# B.E. (CST) 7th Semester Examination: Part III, 2007

## Subject: COMPUTER GRAPHICS (CST-705)

**Full marks: 100** **Time: 3 hours**

1. Attempt question 1 and any **four** from the rest.
2. All parts of a particular question should be answered together.
3. Unless otherwise stated, "*roll*" indicates your Examination Roll Number (last 2 digits).
4. $a\%b$ = remainder obtained when $a$ is divided by $b$.
5. Use graph sheets if necessary.

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1. (a) Write the DDA algorithm on line drawing.

   (b) A digital circle is always minimally connected in 8-neighborhood — justify.

   (c) Let $(roll\%5, roll\%7)$ be the center of a digital circle with radius $r$. If $(i, j)$ be a grid point on this digital circle, then find the relation that gives how $j$ depends on $i$.

   (d) If an object is connected in 8-neighborhood, then state and explain how the background is connected.

   (e) Let $C$ be any real curve segment with finite length that never intersects itself. Justify whether or not the digital representation of $C$ will be always minimally connected in 8-N. [Hint: A curve is said to be "minimally connected" iff removal of any point from the curve makes it disconnected.]

   (f) Explain how a straight line in the $xy$ plane reduces to a point in some other plane under appropriate transformation. Name the transformation and the second plane.

   (g) Show the chain code directions in 8-neighborhood. Hence find the end point of the digital curve with chain code: 2654130, given that its start point is at $(roll\%5, roll\%7)$.

   (h) What is a sliver? In which context slivers are addressed? Give an example.

   (i) Give examples of two convex sets $S_1$ and $S_2$ such that $S_1 \cup S_2$ is not convex. Give examples of two non-convex sets $S'_1$ and $S'_2$ such that $S'_1 \cup S'_2$ is convex.

   (j) Let $P(x, y, z)$ be an object point having $x = roll, y = roll, z = -roll$. If the viewer is at $V(-roll, -roll, 2 \times roll)$, then find the projection of $P$ on the image plane. $(4 \times 10 = 40)$

2. (a) Derive the decision function for Bresenham's digital straight line segment (DSS) drawing algorithm. (5)

   (b) Find the number of E (East) transitions and the number of NE (North-East) transitions corresponding to the DSS $OP$ from $O = (0, 0)$ to $P = (100 + roll, 50 + roll)$. (5)

   (c) Explain how many real lines (infinitely long) are possible, each of which, when digitized, will contain the above DSS ($OP$) as a part of it. (5)

3. (a) Derive the 1st and 2nd order differences for a digital circle with center at $(0, 0)$ and radius $r$ and explain their roles in constructing a digital circle. (10)

   (b) Find the number of E (East) and SE (South-East) transitions in constructing the first octant of a digital circle with center at $(0, 0)$ and radius $r = 20 + roll\%7$. (5)

4. Demonstrate (with clear and precise explanation) the Filling Algorithm using Edge Tables to fill the polygon $ABCDE$ whose vertices (in order) are $A(1, 1), B(6, 3), C(7, 8), D(2, 9), E(5, 3 + roll\%5)$. (15)

5. Explain with different examples the Clipping Algorithm using Region Codes. Consider that two diagonally opposite corners of the clip window are $(0, 0)$ and $(20 + roll\%5, 10 + roll\%7)$. (15)

6. Suggest a method of illumination applicable for a red-colored glass ball immersed in water. Now describe an animation procedure for the above ball gradually sinking down the water under gravity. (15)

7. What is meant by the convex hull of a set of triangles?
   Write an algorithm to find the convex hull of a set $S = \{T_1, T_2, T_3, \ldots, T_n\}$ of $n$ right-angled triangles. Each triangle $T_i (i = 1, 2, \ldots, n)$ is defined by three vertices, namely $A_i, B_i, C_i$, such that the following conditions are simultaneously satisfied: (i) $B_i$ is a $90^0$ vertex lying on the $x$-axis; (ii) the edge $A_iB_i$ is horizontal; and (iii) the edge $B_iC_i$ is vertical. State and justify its time complexity. (15)