



MACHAKOS UNIVERSITY

University Examinations for 2020/2021

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (MATHEMATICS AND COMPUTER SCIENCE)

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

SCO204 DATA STRUCTURES AND ALGORITHMS

DATE: 12/8/2021

TIME: 2:00 – 4:00 PM

INSTRUCTIONS

*This paper consists of **FIVE** questions.*

*Answer **QUESTION ONE** and other **TWO** questions in this paper.*

QUESTION ONE (COMPULSORY) 30 MARKS)

- a) Explain each of the following terms as used in data structures:
- (i) Attribute; (2 marks)
 - (ii) Interface; (2 marks)
 - (iii) Entity set. (2 marks)
- b) A student used a data structure in a program. Explain **three** characteristics of such structures. (6 marks)
- c) (i) Distinguish between *priori analysis* and *posterior analysis* as used in algorithms. (4 marks)
- (ii) With the aid of a diagram in each case, describe **two** asymptotic notations used in algorithms. (4 marks)
- d) Write an algorithm for binary search. (4 marks)
- e) The following data items were stored in a tree.
- 56 45 66 58 33 70 50
- (i) Represent this data items in a binary search tree. (3 marks)
 - (ii) State the order of the data item when the tree in (i) is traversed using the post order strategy. (3 marks)

QUESTION TWO (20 MARKS)

- a) Describe **two** types of algorithms. (4 marks)
- b) A programmer used a queue data structure in a program.
(i) Explain **two** operations that he could carry out. (4 marks)
(ii) State two applications of this data structure in computer science. (2 marks)
- c) Figure 1 shows a graph data structure. Use it to answer the questions that follow.

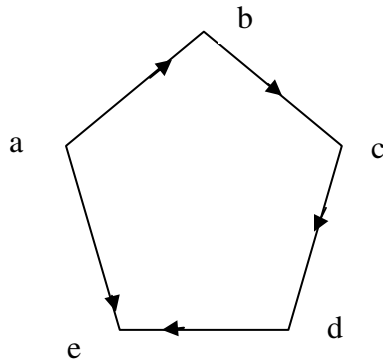


Figure 1

- (i) State the indegree and outdegree of each vertex. (2 marks)
(ii) Prepare the adjacency matrix for this graph. (3 marks)
- d) Outline five characteristics of an algorithm. (5 marks)

QUESTION THREE (20 MARKS)

- a) Explain **three** time complexities in data structures. (6 marks)
- b) Figure 2 shows a data structure used by a student during a practical lesson.



- i) Identify the data structure. (1 mark)
ii) Outline **two** operations that could be carried out on the structure identified in (i) (2 marks)
- c) A student declared a stack data structure of size 6 in a program. The following items were added in the stack sequentially. Data1, Data2, Data3 and Data4.
i) Sketch this data structure. (2 marks)
ii) Two items were removed from the stack and three others Data5, Data6 and Data7 were added. Draw the new stack. (4 marks)

- d) Write an algorithm that could be used to sort items in queue using quick sort. (5 marks)

QUESTION FOUR (20 MARKS)

- a) Explain each of the following terms as used in a tree. (2 marks)
i) Degree; (2 marks)
ii) Siblings. (2 marks)
- b) Write an algorithm for the push operation in a stack. (4 marks)
- c) i) A student wrote an arithmetic expression in an algorithm. Outline **three** types of notations that he could have used. (3 marks)
ii) Distinguish between *associativity* and *precedence* as used in arithmetic operators. (4 marks)
- d) The following data items are stored in an array.
56 49 37 45 72 69

Sort the items in ascending order using bubble sort. Show all the passes. (5 marks)

QUESTION FIVE (20 MARKS)

- a) Outline the steps followed in insertion sort. (4 marks)
- b) Write a program in C language that prompts a user to enter five integers and store them in an array. The program then outputs the integers in reverse order of entry. (6 marks)
- c) Distinguish between *merge sort* and *shell sort*. (4 marks)
- d) The following data items were input in a heap.
35 33 42 10 14 19 27 44 26 31
- i) Create a minimum heap using the data items. (4 marks)
ii) Redraw the heap in (i) if data item 19 is removed. (2 marks)