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**UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR**

**END OF SEMESTER EXAMINATIONS
YEAR ONE SEMESTER TWO EXAMINATIONS**

**FOR THE DEGREE OF BACHELORS OF
SCIENCE**

(INFORMATION TECHNOLOGY)

COURSE CODE: BIT 121

COURSE TITLE: DATA STRUCTURES AND ALGORITHMS

DATE: 25/04/2023 TIME: 2.00 PM - 4.00 PM 2HRS

INSTRUCTIONS

ANSWER QUESTIONS ONE AND ANY OTHER TWO

This Paper Consists of 5 printed pages ➡ Turn Over

QUESTION ONE (COMPULSORY) [30 MARKS]

- a. How can one measure the goodness of an algorithm? [2 marks]
- b. Define the term data structure and give two considerations for one to make a choice of a data structure. [4 marks]
- c. Outline the characteristics of the following data structures and where they are applicable in the real life scenarios.
- i. Stacks [2 marks]
 - ii. Queues [2 marks]
 - iii. Linked lists [2 marks]
- d. What is memory management, how are linked lists represented in a computer memory. [3 marks]
- e. Explain the common operations on a list data structure and two ways of implementing lists. [3 marks]
- f. Using appropriate examples compare the performance of Linear search and binary search algorithms by stating their:
- i. Best cases [2 marks]
 - ii. Worst cases [2 marks]
 - iii. Average cases [2 marks]
- g. Explain briefly Big-oh, Big-Omega and Big-Theta notations using appropriate graphs or diagrams. [3 marks]
- h. For each of the following situations, which of these ADTs (1 through 4) would be most appropriate: (1. a queue, 2. a stack, 3. a list, 4. none of these)

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|------|----------------------------------------------------------------------------------|
| i. | The customers at a KCB bank counter who take numbers to make their turn |
| ii. | Integers that need to be sorted |
| iii. | Arranging plates in the cafeteria |
| iv. | People who are put on hold when they call easy coach to make ticket reservations |
| v. | Converting infix to postfix expression |
| vi. | Message received on WhatsApp or Facebook |

[3 marks]

QUESTION TWO [20 MARKS]

- a. Programming can be viewed as a process of design and implementing algorithms that a computer can use to carry out tasks. Define the two main roles of the programmer. [2 marks]
- b. Explain how a node can be added and removed from a double linked list. [2 marks]

- c. Write a C++/Java statements to create an array called score and initialize its elements as 51, 82, 93, 44, 78, 70, and 73 [2 marks]
- d. Explain the meaning of the following terms and concepts as used in data structures
- Sorting algorithms [2 marks]
 - Searching algorithms [2 marks]
 - Correctness of an algorithm [2 marks]
- e. Suppose the array A contains 8 elements 72, 32, 42, 12, 82, 22, 62 and 52. Explain how you will perform
- Insertion sort [2 marks]
 - Bubble sort [2 marks]
- f. Write a C++ or a Java program to simulate selection sort on the data elements given in part (e) above. [4 marks]

QUESTION THREE [20 MARKS]

- a. Discuss the concept of garbage collection and memory leak [4 marks]
- b. You are given the following structure in a computer memory:

53	63	73	83	93
66	67	69	65	54
71	72	74	75	76

Assuming that the structure is storing student marks. Write a C++/Java statement that:

- creates the structure as it appears [3 marks]
 - Access and retrieve the value 65 from the structure [1 mark]
 - Add the entry having 67 and 76 and assign this value to an integer variable called *temp*. [2 marks]
 - Delete an element 74 from the structure [2 marks]
 - Replace 69 with 95 [1 mark]
 - What are the two main limitations of using array structures? [2 marks]
- c. Represent the following expression tree $(x+y*Z)*(a/b - c)$ and write its prefix and postfix notation or expression. [5 marks]

QUESTION FOUR [20 MARKS]