FINAL ASSESSMENT/EXAMINATION

JANUARY – MAY 2019

Course Code and Title: DSAL2001 – Data Structures and Algorithms

Programme: Bachelor of Applied Science in Computer Engineering..

Date: 08/05/2019   **Time:** 1:00PM - 4:00PM

Duration: three (3) hours

PLEASE READ ALL INSTRUCTIONS CAREFULLY BEFORE YOU BEGIN THIS EXAMINATION

Instructions to Candidates

1. This paper has _16_ pages and _6_ questions for a total of _100_ marks.
2. You are required to answer all questions.
3. You are required to return this question paper.
4. You must write on this question paper in ink.
5. Additional writing paper may be requested if required.

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.

For Examiner's Use Only		
Questions	**Total Marks**	**Marks Obtained**
Question 1	15	
Question 2	20	
Question 3	15	
Question 4	15	
Question 5	15	
Question 6	20	
Total	**100**	

1. A network is represented by the following undirected, weighted graph:
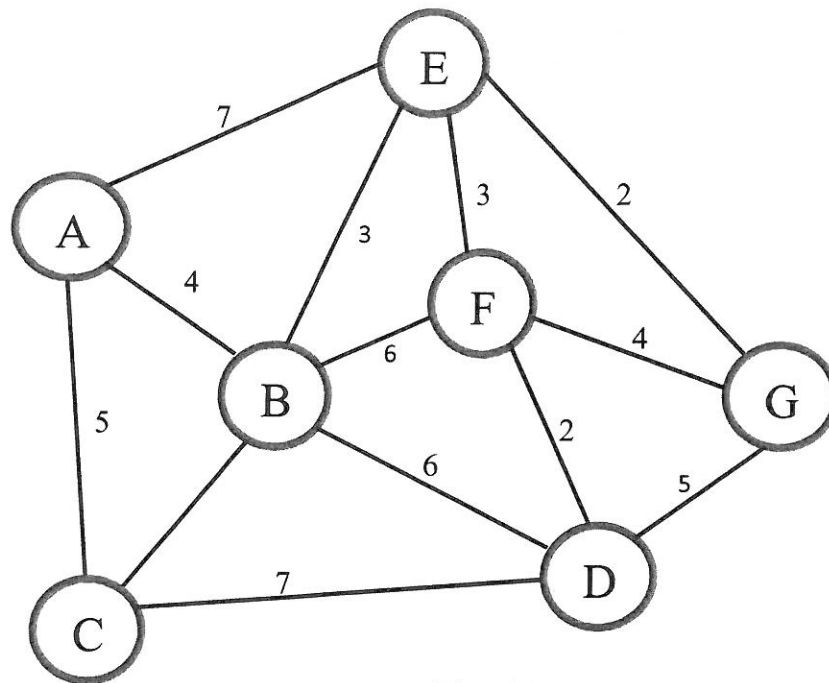

Fig q1.1

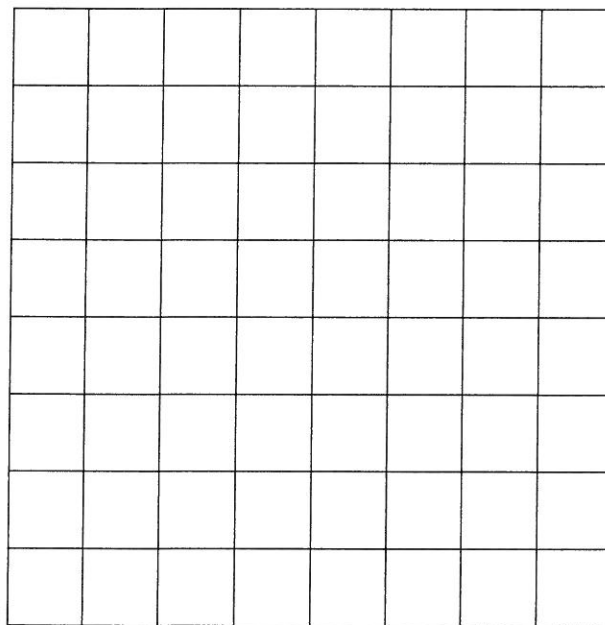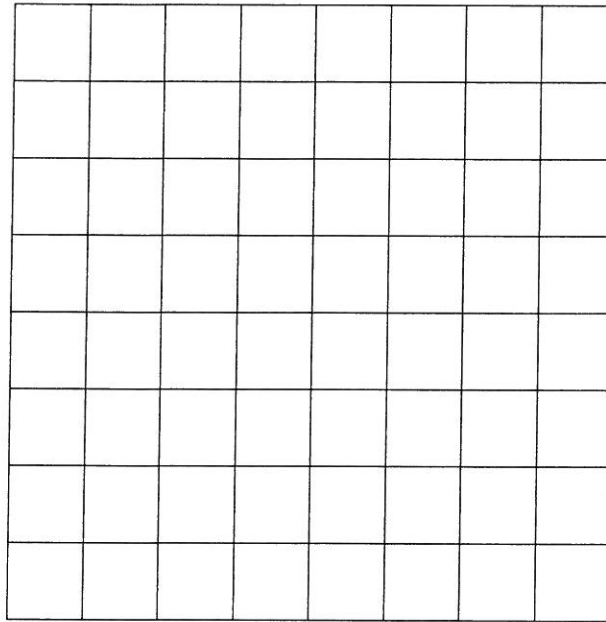a. Using the grid in Fig. 1.2, convert the graph to matrix form.   [3 marks]

Fig q1.2

b. Apply Prim's algorithm to the matrix you found in question **1.a** to find a minimum spanning tree of the graph. [5 marks]

c. Prim's algorithm is considered to be greedy algorithm. [2 marks]
   Explain what is meant by a greedy algorithm.

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d. i. Can there be more than one minimum spanning tree? [2 marks]

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ii.   Explain why or why not.   [3 marks]

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2. a. Write Java code for a method that conducts a binary search on an array of integers for a given target and returns its location if found. [5 marks]
The method signature should be as follows:

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public static int binarySearch(int [] IDnums , int target)
```

b. Construct a Binary Search Tree with the following values: [5 marks]

35, 91, 64, 52, 87, 75, 64, 38, 45, 88, 97

c. What is the output of a post-order traversal of the tree? [5 marks]

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d. Write a recursive method for post-order traversal of a binary tree. [5 marks]

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3. a. Given the following array of integers, A, complete the **Table 3.1** to show all the steps of the **selection sort** algorithm as it sorts the array in **non-descending order**.[5 marks]

34	82	41	77	34	21	63

Array A

Step	Elements in array						
0	34	82	41	77	34	21	63

Table 3.1

All rows may or may not be used for your answer.
Just use that which is needed by the algorithm.

b. Write a method in Java that accepts an array of integers and sorts the array in non-ascending order using the **insertion sort** algorithm, [5 marks]

c. Write a recursive method that takes an integer and returns the factorial of that integer. [5 marks]

4. a. A binary tree has nodes with integer data. Write code for the basic NodeBT class. [4 marks]

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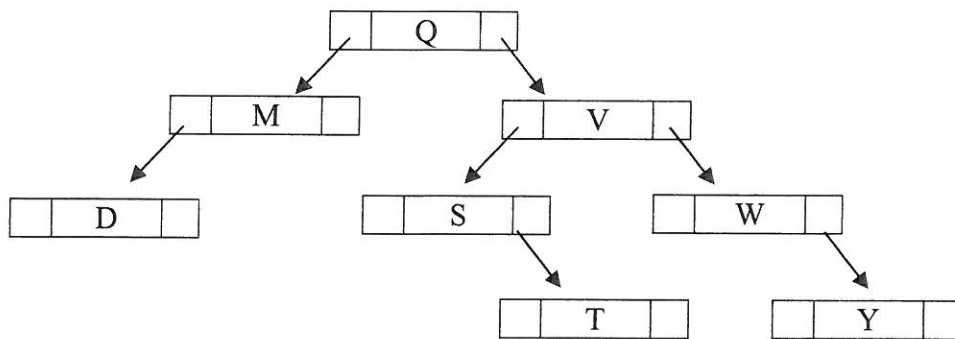
A binary tree is given in fig q4 as follows:

Fig q4

b. Re-draw Fig q4 to show what the tree would be if the node with V is deleted. [5 marks]

c. The node M of the original tree in Fig q4 has been deleted.
Draw the resulting tree. [3 marks]

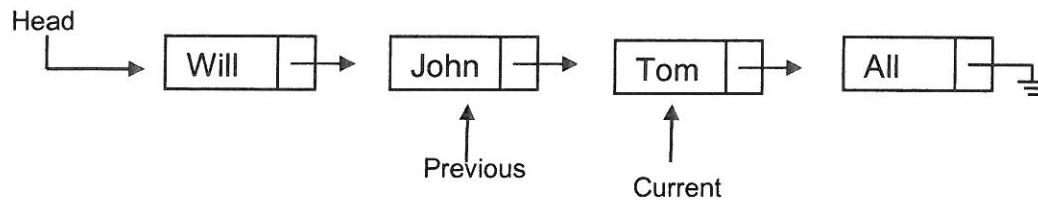d. What would be the output of a breadth-first traversal of the tree? [3 marks]

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5. You are given the following Linked List with various pointers as shown in Fig. q5 below and the key values stored in each node.

Head

| Will | → | John | → | Tom | → | All | ⏚ |

Previous (points to John)

Current (points to Tom)

Fig. q5

a. Write the instructions necessary to remove the node with the key value "Tom" from the linked list shown in Fig. q5 assuming variables head, previous, current etc have been declared properly.   [4 marks]

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b. Draw a diagram to show what the linked list in Fig. q5 looks like after the node with the key value "Tom" has been removed including the status of current, previous, and, head.   [3 marks]

c. Starting with the original linked list in Fig q5, write the instructions necessary to remove the node with key value "Will'.   [4 marks]

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d. Draw a diagram to show what the linked list in Fig. q5 looks like after the node with the key value "Will" has been removed including the status of current, previous, head.   [4 marks]

6. a. Two stacks, stackA and stackB, are implemented in a java program. They are shown below in Fig. 6 after a few lines of code have been executed.
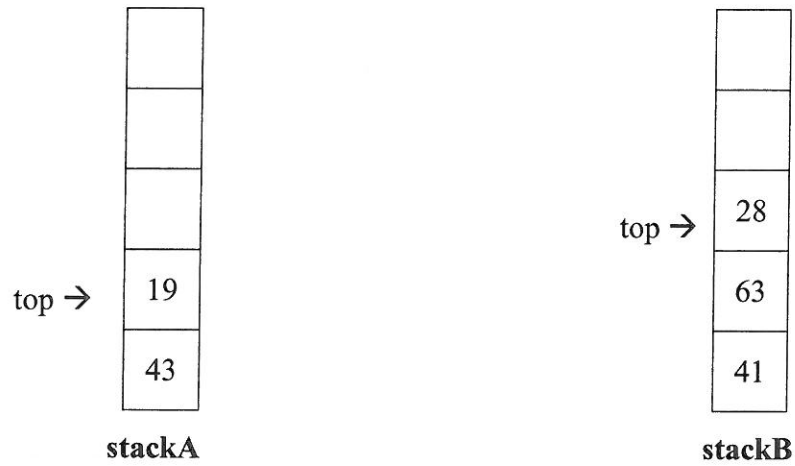

stackA

stackB

top → 19
43

top → 28
63
41

Fig q6

Show the stacks with top and values after the following lines of code are executed in sequence.

i. stackA.push(21);   [2 marks]
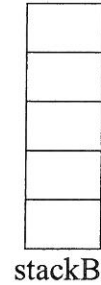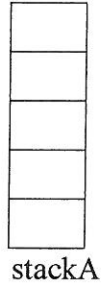

stackA   stackB

ii. stackA.push (stackB.pop());   [4 marks]

stackA   stackB

iii.   stackA.push(stackB.peek());   [4 marks]

stackA

stackB

b.   A queue is implemented in a java program. The queue is initially empty.

Show the state of the queue with front and back after each of the following fragments of code are executed assuming all relevant variables are of the correct type and properly declared.

i.   Queue q = new Queue (15);   [2 marks]

```
q.enqueue (19);
q.enqueue (37);
q.enqueue (23);
q.enqueue (44);
 q.enqueue (7);
```

ii. After the sequence in **part (i)** is executed, the following sequence is then executed. [4 marks]

$$x = q.dequeue\ ();$$

$$q.enqueue\ (x);$$

iii. After the original sequence in **part (i)** is executed, the following sequence is then executed. [4 marks]

$$a = q.peek();$$

$$q.enqueue(a);$$

END OF EXAM!