

Roll Number: _____

Thapar Institute of Engineering & Technology, Patiala

Computer Science & Engineering Department

END SEMESTER EXAMINATION

B. E. (3rd Year)

Course Code: UCS505

Course Name: Computer Graphics

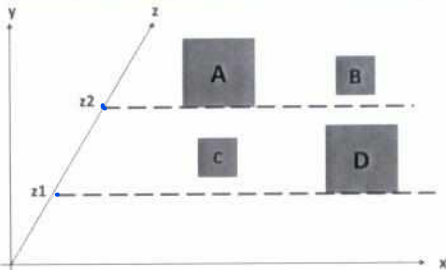
Date: 25th May 2023

Time: 3 Hours, M. Marks: 40

Faculty: Anupam Garg, Amrita Kaur,
Kuntal Choudhary, Harpreet Singh,
Yadwinder Singh

Note: All questions are compulsory. Attempt the subparts of the question at one place.

1.	Devise a scan line algorithm for filling the interior regions with the given input set of vertices having scan lines at $y=7$, $y=5$ and $y=2$. (8)																																										
	<table><tr><th>Vertex</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th></tr><tr><th>X</th><td>1</td><td>1</td><td>2</td><td>2</td><td>5</td><td>5</td><td>7</td><td>7</td><td>5</td><td>5</td><td>3</td><td>3</td><td>1</td></tr><tr><th>Y</th><td>1</td><td>5</td><td>5</td><td>7</td><td>7</td><td>5</td><td>5</td><td>1</td><td>1</td><td>2</td><td>2</td><td>1</td><td>1</td></tr></table>	Vertex	1	2	3	4	5	6	7	8	9	10	11	12	13	X	1	1	2	2	5	5	7	7	5	5	3	3	1	Y	1	5	5	7	7	5	5	1	1	2	2	1	1
Vertex	1	2	3	4	5	6	7	8	9	10	11	12	13																														
X	1	1	2	2	5	5	7	7	5	5	3	3	1																														
Y	1	5	5	7	7	5	5	1	1	2	2	1	1																														
2(a)	Using origin (0, 0, 0) as the center of projection, find the perspective projection of a point P (5, 2, 7) on the view planes defined by following cases. i. If the view plane is taken as $z=2$ (2) ii. If a view plane be determined by a normal vector $N=I-J+K$ and a point $P_0(2, 3, -1)$. (3)																																										
(b)	A unit cube is scaled to twice its size. What are the points of cavalier projection of the scaled cube with $\theta = 30^\circ$. (3)																																										
3(a)	Classify the various Visible Surface Detection Algorithms. Give one example of each type. (2)																																										
(b)	How does the Z-buffer algorithm determine which surfaces are hidden? (2)																																										
(c)	Find a transformation A_V which aligns a given vector V ($V=5I + 4J + 3K$) with the vector K along the positive Z axis by looking at the following figure. (Give Matrix Representation) (Consider only positive values for square roots, e.g. $\sqrt{36} = +6$ only) (4)																																										

4/	 <p>In the above figure, there are 4 polygons. Which of the polygon has the priority to be painted first by performing the depth sorting algorithm? Explain in detail.</p> <p style="text-align: right;">(8)</p>
5(a)	<p>The Bezier curve having n^{th} degree polynomial equation can be represented in the following format as $\mathbf{B}(u) = [\mathbf{U}] [\mathbf{M}_{\text{BEZ}}] [\mathbf{p}_k]$. Here, \mathbf{U} is the row matrix having dimension $[1 \times (n+1)]$, \mathbf{M}_{BEZ} is a square matrix having dimension $[(n+1) \times (n+1)]$, \mathbf{p}_k is a column matrix having dimension $[(n+1) \times 1]$. Represent the equation of 3rd degree Bezier curve according to the above format. Show all the necessary steps to derive and represent the 3rd degree Bezier curve equation.</p> <p>If $\mathbf{p}_k = \mathbf{f}(x_k, y_k, z_k)$, and $\mathbf{B}(u) = \mathbf{f}(x(u), y(u), z(u))$ then write down only the equation of $x(u)$, $y(u)$ and $z(u)$.</p> <p style="text-align: right;">(3+1)</p>
(b)	<p>Calculate the value of $B''(0)$ and $B''(1)$ in 3rd degree Bezier curve (where $B''(u) = \frac{d^2}{du^2}(B(u))$).</p> <p style="text-align: right;">(1)</p>
(c)	<p>Define Bezier surface $P(u, v)$ along with its mathematical equation considering the two orthogonal Bezier Curves whose blending functions are $\text{BEZ}_{k,n}(u)$, $\text{BEZ}_{j,m}(v)$.</p> <p style="text-align: right;">(1)</p>
(d)	<p>Write down all the necessary matrices to derive the 3D reflection matrix about any arbitrary plane passing through (d, e, f). Assume the arbitrary surface normal vector whose direction is $\mathbf{N} = n_x \mathbf{i} + n_y \mathbf{j} + n_z \mathbf{k}$.</p> <p style="text-align: right;">(2)</p>