MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

MUST KNOW CONCEPTS | MKC

CSE | **2020-21**

Course Code & Course Name : 19CSC11 & Design and Analysis of Algorithm

Year/Sem/Sec : II/IV A&B

S.No.	Term	Notation (Symbol)	Concept / Definition / Meaning / Units / Equation / Expression	Units
Unit-I : INTRODUCTION				
1.	Algorithm		Sequence of instructions for solving a problem	
2.	pseudo code		Mixture of a natural language and programming language	
3.	Time efficiency		How much amount of time needed to execute	
4.	Space efficiency		How much amount of space needed to execute	
5.	Exact Algorithm		Solving the problem exactly	
6.	Approximate Algorithm		solving it approximately	
7.	sorting problem		Rearrange the items of a given list in non decreasing order	
8.	searching problem		Finding a given value,	
9.	Analysis Framework		1.Measuring an Input's Size 2. Units for Measuring Running Time 3. Orders of Growth 4. Worst-Case, Best-Case, and Average-Case Efficiencies 5. Recapitulation of the Analysis Framework	
10.	O-notation		$t(n) \le cg(n)$ for all $n \ge n0$.	
11.	Ω-notation		$t(n) \ge cg(n)$ for all $n \ge n_0$.	
12.	ϴ -notation		$c_2 g(n) \le t(n) \le c_1 g(n)$ for all $n \ge n_0$.	
13.	Asymptotic Notations		• O-notation	

			• Omega -notation • ɵ -notation	
14.	Fundamental Data Structures		• Linear Data Structures • Graphs • Trees	
15.	Vertices		a collection of points	
16.	Edges		A collection of points connected by line segments	
17.	Characteristics of Algorithm		Simplicity, Time consuming, easy to understand, generality.	
18.	Methods specifying for an algorithm		Flow chart, Natural language, Program	
19.	Understanding the Problem		It is the first step in solving the problem	
20.	The main measure for efficiency algorithm are		Time and space	
21.	Algorithmic analysis count		The number of arithmetic and the operations that are required to run the program	
22.	The concept of order Big O is important because		It can be used to decide the best algorithm that solves a given problem	
23.	Non-recursive function		Does not references itself	
24.	Recursive function		Function which calls itself again and again	
25.	What are the case does exist in complexity theory		Best case,Worst case,Average case	
Unit-II : BACKTRACKING				
26.	Disjoint Operations		A disjoint-set data structure is a data structure that keeps track of a set of elements partitioned into a number of disjoint (non-overlapping) subsets.	

27.	Two Operations of Disjoint set		Find Union	
28.	Find		Determine which subset a particular element is in. This can be used for determining if two elements are in the same subset.	
29.	Union		Join two subsets into a single subset.	
30.	Graph		A Graph consists of a finite set of vertices(or nodes) and set of Edges which connect a pair of nodes	
31.	Spanning tree		A spanning tree is a sub-graph of an undirected connected graph, which includes all the vertices of the graph with a minimum possible number of edges.	
32.	Minimum Spanning Tree		A minimum spanning tree is a spanning tree in which the sum of the weight of the edges is as minimum as possible.	
33.	The minimum spanning tree from a graph is found using the following algorithms:		1.Prim's Algorithm 2.Kruskal's Algorithm	
34.	Hamiltonian circuit		A cycle that passes through all the vertices of the graph exactly once.	
35.	Eight-queens problem		Classic puzzle of placing eight queens on an 8 × 8 chessboard	
36.	Spanning Tree Applications		Computer Network Routing Protocol Cluster Analysis Civil Network Planning	
37.	Subset Problem		Subset sum problem is to find subset of elements that are selected from a given set whose sum adds up to a given number	
38.	Divide and Conquer method		Smaller sub problems, sub problems are solved recursively	
39.	Applications of divide and conquer		Binary search, quick sort, merge sort, multiplication of large integers	
40.	Backtracking		Depth-first node generation with bounding method.	

41.	Backtracking applications		Electrical engineering, Robotics, Artificial Intelligence, Network communication	
42.	Application of Graphs:		Physics and Chemistry, Mathematics, Social Science	
43.	Mid value in binary search		mid = (low + high) /2, low-0^{th} value and high-last value	
44.	Which method used to find Hamiltonian circuit		Backtracking	
45.	N - Queens problem		The problem is to area n-queens on an n-by-n chessboard so that no two queens charge each other by being same row or in the same column or the same diagonal.	
46.	Hamiltonian cycle		A Hamiltonian cycle is a closed loop on a graph where every node (vertex) is visited exactly once.	
47.	vertex coloring.		t is a way of coloring the vertices of a graph such that no two adjacent vertices are of the same color; this is called a vertex coloring.	
48.	Binary search working		Binary search works by dividing the array into 2 halves around the middle element	
49.	Graph		Consists of a set of vertices, and set of edges	
50.	Graph types		BFS,DFS	
Unit-III : GREEDY METHOD				
51.	Greedy Method		Greedy Method is also used to get the optimal solution	
52.	Applications of Greedy Algorithms		Finding an optimal solution (Activity selection, Fractional Knapsack, Job Sequencing, Huffman Coding). 2. Finding close to the optimal solution for NP-Hard problems like TSP.	
53.	spanning tree		A spanning tree is a subset of an undirected Graph that has all the vertices connected by minimum number of edges	

54.	Warshalls algorithm		Solve all pair shortest path problem	
55.	Floyds algorithm		Find optimal solution	
56.	Greedy technique used in		Minimum spanning tree, shortest path problem	
57.	Examples of Greedy Algorithms		Prim's Minimal Spanning Tree Algorithm. Travelling Salesman Problem. Graph - Map Coloring. Kruskal's Minimal Spanning Tree Algorithm. Dijkstra's Minimal Spanning Tree Algorithm. Graph - Vertex Cover. Knapsack Problem. Job Scheduling Problem.	
58.	Assignment problem		Assign a number of jobs to an equal number of machines so as to minimize the total assignment cost for execution of all the jobs	
59.	single source shortest path algorithm		find minimum distance from source vertex to any other vertex	
60.	All pair shortest path algorithm		find all pair shortest path problem from a given weighted graph	
61.	Knapsack Problem		Given weights and values of n items, put these items in a knapsack of capacity W to get the maximum total value in the knapsack	
62.	applications of Knapsack problem:		Home Energy Management. Cognitive Radio Networks. Resource management in software.	
63.	job sequencing problem		find a sequence of jobs, which is completed within their deadlines and gives maximum profit.	
64.	Analysis for job sequencing problem		O(n2)	
65.	Minimum spanning tree		Minimum spanning tree is the spanning tree where the cost is minimum among all the spanning trees.	
66.	Single source shortest path problem		The single-source shortest path problem, in which we have to find shortest paths from a source vertex v to all other vertices in the graph.	

67.	single-source shortest path application		Dijkstra's algorithm is one of the most popular algorithms for solving many single-source shortest path problem	
68.	Time Complexity of Dijkstra's Algorithm		O (V 2)	
69.	Jobsequencing proble ms has the time complexity		O(n2)	
70.	Memory function		provides the smallest possible search time	
71.	Warshalls algorithm		Solve all pair shortest path problem	
72.	Floyds algorithm		Find optimal solution	
73.	Properties of spanning trees		A spanning tree does not have any cycle. Any vertex can be reached from any other vertex.	
74.	state-space tree		The processing of backtracking is resolved by constructing a tree of choices being made. This is known as state-space tree.	
75.	Knapsack problem		The knapsack problem is a problem in combinatorial optimization: Given a set of items, each with a weight and a value, determine the number of each item to include in a collection so that the total weight is less than or equal to a given limit and the total value is as large as possible.	
Unit-IV : DYNAMIC PROGRAMMING				
76.	Dynamic programming		Reduce the time complexity, provide optimal solution	
77.	Advantages of dynamic programming		Computing Fibonacci numbers, completing binomial coefficient	
78.	Applications of dynamic programming		Find shortest path between all pair of vertices	
79.	chained matrix multiplication		Given a sequence of matrices, find the most efficient way to multiply these matrices together.	
80.	chained matrix multiplication complexity		O (n3)	

81.	Optimal binary search trees		An optimal binary search tree, sometimes called a weight-balanced binary tree	
82.	Traveling sales person problem.		The Travelling Salesman Problem (TSP) is the challenge of finding the shortest yet most efficient route for a person to take given a list of specific destinations.	
83.	Reliability design		Reliability is the probability that a product will continue to work normally over a specified interval of time, under specified conditions	
84.	Optimization problem		To maximize or minimize some values.Ex: Finding the shortest path between two vertices in a graph.	
85.	Polynomial time algorithm.		For input size n, if worst-case time complexity of an algorithm is O(nk), where k is a constant	
86.	Optimal binary search trees complexity analysis		O (n3)	
87.	Floyd Warshall Algorithm		The problem is to find shortest distances between every pair of vertices in a given edge weighted directed Graph.	
88.	The most popular solutions to the Traveling Salesman Problem		The Brute-Force Approach The Branch and Bound Method The Nearest Neighbor Method	
89.	0/1 knapsack problem		put these items in a knapsack of capacity W to get the maximum total value in the knapsack	
90.	Dynamic programming		methods can be used to solve the matrix chain multiplication problem	
91.	Techniques in lower bound theory		• Comparisons Trees. • Oracle and adversary argument • State Space Method	
92.	Real-world TSP Applications		Google Map	

93.	Combinatorial optimization Problems		Combinatorial optimization is a subfield of mathematical optimization that is related to operations research, algorithm theory, and computational complexity theory	
94.	Maximum Flow problem		Maximum amount of flow that the network would allow to flow from source to sink.	
95.	Fundamental Data Structures		• Linear Data Structures • Graphs • Trees	
96.	Vertices		a collection of points	
97.	Edges		A collection of points connected by line segments	
98.	Characteristics of Algorithm		Simplicity, Time consuming, easy to understand, generality.	
99.	Methods specifying for an algorithm		Flow chart, Natural language, Program	
100	Recursive function		Function which calls itself again and again	
Unit-V : BRANCH AND BOUND&NP-HARD,NP-COMPLETE PROBLEMS				
101	P-class		Problems are solvable in polynomial time	
102	NP-class		Problems are verifiable in polynomial time.	
103	Branch and Bound applications		Knapsack Problem N-Queens Problem Traveling Salesman Problem	
104	class does a CNF-satisfiability problem		NP complete	
105	The choice of polynomial class has led to the development of an extensive theory called _________		computational complexity	
106	Travelling Sales man Problem	TSP	The problem is to find the shortest possible route.	
107	Branch and bound		It is generally used for solving combinatorial optimization problems.	

108	How many stages of procedure does a non-deterministic algorithm consist of?		2	
109	The worst-case efficiency of solving a problem in polynomial time is		O(p(n))	
110	Tractable		Problems that can be solved in polynomial time	
111	NP		the class of decision problems that can be solved by non-deterministic polynomial algorithms	
112	Un decidable problems		Problems that cannot be solved by any algorithm	
113	Example of un decidable problem		Halting problem	
114	Backtracking problem		To solve combinational problem, optimization problem, decision problem	
115	Applications of travelling sales man problem		planning, scheduling, logistics and packing	
116	Approximation problem		Near optimal solution for problem	
117	Examples for backtracking		Puzzles such as eight queens puzzle, crosswords, verbal arithmetic, Sudoku, and Peg Solitaire.	
118	Backtracking applications		Electrical engineering, Robotics, Artificial Intelligence, Network communication	
119	Backtracking technique used in		N Queens problem, sum of subset, Sudoku puzzle, Hamiltonian cycle	
120	NP hard problem		Algorithm for solving it can be translated into one for solving any NP-problem (nondeterministic polynomial time)	
121	2-approximation algorithm		Returns a solution whose cost is at most twice the optimal	
122	Examples of NP problem		integers, rearrange the numbers	

123	Base Bound Theory		Calculation of minimum time for execute a algorithm	
124	NP Hard problems		• The circuit-satisfiability problem • Set Cover • Vertex Cover • Travelling Salesman Problem	
125	NP complete problem		No polynomial time algorithm	
Placement Questions				
1	Three times the first of three consecutive odd integers is 3 more than twice the third. The third integer is:		Let the three integers be x, $x + 2$ and $x + 4$. Then, $3x = 2(x + 4) + 3 \Leftrightarrow x = 11$. $\therefore$ Third integer = $x + 4 = 15$.	
2	Look at this series: 7, 10, 8, 11, 9, 12, ...		This is a simple alternating addition and subtraction series. In the first pattern, 3 is added; in the second, 2 is subtracted.	
3	Look at this series: 22, 21, 23, 22, 24, 23, ….		In this simple alternating subtraction and addition series; 1 is subtracted, then 2 is added, and so on.	
4	Look at this series: 53, 53, 40, 40, 27, 27, ...		In this series, each number is repeated, then 13 is subtracted to arrive at the next number.	
5	Look at this series: 1.5, 2.3, 3.1, 3.9, ...		In this simple addition series, each number increases by 0.8.	
6	Three times the first of three consecutive odd integers is 3 more than twice the third. The third integer is:		Let the three integers be x, $x + 2$ and $x + 4$. Then, $3x = 2(x + 4) + 3 \Leftrightarrow x = 11$. $\therefore$ Third integer = $x + 4 = 15$.	
7	Look at this series: 7, 10, 8, 11, 9, 12, ...		This is a simple alternating addition and subtraction series. In the first pattern, 3 is added; in the second, 2 is subtracted.	
8	Look at this series: 22, 21, 23, 22, 24, 23, ...		In this simple alternating subtraction and addition series; 1 is subtracted, then 2 is added, and so on.	
	(112×5^4) = ?		(112×5^4) = 112 x(10)4=112 x 10^4=1120000= $7000022^4$16	
9	It was Sunday on Jan 1, 2006. The day of		On 31st December, 2005 it was Saturday.	

	the week Jan 1, 2010 is		Number of odd days from the year 2006 to the year 2009 = (1 + 1 + 2 + 1) = 5 days. ∴ On 31st December 2009, it was Thursday. Thus, on 1st Jan, 2010 it is Friday.	
10	Today is Monday. After 61 days, it will be:		Each day of the week is repeated after 7 days. So, after 63 days, it will be Monday. ∴ After 61 days, it will be Saturday.	
11	If 6th March, 2005 is Monday,The day of the week on 6th March, 2004 is		The year 2004 is a leap year. So, it has 2 odd days. But, Feb 2004 not included because we are calculating from March 2004 to March 2005. So it has 1 odd day only. ∴ The day on 6th March, 2005 will be 1 day beyond the day on 6th March, 2004. Given that, 6th March, 2005 is Monday. ∴ 6th March, 2004 is Sunday (1 day before to 6th March, 2005).	
12	The days in x weeks x days?		x weeks x days = $(7x + x)$ days = $8x$ days.	
13	On 8th Feb, 2005 it was Tuesday. The day of the week on 8th Feb, 2004 is		The year 2004 is a leap year. It has 2 odd days. ∴ The day on 8th Feb, 2004 is 2 days before the day on 8th Feb, 2005. Hence, this day is Sunday.	
14	The greatest number that will divide 43, 91 and 183 so as to leave the same remainder in each case.		Required number = H.C.F. of (91 - 43), (183 - 91) and (183 - 43) = H.C.F. of 48, 92 and 140 = 4.	
15	The H.C.F. of two numbers is 23 and the other two factors of their L.C.M. are 13 and 14. The larger of the two numbers is:		Clearly, the numbers are (23 x 13) and (23 x 14). ∴ Larger number = (23 x 14) = 322	

16	$(112 \times 5^4) = ?$		(112×5^4) = 112 x(10)4=112 x 10^4=1120000= $7000022^4$16	
17	It was Sunday on Jan 1, 2006.The day of the week Jan 1, 2010 is		On 31st December, 2005 it was Saturday. Number of odd days from the year 2006 to the year 2009 = (1 + 1 + 2 + 1) = 5 days. ∴ On 31st December 2009, it was Thursday. Thus, on 1st Jan, 2010 it is Friday.	
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	remainder in each case.			
23	The H.C.F. of two numbers is 23 and the other two factors of their L.C.M. are 13 and 14. The larger of the two numbers is:		Clearly, the numbers are (23 x 13) and (23 x 14). ∴ Larger number = (23 x 14) = 322	
24	Two trains running in opposite directions cross a man standing on the platform in 27 seconds and 17 seconds respectively and they cross each other in 23 seconds. The ratio of their speeds is:		Let the speeds of the two trains be x m/sec and y m/sec respectively. Then, length of the first train = 27x meters, and length of the second train = 17y meters. $\therefore \frac{27x + 17y}{x + y} = 23$ $\Rightarrow 27x + 17y = 23x + 23y$ $\Rightarrow 4x = 6y$ $\Rightarrow \frac{x}{y} = \frac{3}{2}$.	

Faculty Team Prepared **Signatures**

1.

2.

HoD