

## MCA (Revised)

## Term-End Examination

10423

June, 2015

MCS-031 : DESIGN AND ANALYSIS OF  
ALGORITHMS

Time : 3 hours

Maximum Marks : 100

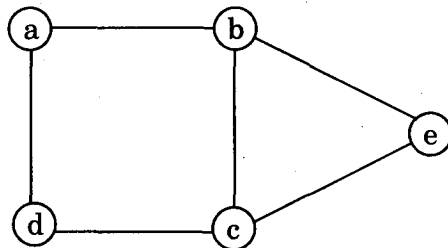
**Note :** Question number 1 is **compulsory**. Attempt any **three** questions from the rest.

1. (a) (i) Solve the recurrence equation  
 $T(n) = 2.T(n/4) + n^3$  for  $n > 1$  and  $T(1) = 1$ .
- (ii) Obtain the asymptotic upper bound  
for  $f(n) = (6n^2 - 5n + 2)^2$ . 4+4
- (b) A binomial coefficient is defined by the following recurrence relation :  
 $C(n, 0) = 1$  and  $C(n, n) = 1$  for  $n > 0$ .  
 $C(n, k) = C(n - 1, k) + C(n - 1, k - 1)$  for  
 $n > k > 0$ .
- (i) Draw the recursion tree for  $C(6, 4)$ . 4
- (ii) Write a recursive function to generate  $C(n, k)$ . 4
- (iii) Give an algorithm based on Dynamic Programming to solve  $C(n, k)$ . 4
- (iv) Compare the time and space requirements of the algorithm in part (iii). 4

- (c) (i) You are given currency of denominations {500, 100, 50, 20, 10, 5}. Give a greedy algorithm to obtain the minimum number of denomination for any amount which is a multiple of 5. 6
- (ii) Write a procedure to merge two sorted arrays. Analyze the running time of your algorithm. 6
- (d) Is the following sequence a heap ? If not, convert it into a heap. 4

$\langle 10, 5, 3, 8, 6, 1, 7 \rangle$

2. (a) (i) Write an algorithm to find the  $i^{\text{th}}$  smallest element in  $O(n)$  time. 6
- (ii) Illustrate the working of your algorithm on the input  $\langle 1, 5, 8, 6, 13, 4, 3 \rangle$  to find the  $4^{\text{th}}$  smallest element. 4
- (b) (i) Define a BFS tree. Give the breadth first traversal for the undirected graph given below, starting from vertex 'a'. 6



- (ii) Give any two applications of Depth first search. 4

3. (a) (i) Explain Dijkstra's shortest path algorithm. 6
- (ii) Find the shortest path in the following graph represented by adjacency matrix, from vertex 'a'. 4

	a	b	c	d	e
a	-	1	15	-	5
b	1	-	2	-	10
c	15	2	-	8	6
d	-	-	8	-	3
e	5	10	6	3	-

- (b) (i) Explain the principle of greedy algorithm. 4
- (ii) Explain Prim's algorithm for Minimum Spanning Tree, and obtain the MST for the graph in question 3 (a) (ii). 6
4. (a) (i) Define Finite Automata and Regular Expression. 4
- (ii) Write Regular Expression for the following: 6
- (1)  $L = (01)^n, n \geq 1.$
- (2) Strings that start with '1' and end with '0'.

- (b) Obtain the CFG for the following : 10
- (i) Strings of matching parenthesis.
  - (ii) Expression of the form  $E = (E + E) * E$ .  
The expression contains : parenthesis,  
operators : +, -, \* and /.
5. (a) Explain the class-P, NP and NP-complete problems. 6
- (b) (i) What is undecidability ? Give an example for an undecidable problem. 5
  - (ii) Design a polynomial time reduction from the vertex cover problem to the clique problem. 9
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