Printed Page:- 04 **Subject Code:- AMICSE0401**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

M.Tech (Integrated)

SEM: IV - THEORY EXAMINATION - (2023 - 2024)

Subject: Design and Analysis of Algorithm

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. The Complexity of Linear Search Algorithm.(CO1) 1

(a) O(n)

(b) O(log n)

(c) O(nlog n)

(d) O(n2)

1-b. Shell sort algorithm is an example of? (CO1) 1

(a) External sorting

(b) Internal sorting

(c) Bottom-up sorting

(d) In-place sorting

1-c. When to choose Red-Black tree, AVL tree and B-trees?(CO2) 1

(a) many inserts, many searches and when managing more items respectively

(b) many searches, when managing more items respectively and many inserts respectively

(c) sorting, sorting and retrieval respectively

(d) retrieval, sorting and retrieval respectively

1-d. In B-tree maximum no of keys are _____if order 4 and of height 3 . (CO2) 1

(a) 255

(b) 63

(c) 127

(d) 188

1-e. Time complexity of Breadth First Search algorithm is : (CO3) 1

(a) O(E+V)

(b) O(V lg E)

(c) O(lg V)

(d) O(E lg E)

1-f. This algorithm is also called "General purpose sorting algorithm" (CO3) 1

(a) Heap sort

(b) Quick sort

(c) merge sort

(d) Counting sort

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. The Data structure used in standard implementation of Breadth First Search is: (CO4) 1

(a) Stack

(b) Queue

(c) Linked List

(d) Tree

1-i. Rabin and Karp Algorithm(CO5) 1

(a) String Matching Algorithm

(b) Shortest Path Algorithm

(c) Minimum spanning tree Algorithm

(d) Approximation Algorithm

1-j. Which of the following is true about NP-Complete and NP-Hard problems. (CO5) 1

(a) If we want to prove that a problem X is NP-Hard, we take a known NP-Hard problem Y and reduce Y to X

(b) The first problem that was proved as NP-complete was the circuit satisfiability problem.

(c) NP-complete is a subset of NP Hard

(d) All of the above

2. Attempt all parts:-

2.a.	Write down the characteristics of algorithm. (CO1)	2
2.b.	Define the properties of B-Tree. (CO2)	2
2.c.	Write short note on Prim's algorithm. (CO3)	2
2.d.	Describe subset sum problem. (CO4)	2
2.e.	Relationship between P, NP and NP Complete. (CO5)	2

SECTION-B 30

3. Answer any five of the following:-

3-a.	Consider an array of length 5, arr[5] = {9,7,4,2,1}. What are the steps of insertions done while running insertion sort on the array? (CO1)	6
3-b.	Write the the big-O notation for (CO1) $f(n) = (n\log n + n^2)(n^3 + 2)$ is?	6
3-c.	Insert the following keys into empty B-tree: 86, 23, 91, 4, 67, 18, 32, 54, 46, 96, 45 with degree t=2 and delete 18, 23 from it. (CO2)	6
3-d.	Write algorithm for extracting minimum element in a fibonacci heap. Also give example. (CO2)	6
3.e.	Define Quicksort . Show all the step for sort the following sequence in non-increasing order using Quicksort algorithm <8,9,1,3,2,4,7,5> (CO3)	6
3.f.	Show the solution of' 4 queen problem using backtracking approach with state space tree. (CO4)	6
3.g.	Explain how to implement an algorithm for Knapsack problem using NP-Hard approach. (CO5)	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	What is recurrence ? Explain all three methods to solve recurrence relation T(n). (CO1) 1)Subtitution Method 2)Recursive Tree Method 3)Master Theorem with Suitable example	10
4-b.	Examine the following recurrence relation: (CO1) (i) T (n) = T (n-1) + n 4 (ii) T (n) = T (n/4) + T (n/2) + n 2	10

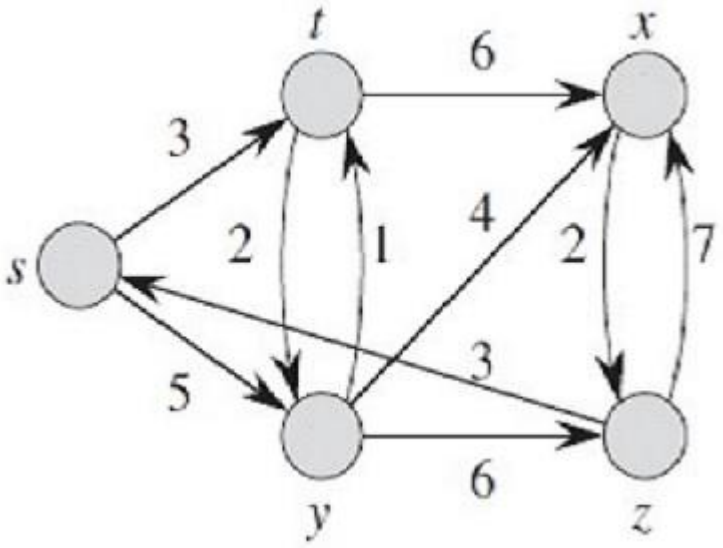
5. Answer any one of the following:-

5-a.	Explain insertion in RED-BLACK tree. Show step for inserting 9, 8,7,6,5,4,3,2 & 1into empty red black tree. (CO2)	10
5-b.	Write algorithm for union of two binomial heaps. Also write its complexity. (CO2)	10

6. Answer any one of the following:-

6-a.	Write Merge sort algorithm. Also Show all step for sort the following sequence in increasing order using merge sort algorithm: 1,9,3,4,10,6,7,8 (CO3)	10

6-b. Implement Prim's algorithm to find minimum spanning tree. Analyze its time complexity. Find MST of the given graph using Prim's algorithm. (CO3) 10



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

7-a. Consider the sum-of-subset problem, n = 4, Sum = 13, and w1 = 3, w2 = 4, w3 = 5 and w4 = 6. Find a solution to the problem using backtracking. Show the state-space tree leading to the solution. (CO4) 10

7-b. 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). (CO4) 10

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

8-a. Define the following problems related to NPC: (CO5) 10
(i) Vertex Cover
(ii) Clique
(iii) SAT and its variants

8-b. Explain the KMP String matching algorithm for finding the pattern on a text and analyze the algorithm. (CO5) 10