B.Sc. Engg. CSE 3rd Semester **10 October 2023 (Afternoon)**

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION **WINTER SEMESTER, 2022-2023**
DURATION: 1 HOUR 30 MINUTES **FULL MARKS: 75**

CSE 4303: Data Structures

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 3 (three)** questions. Figures in the right margin indicate full marks of questions whereas corresponding CO and PO are written within parentheses.

1. a) Why is constant time accessing possible for Arrays but not for Linked Lists? Does this property contradict in the case of an array of strings, in which the strings can have different lengths? $4 + 2$ (CO1) (PO1)

   b) Analyze the worst-case time complexity for the function given in Code Snippet 1. 5 (CO3) (PO2)

```
void Function(int n){
    int i=1, s=1;
    while (s <= n){
        i++;
        s= s+i;
        printf("*");
    }
}
```

Code Snippet 1: Function for Question 1 (b).

   c) Suppose that the numbers 0, 1, 2, ..., 9 were pushed into a stack in that order, but pop operations occurred at random points between the various pushes. The following is a valid sequence in which the values in the stack could have been popped: {3, 2, 6, 5, 7, 4, 1, 0, 9, 8}. 5 (CO2) (PO1)

   Explain why it is not possible that {3, 2, 6, 4, 7, 5, 1, 0, 9, 8} is a valid sequence in which the values could have been popped off the stack.

   d) Propose an algorithm to implement a 'First-In-First-Out Queue' using a 'Priority Queue'. 9 (CO3) (PO2)

2. a) Suppose a set of numbers is stored in a Linked List where the length of the list is unknown. In this case, to find the middle element, one approach can be to scan the entire list to find the length and then scan again from the beginning to locate the (n/2)-th node. Propose a better idea to find the middle element just using one scan. 6 (CO3) (PO2)

   b) A set of numbers is stored in a Binary Max-Heap. Propose an efficient approach to find the minimum element and discuss the Time-complexity. 4 (CO3) (PO2)

   c) Sort the set of characters {f, b, u, e, l, a, k, d, w} using the Heap-sort algorithm in ascending order. 10 (CO1) (PO1)

   d) Draw a binary tree of height 2 whose post-order traversal is 'DEBFCA' and in-order traversal is 'DBEACF'. 5 (CO2) (PO1)

3. a) Analyze the Space Complexity of the 'Level-order Traversal' and 'Post-order Traversal' algorithms of a Binary Tree. 5 (CO3) (PO2)

b) For the set of keys {46, 10, 18, 40, 92, 16, 28} draw Binary Search Trees of heights 2, 3, 4, 5, and 6. The sequence of the keys can be rearranged to adapt the heights. 5 (CO1) (PO1)

c) Perform the following operations in an AVL Tree by showing detailed steps. 15 (CO1) (PO1)

insert (100), insert (75), insert (50), insert (25), insert (30), insert (40), insert (90), delete (75), insert (35), insert (45), insert (47), delete (50), delete (45), delete (90)