ROLL NO. _____

Code: CT42 Subject: DESIGN AND ANALYSIS OF ALGORITHMS

ALCCS – NEW SCHEME

Time: 3 Hours **AUGUST 2013** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE:

- **Question 1 is compulsory and carries 28 marks. Answer any FOUR questions from the rest. Marks are indicated against each question.**
- **Parts of a question should be answered at the same place.**

Q.1 a. Why do we use asymptotic notations in the study of algorithms? Briefly describe the commonly used asymptotic notations.

b. Show that Quick Sort algorithm takes $O(n^2)$ time in the worst case.

c. Explain any two methods to resolve collision during Hashing.

d. Draw BSTs of height 2, 3 and 4 on the set of keys { 10,4,5,16,1,17,21}

e. Give a simple way to implement Disjoint-set data structure.

f. Show that the worst case complexity for simple text search (Naive string matching) to find the first occurrence of a pattern of length **m** on a text of length **n** is **θ(n-m+1)(m-1).**

g. Define Red-Black Tree with an example. **(7×4)**

Q.2 a. Write an algorithm to merge two sorted lists using an auxiliary storage. **(9)**

b. Write down Rabin Karp string matching algorithm. Working modulo q=11, how many spurious hits does the Rabin Karp String matcher encounter in the text T=3141592653589793 when looking for the pattern P=26? **(9)**

Q.3 a. Bob loves foreign languages and wants to plan his course schedule to take the following nine language courses:

LA15, LA16, LA22, LA31, LA32, LA126, LA127, LA141 and LA169.
The course prerequisites are:
LA15: None, LA6: LA15, LA22: None, LA31: LA15, LA32: LA16 & LA31, LA126: LA22 & LA32, LA127: LA16, LA141: LA22 & LA16, LA169: LA32.
Using Graphs, find a sequence of courses that allows Bob to satisfy all the prerequisites. **(8)**

b. Draw a graph with 6 vertices that has unique ordering of vertices when topologically sorted. **(2)**

c. Let G be an undirected connected graph. Give an efficient algorithm to compute the second best minimum spanning tree of G. **(8)**

Q.4 a. Write down Counting Sort algorithm. Illustrate the operation of counting sort on the following array:
A = {7, 1, 3, 1, 2, 4, 5, 7, 2, 4, 3} **(7)**

b. Describe an algorithm that, given n integers in the range 1 to k, preprocesses its input and then answers any query about how many of the n integers fall in the range [a..b] in O(1) time. Ignore the preprocessing time. **(4)**

c. Write an algorithm to find the K^{th} smallest element from a set of n different numbers without sorting it. **(7)**

Q.5 a. Show the results of inserting the keys F, S, Q, K, C, L, H, T, V, W, M, R, N, P, A, B, X, Y, D, Z, E, I in order into an empty B tree of minimum degree 3. Only draw the configurations of the tree just before some node must split, and also draw the final configuration. **(10)**

b. What is backtracking? Find a solution to the 4-Queens problem using backtracking strategy. Draw the solution space using necessary bounding function. **(8)**

Q.6 a. Deduce a recursive definition for finding the minimum cost of Matrix-Chain multiplication problem. Find an optimal parenthesisation of a matrix chain product whose sequence of dimension is:
< 5*10, 10*3, 3*12, 12*5, 5*50, 50*6> **(9)**

b. Write down the Floyd Warshall algorithm to solve the all pairs shortest paths problem on a directed graph. Run your algorithm on the following weighted directed graph and show the matrix D^k that results for each iteration of the outer loop. **(9)**

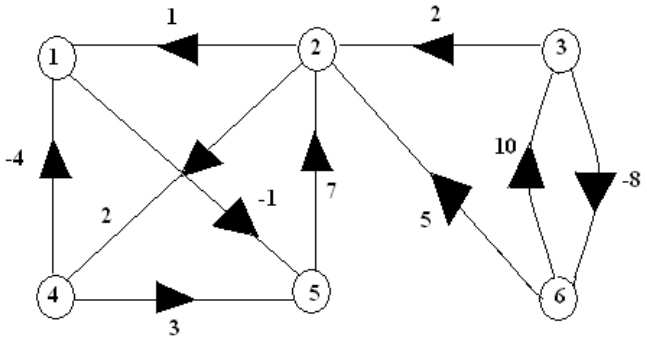

Fig. 1

Q.7 Write short notes on any **THREE** **(3×6)**

(i) Prefix Function in KMP algorithm
(ii) Hash Functions
(iii) Depth First Search
(iv) The Complexity Class NP