*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 $T(n) = 8\ T(n/2) + qn$, 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.

iii) The minimum number of colors needed to color a graph having $n > 3$ vertices and 2 edges is

a) 2 b) 3

c) 4 d) 1.

iv) The diagonal of the adjacency matrix of a graph with a self-loop contains only

a) 1 b) 0

c) –1 d) ∞.

v) Which of the following design techniques is used in the quick-sort algorithm ?

a) Dynamic programming b) Back tracking

c) Greedy method d) Divide and conquer.

vi) The average number of comparisons performed by merge sort algorithm in merging '2' sorted lists of length '2' is

a) 8/5 b) 11/7

c) 11/6 d) 8/3.

vii) Which of the following is useful in traversing a given graph using BFS ?

a) Stack b) Linked list

c) Array d) Queue.

viii) Which of the following can not be performed recursively ?

a) Binary search b) Quick sort

c) DFS d) None of these.

ix) The time-complexity of TSP is

a) $O\left(n^2\ 2^n\right)$ b) $\Theta\left(n^2\ 2^n\right)$

c) $\Omega\left(n^2\ 2^n\right)$ d) none of these.

x) In which sorting technique, is an element placed in its proper position at each step ?

a) Bubble sort b) Quick sort

c) Merge sort d) Heap sort.

## 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 :

   $a_n = 6a_{n-1} - 11\, a_{n-2} + 6a_{n-3}$ for $n$ > = 3 with initial condition $a_0 = 1, a_1 = -1$ and $a_2 = 1$.

6. Define different asymptotic notation ( O, Θ, Ω ) with suitable examples.

## 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 :

   a) 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

   b) 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

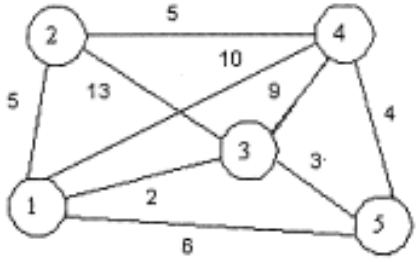
8. Find the optimal parenthesization of a matrix-chain product whose sequence of dimensions is < 5, 10, 3, 12, 5, 50, and 6 >. 5

   a) Give an algorithm for the above procedure. 3

   b) Analyze its complexity. 2

   c) What is the union-find algorithm ? Explain with an example. 5

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



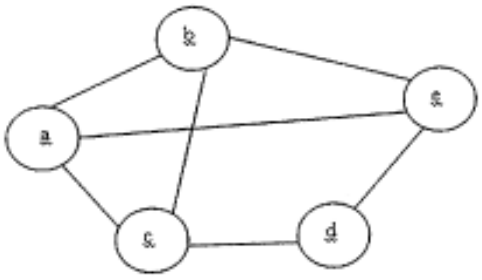

b) Prove that the time complexity of Dijkstra's algorithm is $O(n^2)$.

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

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