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)**

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)**

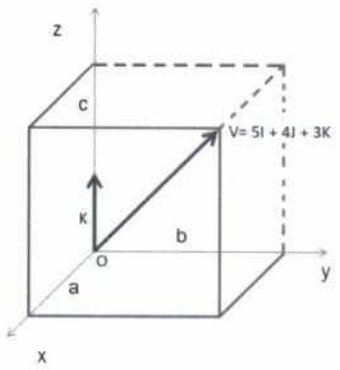
ii. If a view plane be determined by a normal vector N= I-J+K and a point P_o (2, 3, -1). **(3)**

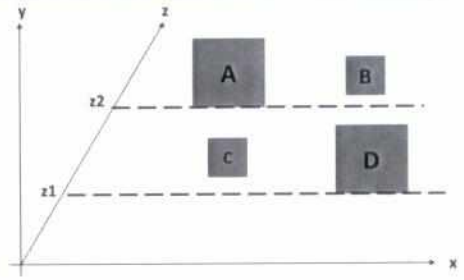
(b) A unit cube is scaled to twice its size. What are the points of cavalier projection of the scaled cube with $\theta = 30^0$. **(3)**

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.	 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. **(8)**
5(a)	The Bezier curve having n^{th} degree polynomial equation can be represented in the following format as **B(u) = [U] [M_{BEZ}] [p_k]**. Here, **U** is the row matrix having dimension **[1 × (n+1)]**, **M_{BEZ}** is a square matrix having dimension **[(n+1) × (n+1)]**, p_k is a column matrix having dimension **[(n+1) × 1]**. Represent the equation of 3^{rd} degree Bezier curve according to the above format. Show all the necessary steps to derive and represent the 3^{rd} degree Bezier curve equation. If p_k = **f** (x_k, y_k, z_k), and **B(u) = f(x(u), y(u), z(u))** then write down only the equation of x(u), y(u) and z(u). **(3+1)**
(b)	Calculate the value of B'' (0) and B'' (1) in 3^{rd} degree Bezier curve (where $B''(u) = \frac{d^2}{du^2}(B(u))$. **(1)**
(c)	Define Bezier surface P (u, v) along with its mathematical equation considering the two orthogonal Bezier Curves whose blending functions are $BEZ_{k,n}(u), BEZ_{j,m}(v)$. **(1)**
(d)	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 **N= n_xi +n_yj+n_zk**. **(2)**