



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering Syllabus

Subject Code : 3164503

Subject Name : Analysis and Design of Algorithms

WEF Academic Year :	2021 - 22
Semester :	6
Category of the Course :	Professional Elective

<b>Prerequisite :</b>	<b>Programming (C or C++), Data Structures</b>
<b>Rationale :</b>	Obtaining efficient algorithms is very important in modern computer engineering as the world wants applications to be time and space and energy efficient. This course enables to understand, analyze and design efficient algorithms for various applications.

## Course Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

## Course Content :

Sr. No.	Course Content	No. of Hours	% of Weightage
1	<b>Basics of Algorithms and Analysis of Algorithm :</b> What is an algorithm? Why to Analyse Algorithms? The efficient algorithm, Average, Best and Worst case analysis, Asymptotic Notations, Analysing control statement, Loop invariant and the correctness of the algorithm, Recurrence (Master Theorem only) Sorting Algorithms and analysis: Bubble sort, Selection sort, Insertion sort, Heap sort, Sorting in linear time : Bucket sort, Radix sort and Counting sort.	9	20
2	<b>Divide and Conquer Algorithm :</b> Introduction, Multiplying large Integers Problem, Problem Solving using divide and conquer algorithm - Binary Search, Max-Min problem, Sorting (Merge Sort, Quick Sort), Matrix Multiplication, Exponential.	7	15



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3	<b>Dynamic Programming :</b> Introduction, The Principle of Optimality, Problem Solving using Dynamic Programming – Calculating the Binomial Coefficient, Making Change Problem, Assembly Line-Scheduling, Knapsack problem, All Points Shortest path, Matrix chain multiplication, Longest Common Subsequence.	8	20
4	<b>Greedy Algorithm :</b> General Characteristics of greedy algorithms, Problem solving using Greedy Algorithm, Elements of Greedy Strategy, Minimum Spanning trees (Kruskal's algorithm, Prim's algorithm), Graphs: Shortest paths, The Knapsack Problem, Job Scheduling Problem.	8	20
5	<b>Exploring Graphs, Backtracking Technique :</b> An introduction using graphs and games, Undirected Graph, Directed Graph, Traversing Graphs, Depth First Search, Breath First Search, Topological sort, Connected components, Backtracking: Introduction, The Eight queens problem.	6	15
6	<b>Introduction to NP-Completeness :</b> The class P and NP, Polynomial reduction, NP- Completeness Problem, NP-Hard Problems. Approximation algorithms.	4	10
	<b>Total</b>	<b>42</b>	<b>100</b>

## Reference Books :

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, PHI.
2. Fundamental of Algorithms by Gills Brassard, Paul Bratley, PHI.
3. Introduction to Design and Analysis of Algorithms, Anany Levitin, Pearson.
4. Foundations of Algorithms, Shailesh R Sathe, Penram.
5. Design and Analysis of Algorithms, Dave and Dave, Pearson.



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## Course Outcome :

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level*
01	Understand Algorithms, Design and Analyze the asymptotic performance of algorithms. Understand P and NP Problems.	UN, AP,AN
02	Derive and solve recurrences describing the performance of divide-and-conquer algorithms.	UN,AP,AN
03	Find optimal solution by applying various methods like Dynamic Programming, Greedy Algorithms, Graph Algorithms etc.	AN,EL,CR

\*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

## Suggested Course Practical List :

1. Implementation and Time analysis of sorting algorithms.  
Bubble Sort, Selection Sort, Insertion Sort, Merge Sort and Quick Sort.
2. Implementation and Time analysis of Linear and Binary Search algorithm.
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 Traversing Methods (DFS and BFS).
10. Implement Prim's algorithm for finding Minimum Spanning Tree.
11. Implement Kruskal's algorithm for finding Minimum Spanning Tree.
12. Implement LCS problem.

## List of Laboratory/Learning Resources Required :

- Computer Laboratory

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