Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth Semester B.Tech Degree Examination June 2022 (2019 Scheme)

Course Code: CST306

Course Name: ALGORITHM ANALYSIS AND DESIGN

Max. Marks: 100 Duration: 3 Hours

PART A

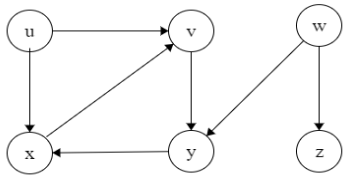
Answer all questions, each carries 3 marks. Marks

1 Let $f(n) = 3n^3 + 2n^2 + 3$ for an algorithm, Let $g(n) = n^3$. Prove that f(n) of this algorithm is in $O(n^3)$ (3)

2 Solve the recurrence $T(n) = 3T\left(\frac{n}{4}\right) + nlogn.$ using Master theorem. (3)

3 Discuss briefly the heuristics, union by rank and path compression, to improve the running time of disjoint set data structure. (3)

4 Consider the directed acyclic graph G=(V,E) given in the following figure. (3)



Find any topological ordering of G.

5 Give the control abstraction of Greedy strategy. (3)

6 Why Strassen's matrix multiplication algorithm is better than traditional divide and conquer algorithm for multilpying two square matrices? What is the recurrence for the number of computational steps taken by Strassen's algorithm and its time complexity? (3)

7 Discuss briefly the elements of dynamic programming with a suitable example. (3)

8 Compare backtracking and branch-and-bound design techniques. (3)

9 Define P, NP and NP complete domains. (3)

10 Compare Las Vegas and Monte Carlo algorithms. (3)

PART B

Answer one full question from each module, each carries 14 marks.

Module I

11 a) Illustrate best case, average case and worst-case complexity with insertion sort algorithm. (9)

b) Give the general idea of the substitution method for solving recurrences. Solve the following recurrence using substitution method. (5)

$$T(n) = 2T\left(\frac{n}{2}\right) + n$$

OR

12 a) Solve the following recurrence using recursion tree method (8)

1) $T(n) = T\left(\frac{n}{3}\right) + T\left(\frac{2n}{3}\right) + cn$

2) $T(n) = 2T\left(\frac{n}{2}\right) + n$

b) Define Big Oh, Big Omega and Theta notations and illustrate them graphically. (6)

Module II

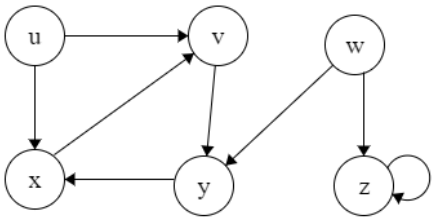
13 a) Give Breadth First Search algorithm for graph traversal. Perform its complexity analysis. (7)

b) Define AVL tree. Construct an AVL tree by inserting the keys: 44, 17, 32, 78, 50, 88, 48, 62, 54 into an initially empty tree. Write clearly the type of rotation performed at the time of each insertion. (7)

OR

14 a) Give Depth First Serach algorith for graph traversal. Perform its time complexity analysis. (7)

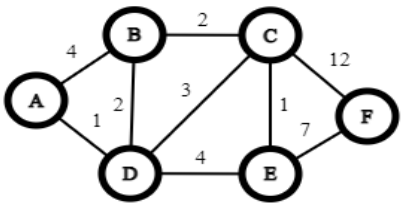
b) Perform DFS traversal on the following graph starting from node A. When multiple nodes are available for next traversal choose nodes in alphabetical order. Classify the edges of the graph into different category. (7)



Module III

15 a) Illustrate the divide and conquer approach by applying 2 way merge sort for the input array: [15,12,14,17,11,13,12,16]. Write the recurrence for merge sort and give the complexity. (7)

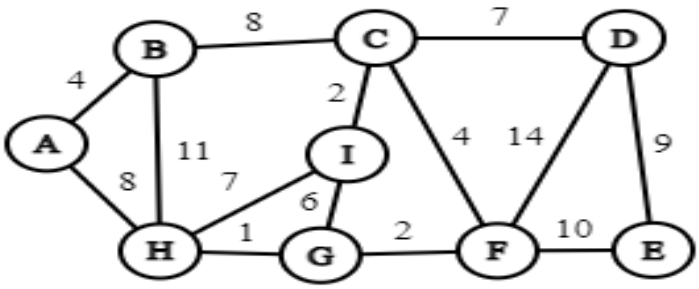
b) Apply Dijkstra's algorithm for single source shortest path to solve the following graph. Assume the source as node A. (7)



OR

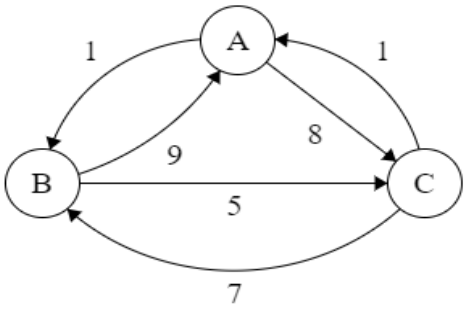
16 a) Consider the following instance of Fractional Knapsack problem with 3 objects. The capacity of the knapsack is 20 units. The weights and profits of the 3 items resprctively are represented by the vectors (w1,w2,w3) = (18,15,10) and (p1,p2,p3)=(25,24,15). Using a greedy strategy compute the optimal solution to this instance. (7)

b) Apply Kruskal algorithm to find minimum cost spanning tree for the following graph (7)



Module IV

17 a) Discuss Floyd-Warshall algorithm for all pair shortest path problem. Solve the following instance using the algorithm. (8)

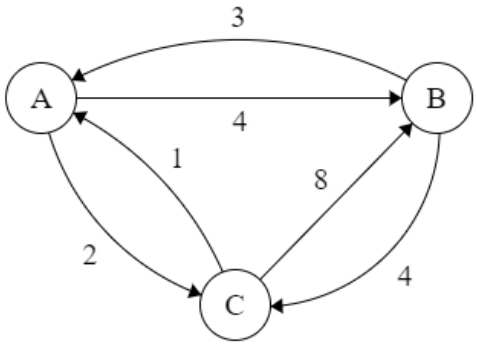


b) Discuss the control abstraction used in backtracking design technique. Draw the state space tree for 4-queens problem. (6)

OR

18 a) Discuss the elements of dynamic programming by considering the matrix chain multiplication problem. (5)

b) Define Travelling Salesman Problem (TSP). Apply branch and bound technique to solve the following instance of TSP. Assume that the starting vertex as A. Draw the state space tree for each step. (9)



Module V

19 a) Prove that CLIQUE problem is NP Complete. (7)

b) Write randomized quicksort algorithm and perform its expected running time analysis. (7)

OR

20 a) Define approximation algorithm. Give an approximation algorithm for bin packing using first fit heuristic and give its approximation ratio. (7)

b) Discuss the advantages of randomized algorithms over deterministic algorithms. Discuss Las Vegas and Monte Carlo algorithms with a suitable example. (7)

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