EASTERN UNIVERSITY, SRI LANKA

DEPARTMENT OF MATHEMATICS

SECOND YEAR EXAMINATION IN SCIENCE (2012/2013)

FIRST SEMESTER (Mar/Apr, 2016)

CS 201 – DATA STRUCTURES AND DESIGN OF ALGORITHMS

Answer all questions **Time: Two hours**

Q1)

a) Define "*data structure*" and state its importance in solving problems.

b) Briefly describe the following terms in data structure:

i) Linear data structure.

ii) Non-linear data structure.

c) List down five characteristics of an *algorithm*.

d) Explain the *asymptotic notations* of an algorithm.

e) Let $P(n)$ and $Q(n)$ be two non-negative functions which are $P(n) = P(n-1) + n$, $P(1) = 1$, $Q(n) = 8n^3 + 4$. Show that $Q(n)$ is asymptotically bigger than $P(n)$.

f) Briefly describe the *recursion* in algorithm design.

g) Write an algorithm to print the Pascal triangle using *recursion*.

```
          1
        1   1
      1   2   1
    1   3   3   1
  1   4   6   4   1
1   5  10  10   5   1
```

Q2)

a) Define the stack data structure and its ADT operations.

b) Write algorithms for the following:

   i. To insert an element into the stack;

   ii. To remove an element from the stack.

c) Briefly describe the stack errors in the data structure.

d) Discuss the pros and cons of using stack data structure.

e) A string is said to be db-mirrored if it is in the form XdbY, where X is a string of
and Y is the reverse of X, d and b are characters 'd' and 'b'. For example goodgirl
and badbboybdyobdab are examples of db-mirrored strings. Suppose you are
check whether a given string is db-mirrored string or not.

Explain briefly how a stack data structure can be used to perform the task.

Write a procedure/function to fulfil the task using a stack data structure.

f) Explain the advantage of *circular queue* compared with *linear queue*.

Q3)

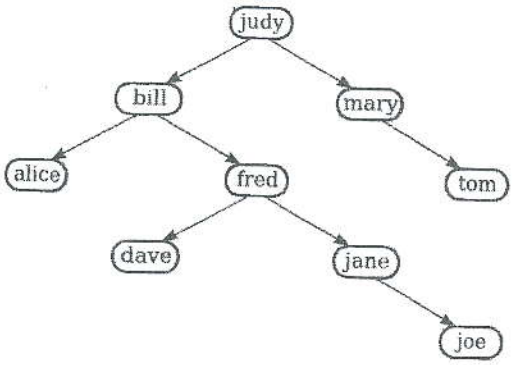
a) Describe briefly the binary tree Data Structure.

b) State clearly the differences between complete and full binary trees.

c) Define each of the following traversals:

(i) pre-order, (ii) in-order, (iii) post-order, (iv) level order.

Consider the binary tree shown in the figure below:

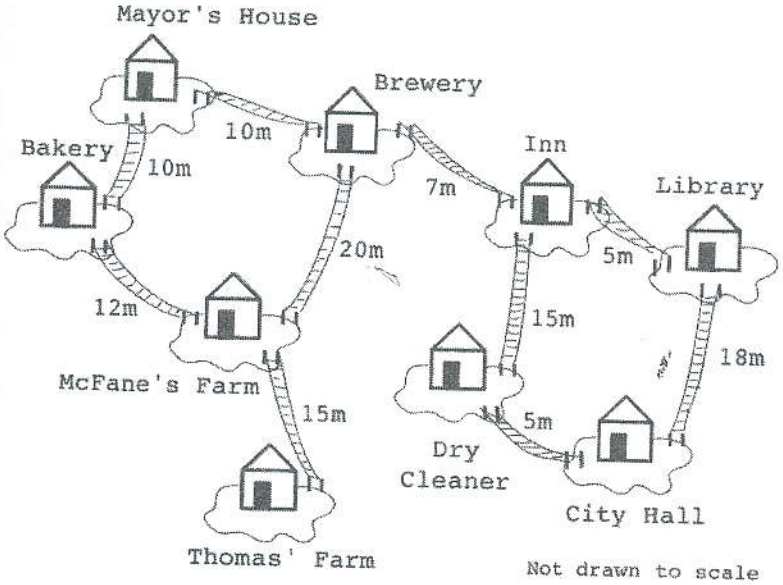


List the names in the nodes in each of the above traversals.

d) Draw a binary tree of 13 nodes labelled B, F, G, H, L, M, N, P, Q, S, T,V, W in such a way that a pre-order traversal results in G, B, H, T, L, M, F, S, W, V, P, Q, N and an in-order traversal results in H, T, B, M, F, L, G, W, P, V, S, Q, N.

e) Describe briefly the shortest path problem and how "Dijkstra's Algorithm" finds a solution for that problem.

f) Find the shortest distance of the places *Inn, Brewery, Mayor's House, Bakery, McFane's Farm, Thomas' Farm, Dry Cleaner,* and *City Hall* from the source place ***Library*** using "Dijkstra's Algorithm".



Q4)

a) Briefly describe the algorithm of divide and conquer method.

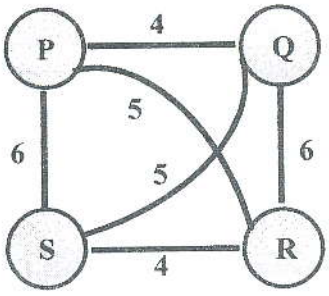
b) Sort the following numbers using the above algorithm.

29	6	20	14	10	4	19	83	12	26

c) Explain the binary search using a suitable example.

d) What are the differences between breadth first search (BFS) and death first sear

e) Consider the following graph illustrating 4 cities P, Q, R, and S with proposed connections and their costs.



Suppose that you want to build a minimum cost spanning tree out of this graph.

i) Give an algorithm for it, and get the minimum cost spanning tree appl algorithm.

ii) Suppose a new city T is added with a proposed cost of C_T for the connection the 4 cities, Show how it would change the new minimum cost spanning tree (to include T)

1. If $C_T < 4$, and
2. If $C_T > 6$.