MACHAKOS UNIVERSITY

University Examinations for 2022/2023

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: **TIME:**

INSTRUCTIONS

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) Data item; (2 marks)
(ii) Entity; (2 marks)
(iii) Record. (2 marks)

(b) Large programs implement data structures. Explain **three** reasons that necessitate this implementation. (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** time complexities in data structures. (4 marks)

(d) Write an algorithm for bubble sort. (4 marks)

(e) The following data items were stored in a tree.

76 89 64 55 40 76 39

(i) Represent this data items in a binary search tree. (3 marks)

(ii) State the output when the tree in (i) is traversed using the post order strategy. (3 marks)

QUESTION TWO (20 MARKS)

(a) Describe each of the following types of algorithms.
(i) Divide and Conquer; (2 marks)
(ii) Greedy. (2 marks)

(b) A programmer used a graph data structure in a program.
(i) Explain **two** operations that he could carry out. (4 marks)
(ii) State **one** application of this data structure in computer science. (1 mark)

(c) Figure 1 shows a graph data structure. Use it to answer the questions that follow.

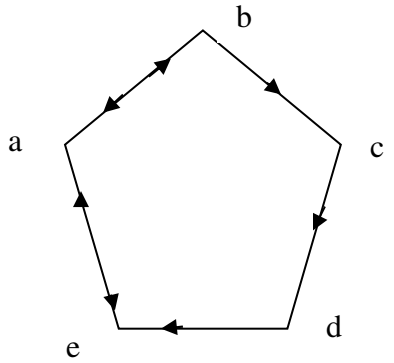


Figure 1

(i) State the indegree and outdegree of each vertex. (2 marks)
(ii) Prepare the adjacency matrix for this graph. (3 marks)

(d) James prefers to write an algorithm before creating a program. Explain **three** characteristics of algorithms that could have led to this preference. (6 marks)

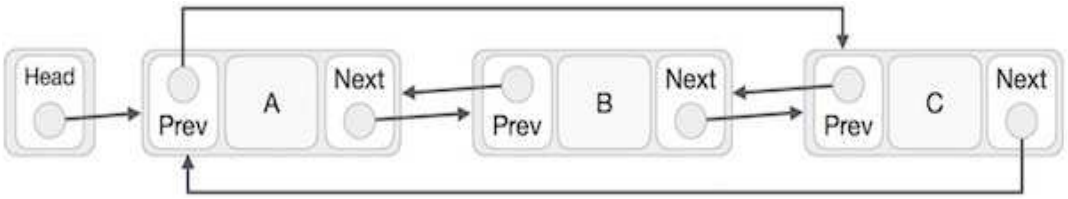
QUESTION THREE (20 MARKS)

(a) (i) Write an algorithm for adding a data item in array. (4 marks)
(ii) Distinguish between *adaptive* and *non-adaptive* sorting algorithms. (4 marks)

(b) Explain each of the following terms as used in data structures.
(i) Pseudocode; (2 marks)
(ii) Traverse. (2 marks)

(c) A student declared a stack data structure of size 6 in a program. The following items were added into the stack sequentially. Element1, Element2 and Element3.
(i) Sketch this stack as it would appear. (2 marks)
(ii) Two items were removed from the stack and four others Element4, Element5 and Element6 and Element7 were added. Draw the new stack. (3 marks)

(d) 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)

QUESTION FOUR (20 MARKS)

(a) Explain each of the following terms as used in a tree.

(i) Depth; (2 marks)

(ii) Leave node. (2 marks)

(b) Write an algorithm for the enqueue operation. (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.

63 59 32 42 77 60

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 initializes an array of integers containing six items. 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.

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35 33 42 10 14 19 27 44 26 31
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(i) Create a minimum heap using the data items. (4 marks)

(ii) Redraw the heap in (i) if data item 14 is removed. (2 marks)