JAHANGIRNAGAR UNIVERSITY

Department of Computer Science and Engineering

3rd Year 2nd Semester Final Examination 2018

Course code: CSE-351 Title: Computer Graphics and Visualization

Time: 3 Hours Full marks: 60

[There are eight questions. Answer any six questions. Each question carries equal marks.]

1.	a) Explain viewing transformation. Derive the expression for window-to-viewport mapping.	5
	b) Identify and describe few important applications of computer graphics.	3
	c) What hardware devices are used for computer graphics?	2
2.	a) Write and explain the Bresenham's circle drawing algorithm.	5
	b) Write and describe the ellipse generating algorithm.	5
3.	a) Explain the DDA scan conversion algorithm in detail.	3
	b) What is transformation? Write short notes on – (i) Translation (ii) Rotation (iii) Scaling and (iv) Shearing.	7
4.	a) What is the homogeneous form of a 3D point? What is the homogeneous equation of a plane? Write down the formula for a translation in homogeneous form.	5
	b) Find the form of the matrix for reflection about a line L with slope m and y intercept (0, b).	5
5.	a) What is clipping? Describe the Cohen-Sutherland algorithm for line clipping.	5
	b) Magnify the triangle with vertices A(0,0), B(1,1) and C(5,2) to twice its size while keeping C(5,2) fixed. Show the results in matrix form.	3
	c) Explain mid-point subdivision strategy in line clipping.	2
6.	a) Find a normalization transformation from the window whose lower left corner is at (0, 0) and upper right corner is at (4, 3) onto the normalized device screen so that aspect ratios are preserved.	5
	b) What is window to viewport mapping?	2
	c) What is the difference between geometric and coordinate transformations?	3
7.	a) Discuss in detail the three dimensional transformation.	3
	b) Find the matrix for mirror reflection with respect to the plane passing through the origin and having a normal vector whose direction is N = I + J + K.	5
	c) What is instance transformation?	

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3rd Year 2nd Semester B.Sc. (Hons.) Final Examination 2019

Course Code: CSE-351 | Course Title: Computer Graphics and Visualization

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Answer any **Six** of the following questions.

1. a) Define computer graphics. Sketch the basic 3D graphics pipeline and explain the pipeline principles. 4
   b) Explain how the look-up table reduces the storage requirement of an image? Describe raster scan and random scan displays. 4
   c) Suppose an RGB raster system is to be designed using 8×10 inch screen with a resolution of 100 pixels per inch in each direction. If we want to store 6 bits per pixel in the frame buffer, how much storage (in bytes) do we need for frame buffer? 2

2. a) Define affine transformation. Consider the line from (18, 10) to (28, 15). Illustrate the Bresenham's Line drawing algorithm to rasterize this line and obtain all the coordinates of the intermediate points and finally plot the points. 4
   b) Define eight way symmetry of a circle. Write down the steps to scan convert an arc of a circle. 4
   c) Why two sets of "decision variables and its derivatives" are required in mid-point ellipse drawing? Explain the transition/termination criteria from region-1 to region-2 in mid-point ellipse drawing algorithm. 2

3. a) Explain three adverse effects of scan conversion. How these can be eliminated? 3
   b) Magnify the triangle with vertices A(0,0), B(1,1) and C(5,2) to twice its size while keeping C(5,2) fixed. Show the results in matrix form. 3
   c) What are homogeneous coordinates? Explain the composite transformation along with matrix which reflects an object about a line with slope $m = \tan 0$. 4

4. a) Define window and viewport. Explain the steps of transforming a world coordinate window into a viewport in device coordinate. 4
   b) Use the Cohen-Sutherland line clipping algorithm to find the clipping categories of the following line segments (show the region codes) against a window: lower left hand corner (40, 10) and upper right hand corner (60, 30). 6

   A set of lines (Defined by two corner coordinates)

   Line 1 : x1 = 50, y1 = 20, x2 = 80, y2 = 10

   Line 2 : x1 = 45, y1 = 25, x2 = 50, y2 = 12

   Line 3 : x1 = 40, y1 = 50, x2 = 54, y2 = 40

   For clipping category candidate, find out the new co-ordinates after clipping.

5. a) Why polynomials of high degree are not useful in curve fitting? 2
   b) Explain the requirements for curve and surface design and also discuss the basis function for B-Spline. 5
   c) Define Bezier curve. Discuss its properties. 3

6. a) Distinguish between perspective and parallel projection. Mention some anomalies while performing perspective projection. 5
   b) Derive a perspective projection matrix when the projection plane is at origin (0,0,0) and 5

8. a) Discuss the importance of wireframe model. 3

b) What is Bezier curve? Discuss its properties. 3

c) What is ray-tracing? Describe how hidden surface removal and projection are integrated into the ray-tracing process. 4

[End of Question Script]

the center of projection is at z = -a and the object is at z = d.

7. a) Mention the significance of hidden surface removal in computer graphics. Explain the divide and conquer strategies of Warnock algorithm. 4

b) Explain how Z-buffer algorithm determines which surfaces are hidden and which are not? Scan convert the following two polygons (The number inside the pixel represents its z-value): 6

1			
2	3		
4	3	5	
4	7	6	2

Polygon-"A"

			1
		3	2
	5	4	2
7	6	5	3

Polygon-"B"

8. a) Define ray casting. Differentiate between object space and image space method. 3

b) Draw RGB and CMY color cube. 3

c) Define Animation. List out the techniques used for animation. 4

Jahangirnagar University
Department of Computer Science and Engineering
3rd Year 1st Semester B.Sc. (Hons.) Final Examination -2022

Course Code: CSE 303
Full Marks: 60

Course Title: Computer Graphics
Duration: 3 hours

Q1. ***Section-I (CO1): Answer all the questions.***

a) Point out the differences between raster and vector graphics. [2]

b) List the adverse effects of scan conversion. Mention the ways to eliminate these adverse effects. [2]

c) Define the following: [2]

i. Window port and viewport

ii. Cel animation and path animation

d) State *Shear* and *Affine* transformations. [2]

e) Differentiate between *local* and *global* illumination models. [2]

f) Outline the notion of *rendering* and *morphing*. [2]

Q2. ***Section-II (CO2): Answer any three of the following.***

a) Discuss perspective projection along with its anomalies. Also explain parallel projection. [4]

b) Describe the Cohen-Sutherland algorithm for line clipping. [4]

c) Given a circle with its center at (0, 3) and a radius of 10. Identify all the pixel positions to draw the circle using Bresenham's circle drawing algorithm. [4]

d) Generalize the scaling matrix with respect to a fixed point ***P(h, k)*** assuming the scaling factors ***m*** and ***n*** along the x-axis and y-axis, respectively. [4]

Q3. ***Section-III (CO3): Answer any three of the following.***

a) Write the steps required to scan-convert an ellipse using the trigonometric and polynomial method. [4]

b) Explain the hidden surface problem. Interpret the steps involved in the ***Z***-buffer algorithm. [4]

c) Explain the curve and surface design requirements and discuss the basis function for ***B***-Spline. [4]

d) Demonstrate the steps of constructing a ***3D*** view without hidden surface removal. [4]

Q4. ***Section-IV (CO4): Answer any three of the following.***

a) Find the normalization transformation that maps a window whose lower left corner is at L(1,1) and upper right-hand corner is at R(3,5) onto a viewport that has lower left corner at (0,0) and upper right corner at (1/2,1/2). [4]

b) Illustrate the steps of developing animation and figure out a basic rule of animation to avoid distortions. [4]

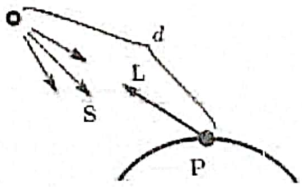
c) Inspect the integration of hidden surface removal and projection into the ray-tracing process. [4]

d) Design the Pseudocode for boundary-filling and flood-filling algorithms. [4]

Q5.

Section-V (CO5): Answer any two of the following.

a) Assume that at a point **P**, the computed color according to a certain illumination model with a single point light source is $\mathbf{I_{point}} = \mathbf{I_a} + \mathbf{I_d}$, where $\mathbf{I_a}$ is ambient component and $\mathbf{I_d}$ is the diffuse component (the specular component is ignored). The light source is now replaced with a spot light source with attenuation with the same intensity and position, and its unit vector direction is S and its distance to P is d. The unit vector from P to the light is L. Starting from $\mathbf{I_{point}}$, give a formula for computing $\mathbf{I_{spot}}$ at P, i.e., the new color at P when lit up by the spot light, as a function of I_a, I_d, S, L and d. Evaluate your formula. [6]



b) Given a Bezier curve with 4 control points- [6]

$B_0[1\ 0]$, $B_1[3\ 3]$, $B_2[6\ 3]$, $B_3[8\ 1]$

Determine any 5 points lying on the curve. Also, draw a rough sketch of the curve.

c) Consider a triangle with vertices (10,20), (10,10), (20,10). Determine the resultant vertices after rotating it about the origin by 30 degree and then do translation by $t_x=5$, $t_y=10$. [6]

Jahangirnagar University
Department of Computer Science and Engineering
3rd Year 1st Semester B.Sc. (Hons.) Final Examination -2021

Course Title: Computer Graphics
Time: 3 hours

Course No: **CSE-303**
Full Marks: **60**

[Answer each of the following questions. Each question carries equal marks. Figures in the right margin indicate marks.]

1. Question No. 1 is based on ***CO1***. This question consists of ***Six*** Sections. Students have to answer ***All of them.***

a) Define computer graphics along with mentioning some graphics primitives. 2
b) Define resolution, scan conversion, and affine transformation. 2
c) Differentiate between geometric and coordinate transformations. 2
d) Distinguish between ambient and diffuse light environment for modeling an object. 2
e) What is viewing transformation? 2
f) What is Beizer curve? Mention any two of its properties. 2

2. Question No. 2 is based on ***CO2***. Students have to answer ***Any Three*** out of ***Four***.

a) Discuss RGB and CMY color models. 4
b) How does the mid-point circle drawing algorithm work? Show that the decision parameter for the mid-point circle drawing algorithm can be expressed by: 4

$$p_{k+1} = p_k + 2x_{k+1} + 1, \quad when\ p_k < 0.$$

c) State the mathematical model or transformation of a perspective projection where the center of projection is at $C\ (0, 0, -d)$. 4
d) Magnify the triangle with vertices A(0,0), B(1,1) and C(5,2) to twice its size while keeping C(5,2) fixed. Show the results in matrix form. 4

3. Question No. 3 is based on ***CO3***. Students have to answer ***Any Three*** out of ***Four***.

a) Why Bresenham's line algorithm is efficient than the direct use of line algorithm in scan conversion? Discuss three adverse side effects in scan conversion. 4
b) Given points $P_1(1,2,0)$, $P_2(3,6,20)$ and $P_3(2,4,6)$ and a view point C (0,0,-10), determine which points obscure the others when viewed from C. 4
c) What is ray-tracing? Describe how hidden surface removal and projection are integrated into the ray-tracing process? 4
d) Find the transformation which maps a rectangular window with x extent x_{wmin} to x_{wmax} in the x-direction and y extent y_{wmin} to y_{wmax} in the y-direction onto a rectangular viewport with x extent x_{vmin} to x_{vmax} and y extent y_{vmin} to y_{vmax}. 4

Question No. 4 is based on ***CO4***.
Students have to answer ***Any Three*** out of ***Four***.

4. a) Find the matrix that represents rotation of an object by 30^0 about the origin and find the new coordinates of the point P(2, -4). 4

   b) Describe Cohen-Sutherland algorithm for line clipping. 4

   c) What is homogeneous coordinates? Explain the composite transformation along with matrix which reflects an object about a line with slope $m = \tan\theta$. 4

   d) Given a point (7, 8) on a circle with its center at the origin. Now calculate the seven other points using eight-way symmetry property of circle. Given the center point coordinates (0, 0) and radius as 10, generate all the points to form a circle. 4

Question No. 5 is based on ***CO5***.
Students have to answer ***Any Two*** out of ***Three***.

5. a) i. How would a flood-fill algorithm fill the region shown in **Fig. 1**, using 8-connected definition for region pixels? 6

   ii. Perform a 45^0 rotation of triangle A(0,0), B(1,1), C(5,2) about the origin and about P(-1, -1).

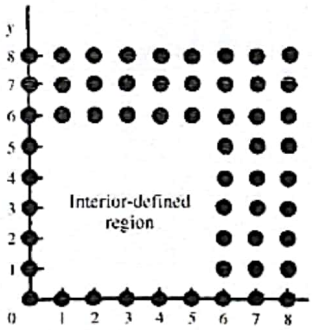


Fig. 1

   b) Consider a rectangular window whose lower left-hand corner is at *L* (-3, 1) and upper right-hand corner is at *R* (2, 6). Find the region codes for the end points of the following two lines using Cohen-Sutherland line clipping algorithm: (*i*) line *A* (-4, 2) *B* (-1, 7); and (ii) line *C* (-2, 3) *D* (1, 2). Also determine the clipping category of the above lines. 6

   c) i. Using the origin as the center of projection, derive the perspective transformation onto the plane passing through the point *R* (X_0, Y_0, Z_0) and having the vector $N = n_1I + n_2J + n_3K$. 6

   ii. Illustrate the Beizer-Bernstein approximation.