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Subject Code: CMCA0203
Roll No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

MCA

SEM:II THEORY EXAMINATION (2025-2026)

Data Structures

Time: 3 Hours **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:-

(1.1) Which of the following best represents a non-linear data structure? (CO1, K1) 1

(a) Array

(b) Stack

(c) Tree

(d) Queue

(1.2) Which asymptotic notation represents tight bound? (CO1, K1) 1

(a) Big-O

(b) Big-Ω

(c) Big-Θ

(d) None

(1.3) Consider the following sequence of operations on an empty stack: (CO2, K3) 1

PUSH(10), PUSH(20), POP(), PUSH(30), PUSH(40), POP()

What will be the element at the top of the stack after performing all operations?

(a) 10

(b) 20

(c) 30

(d) 40

(1.4) Circular queue is mainly used to: (CO2, K2) 1

(a) Increase time complexity

(b) Reduce memory wastage

(c) Avoid recursion

(d) Increase stack size

(1.5) In Binary Search Tree, inorder traversal gives: (CO3, K2) 1

(a) Reverse order

(b) Sorted order

(c) Random order

(d) No order

(1.6) In doubly linked lists, traversal can be performed: (CO3, K2) 1

(a) Only in forward direction
(b) Only in reverse direction
(c) In both directions
(d) None of the above

(1.7) Which representation is better for sparse graph? (CO4, K2) 1

(a) Matrix
(b) List
(c) Both
(d) None

(1.8) In an AVL Tree, what is the balance factor range for every node? (CO4, K2) 1

(a) −2 to 2

(b) −1 to 1

(c) 0 to 1

(d) −1 to 0

(1.9) Collision in hashing can be resolved using: (CO5, K2) 1

(a) Sorting

(b) Chaining

(c) Recursion

(d) Traversal

(1.10) What is the worst-case complexity of bubble sort? (CO5, K2) 1

(a) O(n)

(b) O($n \log n$)

(c) O(n^2)

(d) O(2^n)

2. Attempt all parts:-

(2.1)	Why is array insertion at the beginning so costly? (CO1, K2)	2
(2.2)	Explain how stacks are used in recursion implementation inside programming languages. (CO2, K4)	2
(2.3)	Determine the time complexity to count the number of elements in the linked list. Explain with example. (CO3, K2)	2
(2.4)	Consider that a Binary tree is implemented using array representation. If a node is at index 25 then find index of its parent and children. (CO4, K3)	2
(2.5)	Define a graph. What is the difference between directed and undirected graphs? (CO5, K2)	2

SECTION – B 30

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

(3.1)	Derive a formula for the address calculation of an element of a two-dimensional array if array is stored in row-major order. (CO1, K3)	6
(3.2)	Compare Big-O, Big-Θ, and Big-Ω notations with a suitable example. (CO1, K5)	6

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

(3.3)	Discuss the time complexity of *push()* and *pop()* operations when a stack implemented with a linked list (push at head). (CO2, K4)	6
(3.4)	Describe the Create, Insert (Enqueue), and Delete (Dequeue) operations of a queue with algorithms. (CO2, K3)	6

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

(3.5)	Write the procedure to insert an item at the beginning of a linked list. (CO3, K3)	6
(3.6)	Explain Polynomial representation using Linked List. (CO3,K2)	6

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

(3.7)	Define the Complete Binary tree. How is it different strictly Binary tree? Explain. (CO4, K2)	6
(3.8)	Define a Binary Heap. Construct a Max Heap from the array: 10, 20, 15, 30, 40. Show heap after each insertion. (CO4, K3)	6

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

(3.9)	Discuss the sequential representation a graph in memory. Draw a graph with 6 vertices and at least 2 cycles. Represent the graph using Adjacency matrix. (CO5, K4)	6
(3.10)	Differentiate between Depth First search (DFS) and Breadth First search (BFS). (CO5, K2)	6

SECTION – C 50

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

(4.1)	An array stores marks of *n* students. Write a program to search whether a student scored a particular mark entered by the user. If found, display all positions where the mark occurs. (CO1, K4)	10
(4.2)	A two-dimensional array C[1…3][1…4] is stored in column-major order with a base address of 1500 and an element size of 2 bytes. Derive the column-major address formula and evaluate the memory address of element C[2][3]. Also,	10

critically differentiate row-major and column-major storage mechanisms. (CO1, K3)

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

(5.1) Convert the given infix expression into postfix expression *E* using stack. Trace all the steps clearly : (CO2, K3) 10

$$E = P + (Q * R - (S / T \wedge U) * V) * W$$

(5.2) Explain the concept of circular queue. How does it address the problem of wasted space in a regular queue when implemented using arrays? (CO2, K2) 10

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

(6.1) Explain the difference between singly linked lists and doubly linked lists with a suitable example. Difference between circular and singly linked list traversal. (CO3, K2) 10

(6.2) Consider the following two polynomials: (CO3, K4) 10

$P(x) = 4x^3+3x^2+2x+5$

$Q(x) = 2x^3+5x+1$

Represent both polynomials using linked list nodes in the form: (coefficient, exponent) and perform polynomial addition step-by-step using linked list traversal.

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

(7.1) Explain Inorder, Preorder and Postorder Binary tree traversal operation. A Binary tree *T* has 11 nodes. Draw the tree *T* with following sequences of nodes in inorder and postorder traversals: (CO4, K4) 10

Inorder: D B F E A G C L J H K

Postorder: D F E B G L J K H C A

(7.2) Insert the following elements into an initially empty AVL tree in the given order: 30, 20, 40, 10, 25, 50, 5. 10

Draw the AVL tree after each insertion. Identify the node at which the tree becomes unbalanced (if any). Perform the necessary rotation(s) and draw the balanced AVL tree. (CO4, K3)

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

(8.1) Use Kruskal'salgorithm to find minimum cost spanning tree for the graph given in figure 1. Clearly explain all the steps. (CO5, K3) 10

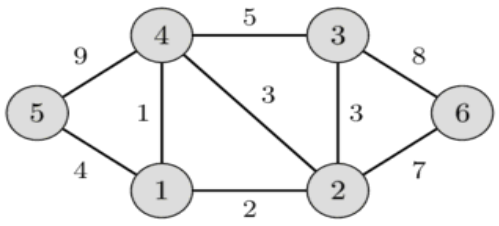

Figure 1

(8.2) Define hashing. Explain the process of inserting and searching for elements in a hash table using a hash function. (CO5, K3) 10