ADVANCED ALGORITHMS

III Semester: CSE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCSC27	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course covers some of the general-purpose data structures and algorithms, and software development. It includes managing complexity, analysis, lists, stacks, queues, trees, graphs, balanced search trees and hashing mechanisms. This course is to how to select and design data structures and algorithms that are appropriate for problems that they might encounter in real life.

II COURSE OBJECTIVES:

The students will try to learn:

I. The advanced methods of designing and analyzing algorithms.
II. The methodology to choose appropriate algorithms and use it for a specific problem.
III. The different classes of problems concerning their computation difficulties.
IV. The recent developments in the area of algorithmic design.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO 1	Make use of recursive algorithm design technique in appropriate contexts	Apply
CO 2	Design and implement linked lists, stacks and queues in Python	Understand
CO 3	Calculate linear programming using Approximation and Randomized algorithm	Apply
CO 4	Experiment flow-networks and matrix computation using strassen's algorithm	Apply
CO 5	Calculate the algorithm complexity using time/space analysis	Apply

IV. SYLLABUS:

MODULE-I: GRAPH ALGORITHMS (09)

Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

MODULE-II: MATROIDS ANDGRAPH MATCHING (09)

Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. Algorithm to compute maximum matching. Characterization of maximum matching by augmentingpaths, Edmond's Blossom algorithm to compute augmenting path.

MODULE-III: FLOW-NETWORKS AND MATRIX COMPUTATIONS (09)

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximumflow algorithm.

Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

MODULE-IV: SHORTEST PATH IN GRAPHS (09)

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm.

MODULE-V: LINEAR PROGRAMMING (09)

Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest: Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

V. TEXT BOOKS:

1. Aho, Hopcroft, “The Design and Analysis of Computer Algorithms”, Ullman.Addison-Wesley Series in Computer Science and Information Processing, 1974.

VI. REFERENCE BOOKS:

1. Cormen, Leiserson, Rivest, Stein, "Introduction to Algorithms",MIT Press, 1989.

VII WEB REFERENCES:

1. https://www.coursera.org/learn/advanced-algorithms-and-complexity
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-854j-advanced-algorithms-fall-2005/

VIII. E-TEXTBOOKS

1. https://people.seas.harvard.edu/~cs224/fall14/index.html