Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

MCA. Sem-IV Examination May- 2011

Subject code: 640010

Subject Name: Analysis and Design of Algorithm (ADA)

Date:26/05/2011 **Time: 02.30 pm – 05.00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Write a recursive algorithm for Binary search of a sorted array of n elements. Derive the time complexity of this algorithm? **07**
Does this algorithm use Divide and Conquer (D&C) strategy? Whether D&C always leads to balanced splitting of the problem or it may lead to imbalanced (or unequal) splitting also?

(b) (i) State the functional algorithmic specification of factorial function: factorial (n). Establish the correctness of this functional algorithm using the Principles of Mathematical Induction. **07**

(ii) Write an efficient version of the following algorithm:

```
x = 0;
for i = 1 to N do
begin
        x = x + 0.01;
        y = (a * a * a + c) * x * x + b * b *x;
        writeln ('x =', x, 'y=', y);
end
```

(iii)

```
p = 0;
for (i=1; i<n; i++) {
        if (a[i] > a[p]) {
            p = i;
        }
}
max = a[p];        /* p is the position of max */
```

Q.2 **(a)** (i) Write an algorithm for multiplying two matrices A and B of size N x N and store result in matrix C. **07**

(ii) Show that the time of this algorithm is proportional to $N + 3 * N^2 + 2 * N^3$. Write down its worst case time complexity.

(b) (i) Briefly describe Pigeonhole Principle (or Dirichlet Drawer Principle) **07**
(ii) State Chinese Remainder theorem
(iii) Describe Big-oh Notation and Theta Notation and write their salient (main) characteristics.

OR

(b) (i) What is Latin square? **07**
(ii) What is Convex Hulls problem? Give an example of a 2-D Convex Hull, and illustrate it with respect to the definition of Convex Hull.

Q.3 **(a)** (i) What is the general structure of problems solved by Greedy algorithm? **07**

(ii) Write down basic steps for solving Knapsack problem using greedy algorithm approach.
Knapsack problem is stated as follows:
There are n objects numbered i, $o \leq i \leq n-1$, having weights w_i and contribution to profit p_i. There is a sack having a capacity of M. If a fraction x_i of the object i is put in the sack, then it increases its weight by $w_i x_i$ and contributes $p_i x_i$ to the profits. Find the filling that maximizes the profits.

(b) Write the dynamic programming algorithm for finding the longest common sub-sequence in a given sequence. **07**

OR

Q.3 **(a)** (i) What is spanning tree? Show examples of some of spanning trees including **07**
a minimum spanning tree of an undirected graph.

(ii) Write the basic steps of Kruskal's algorithm for finding minimum spanning tree.

(b) Write down four basic steps used in a dynamic programming solution. Briefly describe Travelling Salesman Problem and write down the basic solution methodology using dynamic programming approach. **07**

Q.4 **(a)** Describe backtracking strategy. Write down Depth-First Search (DFS) algorithm using Backtracking Strategy. You can simply write a backtrack statement without giving its details. **07**

(b) (i) Derive complexity of Quick-Sort algorithm. **07**

(ii) Briefly describe Splay Trees.

OR

Q.4 **(a)** (i) Describe Backtracking framework and write down the four factors on which the efficiency of backtracking depends. **07**

(ii) What is Hamiltonian Circuit (Cycle)? Can it be used to solve Travelling Salesman Problem? Briefly Explain.

(b) (i) Derive Complexity of Merge-Sort algorithm. **07**

(ii) Briefly describe Binomial Heap.

Q.5 **(a)** (i) Write a brief description of sequential search for unsorted list with n entries under the following headings: **07**

- Problem
- Best Case
- Worst Case
- Average Case
- Space Efficiency

(ii) What is meant by NP problems? Write down the salient (main) characteristics of these problems.

(b) Briefly describe NP-Complete problems. What is the significance of NP Complete problems? Give an example of NP-Complete problem. **07**

OR

Q.5 **(a)** (i) Write a brief description of matching a given pattern string of length m in a text string of length n under the following headings: **07**

- Problem
- Best Case
- Worst Case
- Average Case
- Space Efficiency

(ii) Briefly describe the term Reductions (in the context of NP and NP-Complete Problems). What are its advantages? As a corollary of Reductions, whether the converse is also true?

(b) (i) Write a short note on Approximate Solutions to NP-Complete problems. **07**

(ii) Give examples to show that the assumption that "P means 'easy'" and "'not in P' means 'hard'" is not always true in practice.

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