



Handwritten signature in red ink.

(Knowledge for Development)

**KIBABII UNIVERSITY
(KIBU)**

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
END OF SEMESTER EXAMINATION**

2021/2022 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER EXAMINATION

**FOR THE DEGREE OF BACHELORS OF SCIENCE IN
(INFORMATION TECHNOLOGY)**

COURSE CODE: BIT 121

COURSE TITLE: DATA STRUCTURES AND ALGORITHMS

DATE: 12/05/2022

TIME: 2.00 P.M. – 4.00 P.M.

2HRS

INSTRUCTIONS TO CANDIDATES:

ANSWER QUESTIONS ONE AND ANY OTHER TWO.

Paper Consists of 5 Printed Pages. Please Turn Over ►

QUESTION ONE (COMPULSORY)**[30 MARKS]**

- a. Define the following terms and concepts as used in the study of data structures and algorithms
- i. Data structures **[1 mark]**
 - ii. Abstract Data Type (ADT) **[1 mark]**
 - iii. Linked list **[1 mark]**
- b. i. Explain the implementation of circular queue using array. **[2 marks]**
ii. How an “empty queue” is distinguished from a “full queue”? **[2 marks]**
iii. Write down necessary functions or operations that can be perform on circular queue. **[2 marks]**
- c. Consider the program below:

```
1  import java.io.*;
2  import java.util.Arrays;
3  public class SortingArrayElements {
4  static int sortRowWise(int marks[][] ) {
5  for (int i = 0; i < marks.length; i++) {
6  Arrays.sort(marks[i]);
7  }
8
9  for (int i = 0; i < marks.length; i++) {
10 for (int j = 0; j < marks[i].length; j++) {
11 System.out.print(marks[i][j] + " ");
12 }
13 System.out.println( );
14 }
15 return 0;
16 }
17 public static void main(String args[]) {
18 int marks[ ][ ] = {{45, 78, 72, 71, 57, 70, 58, 80},
19 {34, 56, 76, 24, 54, 75, 49, 64},
20 {60, 64, 65, 42, 63, 73, 80, 67}
21 };
22 sortRowWise(marks);
23 }
24 }
```

Trace the output of this program.

[3 marks]

- d. Write a program segment to create an array called arrayList, place 10 data items in it and display all the items. The output of the program should look like this: **[3 marks]**

```
44 98 65 87 12 32 70 23 54 67
```

e. Consider following list: a [1, 10] = (310,285,179,625,351,423,861, 254,450,520) Sort the above list using bubble sort. Show all intermediate steps. [4 marks]

f. Construct a binary tree representing an arithmetic expression. [4 marks]

$$(((3 + 1) * 3) / ((9 - 5) + 2)) - ((3 * (7 - 4)) + 6)$$

g. Explain with an example the differences between singly linked list and double linked list. [4 marks]

h. Construct a binary search tree for the data items $S = \{416, 891, 456, 765, 111, 654, 345, 256, 333\}$ [3 marks]

QUESTION TWO

[20 MARKS]

a. What is meant by the term sorting? [1 mark]

b. i. Explain why studying data structures requires a good understanding of computer memory. [2 marks]

ii. You are provided with the following values in a computer memory.

34

30

Write a **java** or **C++** code excerpt that will be used to swap the two values. [3 marks]

c. Suppose an array Score contains 9 elements as follows: 23, 11, 61, 52, 13, 71, 45, 3, 15.

Using relevant illustration, explain how you will perform the following Sorting algorithms. [4 marks]

i. Insertion sort

ii. Merge sort

iii. Bubble sort

d. Which algorithm in (b above) to you think is optimal and why? [2 marks]

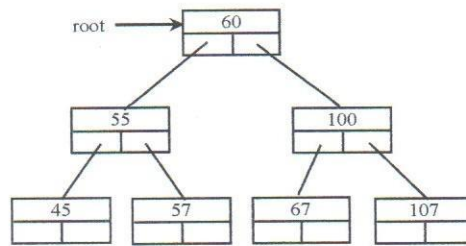
QUESTION THREE

[20 MARKS]

a. i. What is meant by a non-linear data structures? [2 marks]

ii. Using relevant examples distinguish between **Binary trees** and **Binary search trees**. [4 marks]

b. You are provided with the following data items: 30, 50, 80, 103, and 75. Provide a stepwise procedure you will follow in adding the data item on the **BST tree** below and draw the final tree.



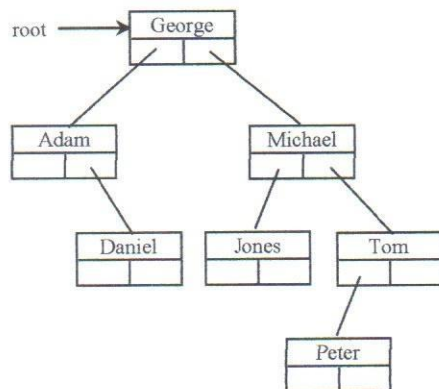
[6 marks]

c. i. What is meant by traversing a tree?

[2 marks]

ii. What will be the outputs of **inorder**, **postorder** and **preorder** respectively when the tree bellow is traversed?

[6 marks]



QUESTION FOUR

[20 MARKS]

a. Define the terms **queue**, **stack** and **heap** as used in the study of data structures and algorithms

[3 marks]

b. Construct an expression tree for the expression $(a + b * c) + ((d * e + 1) * g)$. Give the outputs when you apply polished (**prefix**) and reverse polished (**postfix**) notations.

[6 marks]

c. i. Write a java program to carry out an insertion sort on the following elements.

61, 72, 5, 11, 3, 15

[7 marks]

ii. Write a java code that will be used to search for a key value 3 in the elements in c (i)

[4 marks]

QUESTION FIVE

[20 MARKS]

a. Draw a binary tree to represent the following fully parenthesized expression and evaluate it.

$((8 * 3) + 2) / (21 - (2^3))$

[3 marks]

- b. With relevant illustration explain how a heap can also be treated as a binary tree? [4 marks]
- c. Given a list of 8 Integers elements: {1, 4, 5, 6, 9, 12, 14, and 16}. Explain how searching will proceed by **sequential search** to find (**key=12**) in the list. [4 marks]
- d. Explain the concept of linked list and explain real life scenarios where linked lists are applied [4 marks]
- e. Construct two Binary Search Trees for a collection of values. Tree (a) results if values are inserted in the order 37, 24, 42, 7, 2, 40, 42, 32, 120 and Tree (b) results if the same values are inserted in the order 120, 42, 42, 7, 2, 32, 37, 24, 40. [6 marks]