C4-R4: ADVANCED ALGORITHMS

«QP_SRLNO»

NOTE:

1. **Answer question 1 and any FOUR from questions 2 to 7.**
2. **Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours **Total Marks: 100**

1.

a) Differentiate between Kruskal's and Prim's Algorithm.
b) Briefly discuss time and space complexities of an algorithm.
c) Write an algorithm for testing the primality.
d) Briefly discuss the bin packing problem and propose a first fit based approximation algorithm for bin packing.
e) Apply Bubble sort to sort following set of integers: 10, 9, 8, 7, 6, 5, 3, 2, 1
f) Proper prefix and proper suffix are the two concepts used in Kunth-Morris-Pratt algorithm for string matching. Identify all the proper prefixes and proper suffixes of the string "Snape".
g) Briefly discuss the closest pair problem and write naïve algorithm for finding the closest pair of points in a metric space

(7x4)

2.

a) Discuss the Strassen's method for multiplying two matrices. Generally, this approach is not preferred for practical applications. Discuss the reasons.
b) 0/1 Knapsack is well known problem and effectively solved using Dynamic programming (DP). Give the recurrence for DP based solution of 0/1 Knapsack. Use this recurrence to find the maximum earned profit, if the knapsack capacity is 15 kg. Available items (consider that each item's only one unit is given), their weights and associated profits are given in following table.

Item #	Weight (in Kg)	Profit
Item 1	1	2
Item 2	2	3
Item 3	4	5
Item 4	5	6
Item 5	6	8

(10+8)

3.

a) Besides Prim's and Kruskal's algorithms to compute MST, consider another approach as follows: for a given connected graph, repeatedly remove heaviest edge from the graph such that the resulting graph (after removal of heaviest edge) is still connected. Apply this approach to obtain the MST of the graph given in **Fig. 1.**

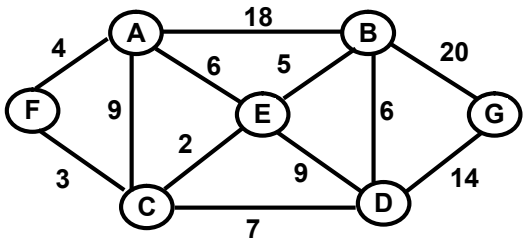

Fig. 1

b) Define and differentiate the worst case, best case, and average case efficiency of algorithms.
c) Compare the NP-complete and NP-hard problems.

(8+5+5)

4.

a) Briefly discuss Breadth First Search (BFS) and explain the BFS algorithm with an example.

b) Why Quick sort is preferred for arrays and Merge sort for linked lists?

c) Differentiate between, Aggregate method, Accounting method (Banker's method), and Potential method to perform Amortized analysis.

(8+5+5)

5.

a) Define Vertex cover problem and briefly discuss the steps of 2-Approximation algorithm to find vertex cover in a graph. Apply this algorithm to find vertex cover for the graph given in **Fig. 2.** Show that the obtained vertex cover (using 2-Approximation) may not be the optimal, but it will never exceed than twice of the optimal vertex cover.

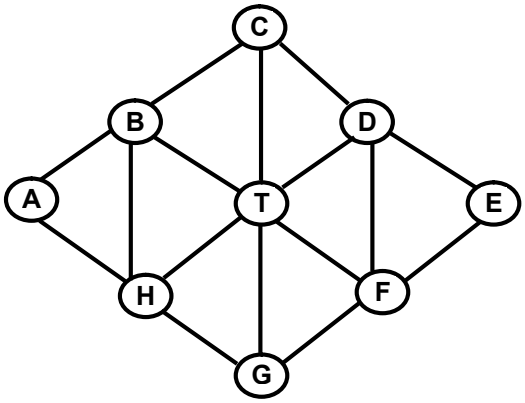

Fig. 2

b) Write the Bellman-Ford algorithm to compute the shortest paths from a single source vertex to all other vertices in a weighted graph.

(10+8)

6.

a) Discuss the Matrix chain multiplication; identify the subproblem and give the recurrence as the Dynamic programming based solution of Matrix chain multiplication.

b) Explain and write Boyer-Moore string matching algorithm.

(9+9)

7.

a) Given a sorted array of n distinct integers A [1, …, n], it is required to find out whether there is an index i for which A[i] = i. Give a divide-and-conquer algorithm that runs in time O(log n).

b) Write the algorithm for Bucket sort and explain it using an example.

c) Construct Huffman tree for the following set of symbols (Frequency of occurring the symbol is given as "Count"):
A (Count = 8), B (Count = 10), C (Count = 3), D (Count = 4), E (Count = 5)

(6+8+4)