Jadavpur University
Department of Information Technology
B. Info. Tech 2nd year 1st semester Supplementary Examination 2023
Subject: Data Structure and Algorithms

Time: 3 Hrs.

Full Marks: 100

(ANSWERS MUST BE BRIEF AND TO THE POINTS)

Answer any five questions

1.

((2+2)+8+8)

a. What condition must be satisfied for the list representation of sparse matrix to be advantageous over general 2-D representation of the same sparse matrix? Express the formula $(n^2-2)*(n-4)$ using big-O notation

b. An array X contains 30 positive integers. Write an algorithm which will find out all pairs of elements whose product is 30. What is the time complexity of your algorithm?

c. Write an algorithm to delete all elements in between and occupying two specified positions from an array of size n.

2.

(8+6+6)

a. Evaluate the following postfix expression using stack :
   2 3 4 * + 8 - 5 1 + *

b. Consider the following operation along with standard Enqueue and Dequeue operations on queues, where k is a global parameter.

```
MultiDequeue (Q)
{
        m=k;
        while (Q is not empty and m>0)
        {
                Dequeue (Q);
                m=m-1;
        }
}
```

What is the worst case time complexity of a sequence of n MultiQequeue () operations on an initially empty queue.

c. Given an efficient array based circular queue Q capable of holding 10 elements. Show the content of Q when the following code is executed:

```
for (int k = 1; k ≤ 7; k ++)

        Q.enqueue (k);

for (int k = 1; k ≤ 7; k ++)

        Q.enqueue (Q.dequeue());
```

3.

(5+5+4+6)

a. You are given a linked list of 0's, 1's, and 2's. Write an algorithm to sort the linked list.

b. Write an algorithm to print the content of a single linked list in reverse order.

c. Write an O(1) algorithm to connect two circular linked lists.

d. Explain what does the following function do?

```
void fun2 (struct node * head)
{
        if (head = = NULL)

                return;

        printf ("%d", head→data);

        if (head→next != NULL)

                fun2(head→next→next);

        printf ("%d", head→data);
```

4.   (6+8+6)

a. Run the heap sort algorithm on the following array to arrange the numbers in decreasing order.
    50 30 60 10 40 20 90 80 100 70

b. Give the best, worst, and average case time complexity of the following algorithms.
    Quick sort, insertion sort, merge sort and selection sort

c. Insert the following elements on-by-one into an initially empty Max-Heap.
    1, 2, 3, 4, 5, 6, 7, 8, 9, 10

5.   (6+4+10)

a. Define complete binary tree, full binary tree, and binary search tree with examples.

b. The pre-order traversal sequence of a binary search tree is: 30, 20, 10, 15, 25, 23, 39, 35, 42. Give the post order traversal sequence of the binary search tree.

c. Insert the following values in an empty AVL tree in the order given.
    1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

6.   (6+8+6)

a. Compare between adjacency matrix and adjacency list representation of a graph.

b. Write down an algorithm for finding minimum cost spanning tree of a graph.

c. Write Dijstra's shortest path algorithm.

7.   (10+10)

a. Write short notes on the following:
    i.   Breadth first search and Depth first search algorithms
    ii. Kruskal's and Prim's algorithm to find spanning tree of a given undirected graph.