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Printed Page:-5 **Subject Code:- BMICA0302**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)
MCA Integrated
SEM: III - THEORY EXAMINATION (2025 - 2026)
Subject: Data Structures

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. The order of an algorithm that finds whether a given Boolean function of n variables 'n' produces a 1 is: (CO1 K1) 1

(a) linear
(b) constant
(c) exponential
(d) logarithmic

1-b. The worst case complexity of Merge Sort is: (CO1 K3) 1

(a) O(1)
(b) O(n*n)
(c) O(log n)
(d) O(n log n)

1-c. The following determines the need for the Circular Queue: (CO2 K2) 1

(a) Avoid wastage of memory
(b) Access the Queue using priority
(c) Follows the FIFO principle
(d) None of the above

1-d. Consider the following operation performed on a stack of size 5. 1

Push(1);
Pop();
Push(2);
Push(3);
Pop();
Push(4);

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Pop();
Pop();
Push(5);
How many elements are left in stack? (CO2 K3)

(a) 1
(b) 2
(c) 3
(d) none of these

1-e. In circular linked list, insertion of node requires modification of: (CO3 K2) 1

(a) One pointer
(b) Two Pointer
(c) Three Pointer
(d) None

1-f. code: 1
self.start = self.start.next
is best suitable for____. (CO3 K2)

(a) deletion from front
(b) deletion from last
(c) insertion at beginning
(d) Insertion at last

1-g. A complete binary tree with the property that the value at each node is at least as large as the value of its children is known as: (CO4,K1) 1

(a) Binary Search Tree
(b) AVL Tree
(c) Completely Balance Tree
(d) Max-Heap

1-h. The number of external nodes in a full binary tree with n internal nodes is: (CO4 K2) 1

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

1-i. The maximum number of edges present in a simple directed graph with 7 vertices if there exists no cycles in the graph- (CO5, k2) 1

(a) 21
(b) 7
(c) 6
(d) 49

1-j. If all the weights of the graph are positive, then the minimum spanning tree of the graph is a minimum cost subgraph. (CO5 K2) 1

(a) TRUE
(b) FALSE

(c) Depends upon Algorithm used to find minimum spanning tree

(d) depends upon edge length

2. Attempt all parts:-

2.a.	Explain Binary Search used for? (CO1, K2)	2
2.b.	Explain Recursion. Demonstrate the importance of base-condition with an example. (CO2, K4)	2
2.c.	Express the following polynomials in Linked List representation: (CO3, K3) a) p1(x) = 23x^9 + 18x^7 + 41x^6 + 163x^4 + 3 b) p2(x) = 4x^6 + 10x^4 + 12x + 8	2
2.d.	Describe Min-Heap and Max-Heap. (CO4 K2)	2
2.e.	Discuss how to represent graph storage using an Adjacency Matrix. (CO5 K2)	2

SECTION-B 30

3. Attempt all parts:-

3.a. Answer any one of the following:-

3.a.(i)	Given a sorted array arr[] = {2, 5, 8, 12, 16, 23, 38, 56, 72, 91} and a target = 23, Find the index of the target using binary search. Demonstrate all the Steps. (CO1, K2)	6
3.a.(ii)	Explain Colum-Major Order Representation. A matrix M[-6…10, 4…15] is stored in the memory with each element requiring 4 bytes of storage. If the base address is 1025, Find the address of M[4][8] when the matrix is stored in column major wise. (CO1 K3)	6

3.b. Answer any one of the following:-

3.b.(i)	Distinguish between stack and queue. (CO2, K4)	6
3.b.(ii)	Explain enqueue and dequeue operations of Queue. What values are returned during the following sequence of queue operations, if executed on an initially empty queue? enqueue(5), enqueue(3), dequeue(), enqueue(2), enqueue(8), dequeue(), dequeue(), enqueue(9), enqueue(1), dequeue(), enqueue(7), enqueue(6), dequeue(), dequeue(), enqueue(4), dequeue(), dequeue(). (CO2 K3)	6

3.c. Answer any one of the following:-

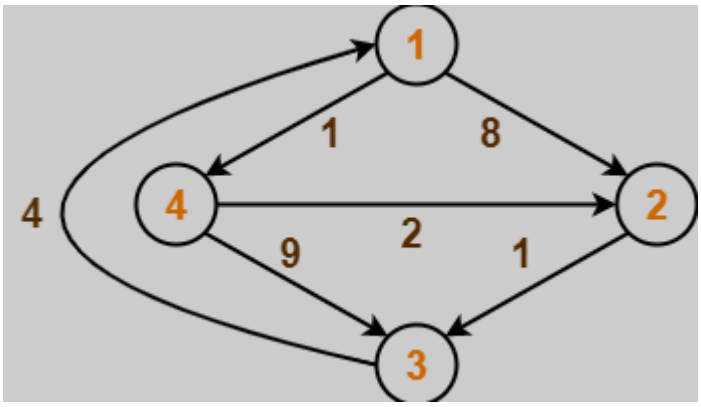
3.c.(i)	Explain Singly Linked List in short. Demonstrate insertion of the element in Single Linked List at the beginning. (CO3, K3)	6
3.c.(ii)	Write a function to create and insert an element in a circular linked list. (CO3, K3)	6

3.d. Answer any one of the following:-

3.d.(i)	Insert the following elements into a Binary Search Tree (BST):- 45, 30, 60, 20, 35, 55, 70 Draw the resulting BST and perform in-order traversal. (CO4, K4)	6
3.d.(ii)	Draw a binary tree T with preorder: EXAMFUN and inorder: MAFXUEN. (CO4, K3)	6

3.e. Answer any one of the following:-

3.e.(i)	Explain Kruskal's Algorithm with suitable example. (CO5 K3)	6

3.e.(ii) 

6

Explain All Pair Shartest path. Using Floyd Warshall Algorithm, Find the shortest path distance between every pair of vertices.(CO5, K4)

SECTION-C 50

4. Answer any one of the following:-

4-a. What are Asymptotic Notations in Complexity Analysis of Algorithms? Explain each one with example. (CO1 K3) 10

4-b. Write down Merge Sort algorithm and using this algorithm sort: 38, 27, 43, 3, 9, 82, 10 in ascending order.
Show steps also. (CO1 K3) 10

5. Answer any one of the following:-

5-a. Explain the basic operations of a stack data structure. Contrast peek() and pop(). (CO2, K3) 10

5-b. Given an infix expression convert it into postfix expression : a+b*(c^d-e)^(f+g*h)-i. (CO2, K4) 10

6. Answer any one of the following:-

6-a. How can we represent a polynomial using a linked list? Write a program in Python to subtract two polynomials represented by linked list. (CO3,K3) 10

6-b. Explain the different types of linked list with diagram. Write python program to implement the insert and delete operation in doubly linked list. (CO3,K4) 10

7. Answer any one of the following:-

7-a. What is a height balanced Tree? Why height balancing of Tree is required? Create an AVL Tree for the following elements: a, z, b, y, c, x, d, w, e, v, f. (CO4 K3) 10

7-b. Construct a B-tree of order 5 by inserting: 3, 14, 7, 1, 8, 5, 11, 17, 13, 6, 23, 12, 20, 26, 4, 16, 18, 24, 25, 19. Delete 6, 23, 3. (CO4, K3) 10

8. Answer any one of the following:-

8-a. Reproduce the behavior of prim's algorithm for the given graph below. Choose the appropriate edges to add them to the MST (Minimum Spanning Tree). Start with Node A. In case of similar weights add nodes alphabetically. (CO5 K4) 10

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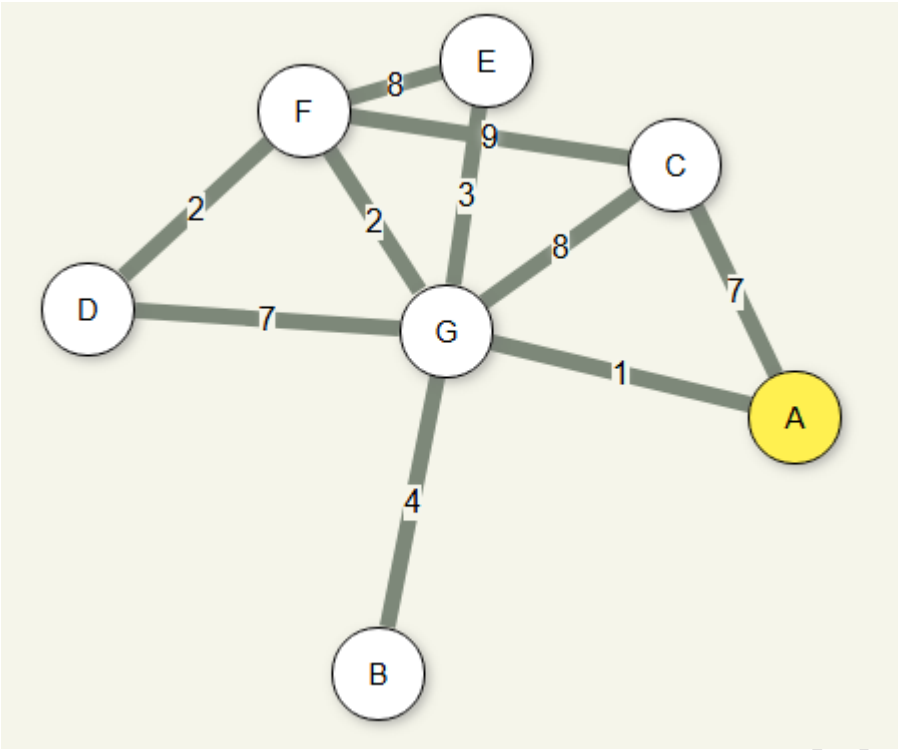

8-b. 10

Differentiate between BFS and DFS. (CO5, K4)