KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Level : B.E./B.Sc.
Year : III
Time : 2 hrs. 30mins.

18 AUG 2024

Course : COMP 342
Semester : I
F. M. : 40

SECTION "B"

[6 Q. × 4 = 24 marks]

Attempt ANY SIX questions.

1. Augmented reality (AR) is an interactive experience that combines the real world and computer-generated 3D content and can be effectively used in the field of Education and training, as a student of Computer Graphics how can you contribute to this field of application using AR give your answer with supporting examples. [4]

2. GPU can process 1 million triangles per second. If a scene requires 500,000 triangles to be rendered, how many scenes can the GPU render per second? Describe basic video controller refresh operations with required block diagram? [2+2]

3. What are the advantages of Cartesian coordinate system over homogeneous coordinate system? Mani sat in the car, and found the side mirror is 0.4m on his left and 0.3m in his front he started his car and drove 10m forward, turned 90 degrees to left, moved 15m forward again, and turned 45 degrees to the right, and stopped? What is the position of the side mirror now, relative to where Rabin was sitting in the beginning? [1+3]

4. Distinguish between Window port and Viewport? Draw a flow chart illustrating the logic of the Liang Barsky Line clipping algorithm? [1+3]

5. What two steps are required to determine whether any given points $\mathbf{P_1}(x_1, y_1, z_1)$, obscures another point $\mathbf{P_2}(x_2, y_2, z_2)$? Explain how does the Z-buffer algorithm determine which surfaces are hidden with an example? [1+3]

6. How do illumination models handle multiple light sources? Describe specular reflection with supporting mathematical calculations and also write the equation that shows the surface lighting effects? [1+3]

7. Write Short notes on: [2+2]
   a. CMY Color model
   b. Key Frame Systems in Animation

SECTION "C"

[2 Q. × 8 = 16 marks]

Attempt ALL questions.

8. Derive all the required decision parameters and write an algorithm for drawing one region of an ellipse with semi major and semi minor axis as $\mathbf{R_X}$, $\mathbf{R_Y}$, and starting from $(\mathbf{R_X}, \mathbf{0})$ using Midpoint algorithm and also derive the boundary condition of two different regions? Digitize a line with end points A (11, 12) and B (15, 14) using Bresenham line drawing algorithm? [6+2]

P.T.O.

9. Find the transformation co-ordinates of a pyramid whose co-ordinates are A(0,0,0), B(1,0,0), C(0,1,0) and D(0,0,1) after performing a **cabinet projection** that makes an angle **30°** with horizontal axis in $\mathbf{X_v}$, $\mathbf{Y_v}$ plane ? Derive 3D composite transformation matrix for rotating a 3D object about an arbitrary axis by an angle **θ°** using homogeneous coordinate? (***Make necessary assumptions) (Actual rotation θ° should be performed on x-axis)*** [Matrix multiplication not needed] [3+5]

10. a. Explain intensity interpolation technique with supporting mathematical calculation and also write its advantages over constant intensity technique? [4]

b. Find the instance transformation which places a half-size copy of a square P(0, 0), Q(1, 0), R(1, 1), S(0, 1) into a master picture coordinate system so that the center of the square is at (-1, -1)? [4]

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Marks Scored:

Level : B.E./B.Sc.
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Exam Roll No. :
Time: 30 mins.
F. M. : 10

Registration No.:
Date : 7 & AUG 2024

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and mark [X] in the most appropriate option:

1. In which area are computer graphics used to create virtual prototypes for design and testing?
   [ ] Education
   [ ] Scientific Visualization
   [ ] Computer-aided design (CAD)
   [ ] Augmented reality

2. If a line is drawn from (1, 1) to (9, 6) using the DDA algorithm, what is the value of Δy per step?
   [ ] 0.5 [ ] 0.75 [ ] 0.625 [ ] 0.67

3. For a circle with radius 7 centered at (0, 0), what is the new decision parameter if the initial decision parameter p_0 is -6 and the current point is (7, 0)?
   [ ] -3 [ ] 3 [ ] -8 [ ] 8

4. If a display has a response time of 5 milliseconds, what is the maximum refresh rate it can support without motion blur?
   [ ] 60 Hz [ ] 120 Hz [ ] 200 Hz [ ] 250 Hz

5. Which of the following holds true for Random Scan Display System:
   a. Uses interlacing
   b. Refresh rate depends directly on picture complexity
   c. Scan conversion is not required
   [ ] a & b [ ] a & c [ ] b & c [ ] a, b &c

6. A graphics card has a core clock speed of 1350 MHz and can perform 4 instructions per clock cycle. How many instructions per second can the card execute?
   [ ] 6.8 billion [ ] 5.4 billion [ ] 7.5 billion [ ] 10.8 billion

7. What is the result of applying a 2D rotation transformation to a point (x, y) by an angle θ?
   [ ] (xcosθ + ysinθ, ycosθ − xsinθ
   [ ] (xcosθ − ysinθ, xsinθ + ycosθ)
   [ ] (xsinθ + ycosθ,ysinθ − xcosθ
   [ ] (xcosθ − ysinθ, ycosθ + xsinθ)

8. In a 2D fixed point scaling coordinate **(x_f, y_f)**. For a vertex with coordinates **(x, y)**, the scaled coordinates **x'** with scaling factor **sx, sy** is calculated as
   [ ] y. sx + x_f . (1-sx)
   [ ] x. sx + x_f .(1-sx)
   [ ] y. sx + y_f . (1-sy)
   [ ] y. sx + x_f . (1-sy)

9. A point P (6, 3) is reflected across the line y = -x. What are the new coordinates of P?
   [ ] (6, -3) [ ] (-3, -6) [ ] (-6, -3) [ ] (3, 6)

10. Given a clipping window with corners (xmin, ymin) = (2, 2) and (xmax, ymax) = (10, 8), A line segment has endpoints P1 (1, 3) and P2 (5, 9). What are the initial outcodes for P1 and P2, respectively?
[ ] 1000 and 0001 [ ] 0001 and 1000 [ ] 0100 and 0010 [ ] 0010 and 0100

11. If a window is defined by (0, 0) to (2, 2) and the viewport is defined by (1, 1) to (3, 3), what will be the viewport coordinates of a point located at (1, 1) in the window?
[ ] (2.5, 2.5) [ ] (2, 2) [ ] (1.5, 1.5) [ ] (3, 3)

12. What will be the final coordinates after 3D rotation of the point P (10, 10, 10, 1) represented in homogenous coordinate at 90° about Y-axis?
[ ] (10, -10, -10, 1) [ ] (-10, -10, -10, 1) [ ] (-10, 10, 10, 1) [ ] (10, -10, 10, 1)

13. Which type of projection is most commonly used in video games and simulations to provide sense of depth and realism?
[ ] Parallel projection [ ] Perspective projection
[ ] Cavalier projection [ ] Isometric projection

14. How does the depth buffer method work?
a. It stores the depth of each pixel in the depth buffer
b. It compares the depth of each new pixel to the depth of the pixel in the depth buffer
c. If the new pixel is closer to the viewer, then its depth is stored in the depth buffer and the old pixel is overwritten
[ ] a & b [ ] b &c [ ] a & c [ ] a, b & c

15. In the context of visible surface detection, what does the term "scanline algorithm" refer to?
[ ] An algorithm that processes each polygon one at a time.
[ ] An algorithm that processes each pixel one at a time.
[ ] An algorithm that processes each horizontal line of pixels one at a time.
[ ] An algorithm that sorts polygons by their depth

16. The Fresnel effect in illumination models primarily affects which type of reflection?
[ ] Ambient reflection [ ] Diffuse reflection
[ ] Specular reflection [ ] Emissive reflection

17. Which of the following characteristics hold true for point source of light?
a. Rays follow radially diverging paths
b. Light source is closer to the scene
c. Size of light source is small compared to object in the scene
[ ] a & b [ ] a & c [ ] b & c [ ] a, b &c

18. Which polygon rendering technique is most suitable for real-time applications like video games due to its balance between quality and performance?
[ ] Flat Shading [ ] Ray Tracing
[ ] Phong Shading [ ] Gouraud Shading

19. Which of the following color models is based on human perception of color?
[ ] RGB [ ] CMYK [ ] HLS/HSV [ ] YIQ

20. Which animation technique involves blending shapes to create smooth transitions between different forms?
[ ] Keyframing [ ] Curve-fitting [ ] Morphing [ ] Skeletal animation