

LIB [7/12/11 (Mon)]

Printed Pages : 4

MCA-312

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 7309

Roll No.

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**M.C.A.**

**(Semester-III) Theory Examination, 2011-12**

**DESIGN & ANALYSIS OF ALGORITHMS**

*Time : 3 Hours*

*[Total Marks : 100*

*Note : Attempt questions from each Section as indicated.*

**Section-A**

1. Attempt *all* parts : 2×10=20

(a) Why don't we allow a minimum degree of  $t=1$  in B-Tree ?

(b) Use mathematical induction to show that when  $n$  is an exact power of 2, the solution of the recurrence :

$$T(n) = \begin{cases} 2 & \text{if } n = 2, \\ 2T(n/2) + n, & \text{if } n = 2^k, \text{ for } k > 1 \end{cases}$$

is  $T(n) = n \log n$ .

(c) Write down the difference between Dynamic Programming and Divide and Conquer Approach.

- (d) Differentiate between average analysis and amortized analysis.
- (e) Prove statement : Subpaths of shortest paths are shortest paths.
- (f) Define NP problems.
- (g) Solve the 4-queen problem using backtracking technique and find.
- (h) Define Approximation Algorithm.
- (i) Disjktra algorithm and Bellmen-Ford algorithm both are single source shortest path algorithm, but both of them differ from each other. Why ?
- (j) Define randomized algorithm.

### Section-B

2. Attempt any *three* parts : 10×3=30

(a) (i) Prove that the height of red black tree is  $2 \log_2(n+1)$ .

(ii) Solve the following recurrences by recursion tree method :

(1)  $T(n) = T(\alpha_n) + T((1-\alpha)n) + c_n$ , where  $\alpha$  is a constant in the range  $0 < \alpha < 1$  and  $c > 0$  is also a constant.

(2)  $T(n) = T(n-a) + T(a) + c_n$ , where  $a \geq 1$  and  $c > 0$  are constants.

- (b) (i) What is the total cost of executing  $n$  of the stack operations PUSH, POP and MULTIPOP, assuming that the stack begins with  $s_0$  objects and finishes with  $s_n$  objects.
- (ii) Define Binomial tree. Prove all properties of Binomial tree.
- (c) What are the basic steps in augmenting ? Augment a BST.
- (d) Discuss the weighted union procedure for data structure for disjoint set and how to improve its worst case complexity.
- (e) (i) Find all solutions to the equation :  

$$35x \equiv 10 \pmod{50}.$$
- (ii) Explain of B-Tree properties.

### Section-C

Attempt any five questions:

10×5=50

3. In a flow network let  $G=(V, E)$  with flow  $f$ ,  $G_f$  is the residual network of  $G$  induced by  $f$ , and let  $f_r$  be a flow in  $G_f$ . Let  $f'=f+f_r$ , that is for each pair  $u, v, \in V$ ,  $f'(u, v)=f(u, v)+f_r(u, v)$ , then show that  $f'$  is a flow in  $G$  with value  $|f'|=|f|+|f_r|$ .

4. Explain the difference between depth first and breadth first searches.
5. Determine the LCS of  $(1, 0, 0, 1, 0, 1, 0, 1)$  and  $(0, 1, 0, 1, 1, 0, 1, 1, 0)$ .
6. Construct the string matching automation algorithm for the pattern  $P = aabab$  and illustrate its operation on the text string:  
 $T = aaababaabaababaab$
7. Apply the Greedy method to solve the following instance of Knapsack problem. Item  $n = 7$  Knapsack capacity  $m = 15$ ,  $(P_1, P_2, \dots, P_7) = (10, 5, 15, 7, 6, 18, 3)$  and  $(w_1, w_2, \dots, w_7) = (2, 3, 5, 7, 1, 4, 1)$ .
8. Write an algorithm for a given number  $n$  to generate the  $n$ th number of the Fibonacci sequence.
9. Explain the pros and cons of the empirical analysis of algorithm.