COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra.)
SHIVAJI NAGAR, PUNE - 411 005

END Semester Examination

(CT-09002) Design and Analysis of Algorithms

Course: B.Tech
Branch: Computer Engineering
Semester: Sem V
Max.Marks:60
Year: 2014-2015
Date:
Duration: 3hrs
Time:-.

Instructions:

MIS No. | | | | | | | | | |

1. Figures to the right indicate the full marks.
2. Mobile phones and programmable calculators are strictly prohibited.
3. Writing anything on question paper is not allowed.
4. Exchange/Sharing of anything like stationery, calculator is not allowed.
5. Assume suitable data if necessary.
6. Write your MIS Number on Question Paper

			Marks
Q.1	a)	What is the time complexity of each of the following operations on an array A of size n of non-zero integers? Justify your answer briefly. i. Find maximum or minimum element from the array A. ii. Find second largest element from array A. iii. Suppose a sorting algorithm takes 1 second to sort 1000 items on your local machine. What is the time complexity involved to sort 10,000 items if you believe that the algorithm takes time roughly proportional to i)n^2 ii) n*logn ?	06
	b)	Show that the following recurrence: $T(n) = 2T(\lfloor \sqrt{n} \rfloor) + lg\ n$ is O(lg n lg lgn) [Use substitution method for solving recurrence] ?	04
Q.2	a)	What is a binary search tree(BST)? Discuss an algorithm of deleting a node from BST? Apply the following deletion operation on the BST constructed for the set of nodes :{55, 33,88,11,22,100,77,66,69,44,99}. i) Delete node 22 ii) Delete node 55 iii) Delete node 100 Analyze the time complexity of deletion algorithm?	08
	b)	Build a min-heap for the following data structure : (7,6,8,4,2,3,1)	02

Q3 **a)** Explain rotation and types of rotations in Red-Black trees? Build a Red-Black tree for the following input [show stepwise each insertion operation, balancing operation and color each node appropriately?] 05

(7, 5, 9, 12, 8, 11, 10)

(c) A complete undirected weighted graph G is given on the vertex set {0, 1, …, n-1} for any fixed n. Determine the cost of the minimum spanning tree obtained using Prim's Algorithm for the graph G if the weight of the edge (u, v) is $((u-1)^2 + v^2)$ for all u, v? Justify your answer. 05

Q.4 (a) Using the dynamic programming design technique, find the optimal tour for the graph specified by the following adjacency matrix. 04

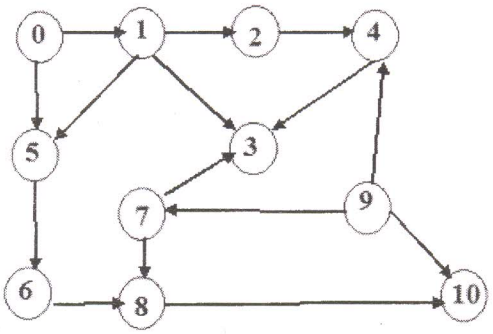
$$G = \begin{array}{c} \begin{matrix} A & B & C & D \end{matrix} \\ \begin{bmatrix} \infty & 12 & 5 & 7 \\ 11 & \infty & 13 & 6 \\ 4 & 9 & \infty & 18 \\ 10 & 3 & 2 & \infty \end{bmatrix} \end{array}$$

(b) Solve the **greedy** knapsack problem for the following data: 04

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)

02

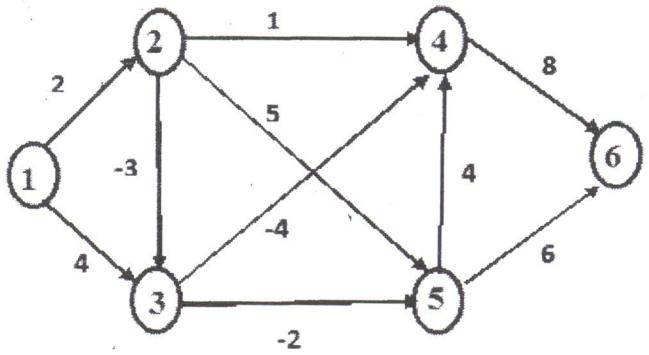
(c) Obtain topological sort order for the following DAG :



Q5 (a) Compute the prefix function $\prod$ for the given pattern. Determine the occurrences of pattern P in the text T by specifying the shift value, if pattern is found. 04

Pattern P : aabab
Text T : aaababaabaababaab

(b) Using Bellman and Ford algorithm, find the shortest path from node 1 to every other node in the graph? The graph consisting of negative edges but no negative cycles? 04



(c) What is the chromatic number of a cycle graph and wheel graph with odd and even number of vertices ? 02

Q.6 (a) What is amortized analysis? Discuss the three different approaches of amortized analysis, with an example of each? 05

OR

(a) Specify the properties to be satisfied by a language $L \subseteq \{0,1\}^*$ to be NP-complete and NP-hard. 05

Prove that :

If any NP-complete problem is polynomial-time solvable then P = NP.

(b) Give the analysis of the hiring problem using indicator random variables? 05

OR

(b) Discuss the three classes of problem : P , NP and NPC. Explain each with the help of an example ? 05