National Institute of Technology, Hamirpur
B. Tech. End Semester Examination - 2023

Semester: $4^{\text {th }}$
Subject Name: Data Structure
Subject Code: MA-223
Branch: Mathematics and Computing

Total Marks: 50
Time: 3 Hours

- All questions are compulsory.

1. (i) Explain the following terms briefly:
a) Data Structures, b) Hashing
(ii) Apply Quicksort algorithm on the given elements and show all the passes:

$$
\begin{equation*}
42,89,63,12,94,27,78,3,50,36 \tag{4}
\end{equation*}
$$

(iii) Solve the following recurrence relation:

$$
\begin{equation*}
T(n)=T(n-1)+1 \tag{2}
\end{equation*}
$$

with initial condition as $T(0)=0$
2. (i) Write a program which uses functions to perform the following operations on single linked list:
a) Insertion, b) Deletion.
(ii) What are Linked Queues? Give pictorial representation.
(iii) Explain linked representation of stack along with schematic diagrams. Also write the algorithm of PUSH and POP operations. (3+3)
3. (i) Construct a Binary Search Tree (BST) for the following sequence of numbers:

$$
\begin{equation*}
45,32,90,34,68,72,15,24,30,66,11,50,10 . \tag{2}
\end{equation*}
$$

Also write its Preorder, Postorder and Inorder traversal.
(ii) Illustrate the steps for converting an Infix expression into a Postfix expression for the following expression:

$$
\begin{equation*}
x^{\wedge} y /\left(5^{*} z\right)+2 \tag{2}
\end{equation*}
$$

(iii) Insert the following keys in the order shown to construct an AVL search tree.

$$
\begin{equation*}
\mathrm{D}, \mathrm{E}, \mathrm{~F}, \mathrm{G}, \mathrm{H}, \mathrm{C}, \mathrm{~B}, \mathrm{~A} \tag{4}
\end{equation*}
$$

4. (i) Deduce a minimum spanning tree for the following graph (Figure 1) using Kruskal's algorithm:
(ii) Consider the graph (Figure 2) below and solve the single source shortest path problem (sourc eA) using Dijkstra's algorithm.
5. (i) Consider the given weighted graph G (Figure 3). Suppose the nodes are stored in memory in an array DATA as follows.
DATA: A, B, C, D

Find the matrix Q of shortest paths using Warshall's Algorithm.
(ii) Explain about Prim's algorithm in detail with example.


Figure 1.


Figure 2.


Figure 3.

