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| Babu Banarasi Das National Institute of Technology & Management, Lucknow. **Department of Computer Science & Engineering**  Computational Geometry Ist Sessional Test 2011-12 (ECS042)  CSE Final Year  MM:100 TT:3H  Note: Attempt all questions, each question carry equal marks. |
| **Q1. Attempt any Four Parts: (5X4)** |
| **(a)** Differentiate classical & computational geometry. |
| **(b)** Discuss convex & concave in context of Computational Geometry. |
| (c) Discuss two fields of application of computational geometry highlighting why classical geometry can’t be applied in such field? |
| (d) Define convex hull. Determine convex hull with an example. |
| (e) Explain Jarvis’s march for convex hull with help of a suitable example. |
| (f) Define Voronoi Diagram. Prove this lemma: The only way in which a new arc can appear on the beach line is through a site event. |

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| **Q2. Attempt any Four Parts: (5X4)** |
| **(a)** Discuss Algorithm SLOWCONVEXHULL(P) where  *Input:* A set *P* of points in the plane.  *Output:* A list L containing the vertices of CH(*P*) in clockwise order.  Also discuss its time complexity. |
| **(b)**Discuss the incremental algorithm of CONVEXHULL(P). Also discuss its time complexity. |
| (c) Prove that The convex hull of a set of n points in the plane can be computed in O(nlogn) time. |
| (d)Discuss the Application Domain of CG in Robotics, and Geographic information systems. |
| (e) Discuss the Plane Sweep Algorithm VORONOIDIAGRAM(P), in detail, also discuss its time complexity. |
| (f) Prove the following:i) Theorem: Every simple polygon admits a triangulation, and any triangulation of a simple polygon with n vertices consists of exactly n−2 triangles.ii) Art Gallery Theorem: For a simple polygon with n vertices, n/3 cameras are occasionally necessary and always sufficient to have every point in the polygon visible from at least one of the cameras. |

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| **Q3. Attempt any Four Parts: (5X4)** |
| (a) Discuss “Arrangements of Lines as Geometric Structure”; Also calculate the cost of adding a line to a set of Lines. |
| (b)Prove Theorem (Zone Theorem): Let M be any set of m lines in the plane. For any line S  M, the size of the zone of S in H(M) is O(m). In other words, the total face-length of all faces in H(M) intersecting S is O(m). |
| (c) Discuss Trapezoidal Decompositions in range queries. |
| (d) Given a set N of half-spaces, construct the facial lattice of the convex polytope formed by them. |
| Discuss arrangements of hyper planes. |
| Discuss Partitioning a Polygon into Monotone Pieces and Triangulating a Monotone Polygon. |

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| **Q4. Attempt any Two Parts: ( 10 X 2 )** |
| (a) Discuss Fortune’s Sweep algorithm for Voronoi diagrams, with its time complexity. |
| (b) Prove the following:  i) Theorem: Every simple polygon admits a triangulation, and any triangulation of a simple polygon with n vertices consists of exactly n−2 triangles.  ii) Art Gallery Theorem: For a simple polygon with n vertices, n/3 cameras are occasionally necessary and always sufficient to have every point in the polygon visible from at least one of the cameras.. |
| (c) What are sweep techniques? Discuss: i) Plane sweep for segment intersections.  ii) Topological sweep for line arrangements. |

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| **Q5.** **Write short notes on any Four: ( 5 X 4 )** |
| (a)Trapezoidal Decompositions in range queries. |
| (b)Ham-Sandwich cuts. |
| (c) Min-Max angle properties of Voronoi diagrams. |
| (d) Linear programming with prune and search. |
| (e) Fractional Cascading. |
| (f) Visibility: Weak & Strong, Reflections. |
| (g) Concatnable queues |