Roll No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech.

(SEM- V  THEORY EXAMINATION(2022-2023)

Subject **Design & Analysis of Algorithms**

Time: 3Hours                                                                   Max. Marks:100

General Instructions:

IMP: Verify that you have received question paper with 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 worst case runtime of linear search(recursive) algorithm (CO1)                   1

a) O(n)
b) O(logn)
c) $O(n^2)$
d) O(nx)

1-b.      The recurrence relation for the linear search recursive algorithm (CO1)             1

a)T(n-2)+c
b) 2T(n-1)+c
c) T(n-1)+c
d) T(n+1)+c

1-c.      Which of the following is the most widely used external memory data structure?       1

(CO2)

a)AVL Tree
b) B-Tree
c) Red Blac Tree
d) Binomial Heap

1-d.      What are the operations that could be performed in O(log n) time complexity by red-   1

black tree?  (CO2)

a) insertion
b)  deletion,

c)  finding predecessor

d) All

1-e.        Which of the following sorting algorithm is stable? (CO3)       1

a) Selection sort

b) Quick sort

c) Binary insertion sort

d) Heap sort

1-f.        Worst case of quick sort is? (CO3)       1

a)Elements are sorted

b)  Elements are sorted in reverse order

c)  Elements are random order sorted

d)  Elements are unsorted

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

a) Stack

b) Queue

c) Linked List

d) Tree

1-h.        In Depth First Search, how many times a node is visited? (CO4)       1

a) Once

b) Twice

c) Equivalent to number of indegree of the node

d) Thrice

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

a)Hashing

b) Sorting

c) Augmenting

d) Dynamic programming

1-j.        Which of the following are the examples of NP-complete Problem (CO5)       1

a) Knapsack problem

b)  Hamiltonian path problem.

c) Subset sum problem

d) All above

2.  Attempt all parts:-

| | | |
|---|---|---|
| 2.a. | List the fundamental steps involved in algorithmic problem solving? (CO1) | 2 |
| 2.b. | Define binomial heap.  (CO2) | 2 |
| 2.c. | Briefly explain the Prim's algorithm (CO3) | 2 |
| 2.d. | Define principle of optimality (CO4) | 2 |
| 2.e. | Define P, NP and NP Complete in decision problem (CO5) | 2 |

SECTION – B

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

| | | |
|---|---|---|
| 3-a. | Explain the concepts of Counting sort and analyse its complexity with suitable example.(CO1) | 6 |
| 3-b. |  Discuss Insertion sort algorithm and analyse it with an example.(CO1) | 6 |

| | | | | |
|---|---|---|---|---|
| 3-c. | Insert the nodes 15 , 13 , 12 , 16 , 19 , 23 , 5 , 8 in empty Red Black tree and delete in the reverse order of insertion.(CO2) | | | 6 |
| 3-d. | Discuss the union operation of Binomial heap with an example. (CO2) | | | 6 |
| 3-e. | Consider following instance for simple knapsack problem. Find the solution using greedy method. (CO3)<br>N=8<br>P= {11,21,31,33,43,53,55,65}<br>W= {1,11,21,23,33,43,45,55}<br>M=110 | | | 6 |
| 3-f. | What is backtracking ? Write general iterative algorithm for backtracking. (CO4) | | | 6 |
| 3-g. | What is travelling salesman problem? Find the solution of following travelling salesman. (CO5)<br>Cost matrix = | | | 6 |

| ∞ | 20 | 30 | 10 | 11 |
|---|---|---|---|---|
| 15 | ∞ | 16 | 4 | 2 |
| 3 | 5 | ∞ | 2 | 4 |
| 19 | 6 | 18 | ∞ | 3 |
| 16 | 4 | 7 | 16 | ∞ |

SECTION – C

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

| 4-a. | What is heap sort? Apply heap sort algorithm for sorting 1,2,3,4,5,6, 7,8,9, 10. Also deduce time complexity of heap sort.(CO1) | 10 |
|---|---|---|
| 4-b. | Solve the given recurrence $T(n)= 4T(n/4)+n$ . Explain the Growth of an functions with an example.(CO1) | 10 |

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

| 5-a. | Explain insertion in Red Black Tree. Show steps for inserting 1, 2, 3. 4, 5, 6, 7, 8 ,9 into empty RB tree.(CO2) | 10 |
|---|---|---|
| 5-b. | Discuss the Fibonacci heap extract min operation on given example. ( CO2) | 10 |
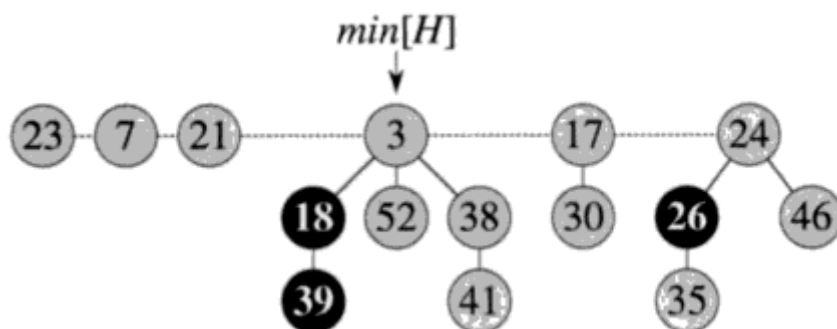


6. Answer any <u>one</u> of the following-

| 6-a. | Discuss knapsack problem with respect to dynamic programming approach. Find the optimal solution for given solution for given problem, w (weight set) ={5, 10. 15,20} and W (Knapsack size) = 25, V(value set)={50, 60 120, 100}.(CO3) | 10 |
|---|---|---|
| 6-b. | Using Strassen's matrix multiplication multiply the following matrices. (CO3) | 10 |

$$A = \begin{bmatrix} 2 & 4 \\ 3 & 2 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix}$$

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

| 7-a. | Discuss the matrix chain multiplication algorithm with the example using four matrices.(CO4) | 10 |
|---|---|---|

| | | |
|---|---|---|
| 7-b. | Write an algorithm for solving n-queen problem. Show the solution of 4 queen problem using backtracking approach.(CO4) | 10 |

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

| | | |
|---|---|---|
| 8-a. | Prove the three coloring problem is NP Complete. (CO5) | 10 |
| 8-b. | What is string matching algorithm? Explain Rabin-Karp method with examples.(CO5) | 10 |