

**UNIVERSITY OF SWAZILAND**  
**Faculty of Science**  
**Department of Computer Science**  
**MAIN EXAMINATION 2008**

**Title of paper: DATA STRUCTURES**

**Course number: CS342**

**Time allowed: Three (3) hours**

**Instructions: Answer any five (5) of the six (6) questions.**

This examination paper should not be opened until permission has been granted by the invigilator.

### **Question 1**

- a) List and describe the operations of the stack ADT. [5]
- b) Give an array based implementation of the stack ADT, including definitions of relevant data types. [15]

### **Question 2**

- a) List and describe the operations of the queue ADT. [5]
- b) Define the meaning of big-O notation. [4]
- c) Write an algorithm that swaps the front and rear items of a given queue, leaving the items in between them unchanged. It may be assumed that the given queue contains at least 2 items. [7]
- d) Analyse the big-O time complexity of the algorithm given in c). [4]

### **Question 3**

- a) Describe in detail the Insert and Delete operations of the list ADT. [4]
- b) Write an algorithm that returns the size of a given list. [5]
- c) Write an algorithm that takes a list of numbers and an additional number (say  $x$ ), and inserts  $x$  immediately after the last existing occurrence of  $x$ . If, however,  $x$  is not already in the list, it should be inserted at the end of the list. [11]

### **Question 4**

- a) Write an algorithm that takes a list of numbers and deletes all its negative-number items. [10]
- b) Analyse the big-O time complexity of the algorithm given in a), assuming that the given list is:
1. array based
  2. linked-list based
- [10]

### **Question 5**

- a) List and describe the operations of the binary tree ADT. [10]
- b) Write an algorithm that returns the size of a given binary tree. [4]
- c) Write an algorithm that returns the depth of a given binary tree. [6]

### **Question 6**

- a) Define the terms (i) *adjacent vertex* and (ii) *distance* in relation to graphs. [2]
- b) Draw a diagram of a directed graph containing 5 vertices and 8 edges. Draw 2 other diagrams to show how this graph will be represented by an *adjacency matrix* and an *adjacency list*. [8]
- c) Write the algorithm for breadth-first traversal of a given graph commencing at a given vertex. [10]