



Name : .....  
 Roll No. : .....  
 Invigilator's Signature : .....

**CS/B. Tech (CSE) / SEM-5/CS-503/2011-12**

**2011**

**DESIGN AND ANALYSIS OF ALGORITHMS**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
 as far as practicable.*

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for the following :  $10 \times 1 = 10$ 
  - i) The running time of an algorithm  $T(n)$ , where ' $n$ ' is the input size is given by  $T(n) = 8T(n/2) + qn$ , if  $n > 1$  and  $T(n) = p$ , if  $n = 1$ , where  $p$  and  $q$  are constants. The order of this algorithms is
 

a) $\Theta(n^2)$	b) $\Theta(n^n)$
c) $\Theta(n^3)$	d) $\Theta(n^{\log n})$
  - ii) Which of the following algorithms solves the All-Pair Shortest Path problem ?
 

a) Dijkstra's	b) Floyd's Warshall's
c) Prim's	d) Kruskal's.

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**GROUP – B**

**( Short Answer Type Questions )**

Write short notes on any *three* of the following.

$$3 \times 5 = 15$$

2. Find the best and worst case time complexity for merge sort.
3. Solve the following Knapsack problem with the given conditions :  $n = 3$  weight of the Knapsack  $M = 20$ , Profits  $(p_1, p_2, p_3) = (25, 24, 15)$  and weight  $(w_1, w_2, w_3) = (18, 15, 10)$ .
4. Differentiate between divide-and-conquer and dynamic programming.
5. Solve the following recurrence relation using generating function :  
$$a_n = 6a_{n-1} - 11a_{n-2} + 6a_{n-3} \text{ for } n \geq 3 \text{ with initial condition } a_0 = 1, a_1 = -1 \text{ and } a_2 = 1.$$
6. Define different asymptotic notation ( $O$ ,  $\Theta$ ,  $\Omega$ ) with suitable examples.

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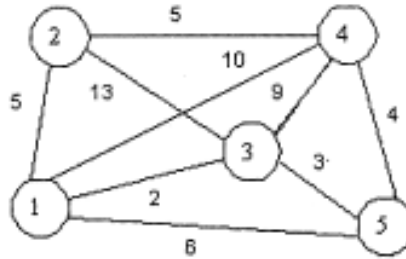
**GROUP – C****( Long Answer Type Questions )**Answer any *three* of the following.  $3 \times 15 = 45$ 

7. Answer the following questions with respect to divide-and-conquer :
- Discuss the procedure for Strassen's matrix multiplication to evaluate the product of 'n' matrices. Find the resulting recurrence relation for the same and analyze its time-complexity. Is this method an improvement over the conventional matrix multiplication method ? If so, why ?  $7 + 1 + 2 + 2$
  - The solution of recursive MAXMIN problem is based on some assumptions Briefly state the assumptions and its effect on the algorithm in comparison the reality. 3
8. Find the optimal parenthesization of a matrix-chain product whose sequence of dimensions is  $\langle 5, 10, 3, 12, 5, 50, \text{ and } 6 \rangle$ . 5
- Give an algorithm for the above procedure. 3
  - Analyze its complexity. 2
  - What is the union-find algorithm ? Explain with an example. 5

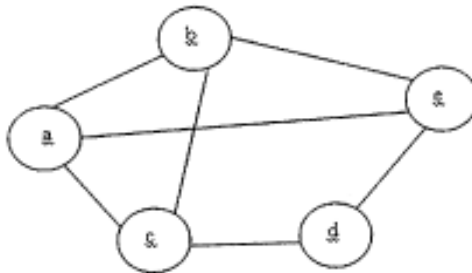
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9. a) Solve the single source shortest path problem for the following graph considering '1' as the source vertex using Dijkstra's algorithm.



- b) Prove that the time complexity of Dijkstra's algorithm is  $O(n^2)$ .
- c) Describe the Floyd's algorithm for all pair shortest path problem. Prove that the time complexity of the algorithm is cubic.  $5 + 3 + 7$
10. a) Describe the Breadth first search algorithm of a given graph and explain its time complexity.
- b) Explain the graph coloring problem and write the algorithm.
- c) Apply backtracking technique to solve the 3-colouring problem for the following graph



$$6 + 6 + 3$$

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11. a) What is Non-deterministic algorithm ? Differentiate between Deterministic and Non-Deterministic algorithm.
- b) Write algorithm to sort an ; array using Deterministic and Non-Deterministic technique. Compare the two techniques and show that the time complexity of non-deterministic technique is better than Deterministic.
- c) Describe  $P$  class, NP class, NP hard and NP complete class and describe their relationships.  $3 + (6 + 2) + 4$
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