



DECEMBER 2024

307/5(N)

**3110901****ALGORITHMS***Time Allowed: 3 Hours**Full Marks: 60*

**Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer.**

**Answer any Five (05) Questions from Group-B.**

**GROUP-A**

1. Choose the correct answer from the given alternatives and explain your answer (any ten) :2x10=20

- i. Which of the following is NOT a characteristic of an algorithm?  
 a. Finiteness                      b. Definiteness                      c. Ambiguity                      d. Input
  - ii. What does the term "multiplicity" refer to in the context of a multiset?  
 a. Number of elements in the multiset                      b. Number of unique elements in the multiset  
 c. Number of times an element appears in the multiset                      d. Total number of multisets that can be formed from a given set
  - iii. What is the time complexity of a Binary Search algorithm in the worst case?  
 a.  $O(n)$                       b.  $O(\log n)$                       c.  $O(n^2)$                       d.  $O(1)$
  - iv. Which of the following sorting algorithms is the most efficient in the average case for large datasets?  
 a. Bubble Sort                      b. Quick Sort                      c. Selection Sort                      d. Insertion Sort
- \*\*\*\*\*
- v. Which approach is more suitable for problems with overlapping subproblems and optimal substructure?  
 a. Divide and Conquer                      b. Dynamic Programming                      c. Both a and b                      d. Neither
  - vi. Which algorithm follows the Divide and Conquer approach?  
 a. Bubble Sort                      b. Merge Sort                      c. Selection Sort                      d. Heap Sort
  - vii. What is the time complexity of Radix Sort?  
 a.  $O(nk)$                       b.  $O(n^2)$                       c.  $O(n \log n)$                       d.  $O(n^3)$
  - viii. Which of the following hashing collision resolution techniques uses a linked list to resolve collisions?  
 a. Linear Probing                      b. Quadratic Probing                      c. Double Hashing                      d. Chaining
  - ix. Which of the following algorithms is used to find the shortest path in a graph with negative edge weights?  
 a. Dijkstra's Algorithm                      b. Prim's Algorithm                      c. Bellman-Ford Algorithm                      d. Kruskal's Algorithm



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- x. What type of approach does Prim's algorithm use to find a minimum spanning tree of a graph?  
a. Divide and Conquer                      b. Dynamic Programming                      c. Greedy Approach  
d. Backtracking
- xi. In the Rabin-Karp algorithm, the hashing technique is used to:  
a. store the string.                      b. calculate the matching of substrings.  
c. compare every substring.                      d. search for substrings by calculating hash values.
- xii. What is the worst-case time complexity of the Quick Sort algorithm?  
a.  $O(n \log n)$                       b.  $O(n^2)$                       c.  $O(n)$                       d.  $O(\log n)$
- xiii. What is the number of edges in a tree with  $n$  nodes?  
a.  $n$                       b.  $n-1$                       c.  $n+1$                       d.  $2n-1$
- xiv. Which of the following is the correct time complexity for constructing a Max-Heap?  
a.  $O(n \log n)$                       b.  $O(n^2)$                       c.  $O(n)$                       d.  $O(\log n)$
- xv. The Knuth-Morris-Pratt (KMP) string matching algorithm preprocesses the pattern to:  
a. avoid rechecking the matched characters.                      b. compare characters from the end.  
c. skip unmatched characters entirely.                      d. directly match the substring.

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#### GROUP-B

- 2. a) Briefly explain key characteristics of every algorithm should have.
- b) What is asymptotic notation? Explain different types of asymptotic notations. 3 + (2 + 3)



- 3. a) Explain divide and conquer approach.
- b) Solve the recurrence relation using substitution method:  $T(n)=2T(n/2) + 1$
- c) Calculate the time complexity of the given pseudo code

```
for(i=0;i<n;i++)
{
    for(j=0;j<n;j++)
    {
        Statement;
    }
}
```

3 + 3 + 2

- 4. a) Explain Selection sort using suitable example.
- b) Compare bubble sort, selection sort and insertion sort. 4 + 4
- 5. a) Illustrate Quick Sort algorithm on the following sequence 38, 81, 22, 48, 13, 69, 93, 14, 45, 58, 79, 72.
- b) Explain best case and worst case time complexity of quick sort. 4 + 4



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6. a) Write algorithm for binary search.

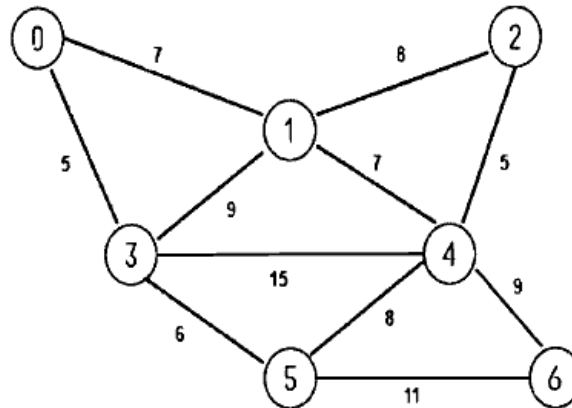
b) What is a collision in hashing? Describe different types collision techniques.

3 + (2 + 3)

7. a) What is a Minimum Spanning Tree (MST)?

b) Find Minimum Spanning Tree (MST) using Kruskal's algorithm.

2 + 6



8. a) Explain DAG using an example.

b) Illustrate Floyd Warshall's algorithm taking a suitable example.

2 + 6

9. a) What are tries (prefix trees), and how are they used in storing strings?

b) Construct a tree for the set of words: "bat", "ball", "doll", "dork", "do", "dorm", "send", "sense".

Draw the tree and explain how it facilitates efficient search operations.

3 + 5

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10. a) Explain the Knuth-Morris-Pratt (KMP) string matching algorithm.

b) Given the text  $T = \text{"ababcabababd"}$  and the pattern  $P = \text{"ababd"}$ , use the KMP algorithm to determine if the pattern exists in the text. Show the construction of the lps (longest proper prefix which is also suffix) array and the step-by-step matching process.

3 + 5