MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING, APPLIED SCIENCES AND TECHNOLOGY

DEPARTMENT: COMPUTER SCIENCE AND INFORMATION SYSTEMS

MODULE: DATA STRUCTURES AND ALGORITHMS

CODE: BCOS122

SESSIONAL EXAMINATIONS
JUNE 2024

DURATION: 3 HOURS

EXAMINER: Dr C. KURANGA

INSTRUCTIONS

1. *Answer **any four** questions*

2. *Each question carries 25 marks*

3. *Start a new question on a fresh page*

Additional material(s): None

Question 1

  a) Explore the classification of data structures.   [5]

  b) Discuss the features of ADT.   [9]

  c) Describe ways of implementing a linked list.   [6]

  d) Explain when a singly linked list can be represented as a circular linked list.   [5]

Question 2

  a) Describe an abstract data type.   [5]

  b) Explore the properties of an algorithm.   [5]

  c) Explain:

        (i)   Time complexity; and   [3]

        (ii)   Space complexity;   [3]

  d) Write a selection sort algorithm and give its time complexities.   [9]

Question 3

  a) Write the routine for the insertion operation of a singly linked list.   [6]

  b) Explain internal and external sorting.   [6]

  c) Discuss problems in hashing.   [4]

  d) Discuss the advantages of a threaded binary tree.   [9]

Question 4

  a) Explain why algorithms are analyzed.   [7]

  b) Discuss enqueue and dequeue operations.   [8]

  c) With the aid of an algorithm, describe merge sort.   [10]

Question 5

  a) Apply *quicksort* to sort the list:

        E, X, A, M, P, L, E

           in alphabetical order.

           Draw the tree of the recursive calls made.   [13]

  b) Explain the following traversal techniques:

        (i)   In-order;   [4]

(ii)   Pre-order; and   [4]

(iii) Post-order.   [4]

Question 6

a) The following algorithm takes as input an array and returns the array with all the duplicate elements removed. For example, if the input array is {1, 3, 3, 2, 4, 2}, the algorithm returns {1, 3, 2, 4}.

Write the big-O complexity of this algorithm, if the set is implemented as:

i.   An AVL tree.   [4]

ii.   A hash table.   [4]

b) Explain the roles of data structures.   [4]

c) Design an algorithm that takes two arrays, and returns true if the arrays are disjoint, i.e. have no elements in common.   [13]

END OF EXAMINATION