SILVER OAK UNIVERSITY

College of Technology

Bachelor of Technology

Information Technology

Course Name: Analysis and Design of Algorithms

Course Code: 1010043316

Semester:5th

Prerequisite:

Basic Knowledge of Programming (C or C++), Data and file structure

Course Objectives:

1. Teaching to analyze the asymptotic performance of algorithms will be prioritized.
2. Major algorithm design techniques will be demonstrated and Important algorithmic design paradigms and analysis methods will be taught.
3. Simple to moderately difficult algorithmic problems in applications will be taught to solve effectively and The hardness of simple NP-complete problems will be convincingly demonstrated.

Teaching Scheme:

Teaching Scheme				
L	T	P	Contact Hours	Credit
4	0	2	6	5

Contents:

Unit	Topics	Teaching Hours	Weightage %
1	**Basics of Algorithms , Mathematics and Analysis of Algorithm :** What is an algorithm?, Properties of Algorithm, Time and Space Complexity, detailed analysis of algorithm, Mathematics for Algorithmic Sets, Functions and Relations, Vectors and Matrices, Linear Inequalities and Linear Equations. The efficient algorithm, Average, Best and worst-case analysis, Amortized analysis , Asymptotic Notations(Big-O, Big-Ω and Big-Θ Notations their Geometrical Interpretation and Examples.), Recurrences: Recursive Algorithms and Recurrence Relations, Solving Recurrences, Analyzing control statement, Loop invariant and the correctness of the algorithm, Sorting Algorithms and analysis: Bubble sort, Selection sort, Insertion sort, Shell sort Heap sort, Sorting in linear time: Bucket sort, Radix sort and Counting sort	14	23
2	**Divide and Conquer Algorithm:** Introduction, Recurrence and different methods to solve recurrence, Multiplying large Integers Problem, Problem Solving using divide and conquer algorithm - Binary Search, Max-Min problem, Sorting (Merge Sort, Quick Sort), Matrix Multiplication, Exponential	8	15

3	**Problem solving using Dynamic Programming and Greedy Algorithm:** Dynamic Programming : Introduction, The Principle of Optimality, Problem Solving using Dynamic Programming – Calculating the Binomial Coefficient, Making Change Problem, Assembly LineScheduling, Knapsack problem, All Points Shortest path, Matrix chain multiplication, Longest Common Subsequence. Greedy Algorithm : General Characteristics of greedy algorithms, Problem solving using Greedy Algorithm - Activity selection problem, Elements of Greedy Strategy, Minimum Spanning trees (Kruskal's algorithm, Prim's algorithm), Graphs: Shortest paths, The Knapsack Problem, Job Scheduling Problem, Huffman code	14	30
4	**Exploring Graphs:** An introduction using graphs and games, Undirected Graph, Directed Graph, Traversing Graphs, Depth First Search, Breath First Search, Topological sort, Connected components	6	10
5	**Backtracking and Branch and Bound:** Introduction, The Eight queens problem , Knapsack problem, Travelling Salesman problem, Minimax principle	4	10
6	**String Matching:** Introduction, The naive string matching algorithm, TheRabinKarp algorithm, String Matching with finite automata, The Knuth-Morris-Pratt algorithm.	4	5
7	**Introduction to NP-Completeness:** The class P and NP, Polynomial reduction, NP- Completeness Problem, NP-Hard Problems. Traveling Salesman problem, Hamiltonian problem, Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE	5	7

Course Outcomes:

Sr. No.	CO Statement	Unit
CO-1	Analyze the asymptotic performance of algorithms.	1
CO-2	Assess recurrences describing the performance of divide-and-conquer algorithms.	2
CO-3	Demonstrate the optimal solution using a range of methods.	3
CO-4	Explain the major graph algorithms, their analyses and model engineering problems, when appropriate.	4,5
CO-5	Apply pattern matching algorithms to find particular patterns.	6
CO-6	Differentiate polynomial and nonpolynomial problems..	7

Teaching & Learning Methodology:

The various methods or tools follows by the faculties to teach the above subject are:

1. The course includes a laboratory, where students get the opportunity to practically apply the theoretical knowledge they have acquired in the lectures.
2. Lectures with attractive PowerPoint presentations

3. Different experiments shall be carried out during the practical sessions.
4. Model based learning

List of Tutorials: Total Hours: 28

Sr. No.	Practical Name
1	Implementation and Time analysis of sorting algorithms. Bubble sort, Selection sort, Insertion sort, Merge sort and Quicksort
2	Implementation and Time analysis of linear and binary search algorithms.
3	Implementation of max-heap sort algorithm
4	Implementation and Time analysis of factorial program using iterative and recursive method
5	Implementation of a knapsack problem using dynamic programming.
6	Implementation of chain matrix multiplication using dynamic programming.
7	Implementation of making a change problem using dynamic programming
8	Implementation of a knapsack problem using greedy algorithm
9	Implementation of Graph and Searching (DFS and BFS).
10	Implement prim's algorithm
11	Implement kruskal's algorithm
12	Implement the LCS problem.

Major Equipment/ Instrument(Software/Hardware):

Computers with latest software configuration, Turbo C

Books Recommended:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivestand Clifford Stein, "Introduction to Algorithms", PHI.
2. E. Horowitz et al., "Fundamentals of Algorithms",W. H. Freeman and Company.
3. Gills Brassard, Paul Bratley, "Fundamental of Algorithms" by PHI.
4. Anany Levitin, "Introduction to Design and Analysis of Algorithms", Pearson.
5. Shailesh R Sathe, "Foundations of Algorithms", Penram
6. Dave and Dave, "Design and Analysis of Algorithms", Pearson.

List of Open-Source Software/learning website:

1. http://www.coursera.org/
2. http://silveroakuni.ac.in/video-lecture
3. https://nptel.ac.in/

CO-PO-PSO Matrix:

Co. No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	2	2	2	2					1				1	2
CO-2	3	3	3	3					1			2	1	2
CO-3	3	3	3	3					1			2	3	2
CO-4	3	3	3	3					1			2	1	2
CO-5	2	3	2	3					1			2	2	2
CO-6	2	2	2	3					1				1	1