NARULA INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT

B.TECH./CSE/EVEN/SEM-IV/R18/ CS402/2021-2022
YEAR: 2022

DESIGN AND ANALYSIS OF ALGORITHMS
CS402

TIME ALLOTTED: 3 HOURS FULL MARKS: 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable

GROUP – A
(Multiple Choice Type Questions)

1. Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

SL	Question	Marks	Co	Blooms Taxonomy Level
(i)	If $f_1(n) \in O(g_1(n))$ and $f_2(n) \in O(g_2(n))$ then $f_1(n) + f_2(n)$ is: a) $O(\min(g_1(n),g_2(n)))$ b)$O(\max(g_1(n),g_2(n)))$ c) $O(g_1(n)+g_2(n))$ d) $O(g_1(n)*g_2(n))$	1	2	3
(ii)	Which one of the following problem is solved using dynamic programming approach, a) All pairs shortest path b) Quick Sort c) Minimum weight spanning tree d)Connected components	1	3	1
(iii)	*The time complexity for recurrence relation* $T(n)= T(n-1) + c$ *is:* a)O(n) b)$O(n^2)$ c)O(nlogn) d)O(2^n)	1	4	4
(iv)	The time complexity of the merge sort, quick sort algorithms in the worst case is : a) $O(n^2)$, O(n log n) b) $O(n^2)$, $O(n^2)$ c) O(n log n), $O(n^2)$ d) O (n log n), O(n log n)	1	1	3
(v)	*The complexity of matrix multiplication algorithm is* a) $O(n^3)$	1	3	3

	b) O(log n) c) $O(n^4)$ d) O(n log n)			
(vi)	Merge sort problem is an example of a) Dynamic Programming b) Greedy Method c) Divide and Conquer d) Backtracking	1	4	2
(vii)	For algorithm using backtracking, use of stack a) is unavoidable, b) can be avoided but helpful, c) not at al necessary, d) should be avoided	1	3	5
(viii)	Which of the following is example of recursion? a) Fibonacci b) Tower of Hanoi c) Factorial d) all of the above	1	1	2
(ix)	The complexity of searching an element from a set of n elements using Binary search algorithm is a) O(n) b) O(log n) c) O(n^2) d)O(n log n)	1	1	3
(x)	Traveling Salesman problem is a) in P class b) in NP class c) NP Complete d) NP Hard	1	5	4
(xi)	BFS of a graph G=(V, E) has running time a) O(|V|log|E|) b) O(|V|) c) O(|E|) d) O(|V|+|E|)	1	4	5
(xii)	Kruskal's algorithm uses.....and Prim's algorithms uses.....in determining MST a) edges, edges b) edges, vertices c) vertices , edges, d) vertices, vertices	1	2	1

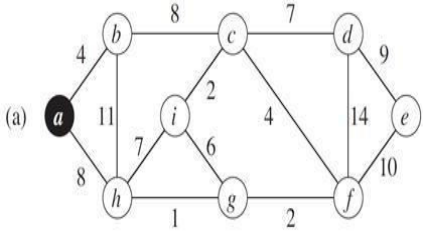
GROUP – B
(Short Answer Type Questions)
(Answer any three of the following) 3 x 5 = 15

	SL	Question	Marks	Co	Blooms Taxonomy Level
2.	(i)	How do you design better algorithms ?	3	3	4
	(ii)	What do you mean by time complexity of algorithms?	1	1	1
	(iii)	What is space complexity?	1	1	1
3.	(i)	What do you mean by recurrence realation?	1	2	
	(ii)	Derive the worst case complexity of quick sort using recursion tree.	3	2	3
	(iii)	What is in-place sorting?	1	1	1
4.	(i)	What is the divide and conquer method ?	2	2	2
	(ii)	What is the basic difference between divide & conquer method and dynamic programming.	3	3	3
5.	(i)	Define different asymptotic notations	2	4	2
	(ii)	Find out time complexity for the recurrence T(n)=2T(n-1)+c.	3	3	5
6.	(i)	What is heap property?	1	1	2
	(ii)	Construct a max-heap using the max-heapify algorithm with the following data. <14,16,11,10,3,7,2,9,4,8,1>	4	5	4

GROUP – C
(Long Answer Type Questions)

(Answer any three of the following) 3 x 15 = 45

	SL	Question	Marks	Co	Blooms Taxonomy Level
7.	(i)	State the general Knapsack problem. Write greedy algorithm and find the complexity of this algorithm.	4	2	2
	(ii)	Find the optimal greedy solution to the Knapsack problem instance n=7, m=15. Where the profits and the weights are as follows: $(p_1, p_2, p_3, p_4, p_5, p_6, p_7)=(10, 5, 15, 7, 6, 18, 3)$ and $(w_1, w_2, w_3, w_4, w_5, w_6, w_7)=(2, 3, 5, 7, 1, 4, 1)$.	6	4	4
	(iii)	Given the character set S=<A,B,C,D,E,F> with the following probability P=<29,25,20,12,05,09> of Huffman coding problem, generate the prefix code and corresponding binary tree using greedy approach.	5	4	4

8.	(i)	Define Spanning Tree and Minimum Spanning Tree.	4	1	1
	(ii)	Explain Prim's Algorithm and derive the complexity of the algorithm.	5	2	3
	(iii)	Find the Minimal Spanning Tree of a connected, undirected graph as given in Fig.2 using Kruskal's Algorithm . 	6	3	3
9.	(i)	Write the algorithm of quick sort and find the best case, worst case and average case time complexity of this algorithm.	5	3	4
	(ii)	What do you mean by dynamic programming? Write the algorithm of matrix-chain multiplication	5	4	5
	(iii)	Find the optimal parenthesize of matrix-chain product whose sequence of dimensions is <5,10,3,12,5,50,6>	5	5	3
10.	(i)	What is non-deterministic algorithm? Differentiate between deterministic and non-deterministic algorithm.	5	3	4
	(ii)	Write an algorithm to sort an array using deterministic and non-deterministic technique. Compare their complexity.	5	4	2
	(iii)	Describe Class-P, Class-NP, NP-Hard and NP-Complete with relation.	5	2	
11.		**Write short notes on (Any three)**			5
	(i)	Bellman Ford Algorithm	5	5	3
	(ii)	Shortest path algorithm	5	3	3
	(iii)	BFS and DFS	5	3	3
	(iv)	8-Queens Problems	5	4	3
	(v)	KMP-String matching	5	4	4