Enrollment No.:_____

Date: 01/12/2025

Subject Code: BETCE15313

Semester: 5

Subject Name: Analysis and Design of Algorithm

Total Marks: 100

Time: 02:30PM To 05:30PM

Instructions:

1. Question No. 1 is Compulsory.
2. Make Suitable Assumptions wherever necessary.
3. Figures to the right indicate full marks.

	Marks

Q.1 (a) Write and explain the recurrence relation of Merge Sort. — **05**

(b) What are the disadvantages of greedy method over dynamic programming method? — **05**

(c) What is minimum spanning tree? Find minimum spanning tree using Prim's and Kruskal's algorithm of the following graph. — **10**
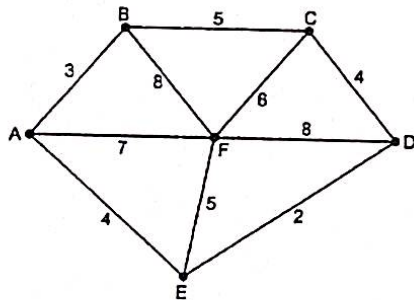
Q.2 (a) What do you mean by asymptotic notations? Explain. — **05**

(b) If two loops are nested, but the inner loop does not depend on the outer loop variable, can the complexity still be multiplied (e.g.,$O(n2)$)? — **05**

OR

(b) Sort the following numbers using counting sort. 1, 3, 2, 4, 1, 2, 4, 3. — **05**

(c) Define P, NP, NP-Complete, and NP-Hard problems with van diagram. Give examples of each. — **10**

OR

(c) Explain Selection Sort Algorithm and give its best case, worst case and average case complexity with example. — **10**

Q.3 (a) Explain shell sort with example. Write the time complexity of shell sort. — **05**

(b) Solve the following Knapsack Problem using greedy method. Number of items = 7, knapsack capacity W = 15, weight vector = {2, 3, 5, 7, 1, 4, 1} and profit vector = {10, 5, 15, 7, 6, 18, 3}. — **05**

(c) Write an algorithm for quick sort and derive best case, worst case using divide and conquer technique also trace given data: (3,1,4,5,9,2,6,5)   **10**

OR

(a) Explain in brief Breadth First Search and Depth First Search Traversal techniques of a Graph with Example.   **05**

(b) What is bounding in the Branch and Bound technique? Why is it important?   **05**

(c) Explain Chained Matrix Multiplication with example.   **10**

Q.4 (a) Arrange the data into ascending order using heap sort. Make necessary assumptions if required. 34, 12, 42, 96, 56, 11, 78.   **05**

(b) If the array is almost sorted but with a few elements out of place, which search (linear or binary) is more efficient and why?   **05**

(c) Write the Master theorem. Solve the following recurrence using it: (i) $T(n)=9T(n/3)+n$ (ii) $T(n)=2T(n/4)+1$ (iii) $T(n)=3T(n/4)+n \log n$ (iv) $T(n)=3T(n/3)+n$ **10**

OR

(a) Find the Optimal Huffman code for each symbol in following text: ABCCDEBABFFBACBEBDFAAAABCDEEDCCBFEBFCAE   **05**

(b) Find Longest Common Subsequence using Dynamic Programming Technique with illustration X={A,B,C,B,D,A,B} Y={B,D,C,A,B,A}   **05**

(c) Solve the following recurrence relation using the substitution method: $T(n)=2T(n/2)+n$, $T(1)=1$ **10**

Q.5 (a) Differentiate between Backtracking and Branch and Bound approaches.   **05**

(b) Rabin-Karp: T='31415926535897 93', P='26535'.   **05**

(c) a) Define the 0/1 Knapsack Problem. b) Solve the following using Dynamic Programming: Item = (1, 2, 3, 4), Value = (45, 30, 45, 10), Weight = (3, 5, 9, 2). Capacity = 16. Show DP table, chosen items, and total value.   **10**

OR

(a) a) Define TSP and its characteristics. b) Explain how Backtracking is applied to TSP with a recursive function. Mention the base case and pruning condition. c) Why is this approach not scalable?   **05**

(b) Discuss the trade-offs between exact algorithms like Backtracking and Branch and Bound vs heuristic approaches for NP-hard problems such as TSP. When would you choose one over the other?   **05**

(c) Finite automata handling overlap: P='aabaa', T='aabaabaabaaabaa'.   **10**