



**NAMIIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY**

**Faculty of Computing and Informatics**

Department of Computer Science

<b>QUALIFICATION</b> : Bachelor of Computer Science, Bachelor of Informatics	
<b>QUALIFICATION CODE:</b> 07BACS, 07BAIF	<b>LEVEL:</b> NQF 6
<b>COURSE:</b> Data Structures and Algorithms	<b>COURSE CODE:</b> DSA610S
<b>DATE:</b> June 2019	<b>SESSION:</b> 1
<b>DURATION:</b> 3 Hours	<b>MARKS:</b> 100

<b>FIRST OPPORTUNITY EXAMINATION QUESTION PAPER</b>	
<b>EXAMINER(S)</b>	MR MIKE ABIA DR CAMERON MACRAE MR JEREMIA LUMBASI MR HERMAN KANDJIMI MR VEERABHADRAM PADURI MR STEVEN TJIRASO
<b>MODERATOR:</b>	PROF. JOSE QUENUM

**THIS QUESTION PAPER CONSISTS OF 5 PAGES**  
(Excluding this front page)

**INSTRUCTIONS**

1. Respond to ALL problems in sections A, B and C.
2. Use the examination script booklet provided.
3. Each section must be started on a new page.
4. NUST examination rules and regulations apply.
5. Follow instructions in the examination script booklet.
6. Write clearly and neatly.

**SECTION A: Multiple Choice**

**[20 marks]**

- Respond to ALL problems in this section.
- Select the most suitable response to each of the problems in this section.

**Problem A1**

Which one of the below mentioned is a data structure?

- A. Peek
- B. pop
- C. Stack
- D. insert

[2 marks]

**Problem A2**

Which of the following is true about recursion?

- A. A recursion happens when an element occurs many times in a linked list.
- B. A recursive program segment is very economic in terms of memory when compared to a well-constructed iterative program segment that performs the same task.
- C. Not all recursive programme segments can be written iteratively.
- D. A recursive program segment calls itself.

[2 marks]

**Problem A3**

Which of the following algorithms is applicable only on sorted data?

- A. Binary search
- B. Sequential search
- C. Linear search
- D. None of the above

[2 marks]

**Problem A4**

Which of the following operations can be performed on singly-linked list, doubly-linked list and circular linked list?

- A. Insertion - adding an element to the list.
- B. Deletion - removing an element from the list.
- C. Search - seek for an element in a given list.
- D. All of the above.

[2 marks]

**Problem A5**

A concise, unambiguous and terminating sequence of operations to be performed to get the solution to a problem is called \_\_\_\_\_.

- A. Complexity analysis
- B. Problem
- C. Algorithm
- D. Requirements

[2 marks]

**Problem A6**

If T is a binary search tree storing 12 elements. What is the smallest possible height of T?

- A. 1 or 2
- B. 3 or 4
- C. 5 or 6
- D. 7 or 8

[2 marks]

**Problem A7**

Which of the following is an approach to traversing a graph?

- A. Binary search.
- B. Sequential search.
- C. Both A and B are approaches to traversing a graph.
- D. None of A or B is an approach to traversing a graph.

[2 marks]

**Problem A8**

What is the time complexity of the following code?

```
int a = 0;
for (i = 0; i < N; i++) {
    for (j = N; j > i; j--) {
        a = a + i + j;
    }
}
```

- A.  $O(N)$
- B.  $O(N \cdot \log(N))$
- C.  $O(N \cdot \sqrt{N})$
- D.  $O(N^2)$

[2 marks]

**Problem A9**

The worst case occurs in linear search algorithm \_\_\_\_\_.

- A. when item is somewhere in the middle of the array
- B. when item is not the array at all
- C. when item is the last element in the array
- D. Item is the last element in the array or item is not there at all

[2 marks]

**Problem A10**

Construct a binary search tree (BST) by inserting the following alphabetically ordered keys in the order they appear here: DCEBHFG. If we count the root as level 0, what keys appear at level 2 of a BST constructed from the sequence D,C,E,B,H,F,G? **Hint:** construct the binary search tree (BST) by picking from left to right, letters from the sequence and inserting them into a BST, thus D is the root of the tree.

- A. G
- B. BH
- C. HG
- D. CE

[2 marks]

**SECTION B**

**[20 marks]**

- Respond to ALL problems in this section.
- Clearly indicate each of the following assertions as true (T) or false (F).

**Problem B1**

A tree is always a linear data structure.

[2 marks]

**Problem B2**

Doubly-linked lists need to be searched using depth-first or breath-first searches.

[2 marks]

**Problem B3**

Push and pop operations are associated with stack data structure.

[2 marks]

**Problem B4**

$O(\log(n))$  is preferable as an algorithm's complexity than  $O(n^2)$ .

[2 marks]

**Problem B5**

An algorithm is a special data structure.

[2 marks]

**Problem B6**

Probabilistic complexity represents the probability of an algorithm processing input in a specific time.

[2 marks]

**Problem B7**

In binary search, start at the beginning of the list and check every element in the list.

[2 marks]

**Problem B8**

Inserting a key into a sorted singly linked list has  $O(n)$  complexity where  $n$  is the number of elements in the list.

[2 marks]

**Problem B9**

Good algorithms are more important than fast computers.

[2 marks]

**Problem B10**

An array cannot be used to implement a binary search tree.

[2 marks]

**SECTION C**

**[60 marks]**

- Respond to ALL problems in this section.

**Problem C1**

The following sequence of numbers needs to be sorted in ascending order: 8,5,2,6,9,3,1,4,0,7. If in-place selection sort was used, copy and complete the table below.

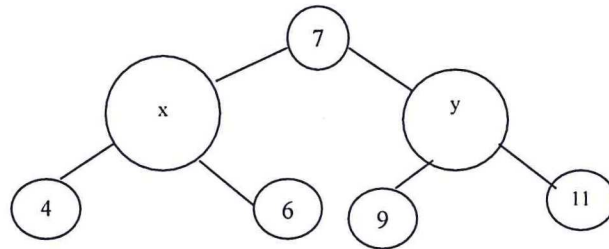
Sequence after Step 1 (Selection 1)	
Sequence after Step 2 (Selection 2)	
Sequence after Step 3 (Selection 3)	

[3x5 marks]

**Problem C2**

A binary search tree is a data structure where each node has a comparable key (non-repeating) and satisfies the restriction that the key in any node is larger than the keys in all nodes in that node's left sub-tree and smaller than the keys in all nodes in that node's right sub-tree. Each non-leaf node has exactly two child nodes. Each child must either be a leaf node or the root of another binary search tree.

In representing some incomplete set of data, a programmer constructed the following binary search tree.



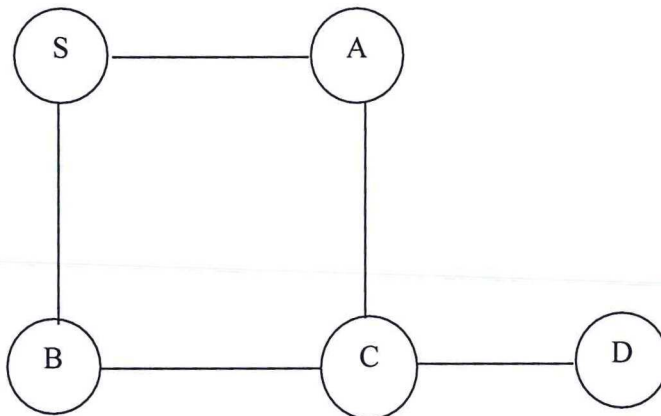
- a. Determine the valid range of values of x.
- b. Determine the valid range of values of y.

[5 marks]

[10 marks]

**Problem C3**

The following diagram represents a graph.



Give the result if the graph is traversed using;

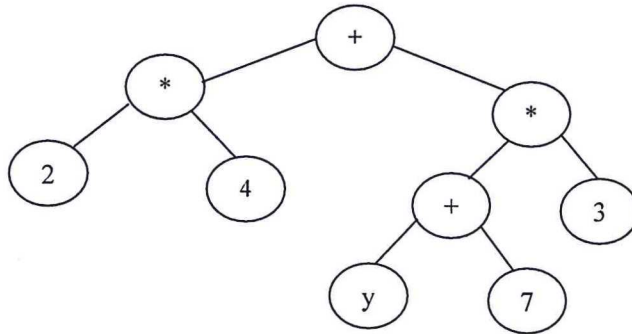
- a. Depth-first-search starting at vertex S
- b. Breadth-first-search starting at vertex S.

[10 marks]

[5 marks]

**Problem C4**

Expression tree is a binary tree in which each internal node corresponds to an operator and each leaf node corresponds to an operand. Given the following expression tree, write down the outcome of in-order traversal of the tree.



[15 marks]

**\*\*\*\*End of Paper\*\*\*\***