



**MULTIMEDIA UNIVERSITY OF KENYA**  
**FACULTY OF COMPUTING AND INFORMATION TECHNOLOGY**  
**UNIVERSITY EXAMINATIONS 2024/2025**  
**SECOND YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF**  
**BACHELOR OF SCIENCE IN COMPUTER SCIENCE**  
**BACHELOR OF SCIENCE IN SOFTWARE ENGINEERING**

**UNIT CODE: CCS 2214      UNIT NAME: DATA STRUCTURES AND ALGORITHMS**

**DATE: JANUARY 2025**

**TIME: 2 HOURS**

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**INSTRUCTIONS:**

**ANSWER YOUR QUESTIONS IN ANSWER BOOKLET PROVIDED.**

**ANSWER QUESTION ONE [COMPULSORY] AND ANY OTHER TWO QUESTIONS.**

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**QUESTION ONE (THIRTY MARKS)**

- a) Define an **abstract data type (ADT)** and give two examples. (4 Marks)
- b) Define the following terms as used in Data Structures and Algorithms. (6 Marks)
  - i. Hashing
  - ii. Hash function
  - iii. Collisions
- c) Sort the array using the **selection sort** algorithm. (4 Marks)  
Array: arr = [3, 1, 4, 1, 5, 9, 2, 6, 5]
- d) Explain how at least three ways that a linked list differs from an array. (6 Marks)
- e) A binary search tree (BST) is a binary tree where each node has at most two children.  
List the two properties that a BST must hold and give the time complexity of at least two operations that are possible on a BST. (4 Marks)

- f) Create a Python class to represent a singly linked list. The class should have two functions:

- `insert_at_beginning`: Adds a new node to the start of the list.
- `print_list`: Displays the values of all nodes in the list.

(6 Marks)

## QUESTION TWO (TWENTY MARKS)

- Explain the **stack data structure** and its main operations. (6 Marks)
- Provide one real-world application of a stack and explain how it is used. (4 Marks)
- Write a **Python** program to implement a stack using an array. Include all the basic operations of a stack. (10 Marks)

## QUESTION THREE (TWENTY MARKS)

- Define dynamic programming. What are the key characteristics of a problem suitable for dynamic programming? (6 Marks)
- Explain the concept of memoization and tabulation. (6 Marks)
- Implement the Fibonacci sequence using dynamic programming in Python. (8 Marks)

## QUESTION FOUR (TWENTY MARKS)

- Define a graph. What are the two main types of graphs? (5 Marks)
- Given the following adjacency matrix, draw the corresponding graph: (5 Marks)

	A	B	C	D
A	0	1	1	0
B	1	0	0	1
C	1	0	0	1
D	0	1	1	0

- Write a Python function to implement Breadth-First Search (BFS) algorithm to find the shortest path between two nodes in an unweighted graph. (10 Marks)

## QUESTION FIVE (TWENTY MARKS)

- Describe the process of Breadth-First Search (BFS) in graph traversal, and explain a situation where BFS is preferred over Depth-First Search (DFS). (6 Marks)
- Describe at least 4 properties of a binary search tree. (8 Marks)
- Implement a Python function that given a binary tree will calculate and return the height of the binary tree using recursion. (6 Marks)