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.

SECTION-A 20

1. Attempt all parts:-

1-a. Which of the following is also known as "Big O" notation (CO1, K1) 1

(a) Time Complexity

(b) Space Compelxity

(c) Worst-Case Analysis

(d) Asymptotic notation

1-b. Which data structure is typically used for implementing a LRU (Least Recently Used) cache? (CO1, K1) 1

(a) Array

(b) Stack

(c) Queue

(d) Hash Map and Doubly linked List

1-c. In binary search, what is the time complexity in the worst case? (CO2, K2) 1

(a) O(log n)

(b) O(n)

(c) O(n log n)

(d) $O(n^2)$

1-d. 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)

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(b) (i×4+j)

(c) (i×j+5)

(d) (i+j×4)

1-e. The main advantage of linked lists over arrays is: (CO3, K1) 1

(a) Faster traversal

(b) Dynamic memory allocation

(c) Compact memory usage

(d) Random access

1-f. Arrays require contiguous memory allocation, whereas linked lists: (CO3,K1) 1

(a) Require larger memory space

(b) Require fragmented memory allocation

(c) Require contiguous memory allocation

(d) Do not require memory

1-g. Evaluate the time complexity of a push() operation in a stack. (CO4,K1) 1

(a) O(1)

(b) O(n)

(c) O(log n)

(d) $O(n^2)$

1-h. Analyze the condition indicating stack overflow when implemented using an array. (CO4, K1) 1

(a) top == maxSize

(b) top == maxSize - 1

(c) top == 0

(d) top == -1

1-i. Which of the following algorithms is NOT a Divide and Conquer algorithm? (CO5, K1) 1

(a) Merge Sort

(b) Quick Sort

(c) Bubble Sort

(d) Binary Search

1-j. What is the worst-case time complexity of Quick Sort? (CO5, K1) 1

(a) O(n)

(b) O(n log n)

(c) O(n^2)

(d) O(log n)

2. Attempt all parts:-

2.a. Let ***f(n)*** *and* ***g(n)*** be asymptotically non-negative functions. Using the definition of Θ-notation , prove that **max** $\{f(n),g(n)\} = \Theta(f(n)+g(n))$. (CO1,K2) 2

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2.b.	Consider array A[6][8], stored in column-major order. Find the address of element A[3][5]. Base address is 2000 and element size is 4 bytes. (CO2,K3)	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 Circular Queue. (CO4,K2)	2
2.e.	Differentiate between Divide and Conquer and Greedy Approach of an algorithm. (CO5,K1)	2

SECTION-B 30

3. Answer any five of the following:-

3-a.	Elaborate the term "Analysis of Algorithm". In the context of analysis of algorithm explain the different types of complexities occurred with the help of proper graphs. (CO1,K1)	6
3-b.	Solve the following recurrence relation using Master Method: $T(n)=\sqrt{2}T(n/2)+\log n$. (CO1,K3)	6
3-c.	Consider the following data: [1,4,7,9,13,17,19]. Perform binary search on the above data and give the algorithm/Program to give the index of element '4' in the array. (CO2,K1)	6
3-d.	Write an algorithm/Program to represent the sparse matrix as an Array. (CO2,K2)	6
3.e.	Write an algorithm/Program to insert and delete a node at a given position in a doubly linked list. (CO3,K1)	6
3.f.	Write a recursive algorithm/Program to generate the Fibonacci series of 5 integers. Also, show diagrammatically the activation record using stack. (CO4,K3)	6
3.g.	Briefly elaborate the "Divide and Conquer" method to solve a problem. Write an algorithm to solve the convex hull with the help of an example. (CO5,K1)	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	Solve the recurrence relation using Recursion-Tree method. (CO1, K3) $T(n)=T(\frac{n}{4})+T(\frac{n}{2})+n^2$	10
4-b.	**Solve the recurrence relation using Recursion-Tree method. (CO1,K3)** $T(n)=T(\frac{n}{2})+T(\frac{2n}{3})+n^2$	10

5. Answer any one of the following:-

5-a.	Apply counting sort on the given array A= [1,3,2,3,4,1,6,4,3]. 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 one of the following:-

6-a.	How to represent the polynomial using linked list? Write an algorithm/Program to add two polynomials using linked list. (CO3,K2)	10

6-b. Discuss Doubly Linked List. Write an algorithm/Program to reverse a single linked list. (CO3,K2) 10

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

7-a. Briefly explain the Recursion and its types with help of an example. State Tower of Hanoi Problem and write a Program using Recursion. (CO4,K1) 10

7-b. Convert the given Infix expression into Prefix expression using stack implementation: (CO4,K2) 10

((H * ((((A + ((B + C) * D)) * F) * G) * E)) + J)

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. Discuss the Knapsack Problem. Solve Fractional Knapsack Problem using greedy programming and generate the maximum profit for the following four items with their weight w={3,5,95} and Profit P={45,30,45,10} with knapsack capacity is 16. (CO5,K3) 10

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