Roll No: -------------------------

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: B.Tech CSE | **Semester – V**
Subject (Course): Computer Graphics | **Max. Marks : 100**
Course Code : CSEG 329 | **Duration : 3 Hrs**
No. of page/s: 2

Section A
(All questions are compulsory and each carry 5 marks)

1. Only define the following terms. (2x5=10)
   a) Polygon Meshes b) Affine transformations c) Convex Hull d) HSI Model
   e) Illumination Model
2. How does a Z-Buffer algorithm recognize that which surface is hidden? Explain with example. (5)
3. Prove: (5)

   $$\sum_{i=0}^{n} B_{n,i}(t) = 1$$

   Where n=no. of control points, $0 \le t \le 1$, $B_{n,i} \rightarrow Blending\ Function$

Section B
(All questions are compulsory and carry 10 marks)

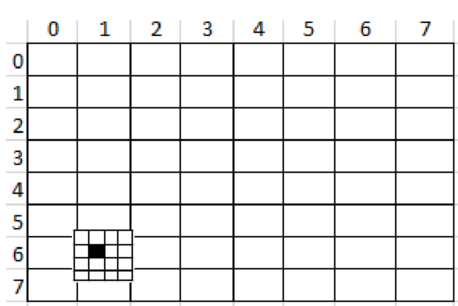
4. Three points on a shiny metallic surface is given A(2,0,4), B(15,0,6) and C(9,0,9). The light vector is L=-i+2j-k and the viewing vector is given by V=i+1.5j+0.5k. Assume that there is only one object and is illuminated by a single light source. Calculate resultant intensity. Take $k_d = 0.2$, $k_a = 0.3$ and $k_s = 0.85$. The value of 'n' for specular reflection is 5. Assume $I_a = 1$ and $I_p = 10$. (10)

5. A solid tetrahedron ABCD is given by Normals are:

   $N_{ACD} = -2i+j+k$, $N_{CBD} = 2i+j+k$, $N_{BAD} = 2j-2k$, $N_{ACB} = -4j$

   A point light source is kept at P(2,3,4). Determine which part of surface will be visible and occluded using Back Face Detection algorithm. (10)

6. Develop an algorithm for generating a quadtree representation for given visible surface (block) in below image by applying the area sub-division tests to determine the values of the quadtree elements. (10)



7. Obtain the mirror reflection of the triangle formed by the vertices A(0,3), B(2,0) and C(3,2) about line passing through the points (1,3) and (-1,-1). (10)

OR

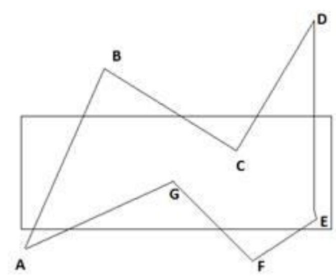
Consider following window coordinates A(100, 10), B(160, 10, C(160, 40), D(100, 40). Find the visible portion of the line segments EF, GH and IJ using Cohen Sutherland algorithm. The points are E(50,0), F(70,80), G(120, 20),H(140, 80),I(120, 5),J(180, 30).

Section C
(All questions are compulsory and each carry 20 marks)

8. Briefly explain B-Spline curve algorithm. Differentiate between Bezier and B-Spline curve. Generate the values of knot vector and find the segments effected by different control points for a B-Spline curve where n=5 and k=3. (7+3+10)

9. A) Consider a Bezier blending function with following control points (2, 2), (2, 5), (5, 5) and (5, 2). Calculate the values for corresponding u={0, ¼, ½, 2/3, ¾,1}. Draw the curve for respective output. (10)

   B) Clip the following figure with Sutherland Hodgeman algorithm and discuss its disadvantage with example. (10)



OR

A) Give a single 3x3 homogeneous coordinate transformation matrix, which will have the same effect as each of the following transformation sequences. (2.5x4=10)
   i) Scale the image to be twice as large and then translate it 1 unit to the left.
   ii) Scale the x direction to be one-half as large and then rotate counterclockwise by 90^0 about the origin.
   iii) Rotate counterclockwise about the origin by 90^0 and then scale the x direction to be one-half as large.
   iv) Translate down ½ unit, right ½ unit, and then rotate counterclockwise by 45^0.

B) Draw the line with the help of Bresenham's algorithm for the following given points P1 (20,10) and P2 (28, 22). (10)

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Section A
(All questions are compulsory and each carry 5 marks)

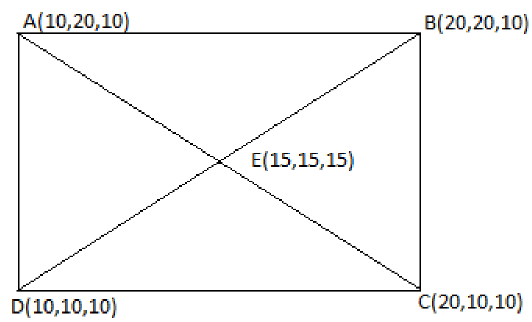
1. Differentiate between: (2.5x4=10)
   a) HSI and RGB Color Model
   b) Object Space and Image Space
   c) Flat and Phong Shading
   d) Raster Scan and Random Scan
2. Briefly explain Boundary fill and Flood fill with example. (5)
3. Write and explain Quadratic Bezier curve equation. Why it is required blending function? (3+2)

Section B
(All questions are compulsory and carry 10 marks)

4. Construct a Beizer curve with following control points A (0,0) B(1,2) C(3,2) and D(2,0). Generate five points of the curve. (10)

5. Draw the line with the help of Bresenham's algorithm for the following given points P1 (20,10) and P2 (28, 22). (10)

6. In the figure (rectangular pyramid) below find the back face using back face detection algorithm, considering viewer is at (30, 40, 30) watching towards origin. (10)



7. Obtain the mirror reflection of the triangle formed by the vertices A(0,3), B(2,0) and C(3,2) about line passing through the points (4,3) and (-1,-2). (10)

OR

Consider following window coordinates A(100, 10), B(160, 10, C(160, 40), D(100, 40). Find the visible portion of the line segments EF, GH and IJ using Cohen Sutherland algorithm. The points are E(50,0), F(70,80), G(120, 20),H(140, 80),I(120, 5),J(180, 30).

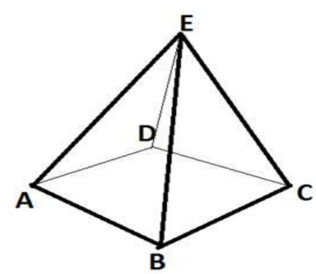
Section C
(All questions are compulsory and each carry 20 marks)

8. A) Derive all the blending function for a beizer curve with 6 control points, also derive relationship between blending function, parameter and geometic vector for a cubic beizer curve. (10)

   B) Define Fractals, mention two important characteristics of Fractals. Generate Koch Curve till 3^{rd} Iteration for an equilateral triangle. (10)

9. For the pyramid shown below and defined by the vertices (20)

$$X=\begin{vmatrix}10 & 0 & 20\\ 20 & 0 & 25\\ 32 & 0 & 20\\ 27 & 0 & 10\\ 20 & 30 & 20\end{vmatrix}\begin{matrix}A\\ B\\ C\\ D\\ E\end{matrix}$$



Reflect the pyramid about an axis passing through vertices E and center of quad ABCD.

OR

Give a single 3x3 homogeneous coordinate transformation matrix, which will have the same effect as each of the following transformation sequences. (4x5=20)

a) Scale the image to be twice as large and then translate it 1 unit to the left.
b) Scale the x direction to be one-half as large and then rotate counterclockwise by 90^0 about the origin.
c) Rotate counterclockwise about the origin by 90^0 and then scale the x direction to be one-half as large.
d) Translate down ½ unit, right ½ unit, and then rotate counterclockwise by 45^0.