Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2022

Subject Code:3150703 Date:09-01-2023

Subject Name:Analysis and Design of Algorithms

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Sort the best case running times of all these algorithms in a non-decreasing order. LCS, Quick-Sort, Merge-Sort, Counting-Sort, Heap-Sort, Selection-Sort, Insertion-Sort, Bucket-Sort, Strassen's Algorithm.	**03**
	(b)	State whether the statements are correct or incorrect with reasons. 1. $O(f(n)) + O(f(n)) = O(2f(n))$ 2. If $3n + 5 = O(n^2)$, then $3n + 5 = o(n^2)$	**04**
	(c)	Explain asymptotic analysis with all the notations and its mathematical inequalities.	**07**
Q.2	**(a)**	What is the use of Loop Invariant? What should be shown to prove that an algorithm is correct?	**03**
	(b)	Apply LCS on sequence <A,B,A,C,B,C> for pattern <A,B,C>	**04**
	(c)	Write and explain the recurrence relation of Merge Sort.	**07**
		OR	
	(c)	Perform the analysis of a recurrence relation T(n)= $2T\left(\frac{n}{2}\right) + \theta(n^2)$ by drawing its recurrence tree.	**07**
Q.3	**(a)**	Consider the array 2,4,6,7,8,9,10,12,14,15,17,19,20. Show (without actually sorting), how the quick sort performance will be affected with such input.	**03**
	(b)	"A greedy strategy will work for fractional Knapsack problem but not for 0/1", is this true or false? Explain.	**04**
	(c)	Apply Kruskal's algorithm on the given graph and step by step generate the MST.	**07**

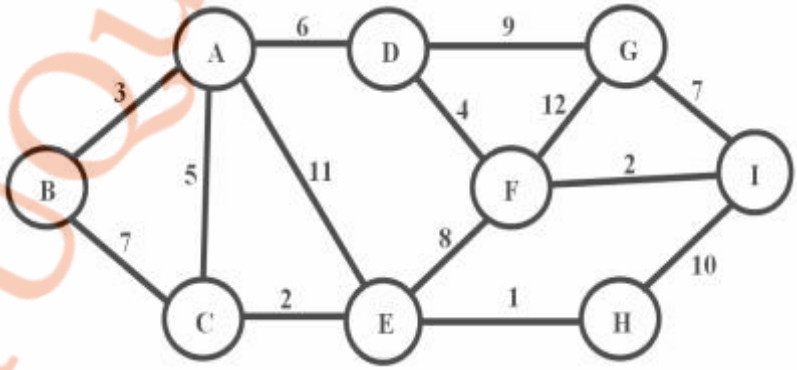


FIG:1

Graph G(V,E)

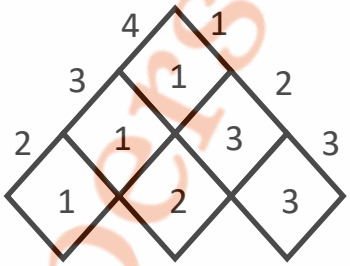
OR

Q.3 **(a)** Consider an array of size 2048 elements sorted in non-decreasing order. Show how the Binary Search will perform on this size by analysis of its recurrence relation. Derive the running time. **03**

(b) Explain the steps of greedy strategy for solving a problem. **04**

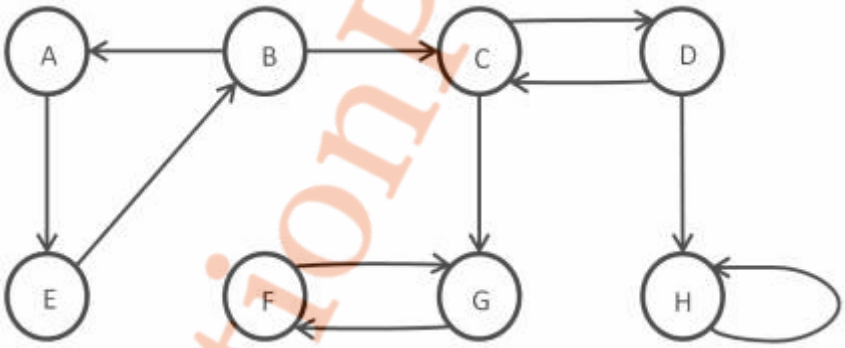
(c) Apply Prim's algorithm on the given graph in Q.3 (C) FIG:1 Graph G(V,E) and step by step generate the MST. **07**

Q.4 **(a)** Given is the S-table after running Chain Matrix Multiplication algorithm. Calculate the parenthesized output based on PRINT_OPTIMAL_PARENTHESIS algorithm. Assume the matrix are names from A_1, A_2, ….,A_n **03**



(b) Explain states, constraints types of nodes and bounding function used by backtracking and branch and bound methods. **04**

(c) Apply the algorithm to find strongly connected components from the given graph. **07**



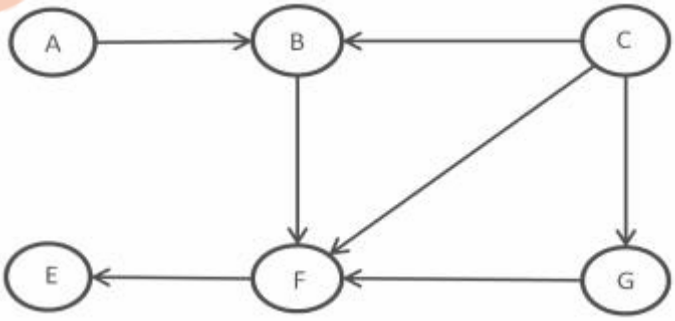
OR

Q.4 **(a)** Consider a Knapsack with maximum weight capacity M is 7, for the three objects with value <3, 4, 5> with weights <2, 3, 4> solve using dynamic programming the maximum value the knapsack can have. **03**

(b) Explain the Minimax principle and show its working for simple tic-tac-toe game playing. **04**

(c) **07**

Given is the DAG, apply the algorithm to perform topological sort and show the sorted graph.



Q.5	**(a)**	When can we say that a problem exhibits the property of Optimal Sub-structure?	**03**
	(b)	Create an example of string P of length 7 such that, the prefix function of KMP string matcher returns $\pi[5] = 3$, $\pi[3] = 1$ and $\pi[1] = 0$	**04**
	(c)	Explain the 3SAT problem and show that it is NP Complete.	**07**

OR

Q.5	**(a)**	Explain Over-lapping Sub-problem with respect to dynamic programming.	**03**
	(b)	Show that if all the characters of pattern P of size m are different, the naïve string matching algorithm can perform better with modification. Write the modified algorithm that performs better than O(n.m).	**04**
	(c)	Explain with example, how the Hamiltonian Cycle problem can be used to solve the Travelling Salesman problem.	**07**

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