Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (R,S) / S6 (PT) / (WP) Exam April 2025 (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		Give the recurrence equation for the binary search algorithm. Solve the equation using the Master's theorem.	(3)
2		Is $2^{(n+1)} \in O(2^n)$? Justify your answer.	(3)
3		Define strongly connected component of a directed graph. Give one example.	(3)
4		Draw the linked list representation of UNION(2,6) of disjoint sets $S_1 =$ {1,2,3,4}and $S_2 =$ {8,12,6}where the funtion **UNION(x,y)** performs the union of sets containing elements **x** and **y**.	(3)
5		Compare the time complexities of Strassen's matrix multiplication with ordinary matrix multiplication. Which algorithm run faster?	(3)
6		Give the control abstraction of greedy algorithm design strategy.	(3)
7		Explain the desirable characteristics of problems that can be solved using dynamic programming	(3)
8		Give the recursive definition for the minimum cost of parenthesizing a matrix chain product $A_i A_{(i+1)} .. A_j$.	(3)
9		Define the complexity classes **P**, **NP** and **NP-Hard**.	(3)
10		Compare Las Vegas and Monte Carlo algorithms for randomized algorithms.	(3)

PART B

Answer onefull question from each module, each carries 14 marks.

Module I

11	a)	Givie the mathematical definition of any three asymptotic notations.	(6)
	b)	Find the time complexity of given recurrence using recursion tree method.	(8)

$T(n) = 3T\left(\frac{n}{4}\right) + cn^2$ when $n > 1$ and $T(n) = 0$ otherwise.

OR

12 a) Solve the recurrence equation using Master's theorem. (8)

(i) $T(n) = 3T\left(\frac{n}{2}\right) + n^2$

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

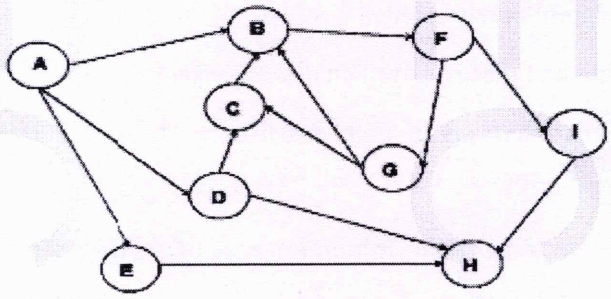
b) Solve the recurrence equation by substitution method. (6)

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

Module II

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

b) Perform Depth First Search (DFS) traversal on the above graph starting from node A. Where multiple node choices may be available for next travel, choose the next node in alphabetical order. Classify the edges of the graph into different category. (7)

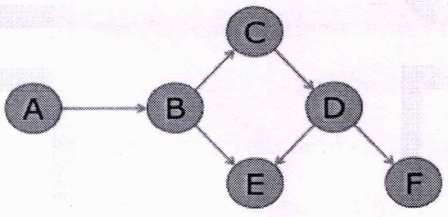


OR

14 a) Construct AVL tree with following nodes. 50, 20, 60, 10, 8, 15, 32, 46, 11, 48 (9)

Explain 4 cases of AVL Tree rotations?

b) (5)



Give any topological ordering of the given graph?

Module III

15 a) Let G= (V,E) be a graph with vertex set V and edge set E. Each edge in E is associated with a nonnegative weight. Give the Kruskal's gredy algorithm for computing a minimum spanning tree of G. What is its time complexity? Justify your answer. (7)

b) Find an optimal solution to the fractional knapsack problem for an instance with number of items 7, Capacity of the sack W=15, profit associated with the items (p1, p2, p3, p4, p5, p6, p7)= (10, 5, 15, 7, 6, 18, 3) and weight associated with each item (w1, w2, w3, w4, w5, w6,w7)= (2, 3, 5, 7, 1, 4, 1). (7)

OR

16 a) Let G= (V, E) be a directed graph with vertex set V and edge set E. Each edge is associated with non-negative weight. Give Dijkstra's algorithm to find a shortest path from a given vertex in V to all other vertices. What is its time complexity? Justify your answer. (7)

b) Give the Divide and Conquer algorithm for 2-way merge sort and calculate its time complexity. (7)

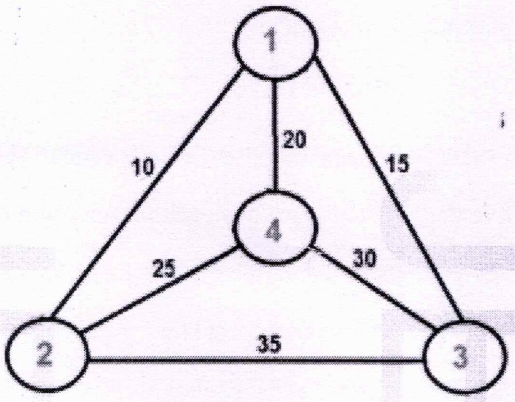
Module IV

17 a) Given a chain of 4 matrices < A1, A2, A3, A4 > with dimensions <5 x 6>, <6 x 4>, <4 x 8>, and <8 x 10>. Fully parenthesisze the given matrices so that the number of scalar multiplications required to compute their product is minimum. What is the value of optimum number of scalr multiplications? (9)

b) Let G= (V, E) be a directed graph with vertex set V and edge set E. Each directed edge in E is associated with real valued weights. Let W be the wieight adjacency matrix of the given graph G. Give the Floyd-Warshall algorithm for computing all pair shortest paths in G and analyse its time complexity. (5)

OR

18 a) Find the minimum TSP tour for the given graph (8)



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

Module V

19 a) Let G= (V, E) be graph with vertex set V and edge set E. Prove that the CLIQUE problem, ie., whether there exist a clique of size k in G, is NP-complete. (9)

b) What is meant by approximation ratio of an approximation algorithm? Define the notions of polynomial time approximation scheme and fully polynomial time approximation scheme. (5)

OR

20 a) Give the randomized version of quicksort algorithm and perform its expected running time analysis. (9)

b) Define the Bin Packing problem and explain about the First Fit strategy for solving it. (5)

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