

**PARUL UNIVERSITY**  
**FACULTY OF ENGINEERING & TECHNOLOGY**  
**B. Tech/Int. B. Tech Winter Examination 2023 - 24**

**Semester: 5/9****Subject Code: 203105374****Subject Name: Design and Analysis of Algorithms****Date: 21/11/2023****Time: 02:00 pm to 04:30 pm****Total Marks: 60****Instructions:**

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1	<b>Objective Type Questions - ( Fill in the blanks, one word answer, MCQ-not more than Five in case of MCQ) (All are compulsory) (Each of one mark)</b>	(15)	CO	PO	Bloom's Taxonomy
	1. In algorithm analysis, which growth rate indicates the most efficient algorithm?  A) Linear ( $O(n)$ ) B) Quadratic ( $O(n^2)$ ) C) Logarithmic ( $O(\log n)$ ) D) Exponential ( $O(2^n)$ )		1	1	<b>L1</b>
	2. What property makes Quick Sort a "divide and conquer" algorithm in the context of sorting?  A) It divides the array into two halves. B) It divides the array based on a pivot element. C) It divides the array into equal subarrays. D) It divides the array into three sections.		2	2	<b>L1</b>
	3. Which algorithm is commonly used for solving the All Pairs Shortest Paths problem in a weighted graph?  A) Dijkstra's Algorithm B) Bellman Ford Algorithm C) Warshall's Algorithm D) Floyd's Algorithm		3	2	<b>L1</b>
	4. Which dynamic programming algorithm is commonly used to solve the Knapsack problem?  A) Floyd's Algorithm B) Warshall's Algorithm C) Dijkstra's Algorithm D) 0/1 Knapsack Algorithm		4	3	<b>L1</b>
	5. What is a key characteristic of problems that are suitable for dynamic programming solutions?  A) They have optimal substructure. B) They involve a large search space. C) They require exhaustive backtracking. D) They have a fixed set of rules.		4	4	<b>L1</b>
	6. Shell Sort employs a diminishing _____ for comparing and swapping elements.		1	5	<b>L2</b>
	7. Quick Sort divides the array based on a _____ element.		2	6	<b>L2</b>
	8. The Strassen Matrix Multiplication algorithm has a time complexity of _____.		2	1	<b>L3</b>
	9. In Selection Sort, the minimum element is selected and swapped with the element at the _____ position.		3	4	<b>L2</b>

	10. The primary advantage of the KMP Algorithm is its ability to avoid unnecessary character comparisons using .		<b>6</b>	<b>6</b>	<b>L1</b>
	11. Briefly explain the concept of "pattern matching" in the context of string matching algorithms.		<b>6</b>	<b>5</b>	<b>L2</b>
	12. What is the main characteristic of Greedy Methods?		<b>3</b>	<b>4</b>	<b>L3</b>
	13. Compare the time complexity of Quick Sort and Merge Sort		<b>2</b>	<b>3</b>	<b>L4</b>
	14. Define the term "algorithm".		<b>1</b>	<b>2</b>	<b>L3</b>
	15. Explain key steps of Binary Search Algorithms.		<b>2</b>	<b>1</b>	<b>L1</b>
<b>Q.2</b>	<b>Answer the following questions. (Attempt any three)</b>	<b>(15)</b>			
	A) Explain the Strassen Matrix Multiplication algorithm, outlining its time and space complexity. How does Strassen Matrix Multiplication differ from the standard matrix multiplication algorithm.		<b>2</b>	<b>3</b>	<b>L2</b>
	B) Differentiate between Merge Sort and Quick Sort, highlighting their key characteristics. Additionally, provide insights into the time and space complexity of both algorithms.		<b>2</b>	<b>2</b>	<b>L3</b>
	C) Explain the Binary Search algorithm and demonstrate its application on the array [1, 3, 3, 4, 7, 8, 9]. Perform a Binary Search to find the index of the target value 7. Provide the step-by-step process and illustrate how the search space is narrowed down. Additionally, mention the time and space complexity of the Binary Search algorithm.		<b>2</b>	<b>8</b>	<b>L5</b>
	D) Describe Dijkstra's algorithm for finding the shortest path in a weighted graph. Explain the key steps involved and provide a numerical example to illustrate its application on a graph. Mention application and limitations of Dijkstra's.		<b>3</b>	<b>7</b>	<b>L4</b>
<b>Q.3</b>	A) Consider the 0/1 Knapsack problem with a knapsack capacity of W and a set of items with respective weights (w1, w2, ..., wn) and values (v1, v2, ..., vn). Find the maximum profit from the given weight and value array with capacity using 0/1 Knapsack problem. Weights: [2, 3, 4, 5] Values: [3, 4, 5, 6] Knapsack Capacity (W): 8	<b>(07)</b>	<b>3</b>	<b>5</b>	<b>L6</b>
	B) Consider the string "aabaaadbaab" and the pattern "aab." Apply the Rabin-Karp algorithm to efficiently detect the occurrences of the pattern in the given string. Explain the key steps of the Rabin-Karp algorithm. Discuss the time complexity and advantages of Rabin-Karp in comparison to other string-matching algorithms.	<b>(08)</b>	<b>6</b>	<b>1</b>	<b>L6</b>
	<b>OR</b>				
	B) Define shell sort. What is the other name of shell sort. Take an unsorted array as an example and sort it using shell sort algorithm. Write Algorithm and code. Also mention time and space complexity.	<b>(08)</b>	<b>1</b>	<b>2</b>	<b>L3</b>

<b>Q.4</b> A) In this graph Vertex A is connected to B with a weight of 2.  Vertex A is connected to C with a weight of 1. Vertex B is connected to C with a weight of 3. Vertex B is connected to D with a weight of 5. Vertex C is connected to D with a weight of 6.	<b>(07)</b>				
Apply Kruskal's algorithm to find the Minimum Spanning Tree (MST) of the given graph. Explain the key steps of Kruskal's algorithm, including how it selects edges and avoids cycles. Illustrate the construction of the MST by detailing the edges chosen at each step and their respective weights. Discuss the final MST and the total weight of the MST in the context of the original graph. Analyze the time complexity of Kruskal's algorithm and compare its performance to other Minimum Spanning Tree algorithms.					
<b>OR</b>					
A) Consider the string "aabbaadbaab" and the pattern "aab." Apply the KMP algorithm to efficiently detect the occurrences of the pattern in the given string. Explain the key steps of the KMP algorithm. Discuss the time complexity and advantages of KMP in comparison to other string-matching algorithms.					<b>(07)</b>
B) Write a short note on Growth of Functions. Explain with graphs and equations. What are the performance to be considered for selecting an algorithm.					<b>(08)</b>