THE UNIVERSITY OF TRINIDAD & TOBAGO

FINAL ASSESSMENT/EXAMINATIONS JANUARY - APRIL 2017

Course Code and Title: DSAL2001 – Data Structures and Algorithm

Programme: B.A. Sc Computer Engineering

Date: 19 April 2017 **Time: 9:00am- 12:00 noon** **Duration: 3hrs**

PLEASE READ ALL INSTRUCTIONS CAREFULLY BEFORE YOU BEGIN THIS EXAMINATION

Instructions to Candidates

1. **This paper has 6 pages and 4 questions.**
2. **You are required to answer ALL questions in the answer booklet.**
3. **Please submit the question paper along with your answer booklet.**

Key Examination Protocol

1. Students please note that academic dishonesty (or cheating) includes but is not limited to plagiarism, collusion, falsification, replication, taking unauthorised notes or devices into an examination, obtaining an unauthorised copy of the examination paper, communicating or trying to communicate with another candidate during the examination, and being a party to impersonation in relation to an examination.
2. The above mentioned and any other actions which compromise the integrity of the academic evaluation process will be fully investigated and addressed in accordance with UTT's academic regulations.
3. Please be reminded that speaking without the Invigilator's permission is **NOT** allowed.

Question 1

Total: 25 marks

a. Trace the execution of the quick sort algorithm over the array below, using the **first** element as the pivot. Sow each pass of the algorithm. (10 marks)

0	1	2	3	4	5	6	7	8	9	10
16	21	45	8	11	53	3	26	49	31	12

b. Write a java class to perform a selection sort on the above array. (7 marks)

c. Write a Java **method** to sequentially search for the value 49 in the above array. (4 marks)

d. Write a Java recursive **method** that finds the power of a number using recursion. (4 marks)

Question 2

Total: 25 marks

a. Consider a hash table consisting of M = 11 slots. Non-negative integer key values are hashed into the table using the hash function h1:

```
int h1 (int key) {
    x = (key + 7) * (key + 7);
    x = x/16;
    x = x + key;
    x = x % 11;
    return x;
}
```

Suppose that collisions are resolved using linear probing. The integer key values listed below are to be inserted, in the order given. Show the **home slot** (the slot to which the key hashes, before any probing), the **probe sequence** (if any) for each key, and the final contents of the hash table after the following key values have been inserted in the given order. Your answer should follow the format given below.

(10 marks)

Key Value	Home Slot	Probe
43		
23		
1		
0		
15		
31		
4		
7		
11		
3		

0	1	2	3	4	5	6	7	8	9	10

b. Write a Java application that implements the stack Abstract Data Type using static storage. Your application should define the following methods: (15 marks)

- public StackX (int s)
- public void push(int n)
- public int pop()
- public int peek()
- public boolean isEmpty()
- public boolean isFull()
- main / test method to display the contents of the stack

Question 3

Total: 25 marks

For the graph shown below, answer the following questions.

a. Is the graph directed or undirected? (1 mark)

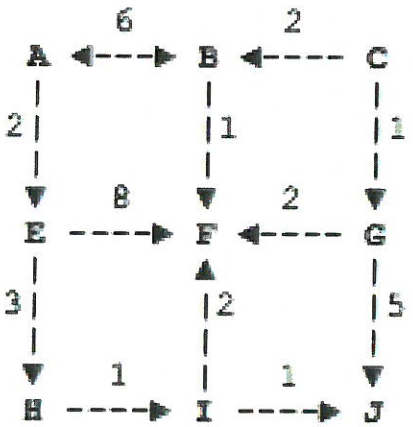
b. Is the graph connected, strongly connected or un-connected? Give reasons for your answer. (2 marks)

c. Construct the following:
   i. adjacency list (4 marks)
   ii. adjacency matrix representation of the graph. (4 marks)

d. Write the path that a depth-first search (DFS) would find from vertex A to vertex I. Assume that any for each loop over neighbors returns them in ABC order. (4 marks)

e. Write the path that a breadth-first search (BFS) would find from vertex A to vertex I. Assume that any for-each loop over neighbors returns them in ABC order. (4 marks)

f. Perform Dijkstra's algorithm on the following graph to find the minimum-weight paths from vertex A to all other vertices. Reconstruct the path from vertex A to vertex F and give the total cost of the path. (6 marks)



Question 4

Total: 25 marks

a. Given the following integer elements: 9, 2, 5, 6, 0, 7, 1, 4, 3 and 8

i. Draw the tree representation of the binary min-heap that results when all of the above elements are added (in the given order) to an initially empty heap. ***Circle*** the final tree that results from performing the additions. (6 marks)

ii. Given your heap from part (i), perform 2 remove-min operations on the heap and draw its state afterward. ***Circle*** the tree that results after the two elements are removed. (4 marks)

iii. Show the final array representation of the heap. (2 marks)

b. Briefly describe the depth-first and breath-first search of trees (3marks)

c. Given the following integer elements: 8, 1, 0, 6, 9, 7, 4, 2, 5, 3

i. Draw the AVL tree that results when the above elements are added (in the given order) to an empty AVL tree. (6 marks)

ii. Draw the AVL tree from part (i) after all of the following elements 3, 6, 8 and 1 are removed. (4 marks)

END OF PAPER