THE UNIVERSITY OF THE WEST INDIES
FIVE ISLANDS CAMPUS

Semester II

Examinations of April/May 2023

Course Code: **COMP2611**

Course Title: **Data Structures**

Date of Assessment: **Thursday 4th May 2023**

Time: **9:00AM**

Duration: **TWO (2) HRS**

INSTRUCTIONS TO CANDIDATES:

This paper has _4_ pages and 3__ questions.

YOU ARE REQUIRED TO ANSWER ___ALL___ QUESTIONS.

THIS ASSESSMENT IS WORTH __60____ % OF YOUR FINAL GRADE.

Question 1

a. You are given the following postorder and inorder traversals of a binary tree.

Postorder	FECHGDBA
Inorder	FCEABHDG

Draw the binary tree.

[4 marks]

b. Each node of a binary search tree has fields left, right, key (an integer) and parent, with the usual meanings. Write a method which, given a pointer to the root of the tree and an integer n, searches for n. If found, return a pointer to the node. If not found, add n to the tree, returning a pointer to the new node. You may assume that the function call newNode (n).

[6 marks]

c. Write a complete function `inOrderSuccessor()` to return the inorder successor of a given node in the BST, number each line of code.

[6 marks]

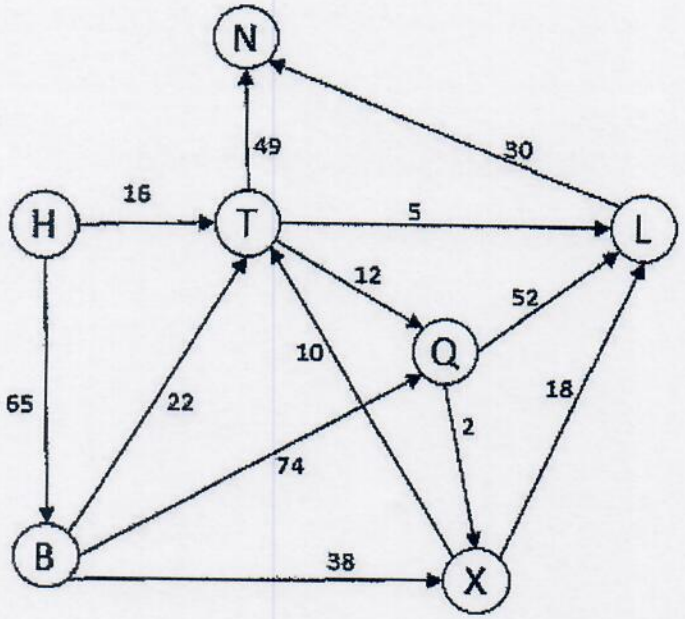
d. Using the line numbers in part(c) and the tree in part(a), list the lines to be executed when finding the inOrder Successor of the root node. For each line of code executed, provide the value for each of the variables on that line, until the inorder successor is returned.

[4 marks]

[20 marks]

Question 2

Given the graph below



(i) Provide the adjacency list and matrix representation of the graph. List nodes in alphabetical order.

[4 marks]

(ii) Give the depth-first and breadth-first traversals of the graph starting at B. Edges leaving a node are processed in alphabetical order. **[2 marks]**

(iii) Assuming that the graph in (a) is undirected, draw the minimal spanning tree obtained by using Kruskal's and Prim algorithm. Show the steps in your derivation. **[8 marks]**

(iv) Assuming that the graph in (a) is undirected derive the minimum-cost paths from the source vertex X to all other vertices using Dijkstra algorithm. At each stage of the derivation, show the current cost in a table (also called length or distance). Finally, for each vertex, show the cost and the path to get to each vertex

[6 marks]

[20 marks]

Question 3

(i) In a hashing applications the key consists of a string of letters. Write a hash function which, given a key and an integer max, returns a hash location between 1 and max, inclusive.

[3 marks]

(ii) Integers are inserted into a hash table H [1 . . 13] using "open addressing with double hashing". The primary hash function is h1(k) = 1 + k % 13. The secondary hash function is h2(k) = 1 + k % 9. Show the state of the array after inserting, in order, the keys 31, 22, 17, 25, 28, 30, 34, 15, 39, 42.

[4 marks]

(iii) Integers are inserted in an integer hash table H [1] to H [n] using double hashing as described in part(ii). Write a function to search for a given value key. If found, the function returns the location containing the key. If not found, the function inserts the key in any empty location. The function returns the location in which the key was inserted. Include hl which produces the initial hash location and the function h2 which is used if a collision occurs. You may assume there is room for new integers.

[5 marks]

(iv) Perform merge sort on the hash Table H[1..13] in part(ii). Show the tree produced when dividing the problem into smaller parts, and how the solution is built, to produce the sorted list.

[4 marks]

(v) Write the recursive method for merge sort, to produce the elements in descending order.

[4 marks]

[20 marks]

END OF QUESTION PAPER