The Co-operative University of Kenya

END OF SEMESTER EXAMINATION APRIL-2019

EXAMINATION FOR THE DEGREE OF BACHELOR OF COMPUTER SCIENCE/ BACHELOR OF INFORMATION TECHNOLOGY

UNIT CODE: BCOM

UNIT TITLE: DATA STRUCTURES AND ALGORITHMS

DATE: 8TH APRIL, 2019   **TIME: 9:00 AM – 11:00 AM**
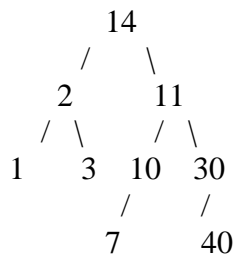
INSTRUCTIONS:
- Answer question **ONE (compulsory)** and any other **TWO** questions

QUESTION ONE
a) Write an algorithm to compute the remainder after subtracting all integers divisible by four and less than 25 from thirty? (4 Marks)
b) Describe the time complexity of the following operations:
    i.   Subtraction operation (2 Marks)
    ii.   Replacing the first five characters in a string with 'e' (2 Marks)
    iii.   iii. The temperature on a sunny day from 6:00PM to 12:00PM (2 Marks)
c) Explain two reasons why you might use a linked list rather than an array (4 Marks)
d) Discuss two reasons why a destructor is necessary? (2 Marks)
e) Explain any two key features of a recursive algorithm (4 Marks)

QUESTION TWO
a) Given the following tree, write the order of nodes visited using:
    i.   In-order traversal (2 Marks)
    ii.   Pre-order traversal (2 Marks)
    iii.   Post-order traversal (2 Marks)

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            14
           /    \
          2      11
        /  \    /  \
       1    3  10   30
               /    /
              7    40
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b) Demonstrate how a binary tree can be stored as an array. Write a formula(s) to determine the child for any parent in a tree as well a formula to determine the parent given a node (child) on the tree. (9 Marks)

QUESTION THREE
a) Write an algorithm to compute the sum of two integers and use it to explain three properties that an algorithm should possess. (5 Marks)
b) Explain is the big-O time complexity of {traversing, inserting a node at the front, inserting a node at the end} of a singly linked list (6 Marks)
c) Write an algorithm that demonstrates the push operation on a stack using an array based stack? (4 Marks)

QUESTION FOUR

a) Given the following array, calculate the result of a bubble sort after the second pass

      11, 8, 4, 14, 13, 11, 5, 9   (6 Marks)

b) Write a class definition that could be used to define a node in a doubly linked list.

          (4 Marks)

c) Write and clearly explain any algorithm that takes O(n) space complexity. (5 Marks)

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