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

Term-End Examination

June, 2010

MMTE-002 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 2 hours   *Maximum Marks : 50*

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

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

   (b) Describe the algorithm for finding the closest pair of points in a finite subset of the plane.   **7**

2. (a) Draw binary search trees of heights 2 and 3 for the set of keys

   $\{6, 7, 9, 11, 12, 14, 15\}$.   **3**

(b) Explain the breadth first search algorithm   **7**
using the graph given below with v_1 as the
source vertex.
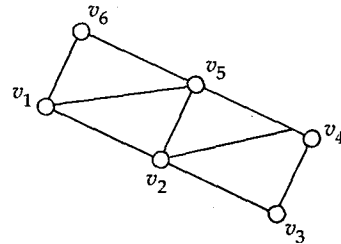
For each stage of the algorithm give :

(i) $d(v)$, $\pi(v)$ for each vertex where $d(v)$
is distance from source to vertex v.
$\pi(v)$ is 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.

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

(b) Illustrate radix sort algorithm using the   **4**
array [2456, 3897, 5692, 7392, 1673, 6183,
4379, 6463, 1229, 9341, 8128].

4. (a) Illustrate the quick sort algorithm using the array A = [11, 9, 7, 8, 10].   5

   (b) Give the procedure CONNECTED - COMPONENTS that computes the connected components of a graph using disjoint set operations, in pseudo - code. For the following graph given below; list the vertices in each connected component. Give the details of output at each iteration.   5
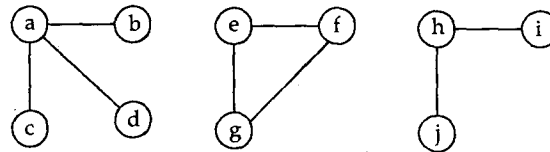

5. (a) Explain with pseudo-code the procedure for splitting a non full internal node in a B-tree.   6

   (b) The tree corresponding to an optimal prefix code is given below :   4
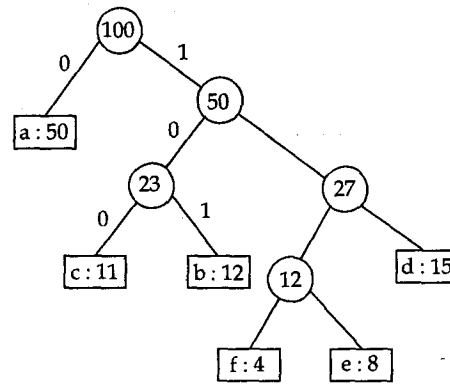
The numbers are the frequency of occurrence of the characters a to f, in thousands, in a file with 1,00,000 characters. Write the character coding of the code and the number of bits required to encode the file.

6. (a) For the following network flow, draw the residual network.   5
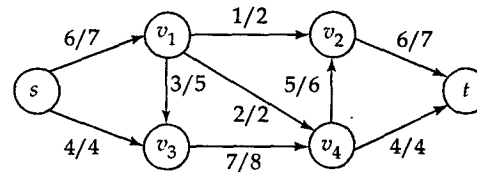
Find an augmenting path p and use it to augment the flow along p. Draw the flow network of the augmented flow.

(b) For the polynomials $f(x) = x^2 + 3x + 1$ and $g(x) = x^2 - x + 1$, find the point value representation using the points $\{1, -1, i, -i\}$. Use the representation to multiply the polynomials f and g in co-efficient form.   5

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