

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech/CSE(O)/SEM-5/CS-503/2012-13**

**2012**

**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) Time complexity for recurrence relation  $T(n) = 2T(\sqrt{n}) + 1$  is
    - a)  $\Theta(\log n)$
    - b)  $\Theta(n^2)$
    - c)  $\Theta(n \log n)$
    - d)  $\Theta(n)$ .
  - ii) Time complexity for the Floyd's algorithm to find all pairs of shortest path of a graph  $G$  with  $V$  vertices and  $E$  edges using dynamic programming method is
    - a)  $O(V^2)$
    - b)  $O(E^2)$
    - c)  $O(V^3)$
    - d)  $O(E^3)$ .
  - iii)  $\Omega$ -notation provides an asymptotic
    - a) upper Bound
    - b) lower Bound
    - c) one that is sandwiched between the two bounds
    - d) none of these.

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- iv) The Big O notation of the expression  $f(n) = n \log n + n^2 + e^{\log n}$  is
  - a)  $O(n)$
  - b)  $O(n^2)$
  - c)  $O(n \log n)$
  - d)  $O(e^{\log n})$ .
- v) Travelling salesman problem belongs to
  - a) P class
  - b) NP class
  - c) NP-hard
  - d) NP-complete class
- vi) Tight bound for building a max heap algorithm will be
  - a)  $O(\log n)$
  - b)  $O(n^2)$
  - c)  $O(n \log n)$
  - d)  $O(n)$ .
- vii) The node removal of which makes a graph disconnected is called
  - a) Pendant vertex
  - b) Bridge
  - c) Articulation point
  - d) Coloured vertex.
- viii) The diagonal of the adjacency matrix of a graph with a self loop contains
  - a) 1
  - b) 0
  - c) -1
  - d) both (a) and (b).
- ix) Lower bound of time complexity for any comparison based sorting algorithm is
  - a)  $O(n)$
  - b)  $O(n \log n)$
  - c)  $O(\log n)$
  - d)  $O(n^2)$ .
- x) Time complexity of non-deterministic algorithm is always
  - a) less than deterministic algorithm
  - b) greater than deterministic algorithm
  - c) equal to deterministic algorithm
  - d) none of these.

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**GROUP – B****( Short Answer Type Questions )**Answer any *three* of the following.  $3 \times 5 = 15$ 

2. What is heap property ? Write an algorithm for deletion of the maximum element from a heap.
3. Use a recursion tree to give an asymptotically tight solution to the recurrence  $T(n) = T(n - a) + T(a) + cn$  where  $a \geq 1$  and  $c > 0$  are constants.
4. Find out the worst case time complexity of merge sort.
5. Derive the time complexity of Tower of Hanoi problem.
6. Write an algorithm to compute  $x^n$  with  $O(\log n)$  complexity.

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

7. a) Find the minimum number of operations required for the following matrix chain multiplication using dynamic programming :

$$A ( 10 \times 20 ) * B ( 20 \times 50 ) * C ( 50 \times 1 ) * D ( 1 \times 100 )$$

- b) Write an algorithm of eight queen problem.
- c) What is tail recursion ? Give an example.  $5 + 5 + 5$

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8. a) 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 table.

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

- b) What do you mean by Dynamic Programming ? What is the difference between dynamic programming and greedy method ? 10 + 2 + 3
9. 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 ?
- b) What is union-find algorithm ? 7 + 2 + 2 + 4
10. a) Design a backtracking algorithm to find all the Hamiltonian cycles in a Hamiltonian graph.
- b) Discuss activity selection problem for job sequencing.
- c) Write the travelling salesman problem with an algorithm. 5 + 5 + 5

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