C1-R4: ADVANCED COMPUTER GRAPHICS

NOTE:

1. **Answer question 1 and any FOUR from questions 2 to 7.**
2. **Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours **Total Marks: 100**

1.

a) What is Hierarchical View Frustum Culling (HVFC)?

b) Explain with two examples, the need of curves and surfaces in graphics.

c) Using pin-hole camera, give a simple perspective model.

d) Describe flocking system technique for animation.

e) What is Radiosity?

f) Explain properties of visible light.

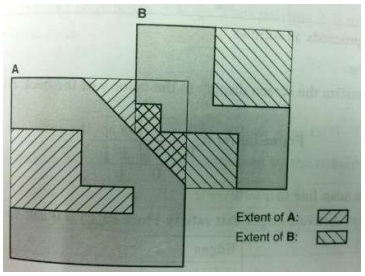
g) Explain the 3D shear transformation.

(7×4)

2.

a) Explain Warnock's Algorithm for hidden surface detection. Extend this algorithm with the help of Weiler-Atherton Algorithm.

b) Apply the "A Scan-line algorithm" to the display of objects A and B.



([5+4]+9)

3.

a) Develop a cavalier and cabinet projections for the cube with one cut off. The position vectors for the cube with one corner removed are

$$[X]=\begin{bmatrix} 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 0.5 & 1 & 1 \\ 0.5 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 0.5 & 1 \end{bmatrix}*$$

b) Prove that an intersection point of two straight lines AB [(-1, -1), (3, 5/3)] and YZ [(-1/2, 3/2), (3, -1/2)] will be exactly the same as the intersection point of transformed intersecting lines AB and YZ drawn after the transformation. Assume that the *x*-*y* plane is used for transformation. The transformation may be taken as: $\begin{bmatrix} 1 & 2 \\ 1 & -3 \end{bmatrix}$.

(9+9)

4.

a) Consider the open B-spline surface defined by the 4 x 4 polygon net:

$B_{1,1}$[-15 0 15]	$B_{2,1}$[-5 5 15]	$B_{3,1}$[5 5 15]	$B_{4,1}$[15 0 15]
$B_{1,2}$[-15 5 5]	$B_{2,2}$[-5 10 5]	$B_{3,2}$[5 10 5]	$B_{4,2}$[15 5 5]
$B_{1,3}$[-15 5 -5]	$B_{2,3}$[-5 10 -5]	$B_{3,3}$[5 10 -5]	$B_{4,3}$[15 5 -5]
$B_{1,4}$[-15 0 -15]	$B_{2,4}$[-5 5 -15]	$B_{3,4}$[5 5 -15]	$B_{4,4}$[15 0 -15]

The surface is fourth-order in both parametric directions (k=l=4). The surface is composed of a single path with parameter ranges 0<=u<=1, 0<=w<=1. Subdivide the surface into 4 subpatches. Maintain a uniform open knot vector.

b) Elaborate the properties of B-splines.

(9+9)

5.

a) Describe any two anti-aliasing techniques?

b) What is Bump Mapping? Detail the differences between bump mapping and normal mapping.

c) What are the problems with interpolated shading?

(6+6+6)

6.

a) What is storyboarding? Explain its importance with suitable diagram with respect to Timeline.

b) Explain the Key-Frame animation system.

c) Explain Motion Capture. What are the various input system used for Motion Capture? Elaboration on how Motion Capture can be used with respect to animation.

(3+6+9)

7.

a) Differentiate between object-space methods and image-space methods with respect to Visible Surface Detection.

b) Clip the line P_1(0,0,-10) to P_2 (0,0,10), using the Liang-Barsky 3D clipping algorithm, with near and far clipping planes at n=1 and f=2.

(9+9)