MIS Number | | | | | | | | | |

COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Govt. of Maharashtra)

End Semester Examination - November, 2013

(CT-402) Design and Analysis of Algorithms

Class: - Final year B. Tech. (Computer Engineering)

Year: - 2013-14 **Semester: - VII**

Duration: - 3 hrs **Max. Marks: - 60**

Instructions:

1. *Make suitable assumptions wherever necessary. If any assumptions are made to solve any question(s), state them in the answer book.*

			Marks
Q.1		What is the complexity of each of the following operations on an nXn matrix 'A' of non-zero integers? Justify your answer briefly. i. Find maximum of elements from both diagonals ii. Find sum of elements from both diagonals iii. Find sum of all elements excluding the diagonal elements iv. Make A[i,1] = 0 by subtracting suitable scalar multiple of first row from i^{th} row for all i >= 2. v. Interchange two columns.	10
Q.2		Answer the following: i. A sorting algorithm takes 1 second to sort 1000 items on your local machine. How long would you expect it to take to sort 10000 items if you believe that the algorithm takes time roughly proportional to (i) n^2 and (ii) n*logn ? ii. Can we say that $2^n \in \theta(2^{n+1})$? Justify your answer. iii. Show that the θ notation is reflexive and symmetric, that is, a. $f(n) \in \theta(f(n))$ b. if $f(n) \in \theta(g(n))$ then $g(n) \in \theta(f(n))$ iv. Show step-by-step sorting of the array (5,2,4,6,1,3,2,6) using MergeSort. v. What is the smallest value of n such that an algorithm whose running time is $100n^2$ runs faster than an algorithm whose running time is 2^n on the same machine?	10
Q.3	(a)	Write an algorithm to find the largest and second largest number in an array of n integers. Analyze your algorithm for best, worst and average cases.	6
	(b)	A complete undirected weighted graph G is given on the vertex set {0, 1, ..., n-1} for any fixed n. What is the cost of the minimum spanning tree of G if the weight of the edge (u, v) is $(u^2 + v^2)$ for all u, v? Justify your answer.	4
Q.4	(a)	Solve the **0/1** knapsack problem for the following data: Number of items n = 5, capacity of knapsack m = 11 Weights: (w1, w2, w3, w4, w5) = (1, 2, 5, 6, 7) Profits: (p1, p2, p3, p4, p5) = (1, 6, 18, 22, 28)	4

(b) Solve the following job scheduling problem (maximizing the profit by completing jobs before their deadlines) using greedy algorithm: 4

N (number of jobs) = 7
Profits: (p1, p2, p3, p4, p5, p6, p7) = (3, 5, 20, 18, 1, 6, 30)
Deadlines: (d1, d2, d3, d4, d5, d6, d7) = (1, 3, 4, 3, 2, 1, 2)

(c) Show the step-by-step construction of a max heap (parent is bigger than children) constructed from the following elements when elements are considered one by one (that is, all elements are ***NOT*** available at the same time): 2

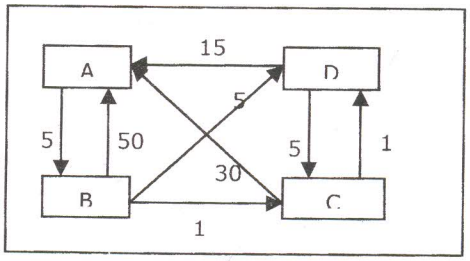
4, 5, 17, 9, 21

Q.5 (a) Find an optimal Huffman code for the messages (A, B, C, D, E) whose access frequencies are as given below: 2

A : 40 B : 15 C : 5 D : 30 E : 85

(b) Let X = **aabaa** and Y = **baba**. Find a minimum-cost edit sequence that transforms X into Y (cost of inserting a character = cost of deleting a character = 1 and cost of replacing a character by a different character = 2). 4

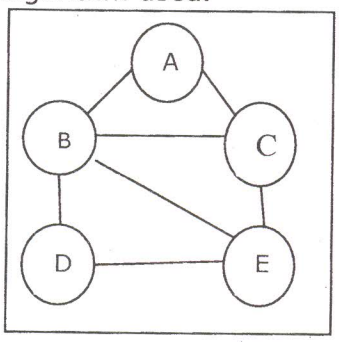
(c) For the graph given below, find shortest path between every pair of vertices: 4



Q.6 (a) Following algorithm is proposed to find the shortest path from node s to node t in a directed graph with some negative edges (but no negative cycles): 2

Add a large constant to each weight so that all weights become positive. Then run Dijkstra's algorithm to find shortest path from s to all other vertices. Return the path from s to t obtained in this process.
Will this work? Either prove that this method will work correctly or give a counter example.

(b) Use backtracking technique to color the following graph. Show the relevant portion of the state space tree that will be generated by the backtracking algorithm used. 4



(c) A greedy approach to CPU scheduling problem for non-preemptive strategy leads to Shortest Job First algorithm (jobs are arranged in increasing order of execution time). Prove that it gives minimum average waiting time. 4

---------- X ---------- X ----------