



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Computer Applications

Level: Post Graduate

Course / Subject Code : MC03094011

Course / Subject Name : Design and Analysis of Algorithms

w. e. f. Academic Year:	2025-26
Semester:	3
Category of the Course:	Core Courses

<b>Prerequisite:</b>	Data Structure, C Programming Language.
<b>Rationale:</b>	The course intends to introduce the concepts of artificial intelligence and its applications. The course provides the opportunities for the learner to learn the artificial intelligence based basic methods and algorithms. This course also covers the knowledge representation and reasoning that help the learners to develop the intelligent systems

### Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Analyze the time and space complexity of algorithms and evaluate the growth of functions.	AN
02	Apply suitable algorithm design methodologies such as divide-and-conquer and randomized algorithms to solve problems.	AP
03	Design efficient solutions using the principles and elements of dynamic programming.	CR
04	Develop algorithms using greedy methods and implement solutions for minimum spanning trees and shortest paths.	AP
05	Solve complex computational problems using backtracking and branch-and-bound strategies.	AP

\*Revised Bloom's Taxonomy (RBT)

### Teaching and Examination Scheme:

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

### Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	<b>Introduction:</b> Role of Algorithms in Computing, Algorithms, Algorithms as a technology, Insertion sort, Analyzing algorithms, Designing algorithms,	5	10



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	Growth of Functions: Asymptotic notation, Standard notations and common functions.		
2.	<b>Algorithms using Divide-and-Conquer, Probabilistic Analysis and Randomized Algorithms:</b> The maximum-subarray problem, Strassen’s algorithm for matrix multiplication, The substitution method for solving recurrences, The recursion-tree method for solving recurrences, The master method for solving recurrences The hiring problem, Indicator random variables, Randomized algorithms.	9	20
3.	<b>Dynamic Programming:</b> Rod cutting, Matrix-chain multiplication, Elements of dynamic programming, Longest common subsequence, Optimal binary search trees.	11	25
4.	<b>Greedy Algorithms Minimum Spanning Trees and Single-Source Shortest Paths:</b> Example—Knapsack Problem, Job Sequencing with Deadlines, An activity-selection problem, Elements of the greedy strategy Growing a minimum spanning tree, The algorithms of Kruskal and Prim, The Bellman-Ford algorithm, Single-source shortest paths in directed acyclic graphs, Dijkstra’s algorithm	10	25
5.	<b>Backtracking, Branch and Bound Algorithms:</b> BFS, DFS, 8-Queen problem, M-Coloring problem, Hamiltonian circuits; <b>Branch-and-Bound algorithms:</b> Examples: Shortest path; 16-Puzzle and 8-Puzzle, 0/1 Knapsack problem, Traveling salesman problem; Limitations of Branch-and-Bound	10	20
<b>Total</b>		<b>45</b>	<b>100</b>

### Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	30	20	10	10

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom’s Taxonomy)

### References/Suggested Learning Resources:

#### (a) Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein, Introduction to Algorithms, Third Edition, MIT Press (2009).
2. Parag H Dave, Himanshu B Dave, Design and Analysis of Algorithms Pearson (2014) Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran Fundamentals of Computer Algorithms Universities Press (2008)
3. S. Baase, Computer Algorithms: Introduction to Design and Analysis, Pearson (2002)



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4. Aho, Hopcroft, and Ullman, The Design and Analysis of Computer Algorithms Addison Wesley
5. Kleinberg Algorithm Design, Pearson (2013)

**(b) Open source software and website:**

1. <https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/>
2. [https://onlinecourses.nptel.ac.in/noc19\\_cs47/preview](https://onlinecourses.nptel.ac.in/noc19_cs47/preview)
3. <https://www.w3schools.com/dsa/>

**Suggested Practical List, if any:**

List of Mandatory Lab Exercises (Write Algorithms and Implement in C/C++ Language) for the following problems, students are expected to write one or more (as the case may be) algorithms along with the complexity of these algorithms, and implement them in C/C++ Language.

1. Find square root of a number. Can we use Divide & Conquer approach for this problem?
2. Determine smallest divisor of an integer.
3. For a given value of n, generate prime numbers  $\leq n$  (more than one algorithms are possible)
4. Find  $X^n$ . Iterative and recursive algorithms are possible.
5. Find Factorial of n. Iterative and recursive algorithms are possible.
6. Generate Fibonacci series up to n terms Iterative and recursive algorithms are possible.
7. Program for finding maximum and minimum number using Divide and conquer.
8. Implement Recursive Binary search and Linear search and determine the time taken to search an element.
9. Sort a given sequence of numbers using (a) Bubble Sort, and (b) Merge Sort
10. Generate permutations of given n numbers. Iterative and recursive algorithms are possible.
11. Implement Strassen's algorithm for matrix multiplication
12. Implement knapsack using greedy algorithm.
13. Implement Matrix multiplication using Dynamic Programming algorithm.
14. Implement Rod-cutting problem using Dynamic Programming algorithm.
15. Implement LCS using Dynamic Programming algorithm.
16. Breadth First Search (BFS) in a binary tree.
17. Depth First Search (DFS) in a binary tree.
18. Prim's algorithm to find minimum cost tree (shortest path in a tree).
19. Kruskal's algorithm to find minimum cost tree (shortest path in a tree).
20. Implement Bellman-Ford Single Source Shortest Path Algorithm

**Suggested Activities for Students, if any:**

- ICT enabled Classroom teaching
- Case study
- Practical / live assignment
- Interactive class room discussions



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## CO- PO Mapping:

Semester 3	Design and Analysis of Algorithms							
	POs							
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-

Legend: '3' for high, '2' for medium, '1' for low and '-' for no correlation of each CO with PO.

Note: The CO-PO mapping is indicative; the institute/faculty member can change as required.

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