ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION   SUMMER SEMESTER, 2016-2017
DURATION: 3 Hours   FULL MARKS: 150

CSE 4607: Computer Graphics and Multimedia Systems
Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) What do you understand by shaders? Differentiate among Ambient, Diffuse and Specular lighting models.   7

    b) What are the problems of Digital Difference Analyzer (DDA) line drawing algorithm? How can midpoint line algorithm improve the performance of line drawing? Derive necessary equations to justify your answer.   10

    c) Discuss by graph: Linear Tone Mapping, Logarithmic Tone Mapping. Which one makes the image look more vibrant? Why?   4+4

2. a) Consider the Table 1. Create Huffman tree from the given information.   3

Table 1: Huffman coding for alphabets

Alphabets	Available Huffman Code
A	00
B	010
C	011
D	10
E	11

    b) Show the compressed output of "EAEBAECDEAEBAEC" by applying Lampel Ziv encoding algorithm.   11

    c) For the same text "EAEBAECDEAEBAEC" in (b), compare which compression algorithm is more effective; Huffman coding or Lampel Ziv encoding? Contrast between their compressed output. Is the algorithm that performed better will always do the same? If not, explain the case.   11

3. a) Briefly discuss the steps of the graphics pipeline. Mention the steps that are user programmable.   10

    b) Explain the steps of Cohen-Sutherland's Algorithm with a suitable example that covers all possible cases of clipping.   15

4. a) Why do we need homogenous coordinates? When does two homogenous coordinates $(x1, y1, w1)$ and $(x2, y2, w2)$ represent the same point?   5

    b) The midpoint scan conversion algorithm is applicable for lines having slopes between 0 and 1. Modify this algorithm to accommodate lines having slopes between 1 and infinity. (Lines with angles between 45 and 90 degrees)   10

    c) How can we improve the performance of the midpoint circle algorithm with the second order differentials? Derive necessary equations to justify your answer.   10

5. a) For the following figures, derive the transform required to go from Figure A1 to Figure B1 and A2 to B2. In each case, check your work by using your transform to compute the location of the tip of the plane in Figure B.   13
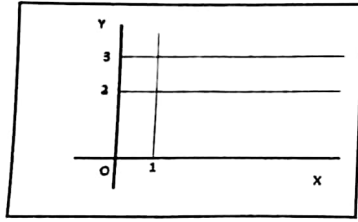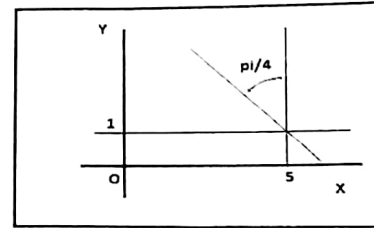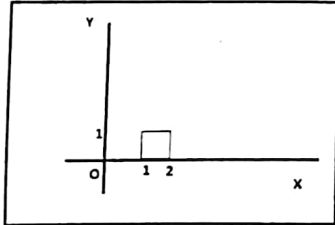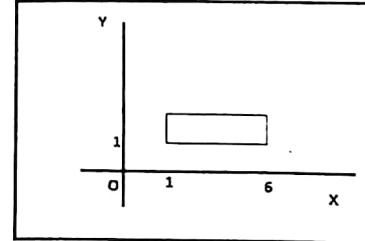

Figure-A1

Figure-B1

Figure-A2

Figure-B2

b) When is the order of matrix multiplication unimportant in transformation of objects?   6

c) What is another name for painter's algorithm? Explain the name followed by the way it works.   2+4

6. a) Explain the architecture of a raster display. "Raster scan display has staircase effect" – Explain the statement with appropriate figure.   10

b) Step by step determine all the intermediate pixel positions along a circle path those lie in the first quadrant of the circle with the radius 10 centered at (0,0) using the midpoint circle drawing algorithm.   15

7. a) Suppose you want to scan convert a curve expressed by the equation $ax^2+bx+c+y=0$. The midpoint algorithm can be adopted in a straightforward way with this equation. Here, only consider the case where you are currently in a region of the curve having the local slope in between 0 and 1. This means the next pixel to be highlighted will either be in the E or NE direction.   21

As in algorithms for scan converting lines and circles, a decision variable d can be defined such that the choice for the next pixel to be highlighted depends only on the sign of d. This decision variable is a function of the midpoint between the E and NE pixels. Answer the followings-

   i. Suppose you are at point (x_p,y_p) on the scan converted curve. Derive the expression for decision variable d, which will be used to determine the next pixel to be highlighted.

   ii. If $d > 0$, which pixel (E or NE) is highlighted next?

   iii. An iterative algorithm can be used to increment the value of the decision variable at each step. Let d' be the decision variable for the point following (x_p,y_p). Define deltaE as (d'-d) when pixel E is chosen next and deltaNE as (d'-d) when pixel NE is chosen next. Write expressions for deltaE and deltaNE as functions of a, b, c, x_p, y_p.

b) State what information does zero frequency components contain in JPEG encoding?   4

8. a) In OpenGL programming, what is GLSL? Why separately GLSL is used in modern OpenGL programming?   6

b) Describe the structure of vertex and fragment shader. Write a main stub that only compiles vertex and fragment shader merging them together.   10

c) In how many ways can the shader programs share their variable? Explain with examples.   9