



THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

JANUARY – APRIL 2019 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER AND LIBRARY SCIENCE

REGULAR PROGRAMME

CMT 304: DATA STRUCTURES AND ALGORITHMS

Date: APRIL 2019

Duration: 2 Hours

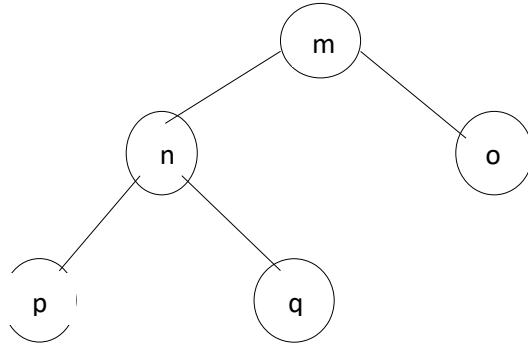
INSTRUCTIONS: Answer Question ONE and any other TWO Questions

- Q1. a) Define the following terms.
- i) Data Structure (1 mark)
 - ii) Algorithm (1 mark)
- b) Explain any two reasons why a software engineer should study about Data Structures and Algorithms. (2 marks)
- c) What is an ADT? Provide an example of an ADT. (2 marks)
- d) Provide the following:
- i) Algorithm to delete data from a queue. (4 marks)
 - ii) Flow chart to delete data from a queue. (4 marks)
- e) The formula to solve the quadratic $ax^2 + bx + c = 0$ is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.
- i) Design an algorithm to solve such an equation. (6 marks)
 - ii) Draw a flowchart to solve the same equation using the if ... and if ... else ... statements, considering all the three cases, i.e., real and unequal roots, real and equal roots and imaginary roots. (10 marks)
- Q2. a) Define the following terms:
- i) Linear List (1 mark)

- ii) Graph **(2 marks)**
- iii) Tree **(2 marks)**

b) By using three nodes, draw a sketch that illustrates a circular single linked list. **(2 marks)**

c) Perform six different traversals on the following binary tree.



(6 marks)

d) Design an algorithm to search for an element x in a one-dimensional array K with n integral elements. **(7 marks)**

Q3. a) Define the following

- i) Stack **(2 marks)**
- ii) Queue **(2 marks)**

b) Explain two application areas for each of the ADTs in Q3. a). **(4 marks)**

c) Consider a double linked list with the elements u, v, w, y and z appearing in the same order. Provide the following.

- i) Algorithm to insert a node with x after w. **(4 marks)**
- ii) Flow chart to achieve the same task. **(8 marks)**

Q4. a) Define the following in regard to trees.

- i) Degree of a tree **(2 marks)**
- ii) Sibling **(2 marks)**

b) Distinguish between the following.

- i) Sorting and searching **(2 marks)**
- ii) Non-circular single linked list and the circular single linked list. **(2 marks)**

c) Give a diagrammatic illustration of a double linked list. What makes it better than a single linked list? **(4 marks)**

d) Consider the data structure below in answering the questions that follow:



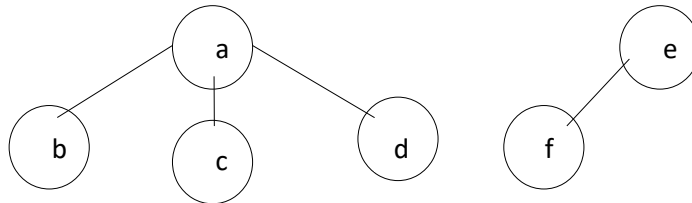
i) Write an algorithm to insert a new node with element Q in the D field after the node with Y in the D – field. **(4 marks)**

ii) Write an algorithm to delete the node with element X in the D-field. **(4 marks)**

Q5. a) i) What is a binary tree? **(2 marks)**

ii) Explain two advantages of a binary tree in relation to a general tree. **(2 marks)**

b) Transform the following forest into a binary tree.



(4 marks)

c) Give the steps to be followed in transforming a general tree into binary form. **(3 marks)**

d) With the help of C language, write a program for the Binary search technique. **(8 marks)**

END