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.   Using asymptotic analysis, we can very well conclude the scenario of an   1
        algorithm. (CO1)

        (a) best case

        (b) average case

        (c) worst case

        (d) best case, average case, and worst case

1-b.   On which algorithm is heap sort based on? (CO1)   1

        (a) Priority queue

        (b) Fibonacci heap

        (c) FIFO

        (d) Binary tree

1-c.   Which one of the following property is correct for Red Black Tree ? (CO2)   1

        (a) Every simple path from a node to descendant leaf contain the same number of black nodes.

(b) If node is red , then one child is red and another is black.

(c) If node is red then both its children is red.

(d) Every leaf node (Sentinel node) is red.

1-d.   Which of the following is the most widely used external memory data   1
structure? (CO2)

    (a) AVL tree

    (b) B-tree

    (c) Red-black tree

    (d) Both AVL tree and Red-black tree

1-e.   What is the worst case complexity of convex hull? (CO3)   1

    (a) O(N)

    (b) O(N log N)

    (c) $O(N^2)$

    (d) O(log N)

1-f.   What is Best case time complexity of Merge Sort ? (CO3)   1

    (a) O(n lg n)

    (b) O(n)

    (c) O(n^2)

    (d) O(lg n)

1-g.   Which of the following is not Branch and Bound strategy to generate branches   1
? (CO4)

    (a) LIFO branch and bound

    (b) FIFO branch and bound

    (c) Lowest cost branch and bound

    (d) Highest cost branch and bound

1-h.   The travelling salesman problem can be solved in : (CO4)   1

    (a) Polynomial time using dynamic programming algorithm.

    (b) Polynomial time using branch and bound algorithm.

    (c) Exponential time using dynamic programming algorithm or branch and bound algorithm .

    (d) Polynomial time using backtracking algorithm

1-i.   The sum and composition of two polynomials are always polynomials. (CO5)   1

    (a) TRUE

(b) FALSE

(c) None

(d) Sometimes

1-j. Let X is a problem that belongs to the class NP. Then which one of the following is. (CO5) 1

    (a) There is no polynomial time algorithm for X.

    (b) If X can be solved deterministically in polynomial time, then P = NP.

    (c) If X is NP-hard, then it is NP-complete

    (d) X may be undecidable.

2. Attempt all parts:-

2.a. Briefly explain about asymptotic notations. (CO1) 2

2.b. Define three operations in red-black tree. (CO2) 2

2.c. Write short note on Dijkstra's algorithm. (CO2) 2

2.d. What are searching technique that are commonly used in Branch-and-Bound Method ? (CO4) 2

2.e. Write short note on Approximation Algorithm. (CO5) 2

SECTION B **30**

3. Answer any five of the following:-

3-a. Discuss Counting sort algorithm and sort the following sequence {4,1,3,4,6,6 } using same . (CO1) 6

3-b. Solve the following recurrence relation using Master's Theorem   (CO1) 6
$T(n) = 3T(n/2) + n^2$

3-c. Define RED-BLACK tree and write down it's properties. (CO2) 6

3-d. Prove that red-black tree with n internal nodes has height at most 2 log(n+1) (CO2) 6

3.e. Write down the Bellman Ford algorithm to solve single source shortest path problem. (CO3) 6

3.f. What is a Hamiltonian Cycle ? Explain how to find Hamiltonian path and cycle using backtracking algorithm. (CO4) 6

3.g. What is randomized algorithms? What is the concept behind randomized algorithms? (CO5) 6

SECTION C **50**

4. Answer any one of the following:-

4-a.	Solve the recurrence relation ? By using back Substitution Method. (CO1) T(n)=1 n=0 T(n)=T(n-1)+1 n>0	10
4-b.	Solve the recurrence (CO1) i) T (n) =3T (n/4) + cn using recursion tree method. ii) T (n) = n + 2T (n/2) using Iteration method. (Given T(1)=1)	10

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

5-a.	Define a B-Tree of order m. Insert the following keys into empty B-tree: 40,35,22,90,12,45,58,78,67,60 and m=4. (CO2)	10
5-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)	10

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

6-a.	Implement Quicksort algorithm. Step by Step sort the following sequence in ascending order using Quicksort algorithm <1,9,8,3,4,2,7,5>. Analyze the algorithm for average-case time complexity. (CO3)	10
6-b.	What is Knapsack problem? Solve Fractional knapsack problem using greedy programming for the following four items with their weights w = {3, 5, 9, 5} and values P = {45, 30, 45, 10} with knapsack capacity is 16. (CO3)	10

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

7-a.	Consider two strings A = "qpqrr" and B = "pqprqrp". Let x be the length of the longest common subsequence (not necessarily contiguous) between A and B and let y be the number of such longest common subsequences between A and B. Then x + 10y = ___. (CO4)	10
7-b.	Construct a planar graph for the following map. Explain how to find m-coloring of this planar graph by using an m-coloring Backtracking algorithm (CO4)	10

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

8-a.	Explain and Write the Knuth-Morris-Pratt algorithm for pattern matching also write its time complexity. (CO5)	10
8-b.	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