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Total Number of Pages: 02

B.Tech / 22IT4PC03T

**4<sup>th</sup> Semester Regular Examination: 2023-24**  
**DESIGN AND ANALYSIS OF ALGORITHMS**  
**BRANCH: IT**  
**Time: 3 Hours**  
**Max Marks: 100**  
**Q Code: Q122**

Answer Question No.1 (Part-I) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.

The figures in the right hand margin indicate marks.

**Part-I**

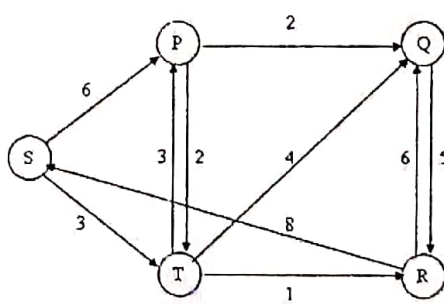
Q No.	CO	Level	Short Answer Type Questions (Answer All-10)	(02x10)
Q1				
a)	1	2	Sort the following expressions in ascending order of their value: $n \log n$ , $n^2$ , $n!$ , $2n$ , $\log n$ , $n^3$ , $\log_2 \log_2 n$ , 200	2
b)	1	2	State a situation when insertion sort is performed with time complexity $O(n)$ . Justify your answer.	2
c)	2	2	Explain the greedy approach to solve knapsack problem.	2
d)	2	2	What is the time complexity of deletion procedure in a heap. Justify your answer.	2
e)	3	2	Out of Prim's and Kruskal's algorithm, which one performs better in minimum cost spanning tree construction?	2
f)	3	2	Which of the two searching algorithms BFS and DFS, is able find the shortest path solution? Justify your answer.	2
g)	3	2	Define number of phases required to find shortest path using Bellman-Ford algorithm having graph of $n$ vertices	2
h)	4	2	Write the advantages of Rabin-Karp String matching algorithm over naïve string-matching algorithm.	2
i)	1	2	What is an algorithm?	2
j)	1	2	What do you mean by Max-Heap?	2

**Part-II**

Q No.	CO	Level	Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)	(06x08)
Q2				
a)	1	3	Solve the following recurrence $T(n) = \begin{cases} 2T\left(\frac{n}{2}\right) + n & \text{if } n > 1 \\ 1 & \text{otherwise} \end{cases}$	6
b)	3	3	What do you mean by minimal spanning tree? Write Prim's algorithm to find the minimum cost spanning tree from a weighted graph.	6
c)	3	3	Explain the different asymptotic notations with example.	6
d)	3	3	Given a sequence of binary digits (0's and 1's). Write a sorting algorithm to sort the numbers in $O(n)$ time.	6

c)	1	2	What is convex hull problem? Design an algorithm to construct a convex hull for a given set of points.	6
f)	3	3	Find the longest common subsequence of the following two sequences using dynamic programming approach. X = "INSTITUTE" Y="NIST"	6
g)	4	3	Design an algorithm to search a string in a text.	6
h)	3	2	Explain the dynamic programming approach to obtain the optimal solution of 0/1 knapsack problem?	6
i)	3	3	Explain the basic operations performed on disjoint sets. Illustrate the operations using linked list representations of disjoint operations.	6
j)	4	2	Differentiate between backtracking and branch and bound technique with suitable example.	6
k)	1	3	Prove that $2n^2 + 4n + 5 = O(n^2)$ .	6
l)	4	3	Given a graph $G=(V,E)$ and a cycle. Design a polynomial time algorithm to verify the given cycle is Hamiltonian or not.	6

### Part-III

Q No.	CO	Level		
<b>Long Answer Type Questions (Answer Any Two out of Four)</b>				
Q3	a)	1	3	<p>If <math>f(n) = a_m n^m + a_{m-1} n^{m-1} + \dots + a_1 n + a_0</math>, <math>a_m &gt; 0</math> then Prove that <math>f(n) = \Omega(n^m)</math></p> <p>(02x16) 8</p>
	b)	1	3	<p>Compute the worst case and average case time complexity of quick sort. State the situations with example where quick sort performs the worst.</p> <p>8</p>
Q4	a)	3	3	<p>Construct the decode tree for the given set of characters and their probability of occurrence in a text. (a, b, c, d, e, f, g) = {5/64, 1/16, 7/64, 1/8, 13/64, 7/32, 3/8}</p> <p>8</p>
	b)	3	3	<p>Find the minimum number of scalar multiplications required to multiply the matrices for the given order <math>M_1(5 \times 10)</math>, <math>M_2(10 \times 5)</math>, <math>M_3(5 \times 50)</math>, <math>M_4(50 \times 10)</math>, <math>M_5(10 \times 20)</math></p> <p>8</p>
Q5	a)	3	3	<p>Find the shortest paths from source vertex 'S' to all other vertices in the following graph using Bellman-Ford Algorithm.</p> <p>8</p>
				
	b)	3	2	<p>Write the pseudo code of Floyd-Warshall algorithm with time complexity. Explain how it is different from Dijkstra's algorithm</p> <p>8</p>
Q6	a)	4	2	<p>Define Class P, NP, NP-C. Prove that the class P language is closed under Intersection and Complementation.</p> <p>8</p>
	b)	2	3	<p>Explain Merge sort algorithm with suitable example and derive the time complexity.</p> <p>8</p>