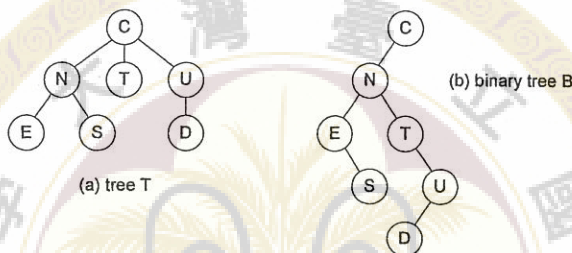


請依照題號順序作答

Please indicate which programming language in C, C++, or Java you are going to use in this exam.
Choose only one language and write it down at the first line of the answer sheet.

1. (10 %) Write a program to concatenate two singly linked lists L and M , with header sentinels, into a single list S that contains all the nodes of L followed by all the nodes of M .
2. (10 %) Write a recursive function in the indicated language for removing all the elements in a stack.
3. (13 %) As shown in the figure below, let B in (b) be the binary tree representing a tree T in (a).
 - a. What are the preorder traversals of B and T , respectively? (4%) Are they equivalent? (1%)
 - b. What are the postorder traversals of B and T , respectively? (4%) Are they equivalent? (1%)
 - c. What is the inorder traversal of B ? (2%) Is it equivalent to some well-structured traversal of T ? (1%)



4. (7 %) An airport is developing an air-traffic control program that handles events such as landings and takeoffs. Each event has a *time-stamp* that denotes the time when the event occurs. The program needs to efficiently perform the following two fundamental operations:
 - Insert an event with a given *time-stamp* (i.e., add a future event)
 - Extract the event with smallest *time-stamp* (i.e., determine the next event to process)
 Which data structure should be used for the above operations? (4%) Why? (3%)
5. (20 %) Develop an algorithm to delete a node from a binary search tree. You must consider every possible case that the node to be deleted has to maintain the invariant of the tree after deletion.
 - a. Write down the pseudo-code of this algorithm. (8%)
 - b. Implement this algorithm using the indicated language based on the pseudo-code. (12%)
6. (10 %) Draw the 2-3-4 tree that results from inserting $p, f, j, h, u, g,$ and b , in the order given, into a 2-3-4 tree that initially contains a single node whose value is m .
7. (10 %) Let $a > 1$ and $b > 1$ be arbitrary constants. Prove that $a^{\sqrt{n}} \in O(b^n)$, no matter how big a is, or how close to one b is. Only n varies; a and b are constant.
8. (10 %) In-place sorting. Show each step of sorting as they sort the arrays into ascending order using:
 - a. Insertion sorting (5%): 15 94 38 27 56 38
 - b. Selection sorting (5%): 17 23 36 8 29 52
9. (10 %) Graphs.
 - a. For the graph below in (a), list every possible order in which depth-first search (DFS) can visit the vertices of the graph if starting from vertex a . (5%)
 - b. For the graph below in (b), is there any order in which breadth-first search (BFS) can visit the vertices that starts at vertex 1 and visits vertex 5 at last? If so, give the order. If not, explain why. (5%)

