

**UNIVERSITY OF SWAZILAND**  
**Faculty of Science**  
**Department of Computer Science**  
**SUPPLEMENTARY EXAMINATION 2007**

**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 queue ADT. [5]

b) Give a linked-list based implementation of the queue ADT, including definitions of relevant data types. [15]

### **Question 2**

a) List and describe the operations of the stack ADT. [5]

b) Discuss the main advantages and disadvantages of the 2 implementations of stacks: array based and linked-list based. [7]

c) Write an algorithm that reverses and swaps the contents of 2 given stacks. For example, if the first given stack is [1, 3, 5] (1 on top) and the second is [7, 2] (7 on top), the algorithm should alter the first to [2, 7] and the second to [5, 3, 1]. [8]

### **Question 3**

- a) List and describe the operations of the list ADT. [10]
- b) Write an algorithm to take a non-empty list of numbers and return the sum of alternating items (every other item) starting with the first. For example, if the given list is [1, 2, 7, 10, -2], the value returned should be  $1+7+-2$  or 6. [10]

### **Question 4**

- a) Give implementations of the Previous and Insert operations for linked-list based lists. [6]
- b) Analyse the big-O time complexities of the implementations given in a). [4]
- c) Write an algorithm to take a list and delete all items except the first. [7]
- d) Analyse the big-O time complexity of the algorithm given in c), assuming that the given list is array based. [3]

### **Question 5**

- a) Define the following terms in relation to trees: *root*, *ancestor* and *sibling*. [3]
- b) List and describe the operations of the binary tree ADT. [10]
- c) Write an algorithm to insert a given entry into a given binary search tree. Assume that the entry's key does not already exist in the tree. [7]

### **Question 6**

- a) With the aid of a graph diagram containing at least 6 vertices and 7 edges, distinguish between breadth-first and depth-first traversal. [6]
- b) Draw diagrams showing the adjacency-matrix representation of the graph in a). [7]
- c) Draw diagrams showing the adjacency-list representation of the graph in a). [7]