INSTITUTE OF TECHNOLOGY

BLANCHARDSTOWN

Year	Year 3
Semester	Semester 1
Date of Examination	Monday 9 January 2012
Time of Examination	12.30pm – 2.30pm

Prog Code	BN302	**Prog Title**	Bachelor of Science in Computing in Information Technology	**Module Code**	COMP H3011
Prog Code	BN013	**Prog Title**	Bachelor of Science in Computing in Information Technology	**Module Code**	COMP H3011
Prog Code	BN104	**Prog Title**	Bachelor of Science (Honours) in Computing	**Module Code**	COMP H3011

Module Title	Data Structures and Algorithms

Internal Examiner(s): *Mr. Arnold Hensman*
External Examiner(s): *Dr. Richard Studdert*

Instructions to candidates:

1) **To ensure that you take the correct examination, please check that the module and programme which you are following is listed in the tables above.**
2) **This paper consists of five questions. Candidates should answer any four questions.**
3) **All questions carry equal marks.**

DO NOT TURN OVER THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Question 1

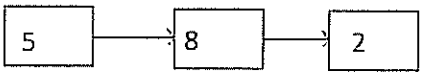
a) Explain the difference between an Abstract Data Type and a Data Structure. Use an example to support your answer.

(5 marks)

b) Write the pseudo code to create a simple class called *Node* which contains a data item and a reference that refers to another node object. Include appropriate access/ modifier methods.

(5 marks)

c) Use the Node from part (b) above set up three nodes in the configuration indicated below:



(5 marks)

d) Discuss any advantages and disadvantages of using a Reference Based List ADT over an array based list.

(5 marks)

e) Using pseudo code and supporting diagrams, explain how you would remove a node from a linked list. You code should refer to the nodes *prev* and *curr*.

(5 marks)

(Total 25 marks)

Question 2

a) Identify four applications of a Stack ADT for text and string processing.

(4 marks)

b) Outline and compare the different possible implementations of a Stack ADT. Outlining the advantages and disadvantages of each.

(6 marks)

c) A palindrome is a word that can be read the same way in either direction, for example, 'racecar' or 'madam'.

Explain how a Stack ADT can be used to find a solution to this problem. Your answer should refer to detailed pseudo-code or Java code.

(10 marks)

d) Discuss the problems that occur in implementing an array based Queue ADT. Describe a solution that uses 'circular array' to overcome these problems.

(5 marks)

(Total 25 marks)

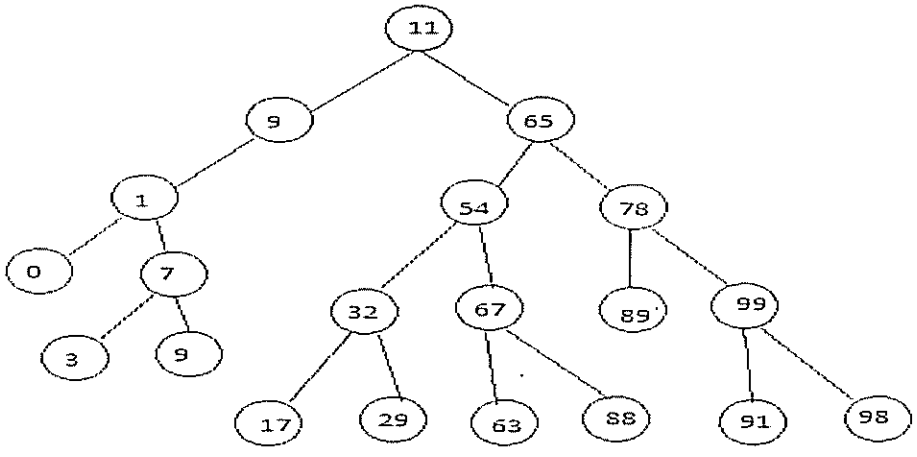
Question 3

a) Explain, with the aid of diagrams, the following terms in relation to a Tree ADT:

i. Binary Search Tree
ii. Subtree of a node
iii. Balanced Tree
iv. Complete Tree

(8 marks)

b) Write out the *inorder*, *preorder* and *post order* output for the tree below:



(6 marks)

c) Write a pseudocode method for a recursive implementation of the inorder traversal.

(5 marks)

d) Write a pseudo-code or Java solution for the following BinaryTree method:

attachRightSubtree(BinaryTree rightTree)

Assume that all class members in classes BinaryTree and BinaryTreeBasis already exist.

(6 marks)

(Total 25 marks)

Question 4

a) Explain, with the aid of diagrams, the following terms in relation to Graphs:

i. Complete Graph
ii. Digraph
iii. Simple Path
iv. Degree of a vertex

(6 marks)

b) Draw the following digraph:

G= ({1, 2, 3, 4, 5, 6, 7}, {(1, 2), (1, 3), (1, 4), (2, 1), (2, 4), (2, 7), (3, 4), (4, 6), (5, 2), (5, 7), (6, 3), (6, 7), (7, 4), (7, 5)})

(5 marks)

c) For the graph in part (b) above list create:

i. Adjacency Matrix

(2 marks)

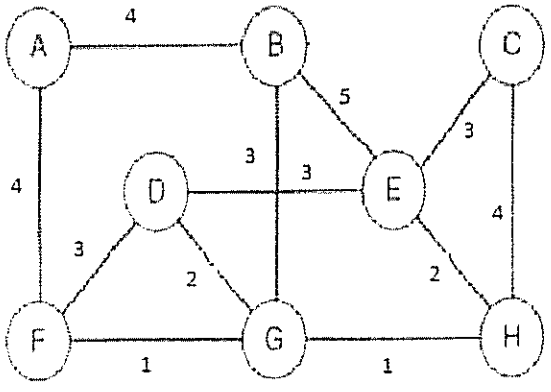
ii. Adjacency List

(2 marks)

d) Describe the Kruskal Minimum Spanning Tree algorithm. Use pseudocode in your answer.

(6 marks)

e) Derive the Minimum-Spanning Tree using the Kruskal algorithm for the following weighted graph (Show all steps):



(4 marks)
(Total 25 marks)

Question 5

a) Explain the phrase "Analysis of Algorithms", making reference to *execution time* and *Big O notation*.

(4 marks)

b) Arrange the following in terms of their order of growth.

$O(2^n)$, $O(n^3)$, $O(1)$, $O(\log_2 n)$, $O(n^2)$, $O(n \log_2 n)$, $O(n)$.

(3 marks)

c) Put the following recurrence relation into closed form:

$$a(n) = a(n-1) + 2$$

subject to the initial condition

$$a_1 = 0$$

(9 marks)

d) Describe the operation of the MergeSort approach to sorting data. Your discussion should make reference to the operation strategy behind MergeSort and also its growth rate in terms of Big O.

(9 marks)

(Total 25 marks)