THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

JANUARY – APRIL 2020 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER AND LIBRARY SCIENCE

REGULAR PROGRAMME

CMT 304 : DATA STRUCTURES AND ALGORITHMS

Date: APRIL 2020	Duration: 2 Hours
INSTRUCTIONS: Answer Question ONE and any other TWO Questions	

Q1. a)   Define the following terms as used in data structures.
  i) Data abstraction
  ii) Data encapsulation
  iii) Data type   **(3 marks)**

  b)   List five benefits of using Abstract Data Types 'ADTs', giving a short
      explanation of each   **(5 marks)**

  c)   Explain in brief the meaning of the following terms as used in Array
      abstract data type.
  i) Row major order
  ii) Column major order   **(4 marks)**

  d)   i)   Explain why a stack should be tested if it is full when performing
           stack operation.   **(2 marks)**
       ii) Write an algorithm for **isFull()** function of a stack identifier
                                                              (6 marks)

  e)   i)   Define an algorithm   **(2 marks)**
       ii) Construct a binary tree and apply the three traversal techniques on
           the following expression (A+B)*(C-D)   **(6 marks)**
       iii) Define ordered List in Abstract data type   **(2 marks)**

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Q2.   a)   i)   Define Binary tree, complete binary tree and full binary tree
                                                          (6 marks)
          ii) Represent the following expression as binary tree and write prefix
               and postfix form of the expression (A+B+C*D)-(A/B-CD+E)
                                                          (6 marks)
          iii) Given a sequence of numbers; 11,6,819,4,10,5,17,43,49,31. Draw
               a binary search tree by inserting the numbers from left to right and
               then show the two trees that can be the result after the removal of
               11   **(8 marks)**

Q3.   a)   Draw a diagram of a **Linked list**, **Circular Linked list** and **doubly linked
           list** with nodes containing the integer values 3, 18,29,58,89.
                                                          (9 marks)

      b)   Describe how a stack and queue can be represented using a linked list?
           What is the main advantage of this representation over Arrays?
                                                          (6 marks)

      c)   Using the linked list concept, write a program for manipulating a Queue
           structure   **(5 marks)**

Q4.   a)   Differentiate the following types of Sort and Search concepts:
               i). Linear and binary search   **(3 Marks)**

               ii). Bubble and selection sort   **(3 Marks)**

               iii). Insertion and Merge sort   **(3 marks)**

      b)   Use the quick-sort algorithm to sort the data: 9,4,10, 3, 2,11
                                                          (4 marks)

      c)   Trace the bubble sort algorithm as it sort the following array into
           ascending order: 30 90 50 35 70 40   **(7 marks)**

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Q5. a) i) State the algorithm of fibonacci sequence and use the algorithm to write a program for computing fibonacci sequence
(5 marks)

ii) List properties that an algorithm should posses **(6 marks)**

b) Use stack to evaluate the postfix expression ABC+D*+E+. Show the status of the stack after each step of the algorithm. Assume the following values for the identifiers:
A=8, B=5, C=3, D=9, E=4. **(5 marks)**

c) Discuss the concept of graph data structure **(3 marks)**

END

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