Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(CSE)(N)/SEM-5/CS-501/2012-13

2012

DESIGN AND ANALYSIS OF ALGORITHM

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 Big O Notation of the expression $f(n) = n \log_2 n + n^2 + e^{\log_2 n}$ is

   a) $O(n \log_2 n)$ b) $O(n^2)$

   c) $O(n)$ d) $O(e^{\log_2 n})$.

   ii) Traveling Salesman Problem is

   a) NP Hard b) NP

   c) NP Complete d) none of these.

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

   a) asymptotically loose b) asymptotically tight

   c) same as Big Oh d) None of these.

   iv) Complexity the recurrence relation $T(n) = 8T\left(\frac{n}{2}\right) + n^2$ is

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

   c) $O(\log_2 n)$ d) $O(n^3)$.

v) Kruskal's Algorithm is an example of
   a) Dynamic Programming
   b) Greedy Method
   c) Both (a) and (b)
   d) None of these.

vi) Complexity of Tower of Hanoi problem is
   a) $O(n)$ b) $O(n^2)$
   c) $O(2^n)$ d) None of these.

vii) Binary Search algorithm can't be applied to
   a) Sorted linked lists b) Sorted binary trees
   c) Sorted linear array d) Sorted integer array.

viii) The technique of Pruning is used in
   a) Branch and Bound
   b) Backtracking
   c) Divide and Conquer
   d) Dynamic Programming.

ix) The tight bound for building a max heap is
   a) $O(n)$ b) $O(\log_2 n)$
   c) $O(n.\log_2 n)$ d) None of these.

x) The worst case running time of a quick sort algorithm is
   a) $O(n^2)$ b) $O(n.\log_2 n)$
   c) $O(n)$ d) $O(\log_2 n)$.

GROUP – B

(Short Answer Type Questions)

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

2. Find the best and worst case time complexity of quick sort.

3. State Master's theorem and find out the time complexity for the recurrence $T(n) = T(2n/3) + 1$.

4. Find the optimal solution using greedy criteria for a knapsack having capacity 100 kg for the following list of items having values and weights as shown in the table.

Item	Value	Weight
I_1	10	15
I_2	20	25
I_3	30	35
I_4	40	45
I_5	50	55

5. Compare and contrast BFS *vs* DFS.

6. Use the recursion tree to give an asymptotically tight solution to the recursion $T(n) = T(n - a) + T(a) + cn$ where $a >= 1$ and $c > 0$ are constant.

GROUP – C
(Long Answer Type Questions)

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

7. Suppose we have a recurrence relation $T(n) = aT\left(\frac{n}{b}\right) + f(n)$, show that the following are true.

   a) If $af\left(\frac{n}{b}\right) = kf(n)$ for some constant $k < 1$., then $T(n) = O(f(n))$. 5

   b) If $af\left(\frac{n}{b}\right) = kf(n)$ for some constant $k > 1$, then $T(n) = O(n^{\log_b a})$. 5

   c) If $af\left(\frac{n}{b}\right) = kf(n)$ for some constant $k = 1$, the $T(n) = O(n \log_b a)$. 5

8. a) Discuss the Bellman-Ford's algorithm for single-source shortest path problem. 7

   b) Prove that the time-complexity of the algorithm is $\Theta(VE)$. 3

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

9. a) What are the characteristics of greedy algorithm ? 3

   b) Discuss the activity selection problem for job sequencing with an example. Prove that the time complexity of the algorithm is $O(n \log n)$. 5 + 3

   c) Differentiate between greedy method and dynamic programming. 4

10. a) Explain the max-flow min-cut theorem with an example. 6

    b) Compare and contrast BFS ans DFS. State the 0/1 knapsack problem. 3 + 2

    c) Describe the Clique Decision Problem (CDP). Prove that the CDP is NP complete. 2 + 2

11. Write short notes on any *three* of the following : 3 × 5

    a) Asymptotic Notations

    b) Strassen's Matrix Multiplication

    c) Approximation Algorithms

    d) Knuth-Morris-Pratt Algorithm

    e) Recursion Trees.