MASENO UNIVERSITY

FIRST YEAR SECOND SEMESTER EXAMINATIONS FOR THE DEGREE BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

(CITY CAMPUS - EVENING)

CIT 108: DATA STRUCTURES AND ALGORITHMS

Date: 31st March, 2014   Time: 5.30 – 7.30 p.m.
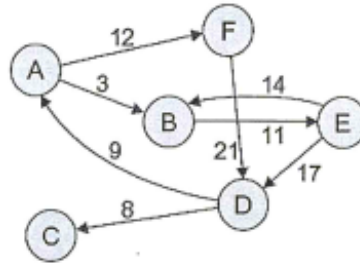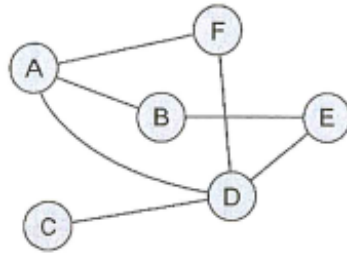
INSTRUCTIONS:

- **SECTION A: Attempt Question 1 (COMPULSORY) 30 marks.**
- **SECTION B: Attempt ANY TWO questions 20 marks each.**
- **Start each question on a new page.**
- **MOBILE PHONES are prohibited in the examination room.**
- **DO NOT WRITE on the question paper.**

QUESTION 1 (30 MARKS)

a. What do you understand by the following terms?
   i) data structure
   ii) List
   iii) Algorithm
   iv) Binary Search Tree(BST)   (4 marks)
b. Identify and briefly describe the SIX goals of a data structure.   (6 marks)
c. Give adjacency matrices and adjacency lists for the graph and digraph
   below.   (8 marks)
   i)   ii)

d. Using the nodes and weights provided below, construct a tree using Huffman's
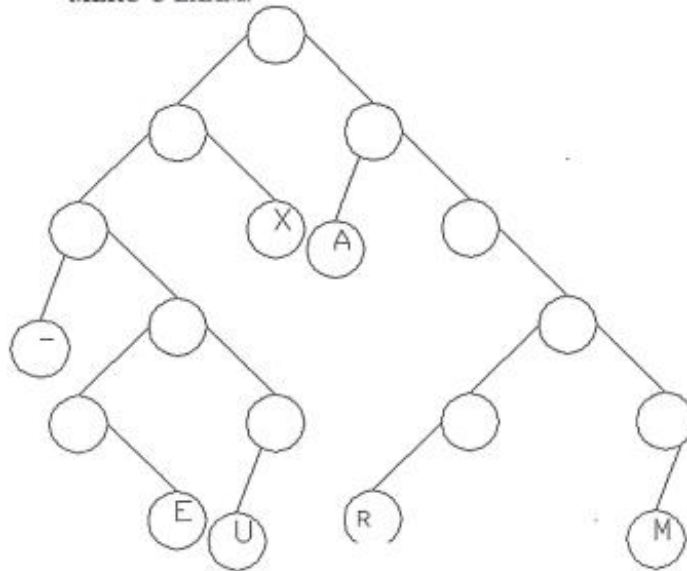   algorithm.   (4 marks)

Weights	0.1	0.2	0.45	0.1	0.15
Nodes	A	B	C	D	E

e. Identify and discuss the FOUR types of linked list implementations.   (8 marks)

SECTION B (ATTEMPT ANY TWO QUESTIONS FROM THIS SECTION)

QUESTION 2

a. Show how the data elements: 67, 33, 21,84,49,50, and 75 can be sorted using the
following sorting schemes.
- i. Quick sort   (3 marks)
- ii. Heap sort   (3 marks)
- iii. Bubble sort   (3 marks)
- iv. Selection sort   (3 marks)

b. Using the tree below and Huffman's coding algorithm, code the message:
MERU-U-EXAM.   (4 marks)

c. Identify TWO scenarios where the following would be an ideal data -
structure to use.
i) Stacks
ii) Queues.   (4 marks)

QUESTION 3

a. Write a program segment that utilizes a stack ADT to implement a decimal to integer conversion algorithm that uses repeated division by two, keeping track of successive
   remainders on a stack. (6 marks)

b. Define the terms below:
   i. Searching
   ii. Traversing
   iii. Sorting
   iv. Merging (4 marks)

c. A [4, 3] is a 2D array stored in column major form, with base address 52722. If each array element requires 2 bytes of memory, calculate the address of A [2, 1]. (3 marks)

d. Translate each of the following infix expressions
   i) (A+B)*(C-D)   into its postfix equivalent (3 marks)

   ii) A*B^C+D/E-F*G into its prefix equivalent (4 marks)

QUESTION 4

a. The most basic of the operations for any data structures is insertion of data. Using linked lists, stacks and queues demonstrate using a procedure (or pseudo code) how this operation is accomplished in these data structures

(18 marks)

b. Cite any TWO tasks that may need to be undertaken before you can insert records into any of the data structures above (2 marks)

QUESTION 5

a. Write a C++ function to insert an item at a given position into an array. (8 marks)

b. Write an algorithm to double the value stored at each node of a linked list. (7 marks)

c. What are the characteristics of a good algorithm? (5 marks)