



**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: JUNE 2023	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 90

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	MR S. TJIRASO
MODERATOR:	MRS P. DOLIAN

INSTRUCTIONS
<ol style="list-style-type: none">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-PROGRAMMABLE CALCULATOR

SECTION A: Multiple Choice Questions

[20 Marks]

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

Problem A1

Which one of the below mentioned data structures is a linear data structure?

[2 Marks]

- A. Binary tree
- B. Binary search tree
- C. Graph
- D. Queue

Problem A2

Which of the following statement(s) is true?

[2 Marks]

Statement A: A binary tree is always a binary search tree.

Statement B: A binary search tree is a graph.

- A. Statement A is true, and statement B is false.
- B. Statement A is false, and statement B is true.
- C. Both statement A and statement B are true.
- D. Both statement A and statement B are false.

Problem A3

Which of the following statement(s) is true?

[2 Marks]

Statement A: All trees are graphs.

Statement B: Not all graphs are trees.

- A. Statement A is true, and statement B is false.
- B. Statement A is false, and statement B is true.
- C. Both statement A and statement B are true.
- D. Both statement A and statement B are false.

Problem A4

Which one of the following operations can be performed on a Binary Search Tree (BST)?

[2 Marks]

- A. Insertion-adding a node into the BST
- B. Deletion-removing a node from the graph
- C. Traversal-visiting all nodes in a BST
- D. All of the above

Problem A5

Given a java code snippet below, what is the output if n=3?

[2 Marks]

```
int add(int n)
{
  int k;
  if (n == 0)
    return 0;
  else
    k = n + add(n-1);
  return k;
}
```

- A. 0
- B. 3
- C. 6
- D. 4

Problem A6

Which one of the following is a time complexity of a recurrence relation for computing the n^{th} Fibonacci number?

[2 Marks]

- A. $T(n) = T(n-2) + c$
- B. $T(n) = T(n-1) + T(n-2) + c$
- C. $T(n) = T(n/2) + c$
- D. none of the above

Problem A7

What is the maximum number of edges a graph with 4 vertices can have?

[2 Marks]

- A. 3
- B. 6
- C. 4
- D. 16

Problem A8

In, searching starts at the beginning of the list and checks every element in the list. [2 Marks]

- A. Binary Search
- B. Linear Search
- C. Bubble Search
- D. Jump Search

Problem A9

.....is the term used to delete an element from stack?

[2 Marks]

- A. Pop
- B. Insert
- C. Delete
- D. Push

Problem A10

.....are a series of instructions that are followed, step by step, to do something useful or solve a problem.

[2 Marks]

- A. Graph
- B. Algorithm
- C. Queue
- D. Stack

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 doubly-linked list is a linear data structure.

[2 Marks]

Problem B2

It is sensible to discuss depth-first and breadth-first searches in linear data structures.

[2 marks]

Problem B3

A Stack follows a LIFO (last-in-first-out) rule.

[2 marks]

Problem B4

Push and pop operations are associated with Binary Search Tree data structure.

[2 marks]

Problem B5

Big-O and Big- Θ (Big-Theta) are both asymptotic notations.

[2 marks]

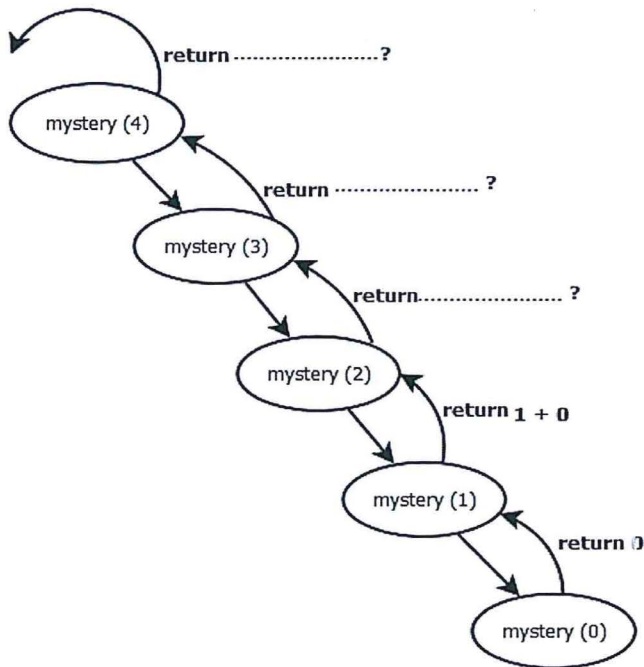
SECTION C: Structured questions

[60 Marks]

- Answer all the questions in the provided booklet.
- The section consists of 3 questions.

Problem C1

Study the tracing of the recursive function `mystery` below and answer all the questions that follow *in the provided booklet*. [18 Marks]



- Complete the missing return statements separated by commas. [6 marks]
- What will be the return value after the function `mystery ()` finishes execution? [2 marks]
- Using a **for loop**, write a java program snippet to implement the function `mystery()`. [10 marks]

Problem C2

Given a hash function h defined by, $h(key)=key \bmod 5$, with linear probing used to insert the keys: 17, 21, 22, 19, 13 into a table indexed from 0 to 4. Populate the hash table. [10 marks]

Problem C3

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

C	C	E	E	E	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]

Average code length: is calculated using the formula

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 *****