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**CSX438** **COMPUTATIONAL GEOMETRY**

**L-T-P-Cr: 3-0-0-3**

**Pre-requisites:** Basic engineering mathematics and graph theory.

**Objectives/Overview:**

The course covers lessons in Introduction using Basic Visibility Problems , The Maximal Points Problem , The Plane Sweep Technique and applications ,Convex Hull Different Paradigms and Quick hull , Dual Transformation and Applications , Lower Bounds on Algebraic tree model , Point Location and Triangulation , Voronoi Diagram and Delaunay , etc.

**Course Outcomes:**

At the end of the course, a student should able to:

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| S.No | Course Outcome | Mapping to POs |
| 1 | Understand geometric preliminaries and convex hull algorithms | PO1, PO3, |
| 2 | Inspect the data structures for storing and searching high dimensional data | PO1, PO3, |
| 3 | Identify segments in polygons. | PO1, PO2, PO3, |
| 4 | Develop solutions for art gallery problems. | PO1, PO2, PO5, PO6, PO11 |

**UNIT I: Introduction Lectures: 10**

Geometry basics - 2D convex hulls: Types of polygons: convex, star, monotone, simple, holes, Convex hull properties, Euler’s formula for planar subdivisions, Data structure for planar subdivision.

Line and segment intersection - Sweep line algorithm, Boolean polygon operations: intersection, union, difference, convex polygon intersection; polygon tangents.

**UNIT II: Orthogonal Range Searching Lectures: 8**

1-Dimensional Range Searching, Kd-Trees, Range Trees, Higher-dimensional Range Trees.

**UNIT III: Triangulaions and Voronoi Diagrams Lectures: 10**

Triangulations: Triangulation theory – dual graph, diagonals, Monotone polygon triangulation, Simple polygon partition into monotone polygons, Trapezoidal partition.

Voronoi diagrams - Definitions, basic properties, Incremental construction, Sweep line algorithm – in detail, Divide and conquer, VD variations and extensions.

**UNIT IV: Problems and Algorithms Lectures: 12**

Art-gallery problems. Arrangements of lines: 2d arrangements, zone theorem, many-faces complexity, algorithms. Sweep techniques: plane sweep for segment intersections, Fortune s sweep for Voronoi diagrams, topological sweep for line arrangements.

**Text/Reference Books:**

1. Mark de Berg, Otfried Schwarzkopf, Marc van Kreveld and Mark Overmars, Computational Geometry: Algorithms and Applications, Springer.
2. Lecture Notes by David Mount.
3. F. P. Preparata and Michael I. Shamos, Computational Geometry: An Introduction, Springer.
4. Joseph O Rourke, Computational Geometry in C, Cambridge University Press.