



MACHAKOS UNIVERSITY

University Examinations for 2017/2018

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)

SIT 206: DATA STRUCTURES AND ALGORITHMS

DATE: 13/12/2017

TIME: 8:30 – 10:30AM

INSTRUCTIONS:

Answer Question ONE and any other TWO Questions

QUESTION ONE (30 MARKS)

- a) Define the terms:
 - (i) Data structure
 - (ii) Algorithm (2 marks)
- b) There are various common problems that applications face currently, which necessitate the use of data structures. Describe three such problems. (6 marks)
- c) Explain the meanings of the following characteristics of an algorithm:
 - (i) Finiteness
 - (ii) Feasibility
 - (iii) Independent (6 marks)
- d) An algorithm is required to compare three numbers then display the largest of the three. Write the algorithm. (6 marks)

- e) With reference to data structures, describe the following terminologies. Provide an example of each.
- (i) Interface
 - (ii) Implementation (4 marks)
- f) Describe the following basic characteristics of data structures:
- (i) Correctness
 - (ii) Time complexity
 - (iii) Space complexity (6 marks)

QUESTION TWO (20 MARKS)

- a) There are three cases usually used to compare various data structure's execution time in a relative manner. Discuss these three cases. (6 marks)
- b) Various data types are used in data structures and algorithms. Describe the two broad categories of data types, giving an example of each. (4 marks)
- c) With respect to arrays:
- i) Differentiate between *size* and *index*. (2 marks)
 - ii) Let **LA** be an unordered Linear Array of **N** elements and **K** is a positive integer such that $K \leq N$. Write an algorithm that inserts an ITEM into the K^{th} position of LA. (4 marks)
- d) With the use of suitable diagrams, differentiate between a circular list and a doubly linked list. (4 marks)

QUESTION THREE (20 MARKS)

- a) Using a suitable diagram, describe the stack data structure. (4 marks)
- b) Discuss three real life application areas of the stack data structure. (6 marks)
- c) (i) Explain the tasks performed by the *push()* and *pop()* operations of the stack. (2 marks)
- (ii) Write appropriate algorithms to illustrate how each of the above operations can be implemented in a stack. Explain your algorithms. (8 marks)

QUESTION FOUR (20 MARKS)

- a) With respect to the tree data structure, define the following terms:
- i Parent
 - ii Child
 - iii Sibling
 - iv Ancestor
 - v Descendant (5 marks)
- b) i) Using a suitable diagram, describe what a binary tree is. (3 marks)
- ii) State three distinct characteristics of a binary tree. (3 marks)
- c) i) Briefly explain an application area of a binary tree. (2 marks)
- ii) Write a suitable algorithm for searching a binary tree. (7 marks)

QUESTION FIVE (20 MARKS)

- a) Distinguish the following constructs used in data structures, giving an example of each:
- (i) Infix, postfix and prefix expressions
 - (ii) Inorder, postorder and preorder traversals (9 marks)
- b) (i) Define a linked list. (1 mark)
- (ii) Using appropriate diagrams, explain how the following operations are carried out on a linked list:
- 1. Insertion of an item. (3 marks)
 - 2. Deletion of an item. (3 marks)
- c) Write suitable algorithms to display the following from a linked list:
- (i) First element (2 marks)
 - (ii) Last element (2 marks)