



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 IN COMPUTER SCIENCE

SCO 204: DATA STRUCTURES AND ALGORITHMS

DATE: 13/12/2017

TIME: 11:00 – 1:00 PM

INSTRUCTIONS

This paper consists of FIVE questions.

Answer QUESTION ONE and other TWO questions in this paper.

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) i) Define the term *algorithm*. (2 marks)
- ii) Explain each of the following data structures: (8 marks)
 - I. Heap;
 - II. Network;
 - III. Doubly linked list;
 - IV. Circular queue.
- b) i) Distinguish between *constructor* and *destructor* as used in data structures. (4 marks)
- ii) Explain **three** operations that could be carried out on a graph. (3 marks)
- c) i) A programmer would like to use a data structure in a program. Explain **three** factors he could consider when choosing a data structure to use. (6 marks)
- ii) Write a C language statement that may be used to declare a two-dimensional array. (2 marks)
- d) Write an algorithm that could be used to sort elements in an array using bubble sort technique. (5 marks)

QUESTION TWO (20 MARKS)

- a) i) Outline **two** advantages of using a linked list in a program. (2 marks)
- ii) The following is a list created by a student during a Data Structures and Algorithm class.
- Use it to answer the question that follows.
- List = {32, 43, 29, 46, 67, 59, 71, 14}
- Write the output when each of the following operations are carried out on the list.
- I. Head(Tail)(Tail)(List)
- II. Empty(List) (4 marks)
- b) i) Write a program in C language that could be used to determine the average of 10 integers using array data structure. (4 marks)
- ii) Distinguish between *malloc* and *calloc* functions as used in linked lists. (4 marks)
- c) Explain the most suitable data structure for each of the following scenarios: (3 marks)
- i) Storing students' details;
- ii) Printing documents;
- iii) Picking printed work from a printer.
- d) Write a pseudocode that could be used to implement binary search. (5 marks)

QUESTION THREE (20 MARKS)

- a) i) Explain the term *upheaping* as used in Data Structures and Algorithms. (2 marks)
- ii) Given data items 65, 47, 35, 28, 39, 50, 20
- Create a minimum heap for the data items. (4 marks)
- b) i) Describe *merge sort* as used in data structures. (2 marks)
- ii) Using selection sort organize the following data items. (3 marks)
- | | | | | |
|----|----|----|----|----|
| 89 | 57 | 42 | 29 | 37 |
|----|----|----|----|----|
- c) Masomo University stores students' data in a database. The database contains fields:
- RegNo, SName, Age and YearofStudy.*
- Using C programming language create a data structure that could be used to store a student details. (3 marks)
- d) Explain **three** types of time complexity. (6 marks)

QUESTION FOUR (20 MARKS)

- a) i) Distinguish between *complete* and *balanced* trees as used in data structures. (4 marks)
- ii) Represent the expression $(a + b) * (y - z)/p$ in an expression tree. (3 marks)
- b) Write a *pseudocode* that may be used to add an item into a queue. (3 marks)
- c) Compare *breadth first* and *depth first* traversal as used data structures. (4 marks)
- d) Joan, a computer scientist used an algorithm in a program. Describe **three** characteristics of algorithms she must have considered. (6 marks)

QUESTION FIVE (20 MARKS)

- a) i) Outline **two** mathematical notations used to classify algorithms. (2 marks)
- ii) Describe **three** classes of algorithms used in computer science. (6 marks)
- b) i) Compare *graph* and *stack* data structures in terms of:
 - I. memory utilization; (2 marks)
 - II. speed of execution. (2 marks)
- iii) During a programming lesson, students were required to carry out a performance analysis of a program they had created. Outline **four** importance of this exercise. (4 marks)
- c) A student represented data using a graph. Describe **two** operations he could carry out on the graph. (4 marks)