AFRICA UNIVERSITY
A United Methodist-Related Institution

"Investing in Africa's Future"

COLLEGE OF ENGINEERING AND APPLIED SCIENCES

NHAI 107: ALGORITHMS AND DATA STRUCTURES

END OF FIRST SEMESTER EXAMINATIONS

NOVEMBER 2025

LECTURER: MR J. CHINZVENDE

TIME: 3 HOURS

INSTRUCTIONS

Answer questions instructed in each section

Start **each** question on a new page.

The marks allocated to **each** question are shown at the end of the section.

Answer all questions in Section A and Chose any 2 in section B

Credit will be awarded for logical, systematic and neat presentations.

Section A [Answer all]

Question One

Define the following terms as they are used in Data Structures and Algorithms.

a. Algorithm
b. Efficiency
c. Flexibility
d. Effectiveness
e. Data structure [10]

Question Two

Write an Algorithm to perform the following on an array

a. Search for an item
b. Delete an item
c. Sort items in descending order
d. Insert an item at the end of the array
e. Update an existing item in the array [10]

Question Three

What is the difference between…

a. Sorting and Searching
b. Bubble sort and selection sort
c. Linear Search and Binary Search
d. Time Complexity: and Space Complexity
e. Primitive Data Structures and Abstract Data Structure [10]

Question Four

What is the difference between a stack and a queue? Explain how these data structures work and provide examples of real-life applications for each. [10]

Question Five

a. Write an algorithm to implement the linked list below
   {3, 5, 13, 2}; **[10]**
b. Write a Python program to print linked list below
   {3, 5, 13, 2}; **[15]**

SECTION B [Answer any Two (2)]

Question Six

An online booking system for flights needs to manage reservations and cancellations.

a. Discuss the advantages of using a priority queue for managing flight bookings based on departure time. **[10]**

b. Implement a function to add a new booking to the priority queue. Explain its time complexity. **[10]**

c. How would you handle cancellations in your priority queue implementation? **[05]**

Question Seven

Africa University is developing a scheduling application that needs to handle efficiently a large number of events and associated time slots.

a. Discuss which data structure(s) would be suitable for storing and retrieving the events based on their time slots. **[10]**

b. Explain the algorithmic operations required to manage efficiently the scheduling process. **[15]**

Question Eight

A navigation system needs to find the shortest route between two locations on a map.

a. Identify and explain the appropriate graph representation (adjacency list or matrix) for the navigation system. **[10]**

b. Outline the steps of Dijkstra's algorithm and implement it to find the shortest path from a starting location to a destination. **[10]**

c. What is the time complexity of your implementation and how does it scale with the number of locations? **[05]**

End of Paper