Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(CSE)/SEM-5/CS-503/2009-10

2009

DESIGN & 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) Lower bound of any comparison sort is

a) $O(\log n)$ b) $O(n^2)$

c) $O(n \log n)$ d) $O(n^2 \log n)$.

ii) $o(g(n))$ is [Read as small *oh* of $g(n)$ is]

a) Asymptotically loose b) Asymptotically tight

c) same as big *oh* d) none of these.

iii) Kruskal algorithm is a

a) Divide & conquer algorithm

b) Branch and bound algorithm

c) Greedy algorithm

d) Dynamic programming.

iv) Travelling salesman problem belongs to

a) *P* class b) *NP* class

c) *NP*-Hard d) *NP*-complete class.

v) Time complexity of insertion sort is

a) Linear b) Quadratic

c) Cubic d) Exponential.

vi) Which one of the following functions is asymptotically smallest ?

a) 2^n

b) $n^{\log n}$

c) $n^{\sqrt{n}}$

d) $(100)^{(\log n)^{1/3} + (\log \log n)^{2/3}}$.

vii) Which one of the following statements is correct ?

a) If $A \leq_P B$ and $B \in P$ then $A \in P$

b) If $A \leq_P B$ and $A \notin P$ then $B \notin P$

c) If $A \leq_P B$ and $B \leq_P C$ then $A \leq_P C$

d) all of these.

viii) Consider the following statements :

I) *NP* hard problem is a subset of *NP* complete problem.

II) An algorithm to multiply two matrices has complexity $O(n^3)$.

Which of the following alternatives is true.

a) I-True, II-False b) Both true

c) Both False d) I-False, II-True.

ix) Optimal substructure property is exploited by

a) Dynamic progamming b) Greedy method

c) Both (a) & (b) d) None of these.

x) Which of the following approaches is adopted in Divide & Conquer algorithms ?

a) Top-down b) Bottom-up

c) Both (a) & (b) d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. a) Derive the complexity of merge sort.

   b) What is the difference between a 0-1 Knapsack problem and a fractional Knapsack problem ? 4 + 1

3. Write an algorithm for eight queens problem.

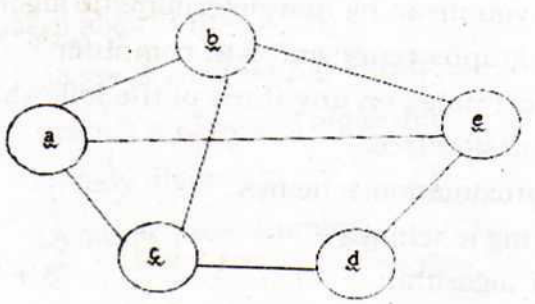
4. State master's theorem and find the time complexity for the following recurrence : 2 + 3

   $T(n) = 2T\left(n^{1/2}\right) + \log n$

5. a) What are the basic characteristics of dynamic programming ?

   b) Write an algorithm for matrix-chain multiplication. 2 + 3

6. Apply backtracking technique to solve the 3-colouring problem for the following graph.



GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Define the classes *P* and *NP*.
   b) Discuss what you mean by polynomial reductions.
   c) Discuss diagrammatically the relations among *P* class, *NP* class, *NP* hard and *NP* complete.
   d) Describe Clique Decision Problem (CDP).
   e) Prove the CDP is NP complete. 2 + 2 + 2 + 2 + 7

8. a) State the general Knapsack problem. Write a greedy algorithm for this problem and derive its time complexity.
   b) Given the weight vector (2, 3, 5, 7, 1, 4, 1) and the profit vector (10, 5, 15, 7, 6, 18, 3) and a Knapsack of capacity 15, find at least three feasible solutions including optimal one for the knapsack problem of seven objects. 10 + 5

9. Write the algorithm of Quick sort. Find the best case, worst case and average case time complexities of this algorithm. 5 + 10

10. a) Explain how do you attempt to solve 15-puzzle problem using branch and bound strategy. Draw a portion of the state space generated by it.
    b) Write an algorithm for finding the minimum spanning tree of a graph. Discuss its time complexity. 8 + 7

11. a) What do you mean by non-deterministic algorithms ?
    b) How are graphs represented in computer ?
    c) Write short notes on any three of the following :
       i) Recursion tree
       ii) Approximation schemes
       iii) Turing machines
       iv) FFT algorithm. 3 + 3 + (3 × 3)