



**MASENO UNIVERSITY**  
**UNIVERSITY EXAMINATIONS 2013/2014**

FIRST YEAR TRI-SEMESTER EXAMINATIONS FOR THE  
DEGREE OF BACHELOR OF SCIENCE IN INFORMATION  
TECHNOLOGY

(CITY CAMPUS – EVENING)

CIT 108: DATA STRUCTURES AND ALGORITHMS

Date: 16<sup>th</sup> July, 2014

Time: 5.30 – 7.30 p.m.

**INSTRUCTIONS:**

1. **SECTION A:** Attempt Question 1 (COMPULSORY) 30 marks.
2. **SECTION B:** Attempt ANY TWO questions 20 marks each.
3. Start each question on a new page.
4. **MOBILE PHONES** are **PROHIBITED** in the examination room.
5. **DO NOT WRITE** on the question paper.

**SECTION A: COMPULSORY**

**Question 1**

- a) What are the TWO major considerations in the choice of a data structure? (4 Marks)
- b) Citing TWO examples in each, discuss the classification of data structures. (4 Marks)
- c) What is
- i. an algorithm? (2 Marks)
  - ii. algorithm complexity (2 Marks)
  - iii. Time-Space trade-off, as relates to algorithms? (2 Marks)
- d) Consider the following algorithm to compute the average of integer values held on a one dimensional array.

```
ALGORITHM AVG ()
1. SUM =0
2. REPEAT FOR i=1,2,...N
3. SUM=SUM+ A[i]
4. AVG=SUM/N
5. END
```

Compute the space complexity of the algorithm. Show your working. (3 Marks)

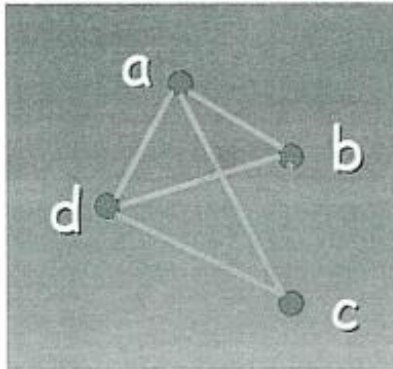
**SECTION B: ATTEMPT ANY TWO QUESTIONS FROM THIS SECTION**

**Question 2**

- a) Using a suitable diagram, discuss the basic ADT model. (9 Marks)
- b) Suppose you are to develop an application for a mobile phone book directory and mail box. Suggest any TWO data structure that you would use. What are the factors that will guide you for your choice (4 marks)
- c) Proper choice of a data structure will result and best possible algorithm and ultimately, results in a good program. Explain. (3 marks)
- d) Differentiate between space complexity and time complexity (4 marks)

**Question 3**

- a) Using well labeled diagram(s) explain the following concepts of a tree. (10 marks)
- i. root
  - ii. Size
  - iii. Depth
  - iv. leaf
  - v. path
- b) Compare the usage of linked lists to arrays as technique of implementing ADTs. (4marks)
- c) Give the adjacency matrix A for the following graph G based on the order: a, b, c, d? (6 marks)



**Question 4**

- a)
- i) What is a heap? (2marks)
  - ii) Map the array below into a heap. (4marks)

80	60	73	35	40	50	70	30	20	39
----	----	----	----	----	----	----	----	----	----

- b)
- (i) Explain how *straight selection sort* works. (4marks)
  - (ii) Perform a selection sort the array below. (2 marks)  
84, 69, 76, 86, 94, 91
- c) Explain FOUR applications of Queue ADT. (2marks)
- d) SEARCH (INFO , LINK, START, ITEM, LOC)LIST is a linked list in memory. Write an algorithm to find the location LOC of the node where an element, ITEM first appears in LIST, or sets LOC = NULL. (6 Marks)

**Question 5**

- a) An automobile company uses an array AUTO to record the number of automobiles sold each year from 1932 through 1984. Rather than beginning the index set with 0, the array begins the index set with 1932 so that:  
AUTO[K] = number of automobiles sold in the year K.  
Base (AUTO) = 200, and  $w = 4$  words per memory cell for AUTO.  
Compute the address of the array element for the year  $K = 1965$  (2 Marks)
- b) LA is a linear array with N elements and K is a positive integer such that  $K < N$ . Write an algorithm to insert an element ITEM into the Kth position in LA. (6 Marks)
- c) Write an algorithm that uses a stack to compute the VALUE of an arithmetic expression P written in postfix notation. (6 Marks)
- d) Describe the following operations as applies to data structures. (4 Marks)
- i. Searching
  - ii. Traversing
  - iii. Sorting
  - iv. Merging
- e) Translate the following infix expression into its postfix equivalent.  
**(A+B)\*(C-D)** (2 Marks)