BACHELOR OF COMPUTER SCIENCE & ENGG. EXAMINATION, 2018
(3rd YEAR , 1st SEMESTER Supplementary)

COMPUTER GRAPHICS

Time: Three Hours **Full Marks: 100**

Answer any FIVE questions

1. a) Develop Sutherland-Hodgman's technique for clipping a polygon against arbitrary convex window; derive/develop any line clipping result that you use. Present the technique as a formal algorithm.

   b) Using the Liang-Barksy algorithm, clip line P1(-1,1) to P2(9,3) against the regular window with lower left and upper right corners at (0,0) & (8,4) respectively. Present your clipping steps in precise tabular form giving values of all related parameters in each step.

   10+10 = 20

2. a) Prove that a parallelogram when transformed by an arbitrary 2 x 2 matrix, the transformed figure is still s parallelogram.
   b) Rasterize 1st quadrant of an ellipse centered at (3,4) with axes aligned to the coordinate axes and a=8, b=5. Your results must be presented in precise tabular form with values of all rasterisation related parameters given in all steps.

   10+10=20

3. a) Consider a hyperbola with a=2 & b=1. Approximate a segment of this hyperbola in the first quadrant with $4 \leq x \leq 8$, using 7 linear segments / 8 points. Use hyperbolic functions for better approximation. Give full numerical details of all your steps, preferably in tabular form.
   b) A cubic Bezier curve segment is described by control points P0(2,2), P1(4,8), P2(8,8), P3(9,5). Another curve segment is defined by Q0(a,b), Q1(c,2), Q2(15,2) & Q3(18,2). Determine values of a,b & c so that two curves join smoothly. Explain your answer.

   10+10 = 20

4. a) Consider the triangle given by A(4,1), B(5,2) & C(4,3). This is first reflected about the X-axis and then the reflected triangle is further reflected about the line y=-x. Find the 3x3 transformation matrix to do this and also the position vectors of the final transformed triangle. Could the same transformation be brought about by rotating the original triangle? If so, by what angle?
   b) Define perspective projection. Give transformation matrices needed for performing orthographic projections on x=0, y=0 & z=0 planes respectively. How can the same be obtained from corresponding perspective projection matrices?

   10+10 = 20

5. a) Develop the Edge-Fill algorithm. Illustrate by giving detailed steps (in tabular form) involved in filling the polygon defined by A(4,2), B(25,2), C(25,10), D(23,8), E(23,6), F(21,6), G(18,9), H(10,9), I(6,5) & J(4,7) in that order.

   b) Illustrate Mid-Point circle rasterization algorithm (using 2^{nd} order partial difference) by rasterising a circle with radius 10 units & center at (6,4). All steps must be clearly shown, preferably in tabular form and explained.

10+10 = 20

6. a) Develop the Mid-Point line rasterization algorithm and illustrate by rasterizing the line segment from A(-5,12) to B(13,-10).

   b) Develop the Mid-Point ellipse rasterization technique. Your starting point should be the equation of an origin centered ellipse; all other details must be developed / derived and explained precisely. Finally, present the technique as a formal algorithm.

10+10=20

7. a) The left and bottom edges of a rectangle are coincident with the Y and X axes respectively, while its top and right edges are at y=512 & x=1023 respectively. A line A(-56, 325), B(1056, -10) passes through this rectangle. Apply Cyrus-Beck algorithm to clip this line against this rectangle. List and explain all computational steps.

   b) Explain Frame Buffer based polygon filling algorithms.

10+10=20

8. Write detailed notes on any two of the following

   a) Cyrus Beck 2D line clipping

   b) Scan-line seed fill technique

   c) Splitting a Bezier curve

10+10 = 20