Printed Page:- 04 Subject Code:- BMICSE0301

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

M.Tech (Integrated)

SEM: III - THEORY EXAMINATION (2024 - 2025)

Subject: Data Structures and Algorithm- I

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

1. Attempt all parts:-

1-a. Which asymptotic notation provides the tightest bound on the runtime of an algorithm? (CO1,K1) 1

(a) Big-Oh

(b) Big-Theta

(c) Big Omega

(d) Little Oh

1-b. For the recurrence $T(n)=3T(\frac{n}{3})+nlogn$, what is the time complexity? (CO1,K1) 1

(a) O(nlog2n)

(b) O(log2n)

(c) O(n2)

(d) O(log3n)

1-c. What is the index formula for accessing an element in a 2-D array with 4 rows and 5 columns (row-major)? (CO2,K1) 1

(a) (i×5+j)

(b) (i×4+j)

(c) (i×j+5)

(d) (i+j×4)

1-d. How many comparisons are needed to search in a sorted array of 1000 elements 1

using Binary Search? (CO2,K1)

(a) At most 9
(b) At most 10
(c) At most 11
(d) Exactly 10

1-e. What is the primary disadvantage of a singly linked list compared to an array? (CO3, K1) 1

(a) Dynamic size
(b) Slow access time
(c) Requires more memory
(d) Simple structure

1-f. Each node in a polynomial linked list contains: (CO3, K1) 1

(a) Coefficient and exponent
(b) Only coefficients
(c) Only exponents
(d) Degree of the polynomial

1-g. Explain the disadvantage of recursion in solving large problems. (CO4,K1) 1

(a) Memory overhead
(b) Simplified logic
(c) Faster execution
(d) Less readable code

1-h. What does the following stack operation output? Push(1), Push(2), Push(3), Pop(), Pop(), Push(4), Pop()? (CO4,K3) 1

(a) 1
(b) 2
(c) 3
(d) 4

1-i. Which of the following is a common application of the Divide and Conquer approach in numerical analysis? (CO5, K1) 1

(a) Numerical integration
(b) Numerical differentiation
(c) Solving differential equations
(d) All of the above

1-j. What is the time complexity of the Divide and Conquer algorithm for solving the Merge Sort problem? (CO5,K1) 1

(a) O(n log n)
(b) O(n^2)
(c) O(n)

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(d) O(log n)

2. Attempt all parts:-

2.a. Calculate the bound of the following functions: (CO1,K2) 2

1. **Find the upper bound:** $f(n) = 5n^2$
2. **Find the Θ bound for** $f(n) = \frac{n^2}{n} - \frac{n}{2}$

2.b. Consider array A[8][6], stored in **row-major order**. Find the address of element A[3][5]. Base address is 2000 and element size is 4 bytes. (CO2,K2) 2

2.c. Mention any two advantages of linked list over arrays. (CO3,K1) 2

2.d. Mention the Underflow and Overflow condition in a stack. (CO4,K2) 2

2.e. Elaborate Task Scheduling Problem. (CO5,K1) 2

SECTION-B 30

3. Answer any five of the following:-

3-a. Elaborate Asymptotic notations (Big O, Big Θ, Big Ω) and explain their significance in analyzing algorithms. (CO1,K1) 6

3-b. Solve the following recurrence relation using Master Method: (CO1,K3) 6

$T(n) = 6T(\frac{n}{3}) + n^2 \log n$

3-c. Consider the following Array: [4,9,1,7,11,17,6]. Perform linear search on the above data and give the algorithm/Program to give the index of element '11' in the array. (CO2,K3) 6

3-d. Write an algorithm/Program to represent the sparse matrix as a Linked List. (CO2,K2) 6

3.e. Write an algorithm/Program to insert and delete a node at a given position in a doubly circular linked list. (CO3,K1) 6

3.f. Pen down the algorithm to implement stack using linked lists. Compare their performance in terms of time and space complexity with array implementation. (CO4,K2) 6

3.g. Briefly elaborate the "Greedy Techniques" method to solve a problem. Write an algorithm to solve the Fractional Knapsack with the help of an example. (CO5,K2) 6

SECTION-C 50

4. Answer any one of the following:-

4-a. Solve the recurrence relation using Iteration method: (CO1, K3) 10

$$T(n) = \begin{cases} 3T(n-1), & \text{if } n > 0 \\ 1, & \text{otherwise} \end{cases}$$

4-b. Solve the recurrence relation using Recursion-Tree method. (CO1, K3) 10

$T(n) = T(\frac{n}{4}) + T(\frac{n}{2}) + n^2$

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

5-a.	Apply insertion sort on the given array **A= [30,50,10,60,20,40,70].** Give an appropriate algorithm for the same problem and also do time and space complexities analysis for the algorithm you will give. (CO2,K3)	10
5-b.	Write a Program to insert and delete an element at a given position in an Array. (CO2,K2)	10

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

6-a.	How to represent the Circular Linked List using an Array. Write an algorithm/Program to insert an element at the end of circular linked list . (CO3,K3)	10
6-b.	Discuss Doubly Linked List. Write an algorithm/Program to insert a single node at a given position in a doubly linked list. (CO3,K2)	10

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

7-a.	Discuss Circular Queue. Implement Circular Queue using Array. Also write an algorithm/program to insert the element at the front and rear end of the queue.(CO4,K3)	10
7-b.	Convert the given Infix expression into Prefix expression using stack implementation: (CO4,K2) ((H * ((((A + ((B + C) * D)) * F) * G) * E)) + J)	10

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

8-a.	Pen down the algorithm to implement the Quick Sort. Perform the Quick sort on the following data: [23,11,5,15,68,31,4,17]. Also explain how partitioning work in quick sort. (CO5, K2)	10
8-b.	Elaborate Activity Selection Problem and solve it for the following data: Start times: [1,2,3,8,10,11], Finish times: [3,5,9,10,12,14. Use the greedy algorithm to determine the maximum number of non-overlapping activities and describe the algorithm and derive its time complexity. (CO5,K2)	10

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