

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
2079 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEI	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Computer Graphics (EX 554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. What is refresh rate? Calculate the size of frame buffer in KB needed to represent the screen of size 4 inch \times 5 inch whose resolution is 128 dpi and uses the 8-bit true color. [4]
2. Devise Bresenham's decision parameter for a straight line with negative slope with $|m| < 1$, applying right to left sampling. Assume that the line lies in the second quadrant. [10]
3. Derive the transformation matrix to reflect the object from line $y = mx + c$. [5]
4. Define window to view port transformation. Clip the line RS, R (2, 4) and S (8, 7) against the window WXYZ, W(3, 3), X(3, 6), Y(7, 6), and Z(7, 3) using Cohen Sutherland algorithms. [5]
5. Describe 3-D viewing pipeline. Obtain the perspective projection matrix for the projection reference point lies on the negative Z-axis. [5+5]
6. What is the importance of parametric cubic curve in graphical modeling? Derive the relation of blending function of Hermite curve using interpolation. [5]
7. Given a Bezier curve with 4 control points A(1, 0), B(3, 3), C(6, 3), D(8, 1). Determine any 5 points lying on the curve. Also draw a rough sketch of the curve. [5]
8. Compare object space method and image space method. Describe the back face detection method with necessary figures and apply this algorithm to find the visibility of a triangular object defined by coordinates (2, 0, 0), (0, 2, 0), (0, 0, 2) when viewed from point (4, 4, 4). [2+4+4]
9. Classify the different types of visible surface detection techniques. Explain about back face detection method for visible surface detection. [5]
10. List the disadvantage of depth buffer method. Explain how scan line method detects the visible surface with example. [5]
11. Write a general illumination model with multiple light sources and explain each term with necessary figures. What is the attenuation factor and how does it affect the intensity calculation? [6]
12. Briefly explain Gouraud shading and Phong shading algorithms with necessary derivations and figures and compare these algorithms. [6]
13. Define callback function. Demonstrate how a polygon can be created using OpenGL. [4]

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1. What are the differences between random and raster display technologies? When do we prefer them? [6]
 2. Write an algorithm for Bresenham's method of line drawing. Digitize a line with end points (10, 20) and (15, 2) using this algorithm. [5+5]
 3. Find the composite transformation matrix for reflection about a line $y = mx + c$. [8]
 4. Describe polygon, Vertex and Edge table. How these terms can be used to construct a model of Dharahara. [2+2+2+2]
 5. What do you understand by affine transformation? Derive expressions for oblique projectiman paralle projection. [2+4+4]
 6. What is a Bezier Curve? Find the coordinates of Benzier curve at $u = 0.25, 0.5$ and 0.75 with respect to the control points (10, 15), (15,20), (20, 35), (25, 10) using Bezier function. [1+5]
 7. How back-face detection method is used to detect visible surfaces? What are it's limitation? Purpose an approach to overcome it's limitations. [4+2+4]
 8. Derive an expression for phong illumination model for light sources. [8]
 9. Find out the total intensity at the centroid of a triangle defined by A(2,1,1), B(0,1,1), C(0,0,1), when illuminated by a point light source of intensity $IL = 0.6$ at (2,2,6) using illumination model. The viewer is at (2,3,6). Assume ambient Intensity $Ia = 0.1$ and parameters: $ka = 0.5$, $kd = 0.8$, $ks = 0.7$, take $n = 10$. [8]
- [centroid: $(x_1 + x_2 + x_3)/3, (y_1+y_2+y_3)/3, (z_1+z_2+z_3)/3$]
10. What is open GL? How can we use lighting in open GL? [2+4]

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1. What is pixel and pixel depth? Let the resolution of screen is 1024×512 . What is the memory captured by the frame buffer that uses primary color for display? [2+3]
2. Derive the p-value for midpoint circle algorithms scanning towards anti clockwise direction starting from $(r,0)$. [7]
3. Compare and contrast between Digital Differential Analyzer line drawing algorithm and Bresenham's Line drawing algorithm. [3]
4. Scale the triangle with vertices A (1,1), B (4,4) and C (2,3) to double along horizontal direction and triple of vertical direction about point (2,3). [6]
5. Use Cohen Sutherland clipping Method to clip a line starting from A (-1,5) and ending at B(3,8) against the window having its lower corner at (-3,1) and upper right corner at (2,6). [4]
6. Why we need projection in computer graphics? How can you reflect an object about an arbitrary axis in 3D? Explain each step in detail. [8]
7. Define Hermite curve. Write the equation of Bezier curve with four control points $p_1 (2,2,0)$, $p_2 (2,3,0)$, $p_3 (3,3,0)$, and $p_4 (3,2,0)$. Find the coordinate pixel of the curve for $u = 0, 1/4, 1/2, 3/4$ and also plot the curve on graph. [8]
8. Differentiate boundary representation and space partitioning representation of polygon surface. If three vertices of a polygon surfaces in anticlockwise direction are V1 (1,0,0), V2 (1,1,0) and V3 (1,0,1). Calculate normal vector of that surface. [4+4]
9. How Scan Line Method is used for visible surface Detection? Explain in detail. [8]
10. Define Illumination and surface rendering. Explain basic illumination model. [2+6]
11. Explain Gouraud shading method with its advantages and disadvantages. [8]
12. Explain the importance of open GL. Write a program to display Red Rectangle in open GL. [7]

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1. What is computer graphics? Calculate the total memory required to store a 10 minute video in a SVGA system with 24 bit true color and 60 fps refresh rate. [2+4]
2. Write an algorithm for drawing a circle. Using midpoint circle drawing algorithm, calculate the coordinates on the first quadrant of a circle having radius 8 and centre (10, 10). [4+6]
3. Is it necessary to construct curves using parametric equations? Justify. List down the steps for modeling curves using splines. [4+4]
4. Reflect the triangle ABC about the line $3X - 4Y + 8 = 0$. The position vector of the coordinate ABC is given A(4, 1), B(5, 2) and C(4, 3). [8]
5. Describe 3D viewing pipeline. Derive complete world-to-viewing coordinate transformation matrix. [3+7]
6. Why do we use geometric tables and attribute tables for defining a polygon surface? How do you calculate the spatial orientation of a polygon? [3+3]
7. What is the limitation of Z-buffer method? How does A-buffer method overcome it, explain? [3+7]
8. Derive the expression to calculate the total light intensity in a point. [8]
9. Compare and contrast between Gouraud and Phong shading model. [8]
10. What is OpenGL? How can we draw colored line and polygon using OpenGL? [2+4]

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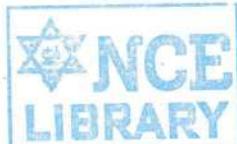
1. Distinguish between Raster and Vector graphics with suitable example. [6]
2. Digitize the endpoint (20, 10) and (30, 18) using Bresenham's algorithm. How the demerits of DDA is addressed in Bresenham's algorithm. [7+3]
3. Derive the composite matrix for rotation about arbitrary point (a, b) in clockwise direction with angle (θ). Write an algorithm for Cohen Sutherland line clipping algorithm. [6+4]
4. What are 3D Rotation and Shearing? Explain with matrix representations. A unit length cube with diagonal passing through (0, 0, 0) and (1, 1, 1) is sheared with respect to yz place with shear constants = 2 in both directions. Obtain the coordinates of all the corners of the cube after shearing. [3+7]
5. What is Parametric Cubic Curve and why do you need it? Write down the step for cubic spline interpolation. [3+5]
6. What is Wire-frame model and why do we need polygon data table? Explain with examples? [5]
7. Describe Z-Buffer method of visible surface detection. Compare this method to other methods of visible surface detection. [6+2]
8. What do understand by diffused and specular reflections and explain in detail how these terms are included in illumination model? [5+5]
9. Define the term illumination and rendering. Write down the steps for phong shading method. [2+6]
10. Write down the Open GL syntax to draw basic 2D geometric primitives with examples. [5]

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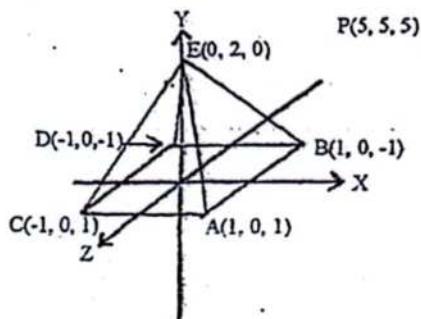
1. Consider 256×256 image with 24-bit true color. If 10 minutes video is capture with frame rate of 50fps calculate the total memory required? [4]
2. Derive the decision parameters for mid-point ellipse drawing algorithm with necessary figures. [10]
3. Why we need clipping operation in graphics? Clip a line having end coordinates (4,12) and (8,8) against a rectangular window having left bottom corner at (5,5) and right top corner at (9,9) using liang barskys algorithm. [2+6]
4. Perform rotation of a triangular with vertices (100,100,100), (200,200,150) and (150, 150, 300) about Y-axis with 45 degree in clockwise direction. Show each step involved. [3+7]
5. Find the equation of the Bezier curve with given four 2D control points (0,0), (8,10), (15,-8), (20,0) and calculate the coordinate point at $u=0.6$. [5+3]
6. Differentiate object space method and image space method. Explain depth buffer method with necessary figures and show the depth calculation steps. What is its drawback? [10]
7. What are the guidelines to generate error free table? How the geometric informations of 3-D objects are stored for the object representation? Explain with examples. [2+6]
8. Derive the expression to calculate the intensity of Specular reflection in the presence of Point light source. Also write the expression for multiple light sources. How do you consider the distance to calculate the intensity for Specular Reflection? [6+2+2]
9. What are the disadvantages of flat shading model? Which method do you prefer to overcome this disadvantages? Explain. [8]
10. Explain the importance of OpenGL in computer graphics. [4]

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1. Compare Raster-scan Display with Random-scan Display. [6]
2. Write the advantages of Bresenham's line drawing algorithm. Digitize the Ellipse with radius $R_x = 12$ and $R_y = 7$ and center (19, 10). [2+8]
3. Define window and view port. Describe about two-dimensional viewing pipeline with matrix representation at each steps. [2+8]
4. Derive an expression for Perspective projection of a 3D point. Also, obtain perspective projection co-ordinates for the pyramid with vertices of base (15, 15, 10), (20, 20, 10), (25, 15, 10), (20, 10, 10) and apex (20, 15, 20) given that $z_{pp} = 20$ and $z_{vp} = 0$. [5+5]
5. Differentiate between Interpolation and approximation. Explain the process of performing curve modeling using splines. [3+5]
6. How can we model cone or cylindrical like surfaces using boundary representation and technique? [6]
7. Explain Back-face detection algorithm for visible surface detection. Find the visibility for the surface BED and ABCD where observer is at P(5, 5, 5). [3+5]



8. Define the term Surface rendering with Illumination model. Derive an expression to calculate the intensity of Diffuse reflection with necessary equations and figures. How do you consider the distance to calculate the intensity for Specular and Diffuse Reflection? [2+5+3]
9. What is Phong shading method? Can we use this method to reduce Mach-Band effect? [6+2]
10. What do you mean call back function? Illustrate with example. [4]
