



**Department of Computer Science & Engineering**  
**Motilal Nehru National Institute of Technology Allahabad**  
**Prayagraj - 211 004 (India)**

**End semester Examination July 2022**

MCA II semester

Subject: Data Structure CS32101

Time: 180 Minutes

M.M : 50

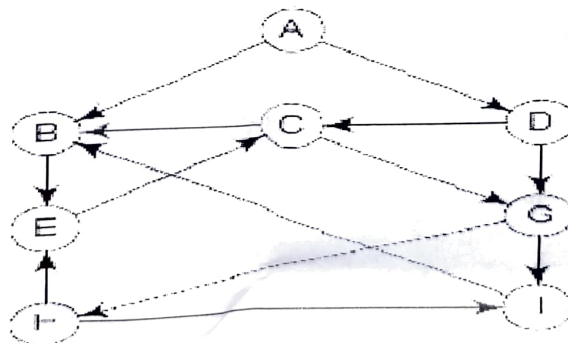
1. All questions are compulsory. All the subparts of a question are to be attempted together.
2. Students are required to **show all the steps** in detail.
3. Be very careful while attempting the linked questions. If initial parts are attempted wrongly, then their linked parts will be treated as wrong.

**Question 1[3+2+3]**

- a. Define **any three** of the following terms:  
(i) Self referential data structure (ii) ADT (iii) External sorting  
(iv) Threaded Binary Tree (v) Multiway search tree
- b. Write a function /Algorithm to find the nodes with minimum and maximum Value in a binary search tree
- c. The preorder traversal sequence of a binary search tree is 30, 20, 10, 15, 25, 23, 39, 35, 42. Find the postorder traversal sequence of the same tree?

**Question 2[3+6+3]**

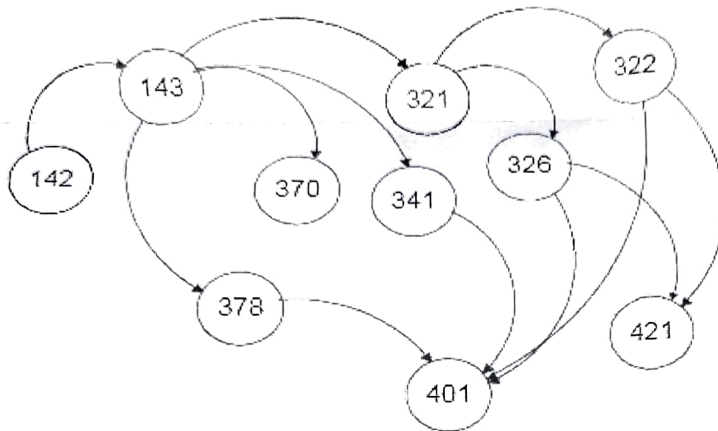
- a. Write down a recursive algorithm to reverse a singly Linked List in  $O(n)$  time.  
(Also trace the Algorithm with the help of a suitable Example)
- b. Differentiate between DFS and BFS (Write algorithm either of one). Consider the graph G given below. Find out its DFS and BFS traversal scheme. (starting vertex A)



graph G

- C. A directed acyclic graph is an excellent way to represent dependency and precedence of process in operating system. For example, in the graph shown below, process id 142 is the independent however process id 421 is dependent on process id 322 and 326.

**Write an algorithm** to create the optimal execution sequence of processes execution if a directed acyclic graph of system processes is given



OR

- ✓ Let  $X_i < X_j$  represents that job  $X_i$  is to be completed before job  $X_j$  can start. Draw the directed acyclic graph for the data given below. Apply topological sort by showing the values of indegree of all the nodes at every step.

$X_1 < X_2$	$X_2 < X_3$	$X_3 < X_5$	$X_5 < X_6$
$X_4 < X_6$	$X_6 < X_7$	$X_1 < X_4$	$X_3 < X_4$
$X_4 < X_5$	$X_5 < X_7$	$X_1 < X_3$	$X_2 < X_4$

### Question 3[6+2+4+5]

- ✓ a. What is B tree? Generate a B tree of Order 5 for given Data 50,85,12,10,6,60,70,80,37,100,120,65,150,62,30,17,15,28,75,78. Compare B and B+ tree (1+4+1)
- ✓ b. Suppose STACK is allocated N=6 memory cells and initially STACK is empty, or, in other words, TOP=0. Find the output of the following module:
1. Set AAA:=2 and BBB:= 5
  2. Call PUSH (STACK, AAA).
  - CALL PUSH (STACK, 4).
  - CALL PUSH (STACK, BBB +2).
  - CALL PUSH (STACK, 9)
  - CALL PUSH (STACK, AAA+BBB).
  3. Repeat while TOP!= 0;

Call POP (STACK, ITEM).

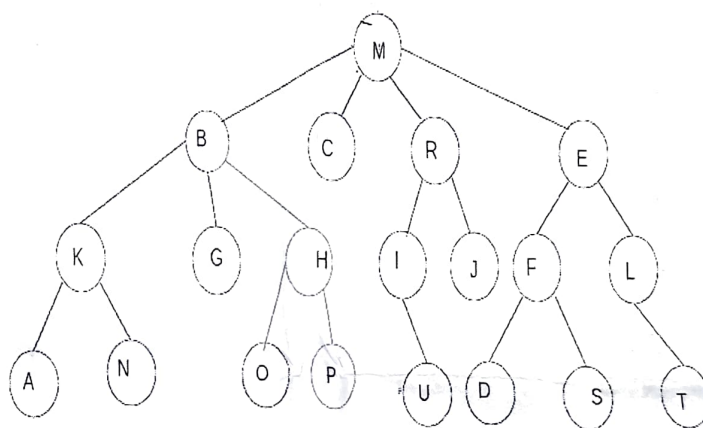
Write: ITEM.

[End of loop].

4. Return.

c. Let  $S$  be a stack of size  $n \geq 1$ . Starting with the empty stack, suppose we push the first  $n$  natural numbers in sequence, and then perform  $n$  pop operations. Assume that Push and Pop operation take  $Y$  seconds each, and  $X$  seconds elapse between the end of one such stack operation and the start of the next operation. For  $m \geq 1$ , define the stack-life of  $m$  as the time elapsed from the end of Push( $m$ ) to the start of the pop operation that removes  $m$  from  $S$ . Find The average stack-life of an element of this stack. (show complete working)

d. What is tree? convert following tree in binary tree. Perform inorder, & preorder, traversal



TREE T

### Question 4 [2+3]

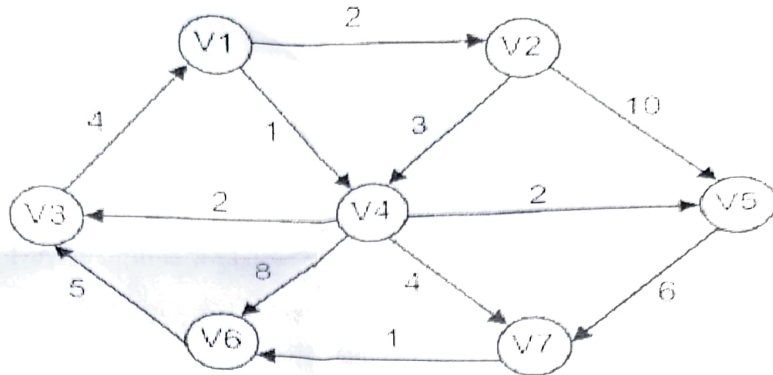
Let  $G = \langle V, E, W \rangle$  be an undirected weighted graph containing  $n$  vertices ( $n$  is atleast two), where  $V = \{v_1, v_2, \dots, v_n\}$  and,  $(v_x, v_y) \in E$  if and only if  $1 \leq 2|x - y| \leq 3$ . The weight over the edge  $(v_x, v_y)$  will be  $w_{xy} = 2(x + y)$ .

a Draw  $G$  for 5 vertices.

c Compute the cost of the minimum spanning tree of  $G$  for  $n$  vertices.

### Question 5 [3+5]

- a. Apply Prim's algorithm to the following graph and obtain minimum spanning Tree.



Give adjacency matrix and adjacency list representation of the graph given above.

- b. Create a double linked list in which info part of each node contains a digit of a given number. the digits should be stored in reverse order i.e. the least significant digit should be stored in first node and most significant digit in last node. If the number is 5468132 then the linked list should be 2->3->1->8->6->4->5->. Write a function to add two numbers represented by linked list.