EASTERN UNIVERSITY, SRI LANKA

DEPARTMENT OF MATHEMATICS

SECOND EXAMINATION IN SCIENCE -2010/2011

FIRST SEMESTER (March/April., 2013)

CS 201 – DATA STRUCTURES AND DESIGN OF ALGORITHMS

PROPER & REPEAT

ANSWER ALL QUESTIONS **TIME ALLOWED: 02 HOURS**

Q1)

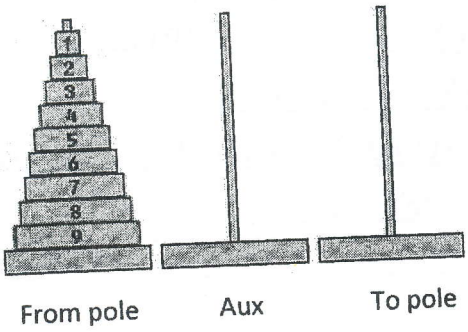
a) Define in your own words what a *data structure* is.
b) Briefly describe the following terms in data structure:
   i. Primitive data type;
   ii. Non Primitive data type.
c) Describe the properties of an algorithm.
d) Explain the Asymptotic notations of an algorithm.
e) Let P(n) and Q(n) be two non negative functions which are
   $P(n) = 8n^{2.5} + 3n^2 + 4n + 8$,
   $Q(n) = 100n^2 + 26$. Show that P(n) is asymptotically bigger than Q(n).
f) Describe *Recursion* in your own words. How it works and write a sample code for it.

Q2)

a) Stack is one of the data structure.
   Write codes for the following Stack operations which:
   i. Check whether the Stack is empty;
   ii. Return front element of the Stack;
   iii. Add an element to the Stack;
   iv. Remove an element from a Stack.
b) Briefly describe the *Stack errors* in the data structure.
c) Describe the Stack applications.
d) Discuss the disadvantages of using Stack data structure.
e) The Tower of Hanoi is a mathematical game or puzzle. It consists of three rods, and a number of disks of different sizes which can slide onto any rod. The puzzle starts with the disks in a neat stack in ascending order of size on one rod, the smallest at the top, thus making a conical shape. The objective of the puzzle is to move the entire stack to another rod, obeying the following rules:

i. Only one disk may be moved at a time.
ii. Each move consists of taking the upper disk from one of the rods and sliding it onto another rod, on top of the other disks that may already be present on that rod.
iii. No disk may be placed on top of a smaller disk.

Write an algorithm to solve the Towers of Hanoi problem using *Stack* data structure.

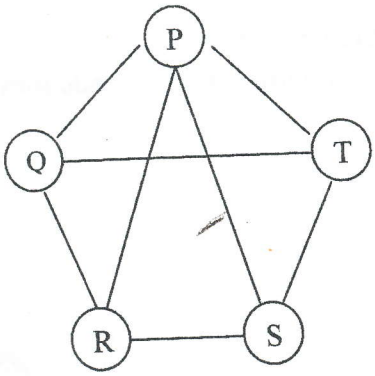


f) Briefly explain the advantage of *Circular Queue* compare with *linear Queue*.

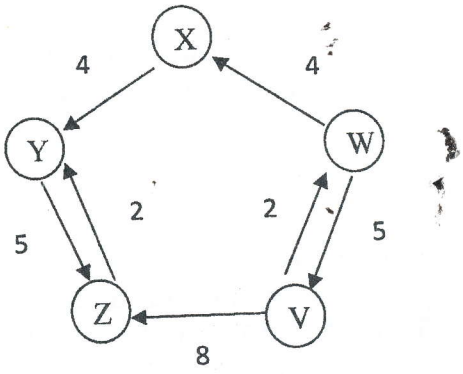
Q3)

a) Write the basic definition of a graph in data structure.
b) Give the adjacency matrices for the following graphs:

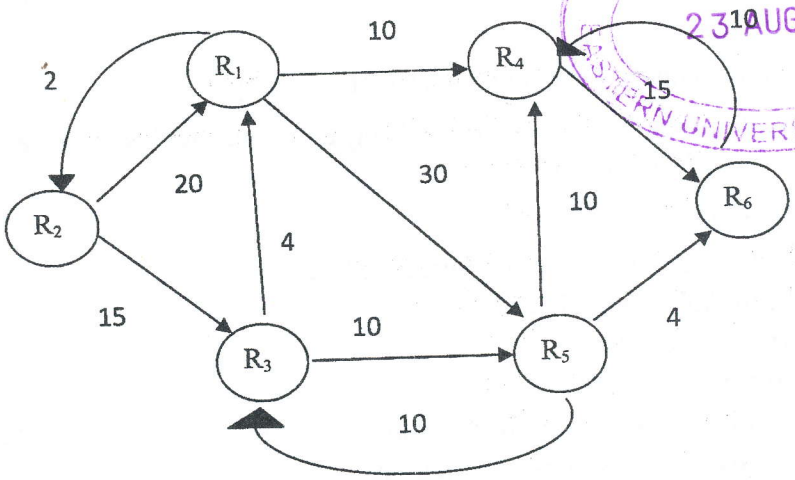
a.



b.



c) Let G (R, E) be a directed graph representing routers of a Network, where R is a set of Routers, R_1, R_2, R_3.....R_n, and E be a set of links e_{ij} directly connecting the routers R_i and R_j
   i. Write an algorithm to find the shortest paths from the router R_1 to all other routers.
   ii. Apply your algorithm to the following instance and find the shortest paths and distances.



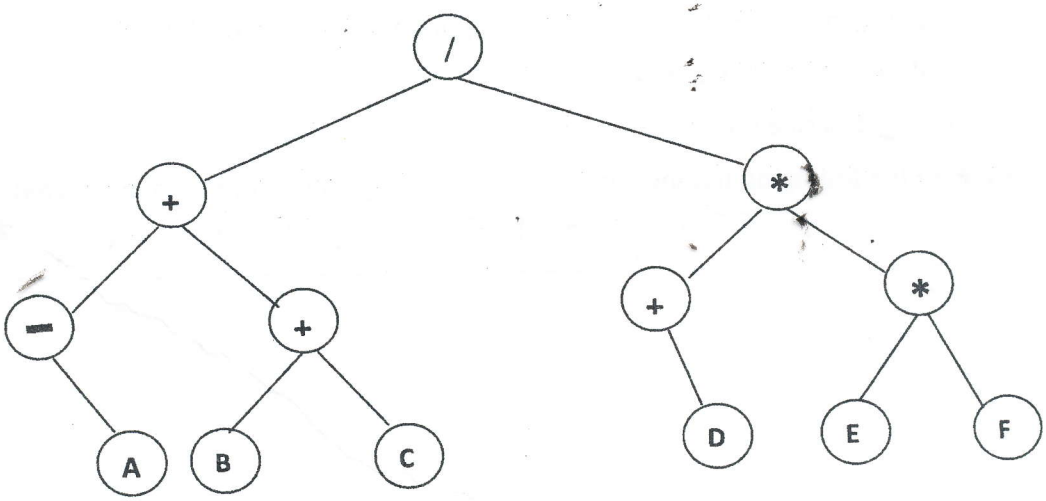
d)

i. Briefly describe a **binary tree.**

ii. The following figure is a binary tree.

Write algorithm for each of the following traversals to visit each node in the tree:

a. Pre-Order;
b. In-Order;
c. Post-Order.



e) Let T be a binary tree of 11 nodes that are labeled A to K in some order and suppose **In-order** traversal and **Pre-order** traversal visit the nodes in the order

A, E, F, D, C, G, I, H, J, K, L, B and

A, B, C, D, E, F, G, H, I, J, K, L respectively

i. Construct the binary tree.

ii. In what order will the post-order traversal visit the nodes?

Q4)

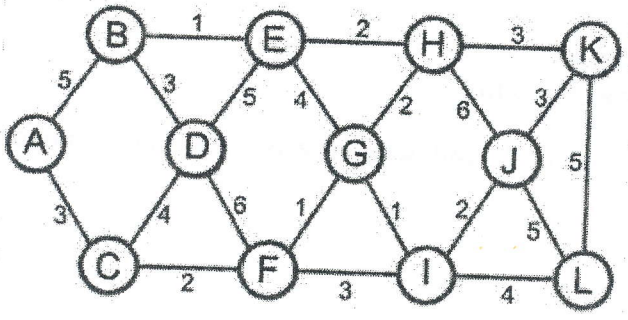
a) Explain the Binary Search using a suitable example.

b) Briefly describe the following searching techniques with suitable examples:
   i. Breadth First Search;
   ii. Depth First Search.

c) Briefly describe the Minimum Spanning Tree.

d) Explain the following algorithms:
   i. Prim's algorithm;
   ii. Kruskal's algorithm.

e) Consider the following graph illustrating 12 cities A, B, C, D, E, F, G, H, I, J, K and L with proposed connections and their costs.



Get the minimum cost spanning tree applying Prim's algorithm.

(show appropriate steps)

f) Briefly describe the Divide and Conquer method.

g) Sort the following numbers using the Mergesort. (**show appropriate steps**)

1	4	19	83	26	12	19	8	2	6

**********End**********