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CSE303 Enrol. No. A2305221002

[ET]

END SEMESTER EXAMINATION : NOVEMBER-DECEMBER, 2023

ANALYSIS AND DESIGN OF ALGORITHMS

Time : 3 Hrs. *Maximum Marks : 60*

Note: ***Attempt questions from all sections as directed. Use of Scientific calculators are allowed.***

SECTION – A (24 Marks)

Attempt any **four** *questions out of* **five.**
Each question carries **06** *marks.*

1. Let f(n) and g(n) be asymptotically positive functions. Using the basic definition of O, Ω, and θ , Prove or disprove each of the following conjectures.

(a) $f(n) = O(g(n))$ *implies* $2^{f(n)} = \Omega(2^{g(n)})$
(b) $min\{f(n), g(n)\} = \Theta(f(n) + g(n))$

P.T.O.

2. Discuss greedy approach for solving fractional knapsack problem. Find the optimal solution of the following instance of knapsack problem (fractional):

Number of objects n=5, Capacity of Knapsack (M)=15

Items	I_1	I_2	I_3	I_4	I_5
Profits	15	12	9	16	17
Weights	2	5	3	4	6

3. Write pseudo-code for computing the Longest common subsequence (LCS) of the two sequences: $X = \{x_1, x_2, \ldots, x_m\}$ *and* $Y = \{y_1, y_2, \ldots, y_n\}$ using dynamic programming.

Determine LCS for the following sequences

X={A,A,B,B,A,B,A,B} and Y={A,B,B,A,A,B,B,A,B}

4. Discuss the steps to solve the travelling salesman problem (TSP) using LC Branch and Bound technique.

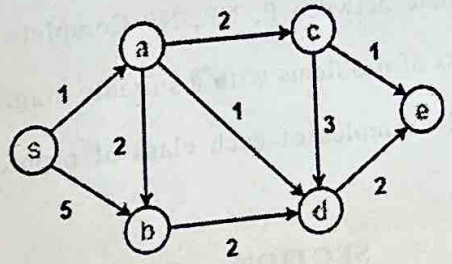
5. Differentiate between P, NP, NP-Complete and NP-Hard class of problems with a suitable diagram. Give at least 2 examples of each class of problems

SECTION – B (20 Marks)

Attempt any **two** *questions out of* **three.**
Each question carries **10** *marks.*

6 (a) Explain the concept of Relaxing an edge (u,v) in Dijkstra's algorithm. Apply Dijkstra's algorithm on the following graph G to find shortest path from vertex [S] to other vertices of G . Step by step calculate shortest path estimate of **d[ ]** value for

each vertex of G and order of vertices gets included in set S.



(6)

(b) Given two sorted array $L[p,\ldots q]$ and $R[q+1,\ldots,r]$, Write a Merge(A,p, q, r) algorithm of **Merge Sort**, which merge these two sorted array $L[p,\ldots q]$ and $R[q+1,\ldots,r]$ to get the one sorte array. Find its time complexity also. (4

7. (a) Solve the matrix chain multiplication problem usi dynamic programming for a sequence dimensions given as [30,35,15,5,10,20,25]

(b) Solve the following recurrences:

$$\text{i) } T(n) = \begin{cases} 1 & n = 0 \\ T(n-1) + \log n & n > 0 \end{cases}$$

$$\text{ii) } T(n) = 2T(\sqrt{n}) + \log n$$

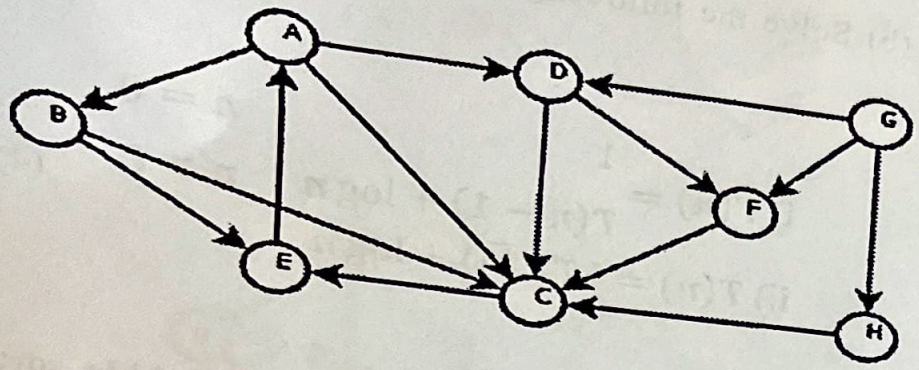
(4)

8. (a) Discuss the time complexity of the Bubble sort, Insertion sort, Quick sort and Merge sort in Best, Average and Worst-case. Also, write if any additional space is required by the algorithms. Which of these sorting algorithms is Stable?

(5)

(b) Differentiate between Depth-First search (DFS) and Best-First search (BFS) with respect to Time and space complexity. Consider the following graph and apply the algorithm to find the DFS and BFS sequence (A is the starting vertex)

P.T.O.



(5)

SECTION – C (16 Marks)

(Compulsory)

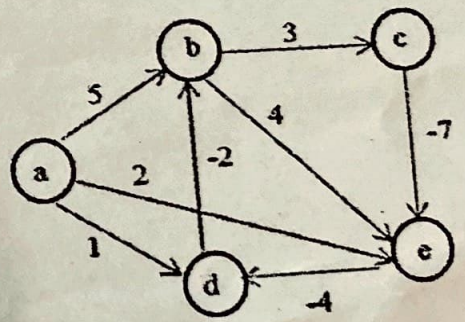
9 Differentiate between LC-Branch and Bound and FIFO-Branch and Bound techniques to solve any optimization problem. Solve the following 0/1 knapsack problem using LC-Branch and Bound.

Number of objects n=4, Capacity of Knapsack (M)=15

Items	I_1	I_2	I_3	I_4
Profits	10	10	12	18
Weights	2	4	6	9

(6)

(b) Write a pseudo code for finding All Pair Shortest path using Floyed-Warshall's algorithm. Analyze its time complexity also. Apply the algorithm to the following graph.



(6)

(c) Show that the Vertex-Cover problem (VCP) is NP-complete. (4)