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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)

M.Tech

SEM: I - THEORY EXAMINATION (2025 - 2026)

Subject: Advanced Data Structures and Algorithms

Time: 3 Hours

Max. Marks: 70

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

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1. Attempt all parts:-

- 1-a. Process of inserting an element in stack is called _____ (CO1,K1) 1
- (a) Create
- (b) Push
- (c) Evaluation
- (d) Pop
- 1-b. List the children for node 'w' of a complete-binary tree in an array representation. (CO2,K1) 1
- (a) $2w$ and $2w+1$
- (b) $2+w$ and $2-w$
- (c) $w+1/2$ and $w/2$
- (d) $w-1/2$ and $w+1/2$
- 1-c. The following given tree is an example of: (CO3, K2) 1
- ```

graph TD
 10((10)) --- 16((16))
 10 --- 12((12))

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- (a) Binary tree
- (b) Binary search tree
- (c) Fibonacci tree
- (d) AVL tree
- 1-d. List the worst case complexity of binary search using recursion. (CO4,K1) 1
- (a)  $O(n \log n)$

- (b)  $O(\log n)$   
(c)  $O(n)$   
(d)  $O(n^2)$
- 1-e. In what manner is a state-space tree for a backtracking algorithm constructed. (CO5, K1) 1
- (a) Depth-first search  
(b) Breadth-first search  
(c) Twice around the tree  
(d) Nearest neighbour first
2. Attempt all parts:-
- 2.a. Write the applications of linked list. (CO1,K2) 2
- 2.b. Suppose that you are performing a reheapification upward. Write a precise condition that describes the situation that causes the reheapification to stop. (CO2,K3) 2
- 2.c. Consider a complete graph G with 4 vertices. How many spanning trees the graph G having? (CO3,K2) 2
- 2.d. For the function  $f(n) = 5n^2 + 3n + 2$ , determine its  $O$ ,  $\Omega$ , and  $\Theta$  notations. (CO4,K3) 2
- 2.e. Name any two problems which can be solved using branch and bound techniques. (CO5,K1) 2

## **SECTION-B**

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3. Attempt all parts:-
- 3.a. Answer any one of the following:-
- 3.a.(i) Describe abstract data type with example. (CO1,K1) 4
- 3.a.(ii) Define how link list can be used to store the polynomial with example also illustrate the addition of two polynomials using link list. (CO1,K3) 4
- 3.b. Answer any one of the following:-
- 3.b.(i) Construct the binary tree for the following sequence of nodes in preorder and inorder respectively. (CO2, K3) 4  
Preorder : G, B, Q, A, C, K, F, P, D, E, R, H  
Inorder: Q, B, K, C, F, A, G, P, E, D, H, R
- 3.b.(ii) Define a height-balanced tree and describe how the height is maintained after adding or deleting nodes. (CO2,K2) 4
- 3.c. Answer any one of the following:-
- 3.c.(i) Write an algorithm to topologically sort for a digraph using DFS. (CO3,K3) 4
- 3.c.(ii) Define single-source shortest path. Write down the Bellman-Ford algorithm for it.(CO3, K3) 4
- 3.d. Answer any one of the following:-
- 3.d.(i) Sort the following array using Quick Sort and show all steps: [30, 10, 50, 20, 40] (CO4, K3) 4
- 3.d.(ii) Define a Binary Search Tree (BST) and explain how Dynamic Programming is used to construct an Optimal Binary Search Tree. (CO4,K2) 4
- 3.e. Answer any one of the following:-

- 3.e.(i) Explain n-queens problem with diagram. (CO5, K2) 4
- 3.e.(ii) Explain Subset-sum Problem. (CO5,K2) 4

**SECTION-C** 35

4. Answer any one of the following:-

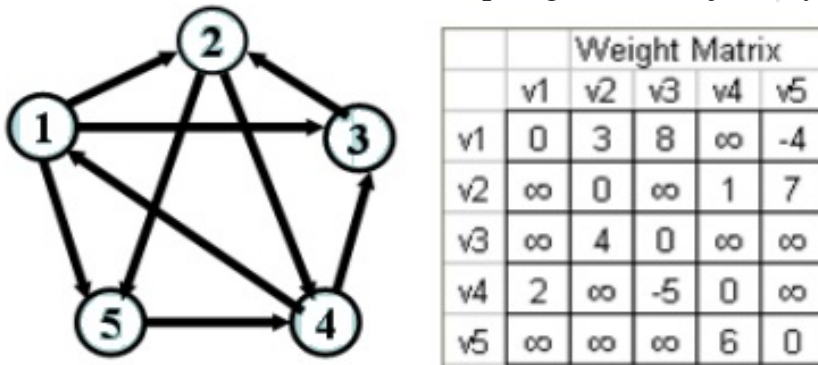
- 4-a. Devise a representation for a list where insertions and deletions can be made at either end. Such a structure is called Deque (Double ended queue). Write algorithms for inserting and deleting at either end. (CO1,K3) 7
- 4-b. Implement queue operations QINSERT and QDELETE using linked list. (CO1,K3) 7

5. Answer any one of the following:-

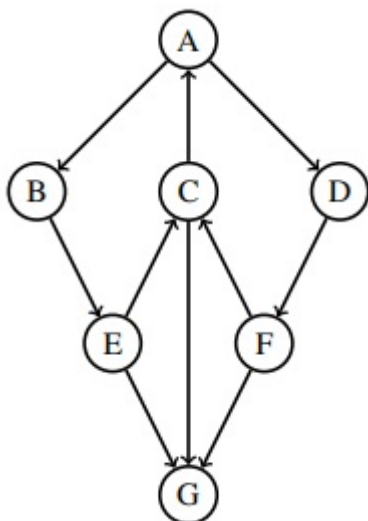
- 5-a. Elaborate B-trees. Construct a B-Tree of order 5 for the following set of Input data: (CO2,K2) 7  
69, 19, 43, 16, 25, 40, 132, 100, 145, 7, 15, 18
- 5-b. Construct AVL Tree for the following sequence of numbers- (CO2,K3) 7  
50 , 20 , 60 , 10 , 8 , 15 , 32 , 46 , 11 , 48

6. Answer any one of the following:-

- 6-a. Run the Floyd Warshall's algorithm on the following digraph Find all pair shortest paths. Show all the intermediate steps. (given its adjacency matrix) (CO3,K3) 7

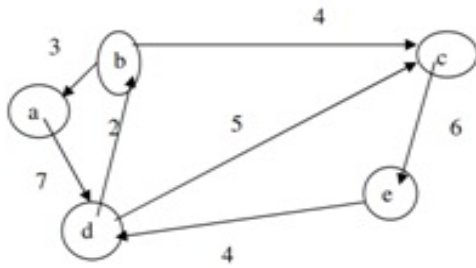


- 6-b. Perform a depth-first search on the following graph starting at A. Label every edge in the graph with T if it's a tree edge, B if it's a back edge, F if it's a forward edge, and C if it's a cross edge. To ensure that your solution will be exactly the same as the staff solution, assume that whenever faced with a decision of which node to pick from a set of nodes, pick the node whose label occurs earliest in the alphabet. (CO3,K3) 7



7. Answer any one of the following:-

- 7-a. Explain the 0/1 knapsack with an algorithm. (CO4,K2) 7
- 7-b. Solve the following instance of All pair source shortest path. Write the algorithm for the same. (CO4,K3) 7



8. Answer any one of the following:-

- 8-a. Take an example of at least 4 cities of your choice and solve the Traveling Salesman Problem using Branch and Bound. Show all steps, including partial paths, lower bounds, and the minimum cost tour. (CO5,K3) 7
- 8-b. Given a graph of at least 5 vertices of your choice, use Backtracking to find a Hamiltonian Cycle. Show all steps, including the path choices and backtracking steps, and identify the Hamiltonian Cycle if it exists. (CO5,K3) 7

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