The Open University of Sri Lanka
Faculty of Natural Sciences
B.Sc./ B. Ed Degree Programme

Department	: Computer Science
Level	: 05
Name of the Examination	: Final Examination
Course Code – Title	: CSU5311 – COMPUTER GRAPHICS
Academic Year	: 2024/2025
Date	: 10.05.2025
Time	: 01.30 p.m. – 03.30 p.m.
Duration	: Two hours only

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **SIX** questions in **SIX** pages.
3. Answer **ANY FOUR** questions, in the provided answer book.
4. Answer for each question should commence from a **new page.**
5. Involvement in any activity that is considered as an exam offense will lead to punishment.
7. Use **blue or black ink** to answer the questions.
8. Clearly state your **Registration Number** for B.Sc/B.Ed Degree Programme in your answer script.

QUESTION 01

(a)

(i) Draw the plan, front-elevation, and side-elevation views for the object Figure 1.

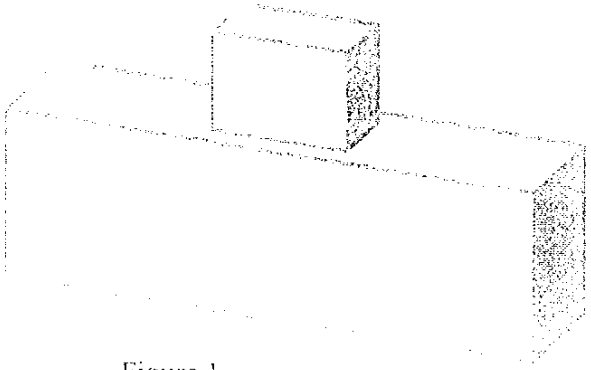

Figure 1

[03 Marks]

(ii) Explain the relationship between the "distance between an object and the center of projection in perspective projection" and image size. Illustrate how the image size varies as this distance changes. [05 Marks]

(iii)List three (03) types of perspective projections. [03 Marks]

(iv) Consider Figure 2.

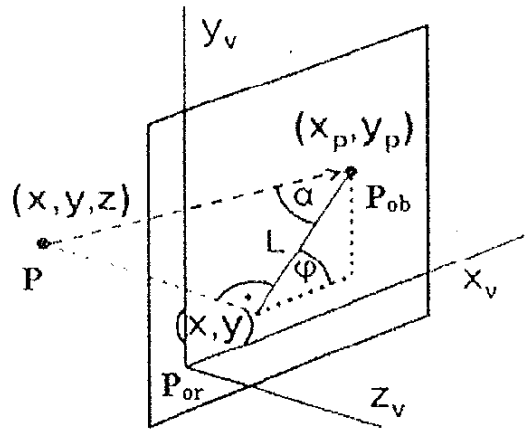

Figure 2

- P_{or} – Orthogonal projection of point P
- P_{ob} – Oblique projection of point P
- L – line joining P_{or} and P_{ob}
- θ (angle made by L with x-axis) = 30°
- α (direction of projection) = 45°

If the coordinates of point P are (4, 5, 6), calculate the coordinates of the oblique projection P_{ob} (x_p, y_p). [06 Marks]

(b) Consider the line segment AB with coordinates (2, 3) and (10, 14). Demonstrate the following reflections on a Cartesian plane.

(i) Reflection about the x-axis
(ii) Reflection about the y-axis
(iii)Reflection about the straight-line y = x
(iv)Reflection relative to the origin

[08 Marks]

QUESTION 02

(i) Use the Liang-Barsky Line Clipping algorithm to find the clipped lines in Figure 3 where clipping window is PQRS. Clearly indicate each step involved in the algorithm.

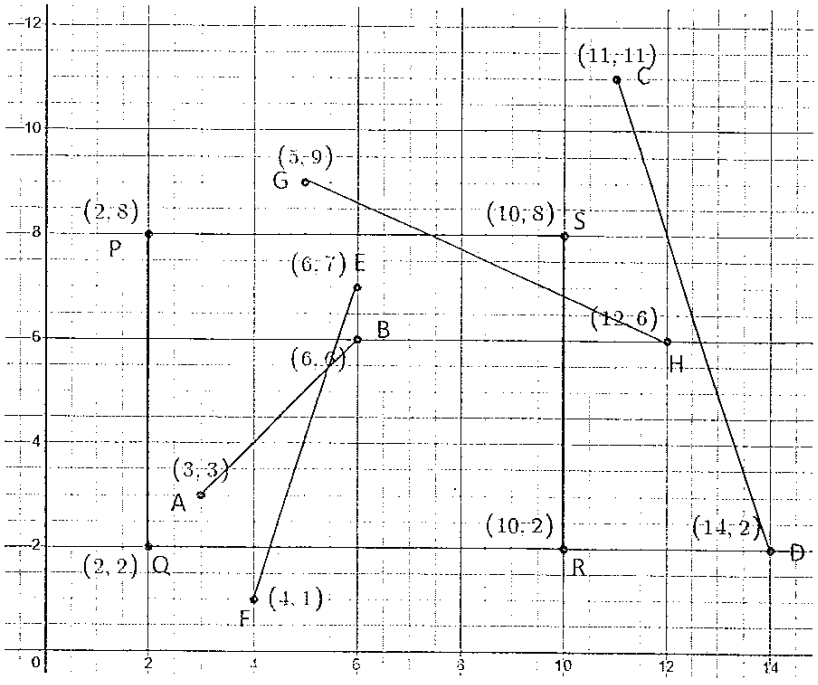

Figure 3

[12 Marks]

(ii) Implement the Sutherland-Hodgeman Polygon Clipping algorithm to find the clipped polygon in Figure 4 where the clipping window is ABCD. Indicate the steps.

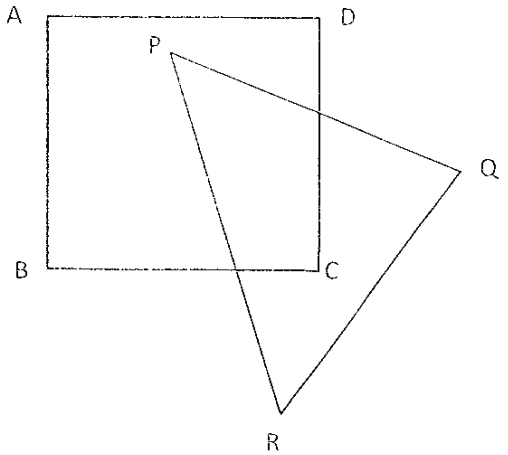

Figure 4

[08 Marks]

(iii) Analyze the influence of clipping planes (front and back) in both parallel and perspective projections in a 3D scene. How do clipping planes affect the clipping operation?

[05 Marks]

QUESTION 03

(i) Draw a realistic view of the object in Figure 5.

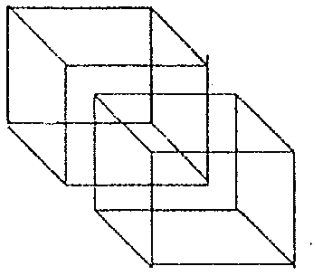

Figure 5

[01 Mark]

(ii) What are the two main visible surface detection methods? Briefly explain each.

[05 Marks]

(iii) Explain how the Z-buffer algorithm determines surfaces which are hidden in a 3D scene.

[05 Marks]

(iv) Explain those three tests performed in the Area Subdivision method for finding the possible positioning of polygon surfaces. Illustrate each test with diagrams

[06 Marks]

(v) Figure 6 illustrates scan lines crossing the projection of two surfaces, S_1 and S_2, in the view plane. Dashed lines indicate hidden part.
Explain the process of the scan-line algorithm for determining visible surfaces.

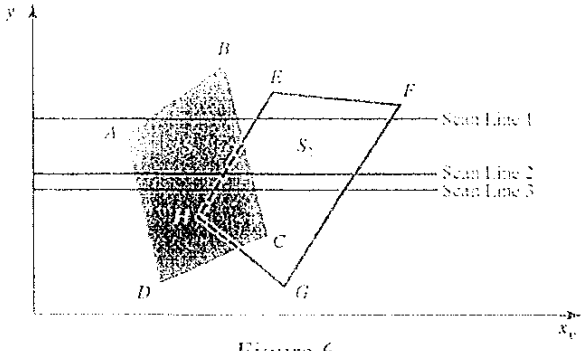

Figure 6

[08 Marks]

QUESTION 04

(a)

(i) Define a vector. [01 Mark]

(ii) Find the value of sin 300°. [02 Marks]

(b)

(i) List four (04) methods of Boundary Representation (B-reps) used in 3D modeling. [04 Marks]

(ii) Represent a point P in 3D space using homogeneous coordinates. Show this representation as a 4-dimensional vector. [02 Marks]

(c)

(i) Consider the tetrahedron in Figure 7 with the following coordinates.

A = (1, 1, 1)
B = (-1, -1, 1)
C = (-1, 1, -1)
D = (1, -1, -1)

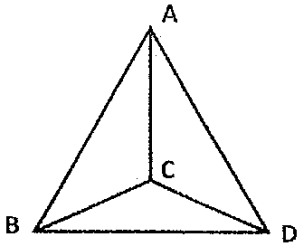

Figure 7

Use homogeneous 3D transformation matrices to solve the following.

A. Translate the object by (3, 3, 3)

B. Scale the object with respect to the origin where the scaling factor = 2.

C. Reflect the object with respect to the XY plane.

[08 Marks]

(ii) Explain the sequence of transformations required for rotating a 3D object about an axis parallel to the x-axis. Illustrate the sequence with diagrams.

[08 Marks]

QUESTION 05

(a) Give one example for the following types of matrices (3 x 3 matrices).

(i) Lower triangular matrix
(ii) Diagonal matrix
(iii)Identity matrix
(iv)Column matrix.

[02 Marks]

(b) Write short notes on the following topics, including diagrams where necessary.

(i) Digital Image
(ii) Random Scan Display (Vector Scan)
(iii)Beam Penetration Method
(iv)2D Hard Copy Device

[08 Marks]

(c)

(i) Using Bresenham's algorithm, draw a line from (2, 2) to (12, 8). Show the values of the decision parameter x and y at each iteration.

[10 Marks]

(ii) Write the steps of the Midpoint Circle algorithm.

[05 Marks]

QUESTION 06

(a)

(i) Draw the cross-section of the human eye. [01 Mark]

(ii) Write short notes on the following color models.

A. RGB Color Model
B. CMY/CMYK Color Model [06 Marks]

(b) What are the three light-emitting sources in computer graphics? Draw diagrams to illustrate each.

[04 Marks]

(c)

(i) Define convex and concave polygons. Provide examples for each.

[02 Marks]

(ii) Write the procedure for 8-connected boundary filling, illustrating the recursive method for filling an 8-connected region.

[08 Marks]

(iii)Illustrate the four possible intersection points in the scan-line algorithm for polygon clipping.

[04 Marks]

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