TECHNICAL UNIVERISTY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY

UNIVERSITY EXAMINATION FOR BACHELOR OF SCIENCE IN
MATHEMATICS & COMPUTER SCIENCE

ICS 2105: DATA STRUCTURES & ALGORITHMS

END OF SEMESTER EXAMINATION
SERIES: APRIL 2013
TIME: 2 HOURS

<u>**Instructions to Candidates:**</u>
You should have the following for this examination
- *Answer Booklet*

This paper consists of **FIVE** questions. Attempt question **ONE** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (Compulsory)

a) Define the following terms:
    (i)   Data structures
    (ii)   Encapsulation
    (iii)   Abstract Data Type (ADT)   **(3 marks)**

b) A good programmer must be able to conceptualize a problem. This he can put down as an algorithm. Algorithms can be expressed in terms of Pseudo code or flowcharts.
    (i)   Justify any **THREE** reasons why analysis of algorithms is important.
    (ii)   State the difference between a recursion and iteration in program development? Use a high level language example to demonstrate the difference.   **(4 marks)**
    (iii)   What is the Big Oh Notation?   **(2 marks)**

c) (i) Name one disadvantage of Binary Tree Data Structure?   **(7 marks)**
(ii) List any **TWO** conditions that should be satisfied when an array type is appropriate for representing an abstract data type.   **(2 marks)**

d) Searching algorithms are used to read a particular record from a collection of records.
    (i)   Explain the Bubble sort algorithm.   **(2 marks)**
    (ii)   Write an algorithm to implement Bubble sorting.   **(3 marks)**

(iii) Write an algorithm to implement the selection sorting. **(3 marks)**

e) Write an algorithm (Pseudocode or structured English) to represent the dequeue operation in a queue data structure. **(4 marks)**

Question Two

a) Define an array data structure. **(2 marks)**

b) Justify any **TWO** reasons why one should implement a list over an array ADT. **(2 marks)**

c) An array contains the following items {45,76, 57, 25, 89, 21, 15, 22} using a high level language, write a program that contains the following features:
   (i) Initialize an array called numbers with the values given above. **(2 marks)**
   (ii) Uses a loop to print all the elements in the array. **(6 marks)**
   (iii) Write a statement that prints only the first element in the array. **(2 marks)**
   (iv) Write a statement that declares a multi-dimensional array structure called Ali of 3 by 5 elements of type int. **(2 marks)**
   (v) Give a statement that refers to the 6th element in array Ali. **(2 marks)**
   (vi) Give a statement that passes the value of the 5th element of Ali to a variable called K.

Question Three

a) Define the following terms where necessary draw a diagram to illustrate your answer.
   (i) Binary tree
   (ii) Balanced binary tree
   (iii) A binary search tree
   (iv) Depth of a tree **(8 marks)**

b) Given the following numbers:
   34, 52, 92, 84, 6, 38, 94, 65, 83
   (i) Create a binary search tree using the given numbers. **(4 marks)**
   (ii) Give the result of traversing the tree you have created in (i) above using the post-order, in-order and pre-order traversal methods. **(6 marks)**

c) List any **TWO** applications for the tree data structure? **(2 marks)**

Question Four

a) Give **TWO** properties that a liner list must adhere to. **(2 marks)**

b) Write an algorithm that explains a linear list insertion **(8 marks)**

c) With an example describe the following two list operations. **(4 marks)**
   (i) Concatenate
   (ii) Append

d) Explain your understanding of ADT list implementation using Dynamic arrays. **(2 marks)**

e) With an illustration differentiate between a Doubling linked list and a circular list. **(4 marks)**

Question Five

a) Describe the ADT stack and give **THREE** examples of application of the ADT in both system and application programming. **(6 marks)**

b) Write a pseudo code that explains the insertion in a stack data structure. **(6 marks)**

c) Describe the following stack operations. **(2 marks)**
   (i)   Pop
   (ii) Push

d) Write a pseudo code that explains the deletion in a stack ADT. **(6 marks)**