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) The degree of a node is the number of children it has. Show that in any binary tree, the numbers of leaves are one more than the number of nodes of degree 2.

b) What is constructor? How it can be declared? Explain why constructor doesn't have any return type?

c) Compare two functions n^2 and $2^n/4$ for various values of n. Determine when second becomes larger than first.

d) Bubble sort algorithm is inefficient because it continues execution even after an array is sorted by performing unnecessary comparisons. Therefore, the numbers of comparisons in the best and worst cases are the same. Modify the algorithm in such a fashion that it will not make the next pass when the array is already sorted.

e) Explain brute force string matching algorithm. Write down advantages and disadvantages.

f) How dynamic binding and polymorphism are related? Describe various restrictions that can be applied to the members of an interface.

g) What is recursion? A recursive procedure should have two properties. What are they? What type of recursive procedure can be converted in to iterative procedure without using stack? Explain with example.

(7x4)

2.

a) How do you find the complexity of an algorithm? What is the relation between the time and space complexities of an algorithm? Justify your answer with an example.

b) Explain method overloading and its usefulness. Give some examples of methods overloading.

c) Write an algorithm for Binary search. What are the conditions under which sequential search of a list is preferred over binary search?

(4+6+8)

3.

a) What is significance of access modifier in Java? Differentiate between public, private and protected access modifiers used in Java.

b) Write an algorithm to evaluate a postfix expression to an infix expression. Execute your algorithm using the following postfix expression as your input: a b + c d +*f ^.

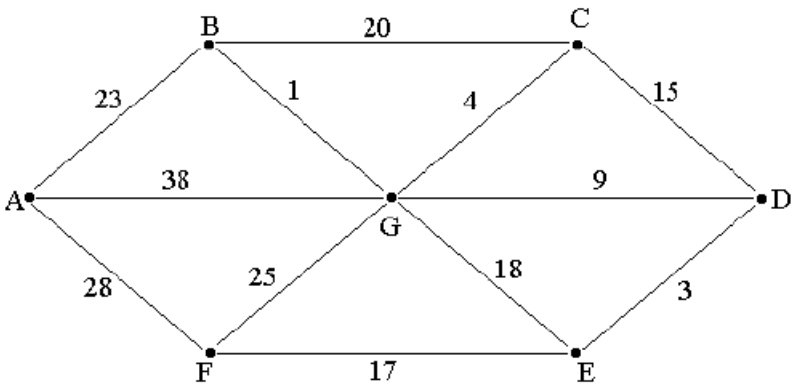
c) Write a Java program for reading lines of text from a file, store them in a linked list, and then print the lines in the linked list. File name will be passed as command line argument.

(6+6+6)

4.

a) What are circular queues? Write down routines for inserting and deleting elements from a circular queue implemented using arrays.

b) Consider the following undirected graph:



i) Find the adjacency list representation of the graph.
ii) Find a depth-first spanning tree starting at A.
iii) Find a breadth-first spanning tree starting at A.
iv) Find a minimum cost spanning tree by Kruskal's algorithm.

(8+10)

5.

a) Two linked lists contain similar type of information in ascending order. Write a program to merge them to a single sorted list.

b) Write a Java Code to implement Insertion Sort and analyze the behavior of insertion sort in three cases: Best, Worst and Average.

(9+9)

6.

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
Traverse the tree in Preorder, Inorder and Postorder.

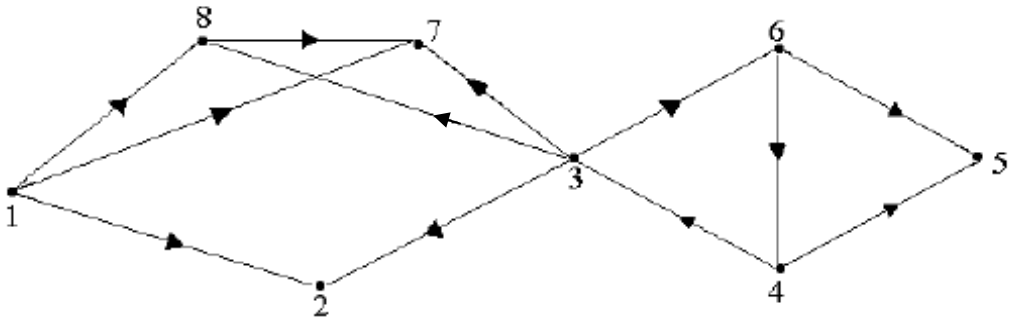
b) How will you represent a max-heap sequentially? Explain with an example. Write an algorithm to insert an element to sequentially represented max-heap.

(9+9)

7.

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.



c) Two Binary trees are similar if both are empty or if both are non-empty and left and right sub trees are similar. Write an algorithm to determine if two binary trees are similar.

(6+8+4)