

**Answer the following question .(70 Marks)**

[Q-1] a) Explain the characteristics and importance of algorithms. [ 7 ]

b) Explain how to analyze time and space complexity of an algorithm. [ 7 ]

Or

a) Discuss red-black trees with insertion and deletion operations.

b) 4. Explain minimum spanning tree algorithms (Prim's and Kruskal's).

[Q-2] a) Explain topological sorting with algorithm and example. [ 7 ]

b) Explain string matching algorithms (Naïve, KMP, Rabin-Karp). [ 7 ]

Or

a) Discuss NP-Hard and NP-Complete problems in detail.

b) Explain the relationship between P, NP, NP-Complete, and NP-Hard problems.

[Q-3] a) Explain approximation algorithms with examples. [ 7 ]

b) Describe backtracking with example (e.g., N-Queens problem). [ 7 ]

Or

a) Discuss binary search and traversal techniques

b) Explain dynamic programming with example (e.g., Matrix chain multiplication).

[Q-4] a) Explain Fibonacci heaps and their advantages. [ 7 ]

b) Explain probabilistic algorithms with examples.. [ 7 ]

Or

a) Describe the operations on a binomial heap with suitable examples.

b) Explain all-pairs shortest path algorithm (Floyd-Warshall).

[Q-5] a) Answer the following question . [ 07 ]

1. Which data structure is used for implementing recursion?

- a) Queue. b) Stack. c) Linked list. d) Array
2. The time complexity of heap sort is:  
a)  $O(n^2)$ . b)  $O(n \log n)$ . c)  $O(\log n)$ . d)  $O(n)$
3. String matching algorithms are used in:  
a) Searching text patterns. b) Graph coloring.  
c) Sorting numbers. d) Data compression.
4. Topological sorting is possible only in:  
a) Directed Acyclic Graph. b) Undirected Graph  
c) Cyclic Graph. d) Weighted Graph
5. The time complexity of merge sort is:  
a)  $O(n)$ . b)  $O(n \log n)$ . c)  $O(\log n)$ . d)  $O(n^2)$
6. Which of the following is a Divide and Conquer algorithm?  
a) Bubble Sort. b) Insertion Sort. c) Merge Sort. d) Selection Sort.
7. Red-black trees are used to:  
a) Balance binary trees. b) Store graphs.  
c) Sort arrays. d) Represent heaps.

**b) Answer the following. Each question carries 1 marks. [ 07]**

1. What is amortized analysis?
2. Define Big O notation.
3. What is a heap?
4. What is hashing?
5. What is a recurrence relation?
6. What is  $\Omega$  (Omega) notation?
7. What are the characteristics of a good algorithm?

