



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name : Bachelor of Computer Applications

Level: UG

Course / Subject Code: BC04001011

Course / Subject Name : Design and Analysis of Algorithms

w. e. f. Academic Year:	2025-26
Semester:	4
Category of the Course:	Core Course (CC)

Prerequisite:	Data Structure, C Programming Language.
Rationale:	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 algorithms by working out for time and space complexity of algorithms, design algorithm and growth of functions.	N C
02	Identify algorithm design methodology to solve problems. Analyze divide-and-conquer, probabilistic analysis and randomized algorithms.	U N
03	Understand dynamic programming, its elements and analyze existing algorithm of dynamic programming.	U N
04	Understand concept of greedy algorithms, analyze amortized analysis and time complexity	U N
05	Understand the concept of minimum spanning trees and apply the knowledge to design algorithm for shortest paths	U A C

*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)	
03	00	02	4	70	30	20	30	150



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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction: Role of Algorithms in Computing: Algorithms, Algorithms as a technology, Insertion sort, Analyzing algorithms, Designing algorithms, Growth of Functions: Asymptotic notation, Standard notations and common functions.	6	10
2.	Algorithms using Divide-and-Conquer, Probabilistic Analysis and Randomized Algorithms: 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	9	15
3.	Dynamic Programming: Rod cutting, Matrix-chain multiplication, Elements of dynamic programming, Longest common subsequence, Optimal binary search trees.	8	12
4.	Greedy Algorithms : Example—Knapsack Problem, Job Sequencing with Deadlines, An activity-selection problem, Elements of the greedy strategy, Huffman codes. Minimum Spanning Trees and Single-Source Shortest Paths: 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	15
5.	Backtracking, Branch and Bound Algorithms: BFS, DFS, 8-Queen problem, M-Coloring problem, Hamiltonian circuits; Branch-and-Bound algorithms: Examples: Shortest path; 16-Puzzle and 8-Puzzle, 0/1 Knapsack problem, Traveling salesman problem	12	18
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
0	30	10	40	0	20

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



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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). (Main Reference Book 1)
2. Parag H Dave, Himanshu B Dave, Design and Analysis of Algorithms Pearson (2014) (Main Reference Book 2)
3. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran Fundamentals of Computer Algorithms Universities Press (2008)
4. S. Baase, Computer Algorithms: Introduction to Design and Analysis, Pearson (2002)
5. Aho, Hopcroft, and Ullman, The Design and Analysis of Computer Algorithms Addison Wesley
6. 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
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. Determine smallest divisor of an integer.
2. For a given value of n, generate prime numbers $\leq n$ (more than one algorithms are possible)
3. Find X^n . Iterative and recursive algorithms are possible.
4. Find Factorial of n. Iterative and recursive algorithms are possible.
5. Program for finding maximum and minimum number using Divide and conquer.
6. Implement Recursive Binary search and Linear search and determine the time taken to search an element.
7. Sort a given sequence of numbers using (a) Bubble Sort, and (b) Merge Sort
8. Implement knapsack using greedy algorithm.
9. Implement Rod-cutting problem using Dynamic Programming algorithm.
10. Implement LCS using Dynamic Programming algorithm.
11. Prim's algorithm to find minimum cost tree (shortest path in a tree).
12. Kruskal's algorithm to find minimum cost tree (shortest path in a tree).
13. Implement Bellman-Ford Single Source Shortest Path Algorithm
14. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm



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Suggested Activities for Students, if any:

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

CO- PO Mapping:

Semester 4	Course Name : Design and Analysis of Algorithms							
	POs							
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	1	1	1	1	1	2
CO2	3	3	3	3	1	1	1	2
CO3	3	3	2	2	1	2	1	2
CO4	3	3	3	2	1	1	1	2
CO5	3	3	3	2	1	1	1	2

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

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