No. of Printed Pages : 4

MCS-031

MCA (Revised)

Term-End Examination

00995

June, 2018

MCS-031 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 hours *Maximum Marks : 100*

Note : *Question no. 1 is* ***compulsory****. Attempt any* ***three*** *questions from the rest.*

1. (a) Multiply the following n-digit decimal numbers, x and y, using the Karatsuba technique, where

$x = x_{n-1}, x_{n-2}, \ldots, x_0$

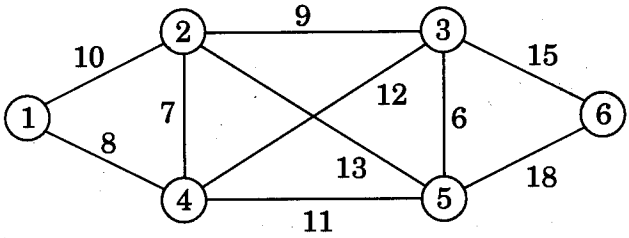
$y = y_{n-1}, y_{n-2}, \ldots, y_0$. 7

(b) Sort the following sequence in ascending order using Insertion sort : 5

{28, 13, 12, 25, 38, 11, 15, 9, 36}

(c) Differentiate between Asymptotic notations, O (Big "oh"), Ω (Big "omega") and Θ (Theta) notations. 6

(d) Define Minimum Cost Spanning Tree (MCST). Find the MCST using the Prim's algorithm for the following graph : 6



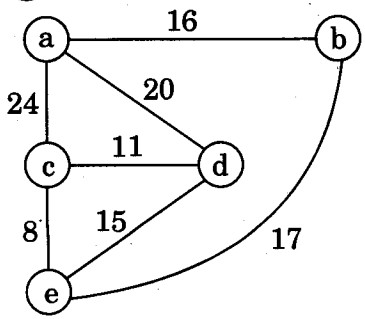
(e) Construct a Deterministic Finite Automata (DFA) for the following Regular Expression : 5

$$(0 + 1)^* (00 + 11) (0 + 1)^*$$

(f) Write the Recursive and Iterative algorithm to compute the Greatest Common Divisor (GCD) of two numbers X and Y. 5

(g) Explain the V. Strassen's matrix multiplication method of multiplying two matrices of size $(n \times n)$. Show that its running time is $O(n \log_2 7)$. 6

2. (a) Write the Dijkstra's algorithm for shortest path. Apply the same for the following graph, to find the shortest path from node (a) : 8



(b) Explain the Chomsky's classification of grammars. 6

(c) Differentiate between the Greedy and Dynamic programming approaches to solve a problem. List 3 problems which use these approaches, respectively. 6

3. (a) Write the Context-Free Grammar (CFG) for the following language : 6

(i) $L = \{a^n b^m c^m d^n \mid m, n \geq 1\}$

(ii) $L = \{\omega d \omega^R \mid \omega \in \{a, b\}^*$ and ω^R is the reverse of $\omega\}$.

(b) Explain the 0/1 Knapsack problem. Solve the following 0/1 Knapsack problem :

Given number of objects n = 6

Capacity of Knapsack (M) = 12

$(p_1, p_2, ..., p_6) = (1, 6, 18, 22, 28, 43)$

and $(w_1, w_2, ..., w_6) = (1, 2, 5, 6, 7, 10)$.

Where p_i's and w_i's are the profits and weights of the corresponding objects. 7

(c) Apply the dynamic programming method to solve the following chain-matrix-multiplication : 7

(M_1, M_2, M_3, M_4) with dimensions $(15 \times 6, 6 \times 50, 50 \times 9, 9 \times 12)$

4. (a) Solve the following recurrence using the Master method : 6

(i) $T(n) = 3T\left(\frac{n}{4}\right) + n \log n$

(ii) $T(n) = 2T\left(\frac{n}{2}\right) + n$

(b) Find the best case and worst case time complexity of Quick Sort by writing their recurrence relation. 7

(c) Define Turing Machine (TM). Design TM for the language

$L = \{a^n b^n \mid n \geq 1\}$. 7

5. (a) Differentiate between P, NP, NP-Complete and NP-Hard problem. 8

(b) Define Push-Down Automata (PDA). Design a PDA that accepts the language EVEN PALINDROME over $\Sigma = \{a, b\}$. 6

(c) Write short notes on the following : 6

(i) Halting Problem of TM

(ii) Post Correspondence Problem (PCP)