

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME I Year Information Technology (Sp. Information Security) Semester- A			
Subject Code & Name	Instructions Hours per Week			Credits			
ISP1C1: Advanced Algorithms	L	T	P	L	T	P	Total
Duration of Theory Paper: 3 Hours	3	1	2	3	1	1	5

Course Objective:

To introduce students a variety of advanced techniques, methods and results from the rapidly-developing field of algorithms to solve problems. To familiarise the state of the art in some areas of algorithmic research, including open problems.

COURSE CONTENT

Unit I

Review of basic concepts; Worst case and average case analysis, Asymptotic notation, Solving recurrence equations, Medians and order statistics, Advanced data structures: Binomial Heaps, Fibonacci Heaps, Data Structures for Disjoint Sets – Disjoint-set operations, Linked-list representation of disjoint sets, Disjoint-set forests, analysis of union by rank with path compression.

Unit II

Advanced Design and Analysis techniques: Greedy and Dynamic Programming strategies, Backtracking, Branch and Bound. Algorithms for Knapsack problems, Matrix-Chain Multiplication problem, Travelling Salesperson Problem (TSP), etc. Amortized analysis: the aggregate method, the accounting method, the potential method, Dynamic tables.

Unit III

Graph algorithms: Breadth-first search, Depth-first search, Topological sorting, Minimum Spanning Trees, Single-Source Shortest Paths, All-Pairs Shortest Paths, Maximum Flows: Augmenting Paths and Push-Relabel Methods, Minimum Cost Flows, Bipartite Matching.

Unit IV

Graph algorithms: Breadth-first search, Depth-first search, Topological sorting, Minimum Spanning Trees, Single-Source Shortest Paths, All-Pairs Shortest Paths, Maximum Flows: Augmenting Paths and Push-Relabel Methods, Minimum Cost Flows, Bipartite Matching.

Unit V

Theory of NP-Hard and NP-Complete Problems: P, NP and NP-Complete complexity classes; A few NP-Completeness proofs; other complexity classes.

Dealing with intractability: Introduction, Combinatorial Optimization, approximation factor, PTAS, FPTAS, Approximation algorithms for vertex cover, set cover, TSP, knapsack, bin packing, subset-sum problem etc. Analysis of the expected time complexity of the algorithms.

Text and Reference books:

- [1] T. Cormen, C. Leiserson, R. Rivest, and C. Stein. Introduction to Algorithms. (3rd Ed). MIT Press, McGraw-Hill, 2010.
- [2] M.T. Goodrich, R. Tamassia, “Algorithm design – Foundations, Analysis, and Internet Examples”, John Wiley, Second Edition.
- [3] V. V. Vazirani, Approximation Algorithms, Springer. 2001.
- [4] Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, Network Flows: Theory, Algorithms, and Applications,
- [5] E Horowitz, S salmi, S Rajasekaran, “Fundamentals of Computer Algorithms”, Second Edition, University Press, 2007.
- [6] Aho, A V Hopcraft Ullman JD, “The Design and analysis of computer Algorithms”, Pearson Education, 2007.