Printed Page:- 04 **Subject Code:- ACSE0501**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: V - THEORY EXAMINATION (2023-2024)

Subject: Design and Analysis of Algorithms

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* **three Sections -A, B, & C.** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION A **20**

1. Attempt all parts:-

1-a. If $f(x) = 3x^2 + x^3\log x$, then f(x) is? (CO1) 1

(a) $O(x^2)$

(b) $O(x^3)$

(c) O(x)

(d) O(1)

1-b. The Worst case occur in linear search algorithm when: (CO1) 1

(a) Item is somewhere in the middle of the array

(b) tem is not in the array at all

(c) Item is the last element in the array

(d) Item is the last element in the array or is not there at all

1-c. The main distinguishable characteristic of a binomial heap from a binary heap is that. (CO2) 1

(a) it allows union operations very efficiently

(b) it does not allow union operations that could easily be implemented in

binary heap

(c) the heap structure is not similar to complete binary tree

(d) the location of child node is not fixed i.e child nodes could be at level (h-2) or (h-3), where h is height of heap and h>4

1-d. How can you save memory when storing color information in Red-Black tree? (CO2) 1

(a) using least significant bit of one of the pointers in the node for color information

(b) using another array with colors of each node

(c) storing color information in the node structure

(d) using negative and positive numbering

1-e. Breadth First Search algorithm uses which of the following data structures? (CO3) 1

(a) Fibonacci Heaps

(b) Linked List

(c) Min-Priority Queue

(d) Stack

1-f. Time complexity of Fractional Knapsack problem is (CO3) 1

(a) O(n)

(b) O(lg n)

(c) O(2 n)

(d) O(n lg n)

1-g. Consider the brute force implementation in which we find all the possible ways of multiplying the given set of n matrices. What is the time complexity of this implementation? (CO4) 1

(a) O(n!)

(b) O(n3)

(c) O(n2)

(d) Exponential

1-h. In dynamic programming, the technique of storing the previously calculated values is called (CO4) 1

(a) Saving value property

(b) Storing value property

(c) Memoization

(d) Mapping

1-i. Problems that can be solved in polynomial time are known as? (CO5) 1

(a) intractable

(b) tractable

(c) decision

(d) complete

1-j. Travelling Salesman Problem belongs to. (CO5) 1

(a) NP-Complete Problem

(b) NP-Hard Problem

(c) NP-soft Problem

(d) None of them

2. Attempt all parts:-

2.a. Find the Time Complexity through substitution method. (CO1) 2

T(n) = 1 , if n=1

T(n)= T(n-1) + Log(n) , if n>1

2.b. What are the basic operation on B-Tree? (CO2) 2

2.c. Point out the pros of Kruskal's Algorithm. (CO3) 2

2.d. What is time complexity of Longest Common Subsequence problem? (CO4) 2

2.e. Define theory of completeness. (CO5) 2

SECTION B **30**

3. Answer any <u>five</u> of the following:-

3-a. Explain asymptotic notations with example. (CO1) 6

3-b. What do you understand by stable and unstable sorting? Sort the following sequence { 25, 57, 48, 36, 12, 91, 86, 32} using Heap Sort. (CO1) 6

3-c. Write an algorithm for union of two Binomial Heap tree. Also explain with example .(CO2) 6

3-d. Insert the following keys into empty B-tree: 40,35,22,90,12,45,58,78,67,60 and m=4. (CO2) 6

3.e. Implement Prim's algorithm. Take an example and find MST of any graph using Prim's algorithm. (CO3) 6

3.f. What is the sum of subsets problem? Let w={5,7,10,12,15,18,20} and m=35. Find all possible subsets of w that sum to m using recursive backtracking algorithm for it. Draw the portion of the state-space tree that is generated. (CO4) 6

3.g. Give some examples of P and NP problem. (CO5) 6

SECTION C **50**

4. Answer any <u>one</u> of the following:-

4-a. Solve the recurrence relation ? By using recursion tree Method or Back Substitution method. (CO1) 10

T(n)=1, If n=0

T(n)=2T(n-1)+1,if n>0

4-b. Explain the algorithm of counting sort. Illustrate the operation of counting sort on the following array A = {0,1,3,0,3,2,4,5,2,4,6,2,2,3}. (CO1) 10

5. Answer any <u>one</u> of the following:-

5-a. Discuss the various cases for insertion of key in red-black tree for given sequence of key in an empty red-black tree- {15,13,12,16,19,23,5,8}. (CO2) 10

5-b. Explain the algorithm to delete a given element in a binomial Heap. Give an example for the same. (CO2) 10

6. Answer any <u>one</u> of the following:-

6-a. Describe the importance of pivot element in quick sort. How the position of it effect the performance of quick sort. Explain with algorithm. (CO3) 10

6-b. Consider the following instances of the fractional knapsack problem: n = 3, M = 20, V = (24, 25, 15) and W = (18, 15, 20) find the feasible solutions. (CO3) 10

7. Answer any <u>one</u> of the following:-

7-a. Solve the instance of 0/1 knapsack problem using dynamic Programming : n = 4, M = 25, (P1, P2, P3 P4) = (10, 12, 14, 16), (W1, W2, W3, W4) = (9, 8, 12, 14) 10

7-b. Illustrate n queen's problem. Examine 4 queen's problem using back tracking method. (CO4) 10

8. Answer any <u>one</u> of the following:-

8-a. Describe in detail Knuth-Morris-Pratt string Matching Algorithm. Compute the prefix function π for the pattern ababbabbabbababbabb when the alphabet is $\sum$ = {a,b}. (CO5) 10

8-b. Define the following problems related to NPC: (CO5) 10

(i) Vertex Cover

(ii) Clique