| MMTE-002 |

M.Sc. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE) (MACS)
M.Sc. (MACS)

Term-End Examination

June, 2012

## MMTE-002 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 2 hours   *Maximum Marks : 50*

Note :   *Answer **any five** questions. Calculators are **not** allowed.*

1. (a) State a loop invariant for the loop given **4** below and justify your answer
   SUM-OF-CUBES
   $m \leftarrow 1$
   for $i \leftarrow 2$ to n
        $m \leftarrow m + i^3$

   (b) Give an algorithm in pseudo code for **6** deleting a node from a binary search tree. Show all the steps when you remove the node containing the key 10 in the following binary search tree.
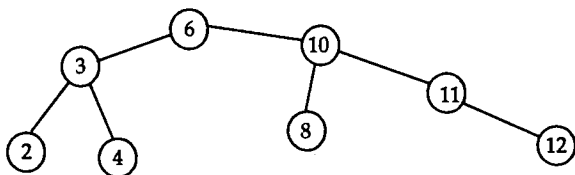
2. (a) For the following network flow, draw the residual network. **5**
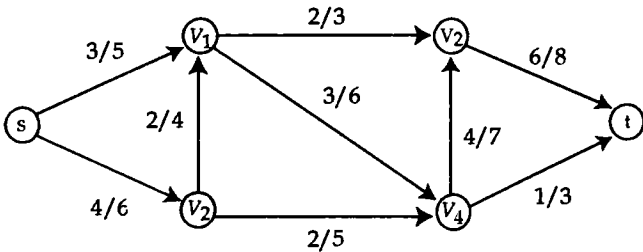
Find the augmenting path p and use it to augment the flow. Draw the network of the augmented flow.

(b) Prove that for Rabin-Karp string matching algorithm, the preprocessing time is Θ (m) and the matching and verification time is Θ $((n-m+1)m)$ where n is the length of the text and m is the length of the pattern. **5**

3. (a) Find all the solutions to the equation $15x \equiv 10 \pmod{35}$. **6**

(b) Illustrate the radix sort algorithm using the array { 2456, 3987, 5793, 7462, 1673, 6237, 4639, 6531, 1329, 9251, 8137 } **4**

4. (a) Let $f(n) = 1^2 + 2^2 + \ldots + n^2$. Show that $f(n) = \Theta$ (n^3) giving the constants. **3**

(b) Explain the breadth first search algorithm 7 using the graph given below with v_1 as the source vertex.
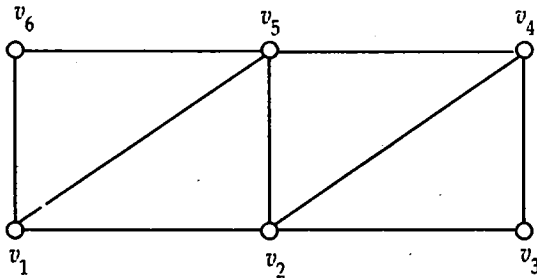


For each stage of the algorithm give :

(i) d(v), π(v) for each vertex where d(v) is the distance from the source and π(v) is the predecessor of vertex v.

(ii) White and gray vertices in the form of sets.

(iii) Vertices in the queue.

Also give the Breadth First Tree.

5. (a) Write the procedure CONNECTED- 5 COMPONENTS that · computes the connected components of a graph using disjoint set operations, in pseudo code for the graph given below :
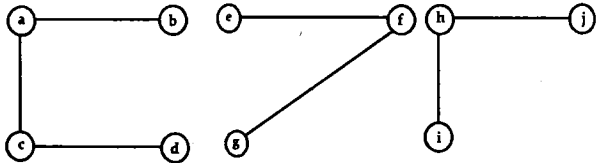
List the vertices in each connected component. Give the details of the output of each iteration.

(b) What is the Haffman code for the following   5
set of frequencies :

A   B   C   D   E
5   6   6   11   20

Show all the steps of the algorithm. Also, compute the number of data bits required to encode the data.

6. (a) Analyse the insertion sort algorithm and   5
show that the best case running time is linear and the worst case running time is quadratic.

(b) Describe the Divide and Conquer algorithm   5
for finding the closest pair of points in a finite sub set of the plane.