No. of Printed Pages : 4

MCS-031

MCA (Revised)

Term-End Examination

December, 2013

12105

MCS-031 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 hours *Maximum Marks : 100*

Note : *Question* ***No. 1*** *is* ***compulsory****. Attempt* ***any three*** *from the remaining questions.*

1. (a) What is an algorithm ? Explain characteristics of an algorithm with the help of an example. **6**

(b) What is big O notation ? Find O ($f(x)$) for $f(x) = 3x^3 + 2x^2 + 4x$. **4**

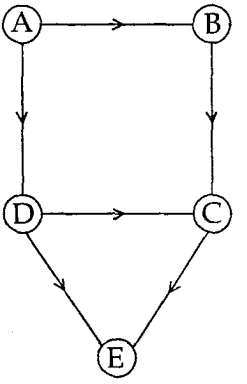
(c) What is dynamic programming ? How it is different from greedy technique of solving problems ? Also give a greedy solution for the change making problem, considering the denominations : **8**

{500, 200, 100, 50, 10, 5, 2, 1}

(d) Sort the following list using insertion sort. Show all intermediate stages while sorting : **6**

70, 40, 60, 80, 20, 6

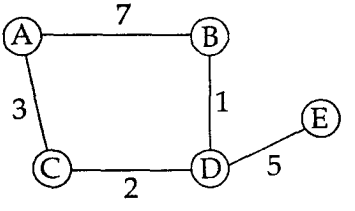
(e) Write algorithm of Depth-First Search and trace how Depth First-Search traverses the graph given below, when starting node is A : 6



(f) What is a heap ? Explain how a heap is built, using a simple example. 5

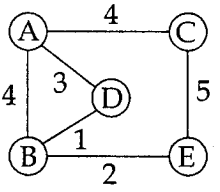
(g) List and explain any five properties of regular expressions. 5

2. (a) What is minimum spanning tree ? Write Prim's algorithm for finding minimum spanning tree and evaluate its time complexity. Also find minimum spanning tree of the following graph, using Prim's algorithm : 10



(b) What is binary search ? Explain its time complexity. Consider an array A = [2, 5, 9, 20, 25, 30, 60]. Find the average number of comparisons made by binary search for successful search in array A's and 'unsuccessful search in array A'. **10**

3. (a) What is Single - Source Shortest Path Problem (SSSPP) ? Explain Dijkstra's algorithm for SSSPP. Also find the minimum distances of all the nodes from node A, which is taken as the source node for the following graph : **10**



(b) Explain the meaning and the language described by each of the following expression : **6**

(i) $(a + b)^*$

(ii) $ab^*a^*(a + b)$

(iii) $ab\ (a + b)^*$

Where '*' is Kleene closure.

(c) Explain NP-hard problem with an example. **4**

4. (a) What is a Turing Machine ? Design a Turing Machine that recognizes language L of all strings over $\Sigma = \{a, b\}$ such that : $a^n b^n$, $n \geq 1$. 8

(b) What is topological sort ? Explain its application with an example. 6

(c) What is Quick Sort ? Explain/analyse the average case time complexity of Quick Sort. 6

5. (a) Draw the recursion tree for the following, also write the following in θ notations 4

$$T(n) = 4T\left(\frac{n}{2}\right) + n^2$$

(b) Prove that the Halting Problem is undecidable. 6

(c) Explain the following problems, together with their respective significance. 10

(i) Undecidable problem

(ii) NP-complete problem