MCA (Revised)

Term-End Examination 12240

December, 2011

MCS-031 : DESIGN AND ANALYSIS OF ALGORITHM

Time : 3 hours *Maximum Marks : 100*

Note : *Question No. 1 is **compulsory**. Attempt **any three** from the rest of the questions.*

1. (a) Explain the relation/difference between a problem and its instance through an example of each. **2**

   (b) State and describe any one of the following two problems : **2**

   (i) The Four - Colour Problem

   (ii) The Fermat's Last Theorem

   (c) State any four characteristics of an algorithm, with an appropriate examples. **4**

   (d) Let $\lfloor x \rfloor$ denote floor function of x and $\lceil x \rceil$ denote ceiling function of x. Find values of : **4**

   (i) $\lfloor 3.4 \rfloor$ (ii) $\lfloor -4.6 \rfloor$

   (iii) $\lceil 2.7 \rceil$ (iv) $\lceil -9.8 \rceil$

(e) Using Insertion Sort or Bubble Sort (state before starting the solution, which algorithm for sorting, you are using), sort the following sequence of integers in decreasing order : 4

85 36 34 109 49 36

(f) Arrange the following growth rates in increasing order : O (4^n), $O(n^4)$, $O(1)$, $O(n^3 \log n)$, where 'O' denotes 'big oh'. 4

(g) Using Principle of Mathematical Induction, prove that $3^0 + 3^1 + .. + 3^n$ is equal to 4

$$\left(\frac{1}{2}\right) \cdot \left(3^{n+1} - 1\right) \text{ for all } n \geq 1.$$

(h) Explain how Binary Search Method finds or fails to find the given value 43 in the sorted array : 4

9, 13, 76, 27, 36, 49, 58, 79, 86.

(i) Write important properties of Depth - first search strategy for traversing a tree and cite an example of its use. 4

(j) Explain the essential idea of Dynamic Programming. How does Dynamic Programming differ from Divide and conquer approach for solving problems ? 4

(k) Available currency notes in India are : Rupee 1, 2, 5, 10, 20, 50, 100, 500 and 1000. Explain how to make Rupees 289 by using minimum number of currency notes. 4

2. (a) Discuss the three control mechanisms in an algorithm : **10**

(i) Direct sequencing

(ii) Selection

(iii) Repetition

(b) Define the function $f(n) = a^n$ recursively, where a is a constant real number and $n \geq 0$ is an integer. **5**

(c) Compare the following sorting algorithms on the basis of comparasion of keys and number of assignments : **5**

(i) Selection sort

(ii) Insertion sort

3. (a) Multiply the following two matrices A and B using Strassen's algorithm : **8**

$$A = \begin{bmatrix} 5 & 6 \\ -4 & 3 \end{bmatrix} ; B = \begin{bmatrix} -7 & 6 \\ 5 & 9 \end{bmatrix}$$

(b) By taking a suitable example of a tree with at least ten nodes, explain the three rules of traversal : **12**

(i) Pre - order traversal

(ii) In - order traversal

(iii) Post - order traversal

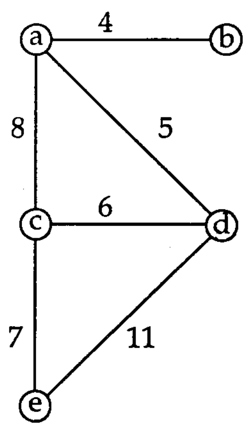
4. (a) Let $C(n, k) = \binom{n}{k}$ denote the number of combinations of k things out of n given things. Let **12**

$C(i, o) = 1$ for all $i = 0, 1, 2, ..., n$ and

$C(o, j) = 0$ for all $j = 1, 2, ..., k$.

Explain, using Dynamic Programming, how to compute C (n, k) for positive integers n and k.

(b) Using Prim's algorithm, find a minimal spanning tree for the graph, given as follows : **8**



5. (a) Define the following, with at least one appropriate example : **6**

(i) Directed Graph

(ii) Single - Source Shortest Path Problem

(b) Find a regular expression for each of the following languages : 6

(i) {a, b, ab, ba, abb, baa, ...}

(ii) {^, a, abb, abbbb, ...}

(c) Define the following : 8

(i) Halting Problem

(ii) Undecidable Problem