NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF COMPUTING AND INFORMATICS

DEPARTMENT OF SOFTWARE ENGINEERING

QUALIFICATION: BACHELOR OF COMPUTER SCIENCE	
QUALIFICATION CODE: 07BCMS	**LEVEL:** 7
COURSE: DATA STRUCTURES AND ALGORITHMS 2	**COURSE CODE:** DSA711S
DATE: JULY 2023	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 90

SECOND OPPORTUNITY / SUPPLEMENTARY EXAMINATION QUESTION PAPER	
EXAMINER(S)	**Mr S. TJIRASO**
MODERATOR:	**MRS P. DOLIAN**

INSTRUCTIONS
1. Answer ALL the questions. 2. Read all the questions carefully before answering. 3. Number the answers clearly

THIS QUESTION PAPER CONSISTS OF 7 PAGES
(Including this front page)

PERMISSIBLE MATERIALS

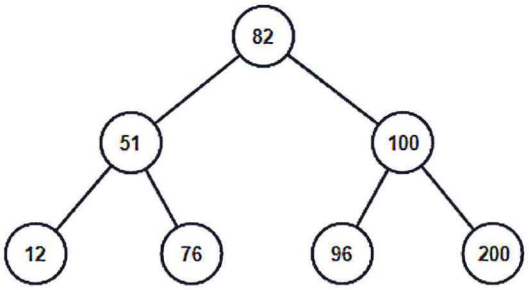
1. NON-PRGRAMMABLE CALCULATOR

SECTION A: Multiple Choice Questions **[20 Marks]**

- Answer all the questions in the provided booklet.
- The section consists of 10 questions.

Problem A1

Study the **Binary Search Tree** below.



What is the height of node 96? [2 Marks]

A. 7
B. 82
C. 0
D. 2

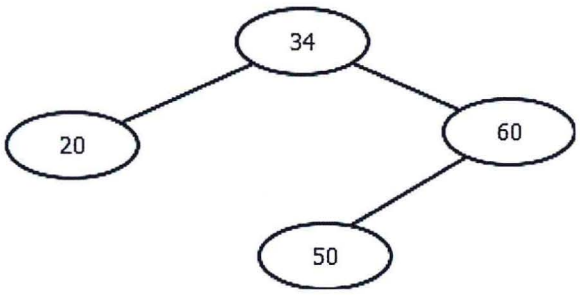
Problem A2

Given an AVL tree of size n, what would be the maximum number of steps required to find a node k placed anywhere in the tree? [2 Marks]

E. $O(e^n)$
A. O(n)
B. O(log(n))
C. O(1)

Problem A3

Given the BST below, what will be the value of height as returned by the function **max**? [2 marks]



$height=max(height_l, height_r)+1$

A. 1
B. 2
C. 0
D. None of the above

Problem A4

What is the depth of node 34 in the tree in **Problem A3** above? [2 Marks]

A. 0
B. 1
C. 2
D. None of the above

Problem A5

What is the height of node 60 in the tree in **Problem A3** above? [2 Marks]

A. 0
B. 1
C. 2
D. None of the above

Problem A6

A binary search tree is constructed by inserting the following elements in order: 60,25, 72, 15, 30, 68, 100, 13, 18 ,47, 70. How many number of left subtree nodes? [2 Marks]

A. 5
B. 7
C. 3
D. 6

Problem A7

A hash function h defined *h(key)=key mod 7*, with linear probing, is used to insert the keys 45, 46, 80, 56, 92, 19, 65 into a table indexed from 0 to 6. What will be the location of key 19? [2 Marks]

A. 3
B. 6
C. 5
D. 4

Problem A8

Linear Probing is a conflict resolution technique in_____? [2 Marks]

A. Hashing
B. Searching
C. Queue
D. Sorting

Problem A9

Which of the following statement is correct with respect to pushing data onto stack data structure? [2 Marks]

A. Push(int data)

B. Push()

C. Pop(int data)

D. None of the above

Problem A10

Which one of the following techniques is not used in the Binary tree? [2 Marks]

A. Inorder traversal

B. Postorder traversal

C. Randomized traversal

D. Preorder traversal

SECTION B: True and False Questions **[10 Marks]**

- Answer all the questions in the provided booklet.
- The section consists of 5 questions.

Problem B1

A recursive function without a base case is equivalent to an infinite loop. [2 Marks]

Problem B2

The head of a singly-linked always points to the last node. [2 Marks]

Problem B3

Given the following recursive function;

```
public int factorialRecursive(int total, int n) {
        if (n <= 0) {
            return total;
        }

        total = total * n;

        return factorialRecursive(total, n - 1);
    }
```

The line below is the correct base and recurisve case(s) for the function. [2 Marks]

Line: Base case is n == total and the recursive case total == n

Problem B4

Hashing is aimed at achieving searches, deletions and insertions in O(n). [2 Marks]

Problem B5

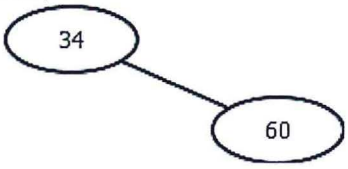
Two distinct keys hashing to the same index is known as coalition. [2 Marks]

SECTION C: Structured questions **[60 Marks]**

- Answer all the questions in the provided booklet.
- The section consists of 5 questions.

Problem C1

Study the Binary Search Tree below



Write down all its BST traversals output below:

i. Preorder traversal [2 Marks]

ii. Inorder traversal [2 Marks]

iii. Postorder traversal [2 Marks]

iv. What is the depth of 60? [2 Marks]

Problem C2

Explain the difference between recursion and iteration as problem-solving approaches? [4 marks]

Problem C3

Construct a BST for the elements: 9, 8, 12, 16, 10, u sing post order traversal. [10 marks]

Problem C4

Name and briefly explain any three types of AVL tree rotations [6 marks]

Problem C5

Huffman Coding is a technique of compressing data to reduce its size without losing any of the details. Some of the benefits of compressing data are that it can be transmitted faster over the network and can reduce "data" costs for mobile subscribers for example. Huffman Coding is one of many examples of binary tree applications.

Suppose the following string is to be sent over a network

M	M	S	E	S	S	K

Task:

a) What is the total size of the string as it is (in bits)? [2 marks]

b) What is the average code length (ACL) of the compressed code? [4 marks]

c) Apply Huffman Coding on the string and determine the Huffman tree, the code and code length of each character. [22 marks]

d) What is the size of the encoded string? [4 marks]

********** End of Exam**********