# Final Assessment Test – April 2023

VIT
Vellore Institute of Technology

Course: **BCSE204L - Design and Analysis of Algorithms**

Class NBR(s): **2864/2868/2869/2872/2874/2876/2878 /2879/2881/2882/2886/2889/2891/2895/2896/2897/ 2899/2900/2902/2904/2905/2908/2910/4349/4351**

Slot: **G2+TG2**

Time: **Three Hours**

Max. Marks: **100**

**KEEPING MOBILE PHONE/SMART WATCH, EVEN IN "OFF" POSITION IS TREATED AS EXAM MALPRACTICE**

**General Instructions: Draw Diagram Wherever Necessary**

**Answer ALL Questions**

**(10 X 10 = 100 Marks)**

1. i. Write a non-recursive algorithm to find the sum of first 'n' odd numbers. Using the loop invariant property, prove the correctness of the algorithm. **[6]**

   ii. Solve the following recurrence relations and find the time complexity for the following using master method. **[4]**
   a) $T(n) = 3T(n/3) + O(n^{1/2})$
   b) $T(n) = 4T(n/2) + n^2$

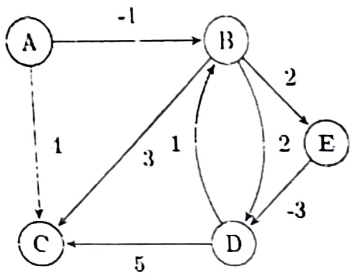
2. State the fractional knapsack problem. Use the algorithm for fractional knapsack problem using greedy method and find an optimal solution for an instance with number of items n = 7, capacity of the sack W = 23, profit associated with the items (p1, p2, ..., p7) = (29, 17, 20, 19, 6, 28, 42) and weight associated with each item (w1, w2, ..., w7) = (7, 5, 6, 3, 9, 2, 5). Show the steps of your work.

3. Given a sequence of matrices <8, 5, 10, 20, 5>. Using Dynamic programming find the minimum number of scalar multiplications needed and also write the optimal multiplication order.

4. Given the following number of jobs: n = 4, penalties (p1, p2, p3, p4) = (5, 10, 6, 4) deadlines (d1, d2, d3, d4) = (1, 2, 2, 1) and execution times (t1, t2, t3, t4) = (1, 2, 1, 2). Find the actual cost and feasible jobs done using branch and bound technique.

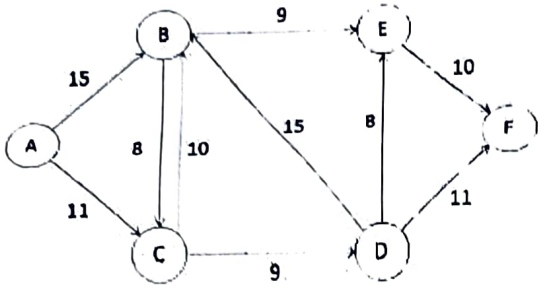
5. For string matching, with the hash function Pattern (P) mod q, where q = 13, how many spurious hits does the Rabin-Karp matcher encounters in Text T = 42637135421 and P = 54 and also find the number of shifts to find the pattern. Write the pseudocode and also discuss about the time complexity of the same.

6. i. Elaborate the procedure to find the shortest path from source to all other vertices in the given graph using Bellman Ford algorithm and discuss how the dynamic programming strategy is applied for the same. **[8]**




   ii. State how Bellman Ford algorithm is used for detecting negative weight cycles. **[2]**

7. Describe flow networks and apply the Ford – Fulkerson algorithm using augmented paths to find the possible maximum flow through the given flow network.




Discuss the step by step procedure along with its terminologies and pseudocode.

8. Given the following set of points 'P' in a plane. Construct the smallest polygon Q such that each and every point in 'P' is either on the boundary or inside the polygon. Use the Graham's Scan algorithm to wrap the points given below in counter clockwise direction to find the polygon.

(2,1)(3,3)(5,4)(-2,2)(-3,1)(-4,3)(-1,-2)(-3,-4)(2,-3)(4,-4)

9. Write the pseudo code for solving hiring problem. Consider the cost to interview as ci per candidate and the cost to hire the candidate is ch. Analyze the performance and prove that when the n candidates are presented in random order, then algorithm Hire-Assistant has a hiring cost of O(ch ln n).

10. Prove clique decision problem is NP-complete with the help of the following 3 CNF Sat.

$$(a \vee \overline{b} \vee \overline{c}) \wedge (\overline{a} \vee b \vee c) \wedge (a \vee b \vee c)$$

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