Indian Institute of Technology, Kharagpur
Computer Science and Engineering Department

Spring Semester Examination: 2011-2012
COMPUTER GRAPHICS (CS 43004/CS 43302/CS 60012)

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

1. Attempt Question 1 (40 marks) and any three ($20 \times 3 = 60$ marks) from the rest.
2. All parts of a particular question should be answered together.
3. Credits will be given for neat and to-the-point answering.

1. (a) Suggest a procedure to plot $y = a \sin x (x \in [0, 2\pi])$ as a digital curve connected in 8-neighborhood.
   (b) Differentiate between parametric continuity and geometric continuity for a cubic curve with proper examples.
   (c) How many vanishning points can exist for a regular hexagonal prism? Explain with theoretical justification and proper diagram. (A hexagonal prism has two regular hexagonal faces connected by six identical rectangles.)
   (d) Distinguish between diffuse reflection and specular reflection w.r.t. their theoretical foundation and practical significance.
   (e) Prove or disprove: "Intersection of two 3D convex polyhedrons is always convex". ($8 \times 5 = 40$)

2. A hexagon $abcdef$ has $a = (0,0), b = (2,1), c = (3,0), d = (5,5), e = (3,2), f = (1,3)$. Demonstrate the filling algorithm on it using edge tables.

3. Explain parametric line clipping with proper demonstration on suitable examples. Compare its performance for a rectangular clip window with the Cohen-Sutherland algorithm based on region codes.

4. Suggest an algorithm to triangulate a (thin and hollow) cylinder C of radius r and length l. The maximum distance $d(T, C)$ of each triangle T from C should be less than a given value, δ.
   Note that $d(T, C) < \delta$ if and only if for any point $p(x, y) \in T$, there exists some point $p'(x', y') \in C$ such that $(x - x')^2 + (y - y')^2 < \delta^2$.

5. The file `a.obj` contains:
   (i) vertex info: index and 3D coordinates of each vertex;
   (ii) face info: index of each face and indices of verices describing the face.
   Each face in `a.obj` is triangular, and there are some adjacent faces which are coplanar.
   Suggest a procedure that reports each *maximal subset S of coplanar faces* in `a.obj`.
   Note:

   (c1) S should contain at least two faces.
   (c2) For each face $f \in S$, there exists some other face $f' \in S$ such that f and f' are coplanar and adjacent (i.e., share a common edge).
   (c3) There is no face f'' which is coplanar and adjacent to some face $f \in S$ but does not belong to S (thus S is maximal).