



# MERU UNIVERSITY COLLEGE OF SCIENCE & TECHNOLOGY

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## University Examinations 2012/2013

FIRST YEAR, SECOND SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR  
OF SCIENCE IN COMPUTER SCIENCE AND BACHELOR OF MATHEMATICS AND  
COMPUTER SCIENCE

AND

SECOND YEAR, FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF  
BUSINESS INFORMATION TECHNOLOGY

### ICS 2105: DATA STRUCTURES AND ALGORITHMS

DATE: AUGUST 2012

TIME: 2 HOURS

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INSTRUCTIONS: *Answer question one and any other two questions*

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#### QUESTION ONE – 30 MARKS

a. Define the following terms:

(10 Marks)

- i. Abstract data type
- ii. Data structure
- iii. Data object
- iv. Algorithm complexity
- v. Abstraction

b. Consider the binary tree below:

Use the following traversal techniques to insert the values 5, 23, 7, 2, 10, 16, 13 in the tree. In each case give the resulting binary tree. (9 Marks)

- i. Pre-order traversal
  - ii. In order traversal
  - iii. Post order traversal
- c. Briefly describe two areas of applications of the stack ADT. (4 Marks)
- d. A stack can be implemented as either an array or a linked list
- i. Give two differences between these two implementations. (4 Marks)
  - ii. In the linked list implementation, it is not necessary to check whether the stack is full, whereas this is essential in the array implementation. Briefly explain why this is the case. (3 Marks)

### QUESTION TWO – 20 MARKS

- a. Briefly describe the two basic operations on a queue ADT. In each case give the general syntax of the implementation. (6 Marks)
- b. Consider the numbers 20, 4, 19, 17, 2, 8, 13, 14, 7, 18. Describe the bubble sort procedure by sorting the numbers showing the resulting list in each step. (10 Marks)
- c. Consider two algorithms one having a complexity of order **Olog(n)** and the other having a complexity of order **On<sup>2</sup>**. Which of the two algorithms is more efficient and why? (4 Marks)

### QUESTION THREE – 20 MARKS

- a. Define a linked list ADT. (2 Marks)
- b. With the help of a relevant illustration, describe the steps you would take to delete the last node from a linked list. (6 Marks)
- c. What is a hash function and how is it used in sorting data? (4 Marks)
- d. Briefly describe two applications of a tree data structures. (4 Marks)

### QUESTION FOUR – 20 MARKS

- a. Recursion is a very powerful technique for implementing algorithms, as an alternative to iterative operations (loops)
- i. What is recursion? (2 Marks)
  - ii. State the three conditions that a problem must meet for it to be solvable by recursion. (3 Marks)
  - iii. Using the binary search as an example, describe the recursive and stopping cases of a recursive procedure. (4 Marks)
- b. Briefly outline the algorithm for insertion sort implementation. (7 Marks)
- c. Briefly describe the following data structures: (4 Marks)
- i. Huffman tree
  - ii. Weighted graph

**QUESTION FIVE – 20 MARKS**

- a. You wish to implement a patient scheduling system for a hospital. State two data structure you would use and explain where each is applicable. (6 Marks)
- b. Distinguish between directed graph and undirected graph. (2 Marks)
- c. With respect to a tree data structure, define the following terms: (8 Marks)
  - i. Leaf node
  - ii. Complete tree
  - iii. Balanced tree
  - iv. Order of a tree
- d. State and briefly explain the two types of algorithm complexity. (4 Marks)