KABARAK UNIVERSITY

EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE

COURSE CODE: COMP 123

COURSE TITLE: DATA STRUCTURES

STREAM: Y1S2

DAY: MONDAY

TIME: 9.00 – 11.00 A.M.

DATE: 23/03/2009

INSTRUCTIONS:

- **Answer The First Question and any Other Two Questions.**
- **Time: 2 Hours**

PLEASE TURN OVER

Question 1(30 Marks)

(a). (i). List four basic operations of a linear list. **(1 Mark)**

(ii). Explain the main difference between an ordinary list and a linked list.**(1 Mark)**

(iii). Assume you want to remove the element in position **a** (for an integer **a**) in a linear list. Give the things you need to do to effect that removal. **(3 Marks)**

(b). (i). What is a stack? **(1 Mark)**

(ii). Describe two applications of stacks in computer science. **(4 Marks)**

(c). (i). List four basic operations of a queue. **(1 Mark)**

(ii). Describe how a circular queue is implemented. **(3 Marks)**

(iii). Explain the main advantage of circular a queue over a linear queue. **(1 Mark)**

(d). (i). Define the following terms concerning trees.

(I) A tree. (II). A node
(II). A binary tree. (IV). A binary search tree. **(2 Marks)**

(ii). Describe application area of trees in computer science. Illustrate. **(3 Marks)**

(e). (i). Explain how you can swap values of two variables named **m** and **n**. **(2 Marks)**

(ii). Describe how an insertion sort is done. **(3 Marks)**

(f). (i). Describe how a binary search is done. **(3 Marks)**

(ii). Explain a strength and a limitation of the binary search over the linear search. (**2 Marks)**

Question 2 (20 Marks)

(a). Describe how you convert a base ten number into its binary equivalent using a stack. Illustrate with conversion of the number 4. **(3 Marks)**

(b). Write an algorithm to evaluate RPN expressions using a stack. **(5 Marks)**

(c). Write down the equivalent RPN form of the following expression.
6 / (8 - 2 * 3) **(2 Marks)**

(d). Use the algorithm in part (b) above to evaluate the above RPN expression (in part (c)). Show the contents of the stack after each step. **(5 Marks)**

(e). Show the steps of converting the following infix expression into its postfix (RPN) expression using a stack. (Show the contents of the output as well as the stack after each step using the format shown below the expression). A / (B * C) – D **(5 marks)**

Step	Operation	Stack Contents	Outputs

Question 3 (20 Marks)

(a). Describe three different ways of implementing a linear queue. For each method, show what happens during;
(I). Initialization of the queue. (II). Inserting of an element **x**.
(III). Removal and returning of an element.

NB:

- Use **a[]** as the name of the queue.
- Assume other functions **empty()** and **full()**
- Assume the queue is of integer type. **(9 Marks)**

(b). Explain a limitation of each of the above three methods. **(3 Marks)**

(c). Assume a circular queue named **a[b].** Write algorithms to do the following using the circular queue.
(i). Initialize the queue. (ii). Insert an element named **e**.
(iii). Remove and display an element. (iv). Check if queue is full
(8 Marks)

Question 4 (20 marks)

(a). (i). Write down the
(I). LPR (II). PLR and (III). LRP traversals of the following binary tree.

(4.5 Marks)

(ii). Construct a binary search tree of the following expression.
(A / B + C) - (D + E * F) / G **(3.5 Marks)**

(b). Show the contents of the new list after each pass when you perform bubble sorting (in ascending order) of the following list of numbers: **18, 16, 13, 15.** **(3 marks)**

(c). Consider the following list: **5, 6, 9, 10, 15, 20, 30, 40, 42, 50, 60, 65, 70, 80, 90.**

Write down the sequence of the elements that are compared with the search element (80) during a binary search of the search element. **(3 marks)**

(d). Consider an integer-type linear list implemented as an array **a[b].** Assume the array currently contains **c** integers (where **c<b**). Write an algorithm to receive an element as well as the position to insert the element in the list, and then insert the element in that position (assume the array is a global variable). Include all validations. **(6 marks)**

Question 5 (20 Marks)

(a). (i). Describe how a selection sort is done. **(3 marks)**

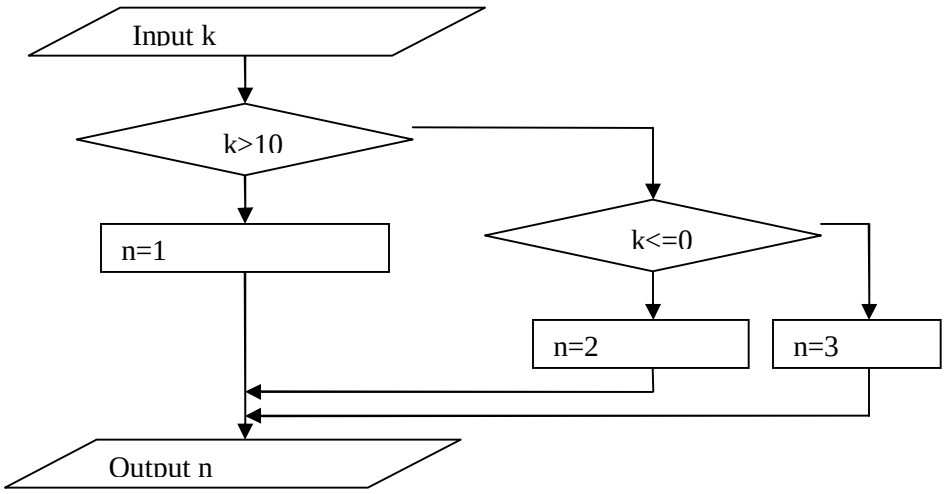
(ii). Write down an algorithm to carry out a selection sort (ascending order) of the float-type array **a[b].** **(5 marks)**

(iii). Show the contents of the new list after every pass of sorting the following list (into ascending order) using the selection sort method: **20, 15, 10, 8, 5, 3, 1** **(3 marks)**

(iv). Repeat the above sorting (in part a(iii)) using the insertion sort method. **(3 Marks)**

(b). (i). Write an algorithm to input elements of the array **a[50]**. The algorithm then outputs the indices of the positive elements in the array. **(4 marks)**

(ii). Consider the following flowchart and answer the questions below.



Required

Fill in the following test table for the flowchart. **(2 Mark)**

Input	**Output**
0	
-3	
15	
10	