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.*

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SECTION A   20

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1. Attempt all parts:-

1-a.   Merge sort uses which of the following technique to implement sorting? (CO1)   1

        (a) backtracking

        (b) greedy algorithm

        (c) dynamic programming

        (d) divide and conquer

1-b.   The worst case complexity for insertion sort is (CO1)   1

        (a) $O(n)$

        (b) $O(\log n)$

        (c) $O(n\log n)$

        (d) $O(n^2)$

1-c.   What is the special property of red-black trees and what root should always   1
      be? (CO2)

        (a) color which is either red or black and root should always be black color
        only

(b) height of the tree

(c) pointer to next node

(d) a color which is either green or black

1-d.   Number of node at depth i in binomial heap B_k. (CO2)   1

(a) n^2

(b) n^3

(c) $^k c_i$

(d) 2^k

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

(a) O(V lg E)

(b) O(E+V)

(c) O(lg V)

(d) O(E lg E)

1-f.   We can solve Single-Source shortest path problem using (CO3)   1

(a) Kruskal's Algorithm

(b) Prim's Algorithm

(c) Dijkstra's Algorithm

(d) Flyod-Warshal Algorithm

1-g.   Depth First Search is equivalent to which of the traversal in the Binary Trees?   1
(CO4)

(a) Pre-order Traversal

(b) Post-order Traversal

(c) Level-order Traversal

(d) In-order Traversal

1-h.   Travelling salesman problem is an example of.....(CO4)   1

(a) Dynamic Algorithm

(b) Greedy Algorithm

(c) Recursive Approach

(d) Divide & Conquer

1-i.   Basic principle in Rabin Karp algorithm: (CO5)   1

(a) Hashing

(b) Sorting

(c) Augmenting

(d) Dynamic Programming

1-j. What does NP stands for in complexity classes' theory? (CO5)   1

    (a) Non polynomial

    (b) Non-deterministic polynomial

    (c) Both (a) and (b)

    (d) None of the mentioned

2. Attempt all parts:-

2.a. Write the difference between an Algorithm and a Program .(CO1)   2

2.b. Define Binomial heap.(CO2)   2

2.c. Write the procedure to relax an edge (u ,v). (CO3)   2

2.d. Explain N-Queen problem with its complexity? (CO4)   2

2.e. Compare NP-hard and NP-completeness. (CO5)   2

SECTION B   30

3. Answer any five of the following:-

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

3-b. Solve the following recurrence relation using master's theorem (CO1)   6
$T(n) = 7T(n/2) + 3n^2 + 2$

3-c. Insert the nodes 15, 13, 12, 16, 19, 23, 5, 8 into empty Red Black Tree (CO2)   6

3-d. Explain the algorithm to delete a given element in a binomial Heap. Give an example for the same. (CO2)   6

3.e. Write algorithm to solve fractional knapsack problem. For the given items find the optimal solution: I:, W: <60, 20, 40, 30, 50>, P: <120, 100, 90, 90, 50>, capacity of knapsack = 100. (CO3)   6

3.f. Write an algorithm of Sum-of-subset problem using backtracking approach. Find all possible solution for following instances using same if m=30 and S=< 1,2,5,7,8,10,15,20,25>. (CO4)   6

3.g. Define Hamiltonian path? Generalize that Hamiltonian cycle is an undirected graph. (CO5)   6

SECTION C   50

4. Answer any one of the following:-

4-a. Solve the following recurrences using master method. (CO1)   10
(i) T(n) = 4 T(n/2) + n2
(ii) T(n) = 2T(n/2) + n2 / lg2 n
(iii) T(n) = 2T(n/3) + n2

4-b.   Write the algorithm of Counting sort? Sort the following elements using Counting sort algorithm < 4, 8, 4, 2, 9, 9, 6, 2, 9> (CO1)   10

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

5-a.   Write algorithm for extracting minimum element in a fibonacci heap. Also give example? (CO2)   10

5-b.   Insert the following element in an initially empty RB-Tree. 12, 9, 81, 76, 23, 43, 65, 88, 76, 32, 54. Now Delete 23 and 81. (CO2)   10

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

6-a.   Explain data compression techniques? Write algorithm to implement Huffman code and analyze the algorithm step by step. Find the Huffman code for the character of given text file Character Frequency:<45, 25, 20, 5, 10, 15>   (CO3)   10

6-b.   How Divide and Conquer technique is used to solve a problem efficiently? Explain the use of pivot element in Quick sort. Write the algorithm for quick sort.   10

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

7-a.   Explain 8 queen problem. Make a state space tree and find the solution for 8 queens problem.(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.   Discuss in detail about the class P, NP, NP-hard and NP-complete problems. Give examples for each class. (CO5)   10

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