GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2020

Subject Code:3150703 **Date:29/01/2021**

Subject Name:Analysis & Design of Algorithms

Time:10:30 AM TO 12:30 PM **Total Marks: 56**

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	(a)	What is an algorithm? Why analysis of algorithm is required?	03
	(b)	What is asymptotic notation? Find out big-oh notation of the $f(n)= 3n^2+5n+10$	04
	(c)	Write an algorithm for insertion sort. Analyze insertion sort algorithm for best case and worst case.	07
Q.2	(a)	What is the difference between selection sort and bubble sort?	03
	(b)	Write iterative and recursive algorithm for finding the factorial of N. Derive the time complexity of both algorithms.	04
	(c)	Solve following recurrence relation using iterative method $T(n)=2T(n / 2) + n$	07
Q.3	(a)	How divide and conquer approach work?	03
	(b)	Trace the quick sort for data A = {6,5,3,11,10,4,7,9}	04
	(c)	Explain master theorem and solve the recurrence $T(n)=9T(n/3)+n$ with master method	07
Q.4	(a)	Write the characteristics of greedy algorithm.	03
	(b)	Trace the merge sort for data A = {6,5,3,11,10,4,7,9}	04
	(c)	Find minimum spanning tree for the given graph in fig-1 using prim's algorithm	07

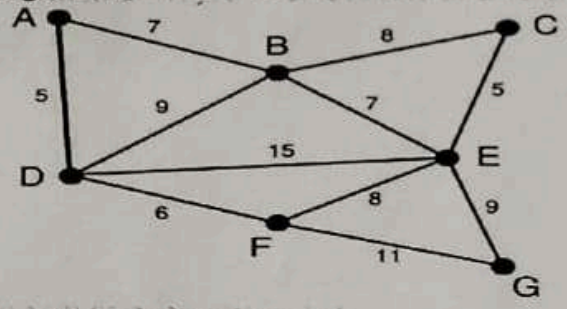

Fig-1

Q.5	(a)	How huffman code is memory efficient compare to fixed length code?	03
	(b)	Give difference between greedy approach and dynamic programming.	04
	(c)	Find the Huffman code for each symbol in following text ABCCDEBABFFBACBEBDFAAAABCDEEDCCBFEBFCAE	07
Q.6	(a)	What is principal of optimality? Explain its use in Dynamic Programming Method.	03
	(b)	Find out minimum number of multiplications required for multiplying: A[1 × 5], B[5 × 4], C[4 × 3], D[3 × 2], and E[2 × 1].	04
	(c)	Solve following knapsack problem using dynamic programming algorithm with given capacity W=5, Weight and Value are as follows :	07

(2,12),(1,10),(3,20),(2,15)

Q.7 **(a)** What is finite automata? How it can be used in string matching? **03**

(b) Differentiate BFS and DFS **04**

(c) Explain Backtracking Method. What is N-Queens Problem? Give solution of 4-Queens Problem using Backtracking Method. **07**

Q.8 **(a)** Explain Minimax principal. **03**

(b) Define P, NP, NP-complete, NP-Hard problems. **04**

(c) Explain rabin-karp string matching algorithm. **07**

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MADHUBEN & BHANUBHAI PATEL INSTITUTE OF TECHNOLOGY
(CONSTITUENT INSTITUTION OF CVMU)
BE – SEMESTER – 5(2ND WEEKLY TEST) – AUGUST 2022
102045601 – DESIGN AND ANALYSIS OF ALGORITHMS

DATE: 22ND AUGUST 2022 **TIME: 09:00 A.M. TO 09:30 A.M.** **MAXIMUM MARKS: 20**

Q-1	Solve Tower of Hanoi problem using recurrence.	**5 Marks**
Q-2	Write a program/algorithm of Merge Sort Method and analyze it with example.	**5 Marks**
Q-3	Explain the use of Divide and Conquer Technique for Binary Search Method. What is the complexity of binary Search Method? Explain it with example.	**5 Marks**
Q-4	Explain in brief characteristics of greedy algorithms.	**5 Marks**
	OR	
Q-4	Explain Strassen's Matrix multiplication with example.	**5 Marks**

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Enrollment No. 120020401176

MADHUBEN AND BHANUBHAI PATEL INSTITUTE OF TECHNOLOGY

(CONSTITUENT INSTITUTION OF CVMU)

BE – SEMESTER - 5 WEEKLY TEST – JULY 2022

Design and Analysis of Algorithm (102045601)

Date: 25-07-2022 **Time: 9:00 AM to 9:30 AM** **Maximum Marks: 20**

Q.1. Answer the Following. (Each question carries one mark). **[10]**

1) The way a card game player arranges his cards as he picks them one by one can be compared to which sorting algorithm. Selection
2) Provide the increasing order of asymptotic complexity of functions f1, f2, f3 and f4?
   f1(n) = 2^n , f2(n) = n^(3/2) , f3(n) = nLogn ,f4(n) = n^(Logn)
3) How many numbers of comparisons are required in insertion sort to sort a file if the file is already sorted? n-1
4) The worst-case time complexity of Bubble Sort is n^2.
5) In a Max heap the largest key is at root.
6) Define algorithm?
7) What is asymptotic notation?
8) List out asymptotic notation Θ, Ω, O
9) List out the algorithms for sorting in linear time. Bucket, Counting
10) List characteristics of algorithm?

Q.2 A) Solve Following Recurrence relation using substitution method **[5]**

a. $T(n) = 1$,$n=0$

$T(n) = T(n-1) + 1$,$n>0$

B) Solve following Recurrence relation using Master Theorem. **[5]**

a. $T(n)=3T(n/2) + n$

b. $T(n)=2T(n/4) + n^2$

---------- All the best ----------

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– V (New) EXAMINATION – WINTER 2019

Subject Code: 2150703 **Date: 25/11/2019**

Subject Name: Analysis and Design of Algorithms

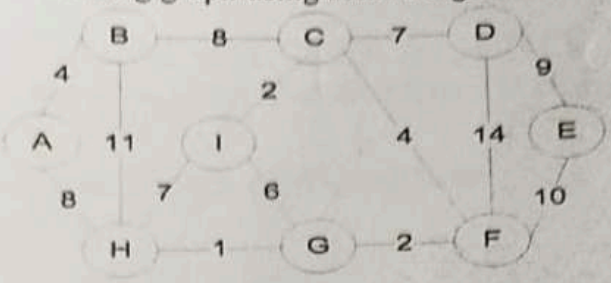
Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	(a)	Find Omega (Ω) notation of function $f(n)=2n^2 + 6\,n * \lg n + 6n$.	03
	(b)	Define Big-oh and Theta notations with graph.	04
	(c)	Write sequential search algorithm and analyze it for worst case time complexity. Represent its time complexity using Big-oh (O) notation.	07
Q.2	(a)	Find upper bound of function $f(n)= \lg(n^2) + n^2 \lg n$.	03
	(b)	If $P(n) = a_0 + a_1 n + a_2 n^2 + \ldots\ldots + a_m n^m$ then prove that $P(n) = O(n^m)$. Here $a_0, a_1, a_2 \ldots\ldots a_m$ are constants and $a_m > 0$.	04
	(c)	Solve following recurrence relation using suitable method and express your answer using Big-oh (O) notation. $T(n) = T(n/3) + T(2n/3) + \Theta(n)$	07
		OR	
	(c)	Solve following recurrence relation using suitable method and express your answer using Big-oh (O) notation. $T(n) = 2\,T(n/2) + n^2$	07
Q.3	(a)	If $T_1(n) = O(f(n))$ & $T_2(n) = O(g(n))$ then prove that $T_1(n) + T_2(n) = \max(O(g(n)), O(f(n)))$.	03
	(b)	Illustrate the working of the quick sort on input instance: 25, 29, 30, 35, 42, 47, 50, 52, 60. Comment on the nature of input i.e. best case, average case or worst case.	04
	(c)	Write greedy algorithm for activity selection problem. Give its time complexity. For following intervals, select the activities according to your algorithm. I_1 (1-3), I_2 (0-2), I_3 (3-6), I_4 (2-5), I_5 (5-8), I_6 (3-10), I_7 (7-9).	07
		OR	
Q.3	(a)	Arrange following growth rates in increasing order. $O(n^{1/4}), O(n^{1.5}), O(n^3 \lg n), O(n^{1.02}), \Omega(n^6), \Omega(n!), O(\sqrt{n}), O(n^{6/2}), \Omega(2^n)$	03
	(b)	Illustrate the working of the merge sort algorithm on input instance: 10, 27, 30, 88, 17, 98, 42, 54, 72, 95. Also write best case time complexity of merge sort algorithm.	04

(c) What is a minimum spanning tree? Draw the minimum spanning tree correspond to following graph using Prim's algorithm. **07**



Q.4 (a) What is Principle of Optimality? Explain it with example. **03**

(b) Consider the instance of the 0/1 (binary) knapsack problem as below with P depicting the value and W depicting the weight of each item whereas M denotes the total weight carrying capacity of the knapsack. Find optimal answer using greedy design technique. Also write the time complexity of greedy approach for solving knapsack problem. **04**

P = [40 10 50 30 60] W = [80 10 40 20 90] M = 110

(c) Find the optimal way of multiplying following matrices using dynamic programming. Also indicate optimal number of multiplications required. **07**

A:3 x 2, B: 2 x 5, C:5 x 4, D: 4 x 3, E: 3 x 3

OR

Q.4 (a) Explain depth first traversal using suitable example. **03**

(b) Explain Binomial Coefficient algorithm using dynamic programming. **04**

(c) Find the longest common subsequence for the following two sequences using dynamic programming. Show the complete process. **07**

X = 100101001

Y = 101001

Q.5 (a) Define P and NP problems. Also give example of each type of problem. **03**

(b) Draw the state space tree diagram for 4 Queen problem and also show the tree after applying backtracking. **04**

(c) Explain Rabin – Karp algorithm with example. What is expected running time of this algorithm? **07**

OR

Q.5 (a) Define NP-Complete and NP-Hard problems. Also give examples. **03**

(b) Explain the naive string matching algorithm. **04**

(c) State whether Hamiltonian problem is a NP-Complete problem? Justify your answer. **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– V (New) EXAMINATION – WINTER 2019

Subject Code: 2150703 **Date: 25/11/2019**

Subject Name: Analysis and Design of Algorithms

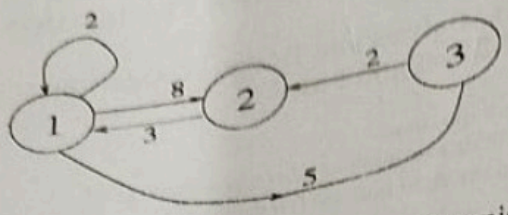
Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

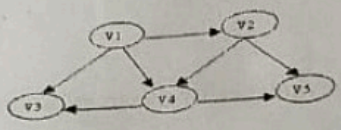
			MARKS
Q.1	(a)	Find Omega (Ω) notation of function $f(n)=2n^2 + 6\,n * \lg n + 6n$.	03
	(b)	Define Big-oh and Theta notations with graph.	04
	(c)	Write sequential search algorithm and analyze it for worst case time complexity. Represent its time complexity using Big-oh (O) notation.	07
Q.2	(a)	Find upper bound of function $f(n)= \lg(n^2) + n^2 \lg n$.	03
	(b)	If $P(n) = a_0 + a_1 n + a_2 n^2 + \ldots\ldots + a_m n^m$ then prove that $P(n) = O(n^m)$. Here $a_0, a_1, a_2 \ldots\ldots a_m$ are constants and $a_m > 0$.	04
	(c)	Solve following recurrence relation using suitable method and express your answer using Big-oh (O) notation. $T(n) = T(n/3) + T(2n/3) + \Theta(n)$	07
		OR	
	(c)	Solve following recurrence relation using suitable method and express your answer using Big-oh (O) notation. $T(n) = 2\,T(n/2) + n^2$	07
Q.3	(a)	If $T_1(n) = O(f(n))$ & $T_2(n) = O(g(n))$ then prove that $T_1(n) + T_2(n) = \max(O(g(n)), O(f(n)))$.	03
	(b)	Illustrate the working of the quick sort on input instance: 25, 29, 30, 35, 42, 47, 50, 52, 60. Comment on the nature of input i.e. best case, average case or worst case.	04
	(c)	Write greedy algorithm for activity selection problem. Give its time complexity. For following intervals, select the activities according to your algorithm. I_1 (1-3), I_2 (0-2), I_3 (3-6), I_4 (2-5), I_5 (5-8), I_6 (3-10), I_7 (7-9).	07
		OR	
Q.3	(a)	Arrange following growth rates in increasing order. $O(n^{1/4}), O(n^{1.5}), O(n^3 \lg n), O(n^{1.02}), \Omega(n^6), \Omega(n!), O(\sqrt{n}), O(n^{6/2}), \Omega(2^n)$	03
	(b)	Illustrate the working of the merge sort algorithm on input instance: 10, 27, 30, 88, 17, 98, 42, 54, 72, 95. Also write best case time complexity of merge sort algorithm.	04

(c) Solve all pair shortest path problem for the following graph using Floyd's algorithm. 07



Q.4 (a) What are the disadvantages of greedy method over dynamic programming method? 03

(b) What is DFS? Explain with example. Show the ordering of vertices produced by Topological-sort for the following graph. 04



(c) Solve the following Knapsack Problem using greedy method. Number of items = 5, knapsack capacity W = 100, weight vector = {50, 40, 30, 20, 10} and profit vector = {1, 2, 3, 4, 5}. 07

OR

Q.4 (a) Write an algorithm for Huffman code. 03

(b) What is an approximation algorithm? Explain performance ratio for approximation algorithm. 04

(c) Explain use of branch and bound technique for solving assignment problem. 07

Q.5 (a) Write Naive string-matching algorithm. Explain notations used in the algorithm. 03

(b) Explain polynomial-time reduction algorithm. 04

(c) Working modulo q = 11. How many spurious hits does the Rabin-Karp matcher encounter in the text T = 3141592653589793 when looking for the pattern P =26? 07

OR

Q.5 (a) Which are the three major concepts used to show that a problem is an NP-Complete problem? 03

(b) Explain breadth first search with example. 04

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2018

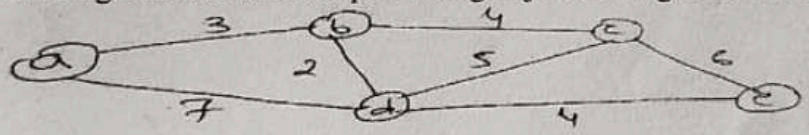
Subject Code:2150703 **Date:27/11/2018**

Subject Name:Analysis and Design of Algorithms

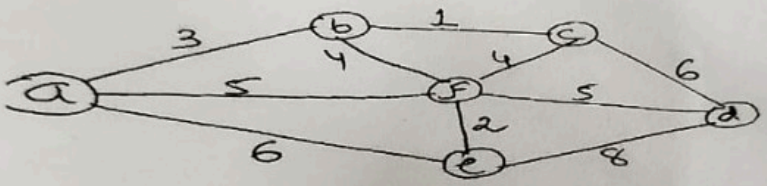
Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	(a)	Define Algorithm, Time Complexity and Space Complexity.	03
	(b)	Differentiate branch and bound and back tracking algorithm.	04
	(c)	Analyze Selection sort algorithm in best case and worst case.	07
Q.2	(a)	Solve the recurrence $T(n) = 7T(n/2) + n^3$	03
	(b)	Explain: Articulation Point, Graph, Tree	04
	(c)	Write Merge sort algorithm and compute its worst case and best-case time complexity. Sort the List G,U,J,A,R,A,T in alphabetical order using merge sort.	07
		OR	
	(c)	Consider Knapsack capacity W=9, w = (3,4,5,7) and v=(12,40,25,42) find the maximum profit using dynamic method.	07
Q.3	(a)	Differentiate the Greedy And Dynamic Algorithm.	03
	(b)	Demonstrate Binary Search method to search Key = 14, form the array A=<2,4,7,8,10,13,14,60> .	04
	(c)	Solve Making change problem using dynamic technique. d1 = 1, d2=2, d3=4, d3=6, Calculate for making change of Rs. 10.	07
		OR	
Q.3	(a)	Find out the NCR $\binom{5}{3}$ Using Dynamic Method.	03
	(b)	Find single source shortest path using Dijkstra's algorithm form a to e.	04
			
	(c)	For the following chain of matrices find the order of parenthesization for the optimal chain multiplication (13,5,89,3,34).	07
Q.4	(a)	Explain Tower of Hanoi Problem, Derive its recursion equation and computer it's time complexity.	03
	(b)	Explain finite automata algorithm for string matching.	04
	(c)	Find out LCS of A={K,A,N,D,L,A,P} and B = {A,N,D,L}	07
		OR	
Q.4	(a)	Explain Principle of Optimality with example.	03
	(b)	Define BFS. How it is differ from DFS.	04
	(c)	Solve the following instance of knapsack problem using Backtracking Technique. The Capacity of the Knapsack W = 8 and w = (2,3,4,5) and value v = (3,5,6,10)	07
Q.5	(a)	Draw the state space tree Diagram for 4 Queen problem.	03
	(b)	Define P, NP, NP-Hard and NP-Complete Problem.	04

(c) Find out the Minimum Spanning Tree using Kruskal Algorithm for given Graph. **07**

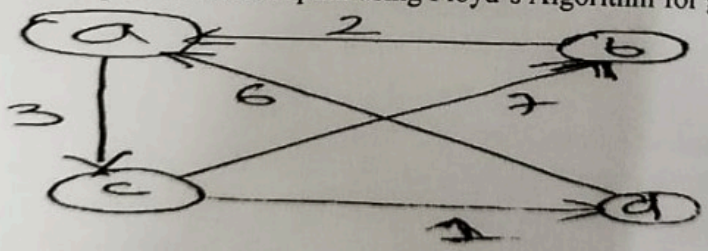


OR

Q.5 (a) Explain naïve string matching algorithm with example. **03**

(b) Explain DFS algorithm in brief. **04**

(c) Find all pair of shortest path using Floyd's Algorithm for given graph **07**



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Seat No.: _____ Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2021

Subject Code:3150703 **Date:17/12/2021**

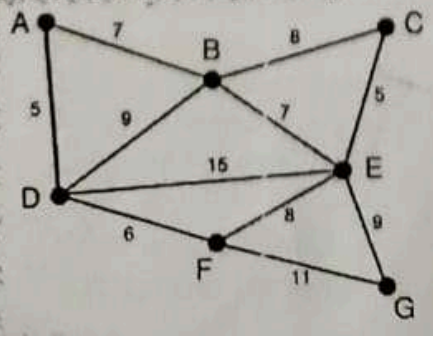
Subject Name:Analysis and Design of Algorithms

Time:02:30 PM TO 05:00 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)	Define algorithm. Discuss key characteristics of algorithms.	03
	(b)	Explain why analysis of algorithms is important? Explain: Worst Case, Best Case and Average Case Complexity with suitable example.	04
	(c)	Write and analyze an insertion sort algorithm to arrange n items into ascending order.	07
Q.2	(a)	Write an algorithm of Selection Sort Method.	03
	(b)	Sort the following numbers using heap sort. 20, 10, 50, 40, 30	04
	(c)	Sort the following list using quick sort algorithm: <50, 40, 20, 60, 80, 100, 45, 70, 105, 30, 90, 75> Also discuss worst and best case of quick sort algorithm.	07
		OR	
	(c)	Apply merge sort algorithm on array A = {2,7,3,5,1,9,4,8}. What is time complexity of merge sort in worst case?	07
Q.3	(a)	What is Principle of Optimality? Explain its use in Dynamic Programming Method	03
	(b)	Explain Binomial Coefficient algorithm using dynamic programming.	04
	(c)	Solve the following 0/1 Knapsack Problem using Dynamic Programming. There are five items whose weights and values are given in following arrays. Weight w [] = {1,2,5,6,7} Value v [] = {1, 6, 18, 22, 28} Show your equation and find out the optimal knapsack items for weight capacity of 11 units.	07
		OR	
Q.3	(a)	Compare Dynamic Programming Technique with Greedy Algorithms	03
	(b)	Give the characteristics of Greedy Algorithms.	04
	(c)	Obtain longest common subsequence using dynamic programming. Given A = "acabaca" and B = "bacac".	07
Q.4	(a)	Using greedy algorithm find an optimal schedule for following jobs with n=7 profits: (P1, P2, P3, P4, P5, P6, P7) = (3, 5, 18, 20, 6, 1, 38) and deadline (d1, d2, d3, d4, d5, d6, d7) = (1, 3, 3, 4, 1, 2, 1)	03
	(b)	Find Minimum Spanning Tree for the given graph using Prim's Algo.	04

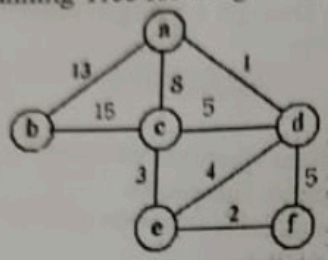


(c) Explain in brief Breadth First Search and Depth First Search Traversal techniques of a Graph with Example. 07

OR

Q.4 (a) Find an optimal Huffman code for the following set of frequency. A : 50, b: 20, c: 15, d: 30 03

(b) Find Minimum Spanning Tree for the given graph using Kruskal Algo. 04



(c) Explain Backtracking Method. What is N-Queens Problem? Give solution of 4- Queens Problem using Backtracking Method 07

Q.5 (a) Define Articulation point, Acyclic Directed Graph, Back Edge 03

(b) Show the comparisons that naïve string matcher makes for the pattern p=0001 in the text T=000010001010001 04

(c) Explain spurious hits in Rabin-Karp string matching algorithm with example. Working modulo q=13, how many spurious hits does the Rabin-Karp matcher encounter in the text T = 2359023141526739921 when looking for the pattern P = 31415? 07

OR

Q.5 (a) Explain polynomial reduction. 03

(b) Differentiate branch and bound and back tracking algorithm. 04

(c) Explain P, NP, NP complete and NP-Hard problems. Give examples of each 07

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2018

Subject Code:2150703 **Date:04/05/2018**

Subject Name:Analysis and Design of Algorithms

Time:02:30 PM to 05:00 PM **Total Marks: 70**

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q.1 **(a)** Define Algorithm. Discuss key characteristics of algorithm. **03**

(b) Prove or disprove that $f(n) = 1 + 2 + 3 + ... + n \in \Theta(n^2)$. **04**

(c) Which are the basic steps of counting sort? Write counting sort algorithm. Derive its time complexity in worst case. **07**

Q.2 **(a)** What are the advantages of dynamic programming method over devide-&-conquer method? **03**

(b) Solve following recurrence using recursion tree method: $T(n) = 3T(n/3) + n^3$. **04**

(c) Write standard(conventional) algorithm and Strassen's algorithm for matrix multiplication problem. What is the recurrence for Strassen's algorithm? Solve it using master method to derive time complexity of Strassen's algorithm. **07**

OR

(c) Discuss best case, average case and worst case time complexity of quick sort. **07**

Q.3 **(a)** Justify with example that shortest path problem satisfies the principle of optimality. **03**

(b) Which are the three basic steps of the development of the dynamic programming algorithm? Mention any two examples of dynamic programming that we are using in real life. **04**

(c) Solve the following making change problem using dynamic programming method: Amount = Rs. 7 and Denominations: (Rs. 1, Rs. 2 and Rs. 4) **07**

OR

Q.3 **(a)** Justify with example that longest path problem does not satisfy the principle of optimality. **03**

(b) Discuss general characteristics of greedy method. Mention any two examples of greedy method that we are using in real life. **04**

Q.5	(a)	Explain in brief socket, multiplexing and demultiplexing.	03
	(b)	How DHCP protocol works?	04
	(c)	Explain TCP segment structure and justify the importance of its field values.	07

OR

Q.5	(a)	Describe how a botnet can be created, and how it can be used for a DDoS attack.	03
	(b)	What do you mean by random access protocols? Explain slotted ALOHA in brief.	04
	(c)	Explain IPv4 datagram format and importance of each field	07