BACHELOR OF COMP. SC. & ENGINEERING EXAMINATION, 2011

(3^{rd} year,1st Semester)

COMPUTER GRAPHICS

Time: 3 hours Full Marks: 100

Answer any FIVE questions.
(Parts of a question must be answered together)

1. a) Rasterise a straight line segment from A(2,3) to B(-1,-1) using Bresenham's algorithm (integer version); give details of all steps, preferably in tabular form.

   b) Rasterise the same line segment AB as in (a), using Mid-Point algorithm; give details of all steps, preferably in tabular form.

   c) Compare the list of pixels obtained in (a) with that obtained in (b) and comment; also compare the actual number of computation steps required in (a) with those in (b) and comment. **8+8+4**

2. Consider the triangle A(2,2), B(4,2), C(4,4) and do the following:

   i) Rotate the triangle ABC ccw about origin by 90°; then reflect the rotated triangle about line y = - x to obtain triangle A' B' C' ; find position vectors for A' ,B' and C'.

   ii) Reflect the triangle ABC about line y = - x & then rotate the reflected triangle ccw about origin by 90° to get triangle A*B*C* ; find position vectors for A*,B* and C*.

   iii) Is it possible to combine A' B' C' and A*B*C* to generate a symmetric 2D object with its centroid at the origin? If yes, give transformation matrix(ces) necessary to do this & explain your answer; If not, explain why.

   iv) Find area of A' B' C' and A*B*C* taken together without actually using the position vectors for A' ,B', C', A*,B*,C* ; explain your answer.

   5+5+5+5

3. a) There are two triangles. The first, T_1 is defined by A(2,2), B(14,2), C(8,8) and the second, T_2 is given by D(6,3), E(10,3) & F(8,5). Fill the space between triangles T_1 & T_2 using incremental active-edge list approach; avoid under/over filling and give numerical details of all your steps.

   b) Explain the Scan-line seed-fill technique for filling arbitrary polygons.

   c) Compare the filling technique in (b) with the simple Seed-fill technique **9+7+4**

4. a) A regular clipping window has its lower left corner at (3,4) and upper right corner at (10,9). Clip line segment A(2,1) B(9,2) against this window using Sutherland-Cohen algorithm. Give complete details of your steps.

b) Perform the same clipping task as in (a) using Cyrus-Beck algorithm and compare the results. **10+10**

5. a) A pyramid defined by vertices A(0,0,0), B(1,0,0), C(0,1,0) and D(0,0,1) is rotated ccw by 45° about the line passing through the vertex C(0,1,0) and having direction vector [0 1 1]. Perform the required transformation(s) and obtain vertex coordinates of the pyramid.

b) Prove that after a 3D object is rotated about one of the principal coordinate axes (i.e., x, y or z), the coordinates of all vertices along the corresponding axis remain unchanged for the transformed object.

c) Prove formally that for perspective projection, centre of projection and corresponding vanishing point are equidistant from the plane of projection. **8+6+6**

6. a) Show that

$$\sum_{i=0}^{n} J_{n,i}(t) = 1, \; 0 \le t \le 1$$

for all Bezier curves with exactly 6 polygon defining vertices where $J_{n,i}$ has usual meaning .

b) Explain significance of the constraint as in (a) on the general shape and nature of a Bezier curve.

c) A Bezier curve segment is defined by control points $P_0(2,2)$, $P_1(4,8)$, $P_2(8,8)$ and $P_3(9,5)$. Another curve segment is defined by $Q_0(a,b)$, $Q_1(c,2)$, $Q_2(15,2)$ and $Q_3(18,2)$. These two segments join smoothly. Find values of a, b, c. **10+5+5**

7. Write short notes on any two:
   - i) Mid-point ellipse rasterisation.
   - ii) Liang-Barsky clipping algorithm.
   - iii) Second order difference Mid-point circle rasterisation.
   - iv) General blending function. **10 + 10**