KISII UNIVERSITY

UNIVERSITY EXAMINATIONS

SECOND YEAR EXAMINATION FOR THE AWARD OF THE DEGREE OF BACHELOR OF SCIENCE OF INFORMATION TECHNOLOGY/BACHELOR OF APPLIED COMPUTER SCIENCE
SECOND SEMESTER 2023/2024
[JAN – APRIL, 2024]

ACMP 228/BIT 203/INS 457: DATA STRUCTURES AND ALGORITHMS

STREAM: Y2 S2   **TIME: 2 HOURS**

DAY: MONDAY, 3:00 - 5:00 P.M.   **DATE: 22/04/2024**

INSTRUCTIONS

1. *Do not write anything on this question paper.*
2. *Answer question ONE (Compulsory) and any other TWO questions.*

QUESTION ONE (COMPULSORY) (30MKS).

a) Describe a data structure? Discuss three problems that are solved by data structures.   (4 marks)
b) Define the following: (5 marks)
       i.   Index
       ii. Data Item
       iii. Interface
       iv. Algorithm
       v.   Implementation
c) Describe three differences between a stack and a queue.   (6 marks)
d) Differentiate between dynamic linear and static linear data structures.
                                                                 (4 marks)
e) Define Breath First Search(BFS) algorithm. Give two ways to do Breath First Search(BFS).   (6 marks)
f) A friend has consulted you on coming up with a software for his fresh product shop. He wishes to ensure that all products take the shortest time possible, by selling the products in the order they came. What data type,

and data structures would you recommend for this implementation. Explain your answer. (5 marks)

QUESTION TWO (20 MKS)

a) Discuss an array. Describe how an array differs from Linked lists. (4 marks)

b) Describe three operations that can be performed on arrays, and provide the corresponding methods in python programming language. (6 marks)

c) Describe a stack data structure. Identify the operations that can be performed on a stack. (4 marks)

d) Discuss the following characteristics of data structures. (6 marks)

   i. Correctness.

   ii. Time Complexity.

   iii. Space Complexity.

QUESTION THREE (20MKS).

a) Discuss the following as used in tree data structure: (5 marks)
   i. Path
   ii. Root
   iii. Parent
   iv. Child
   v. Leaf

b) The nodes on a tree are connected via edges (links), therefore we cannot randomly access a node in a tree. Hence, we always start traversing the tree from the root (head) node. Describe three ways which we use to traverse a tree. (6 marks)

c) Differentiate between directed and undirected graphs with diagrammatic examples. (4 marks)

d) Describe two traversal operations that can be performed on a graph.

(5 marks)

QUESTION FOUR (20MKS)

a) Differentiate between the following abstract data types: stack and a queue.

(5 marks)

b) Explain two real life applications of the following data structures: (5 marks)

   Linked list, Stack, Queue, Array and Tree.

c) Sorting techniques in data structures is a process of rearranging data elements in an array or list in order to make it easier to search and retrieve. By sorting in data structure, the complexity of searching for a particular item is reduced. Describe the following sorting techniques: (10mks)

   i.   Quick sort

   ii. Bubble sort

   iii. Merge sort

   iv. Insertion sort

   v.   Selection sort

QUESTION FIVE (20MKS)

a) The Traveling Salesman Problem (TSP) is the challenge of finding the shortest path or shortest route for a salesperson to take, given a starting point, a number of cities (nodes), and optionally an ending point. It is a well-known algorithmic problem in the fields of computer science, with important real-world applications for logistics and delivery businesses.

i.   Identify and describe three algorithms that can be used to solve the travelling salesman problem.   (10 marks)

ii. With reference to the Travelling Salesman Problem explain what is meant by combinatorial explosion and what effect this has in finding an optimal solution.   (6 marks)

iii. Propose a solution to the combinatorial problem identified above. (4 marks)