M. Tech, Sem I, Mid Semester Examination 2, Total marks: 20 Duration: 1 hour

1. Answer any *four* questions from the following: **[2 x 4= 8]**

a) Define P and NP class.

b) State true or false with justification: a polynomial number of calls to polynomial-time subroutines may result in an exponential-time algorithm.

c) Define the prefix function used in finite automata based string matching.

d) Define the suffix function used in KMP algorithm for string matching.

e) Differentiate between randomized and deterministic algorithm.

2. Answer any *three* questions from the following: **[4 x 3= 12]**

a) Prove that search in a skip list is O(log n) on expectation.

b) Prove that SAT is polynomial time reducible to Vertex cover Problem.

c) In randomized closest pair algorithm, how is randomization used? State and prove the expected time complexity of randomized closest pair algorithm.

d) Why do you compute expected running time for any randomized algorithm ? Does randomization improves efficiency for Quicksort and Selection Algorithm? Justify your answer.

M. Tech, Semester I, Mid Semester Examination 2 **Total marks: 20** **duration: 1 hour**

1. Answer any *four* questions from the following: **[2 x 4= 8]**

a) State TRUE OR FALSE: Let G be an arbitrary flow network, with a source s, a sink t, and a positive integer capacity c_e on every edge e. If f is a maximum s-t flow in G, then f saturates every edge out of s with flow (i.e., for all edges e out of s, we have $f(e) = c_e$).

b) Give the Dynamic Programming formulation for the all pair shortest path problem.

c) If n element input to the Select algorithm (finding kth smallest element) is already sorted and I want to find the $n/4^{th}$ smallest element, after how many recursions will you get the n/4 th smallest element?

d) Give the reduction of circulation problem to network flow problem.

e) What is the total number of paranthesization possible for a sequence of 5 matrices A_1, A_2,A_3,A_4, A_5?

2. Answer any *three* questions from the following: **[4 x 3= 12]**

a) i) Given a Flow Network G(V,E), where V = {s,u,v,t} and edge e = (x,y, c_e) in E as { (s,u,1), (s,v,1), (u,t,1),(v,t, 1), (u,v,1)}. List all the minimum s-t cuts in the flow network.

ii) Prove that minimum s-t cut is maximum flow in the graph.

b) I) Rewrite the divide and conquer closest pair algorithm such that in the combined step every point to the left of vertical line L is compared with every points to the right of L.

ii) Express the time complexity of the modified closest pair algorithm in i) by a recurrence relation and give the time complexity.

c) A contiguous subsequence of a list S is a subsequence made up of consecutive elements of S. for example if S is 5,15,-30,10,-5,40,10, then 15,-30,10 is contiguous subsequence but 5,15,40 is not. You are given a list of numbers a_1,a_2, …, a_n , formulate a dynamic programming formulation to compute a contiguous subsequence whose sum is maximum. For the example, 10, -5, 40, 10 with sum 55 is maximum.

d) Show the steps of divide and conquer algorithm to multiply two long binary integers 10011011 and 10111010.