C0-R4.B3: DATA STRUCTURE THROUGH JAVA

NOTE:

1.	**Answer question 1 and any FOUR from questions 2 to 7.**
2.	**Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours **Total Marks: 100**

1.
a) Write a recursive function to count the number of nodes in a binary tree.
b) Constructor declarations are very much like method declarations. However, some restrictions on constructors should be applied. Explain those restrictions. Write the general syntax of constructor.
c) What do you mean by complexity of an algorithm? Explain the meaning of worst case analysis and best case analysis in brief.
d) How many key comparisons and assignments, an insertion sort makes in its worst case?
e) Define data type and abstract data type. Comment upon the significance of both.
f) Prove the hypothesis that "A tree having 'm' nodes has exactly (m–1) edges or branches".
g) Can a Queue be represented by circular linked list with only one pointer pointing to the tail of the queue? Substantiate your answer using an example.

(7x4)

2.
a) Two linked lists contain information of the same type in ascending order. Write a module to merge them to a single sorted linked list.
b) Given a set of input representing the nodes of a binary tree, write a non recursive algorithm that must be able to output the Pre-order and In-order Traversal.
c) Reverse the order of elements on a stack S
   i)   using two additional stacks.
   ii)   using one additional queue.

(5+8+5)

3.
a) What is a Binary Search Tree (BST)? Make a BST for the following sequence of numbers.
        45, 36, 76, 23, 89, 115, 98, 39, 41, 56, 69, 48
   Write Pre-order, In-order and Post-Order Traversal.
b) Explain how to implement two stacks in one array A[1..n] in such a way that neither stack overflows unless the total number of elements in both stacks together is n. The PUSH and POP operations should run in O(1) time.
c) Consider the following specification of a graph G
   V(G) = {1,2,3,4}
   E(G) = {(1,2), (1,3), (3,3), (3,4), (4,1)}
   i)   Draw an undirected graph.
   ii)   Draw its adjacency matrix.

(9+4+5)

4.
a) How do you rotate a Binary Tree? Explain right and left rotations with the help of an example.

b) Show the result of running BFS and DFS on the directed graph given below using vertex 3 as source. Show the status of the data structure used at each stage.

(9+9)
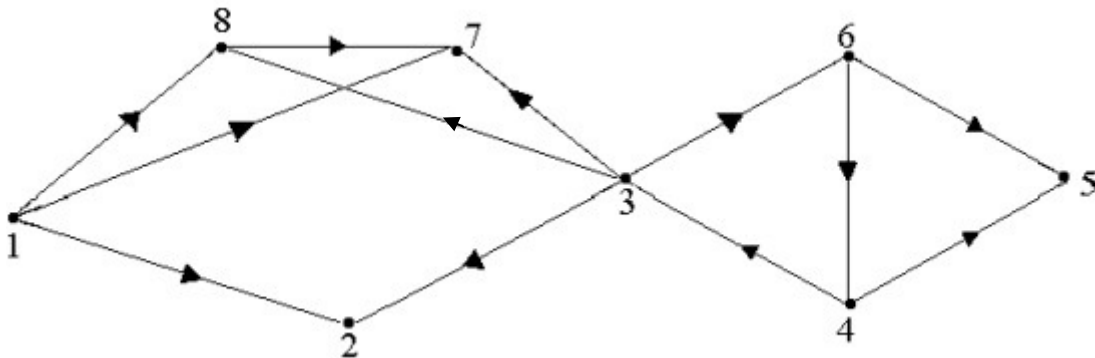
5.
a) Why do we use asymptotic notation in the study of algorithm? Describe commonly used asymptotic notations and give their significance.
b) Write an algorithm to insert an element to a max-heap that is represented sequentially
c) In java classes, constructors, methods and fields are regulated using access modifiers. What is access modifier and explain various access modifiers available in java.

(7+5+6)

6.
a) Construct a binary tree whose nodes in in-order and preorder are given as follows:
   In-order : 10, 15, 17, 18, 20, 25, 30, 35, 38, 40, 50
   Preorder: 20, 15, 10, 18, 17, 30, 25, 40, 35, 38, 50
b) Compare and contrast following sorting techniques with respect to memory space and computing time.
   Insertion Sort, Heap Sort, Merge Sort, Quick Sort.

(9+9)

7. Write short notes on **any three** of the following:
a) B Tree
b) Merge Sort
c) Threaded Binary Tree
d) Height Balance Tree (AVL Tree)

(3x6)