203 | Computer Graphics |Fall 2023 | Quiz - 2 | Marks 20 | **SET E**

Date: 5/6/2024 | Time: 30 minutes

ID:..... Name:..... Section:.....

1. **[8 marks]** Show that reflection about the line y = x in two-dimensional space is equivalent to a rotation of 90 degrees followed by a reflection about the y-axis.

2. **[12 marks]** Stretch the clock OACB (shown in the figure) by 150% along one of its diagonals so that 10:00 through 4:00 move to the northeast, and 9:00 through 5:00 move to the southwest keeping the center of the clock fixed. The four vertices of the clock are O(2,2), A(2,6), C(6,6), and B(6,2). Perform all the transformations and find the final vertices.



CSE 4203 | Computer Graphics |Fall 2023 | Quiz - 2 | Marks 20 | **SET F**

Date: 5/6/2024 | Time: 30 minutes

ID:..... Name:..... Section:.....

1. **[8 marks]** Prove that two successive reflections across perpendicular lines are equivalent to a single rotation.

2. **[12 marks]** Consider a rectangle with vertices A(10, 12), B(16, 12), C(16, 16) and D(10, 16). Reflect the rectangle along the line 2y - 6x + 2 = 0 using 2D transformation. You must -

   a. Mention the steps.
   b. Determine the composite transformation matrix.
   c. Calculate and plot the final vertices

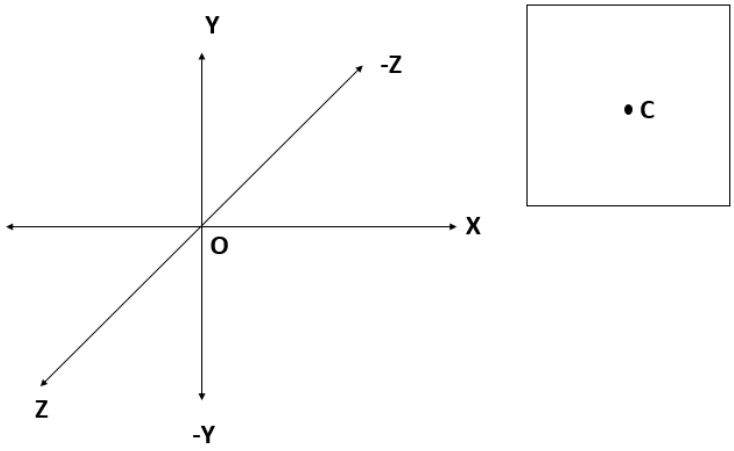
CSE 4203 | Computer Graphics | Fall 2023 | Quiz - 3 | Marks 20 | **SET A**

Date: 3/7/2024 | Time: 30 minutes

ID:..... Name:..... Section:.....

1) Consider a square in a 3D canonical coordinate system (see the following figure). The square has a side of 10 units with a center at C(0, 0, -20). Also, consider a camera coordinate with origin e and basis {u, v, w}. The eye of the camera frame is placed in the upper right corner of the square. The goal is to point the camera viewing direction at point **C** and capture it.

   a) **[10 Marks]** Determine the basis and eye matrix
   b) **[10 Marks]** Determine the position of point **C** w.r.t the camera coordinate.



CSE 4203 | Computer Graphics | Fall 2023 | Quiz - 4 | Marks 20 | Time: 120 minutes | **SET A**

ID:..... Name:..... Section:.....

1. Apply the midpoint line drawing algorithm to draw a line from (1, p) to (-3, p + 9) and plot the points.

Here, $p = (-1)^n \times n$
[n = last 2 digits of your ID]

Necessary adjustments of the original algorithm for different octants are provided below:

(1) plot(x, y)	(2) swap(x, y); plot(y, x)	(3) x=−x; swap(x, y); plot(−y, x)	(4) x=−x; plot(−x, y)
(5) x=−x; y=−y; plot(−x, −y)	(6) x=−x; y=−y; swap(x, y); plot(−y, −x)	(7) y=−y; swap(x, y); plot(y, −x)	(8) y=−y; plot(x, −y)

a) [15 marks] Show the values of the decision variables and the points for each step (in a tabular format).

b) [5 marks] Plot the final points