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Paper Code : IT-501

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) The functions f & g are non-negative functions. The function $f(n) = O(g(n))$ if and only if there exist positive constants c & n_0 such that ..... for all n, $n \geq n_0$.

a) $f(n) \leq C^* g(n)$

b) $f(n) = C^* g(n)$

c) $f(n) \geq C^* g(n)$

d) $f(n) ! = C^* g(n)$.

ii) Which of the following shows the correct relationship among some of the more common computing times on algorithms ?

a) $O(\log n) < O(n) < O(n^* \log n) < O(2^n) < O(n^2)$

b) $O(n) < O(\log n) < O(n^* \log n) < O(2^n) < O(n^2)$

c) $O(n) < O(\log n) < O(n^* \log n) < O(n^2) < O(2^n)$

d) $O(\log n) < O(n) < O(n^* \log n) < O(n^2) < O(2^n)$.

iii) The recurrence relation $T(n) = 2T\left(\frac{n}{2}\right) + n$ is satisfied by

a) $T(n) = O(n^2)$

b) $T(n) = O(\log(\log n))$

c) $T(n) = O(n \log n)$

d) $T(n) = O(n^2 \log n)$.

iv) What is the type of the algorithm used in solving the 8 Queens problem ?

a) Greedy

b) Dynamic

c) Branch and Bound

d) Backtracking.

v) Which of the sorting algorithm does not have a worst case running time of $O(n^2)$?

a) Selection sort

b) Insertion sort

c) Merge sort

d) Quick sort.

vi) The running time of quick sort depends heavily on the selection of

a) No. of inputs

b) Size of elements

c) Arrangement of elements in array

d) Pivot element.

vii) Which is not a feasible solution for the following job sequence problem ?

Item :	1	2	3	4
Profit :	100	10	15	27
Deadline :	2	1	2	1

a) (1, 4) b) (2, 4)

c) (4, 3) d) (1, 2).

viii) The running time of Kruskal's algorithm for MST is

a) $O(E)$ b) $O(V)$

c) $O(E \log V)$ d) All of these.

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ix) Find an optimal parenthesization of a matrix chain product whose sequence of dimension s is

$< 5, 4, 6, 2, 7 >$

a) 156 b) 154

c) 158 d) 157.

x) The running time of Strassen's algorithm for matrix multiplication is

a) $\theta(n)$ b) $\theta(n^3)$

c) $\theta(n^2)$ d) $\theta(n^{2.81})$.

GROUP – B

(Short Answer Type Questions)

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

2. Discuss Job sequencing problem with deadline with an example.

3. Write down the differences between : $2 \times 2\frac{1}{2}$

a) Prim's and Kruskal's algorithm

b) fractional and 0/1 Knapsack problem.

4. Find the best and worst case complexities of Quick sort.

5. Define different asymptotic notations with graphical representation.

6. What is the union-find algorithm ? Explain with an example.

GROUP – C

(Long Answer Type Questions)

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

7. a) What are the basic characteristics of Dynamic Programming ?

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

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

   c) Find the optimal solution using greedy criteria for a knapsack having capacity 60 kg for the following list of items having values and weights as shown in table

Item	*Weight*	*Profit*
I1	5	30
I2	10	20
I3	20	100
I4	30	90
I5	40	160

5 + 5 + 5

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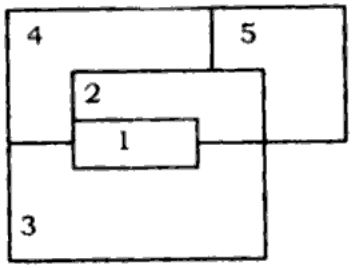
8. a) Consider the following map and convert it into a planar graph and draw the state space tree to colour the graph with four (*R*, *G*, *B* and *Y*) colours.



   b) State Master's theorem and apply it to solve the following recurrence equation :

$$T(n) = 3T\left(\frac{n}{2}\right) + n .$$

   c) What are the basic characteristics of Greedy Approach ? 5 + 5 + 5

9. a) Find out the time complexity of Insertion sort from the algorithm.

   b) Compare between BFS and DFS.

   c) Write the algorithm of Quick sort. Then find the average case time complexity of the algorithm. 5 + 5 + 5

10. a) Write the algorithm for solving *N*-Queen problem.

    b) Discuss Bellman-Ford algorithm for Single Source Shortest path problem.

    c) Explain max-flow min-cut theorem with an example. 5 + 5 + 5

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

a) P, NP, NPH and NPC class problems

b) 15 puzzle problem

c) Travelling Salesman Problem

d) Approximation Algorithm

e) KMP string matching algorithm.