



**MAULANA ABUL KALAM AZAD UNIVERSITY OF  
TECHNOLOGY, WEST BENGAL**

**Paper Code : CS-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) Which of the following algorithm design techniques is used in quick sort algorithm ?
- a) Dynamic programming
  - b) Backtracking
  - c) Divide and Conquer
  - d) Greedy method.

- 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) Travelling Salesman problem is
- a) NP Hard
  - b) NP
  - c) NP Complete
  - d) None of these.
- iv) Complexity of the recurrence relation  $T(n) = 8T(n/2) + n^2$  is
- a)  $O(n)$
  - b)  $O(n^2)$
  - c)  $O(\log_2 n)$
  - d)  $O(n^3)$ .

- v) The minimum number of colours needed to colour a graph having  $n > 3$  vertices and 2 edges is
- a) 2                                      b) 3  
c) 4                                      d) 1.
- vi) The fractional Knapsack problem can be solved by using
- a) Greedy method  
b) Divide & Conquer Method  
c) Dynamic Programming  
d) None of these.
- vii) Time complexity of Binary Search Algorithm on  $n$  items is
- a)  $O(n)$                                       b)  $O(n^2)$   
c)  $O(n \log n)$                                       d)  $O(\log n)$ .
- viii) The time factor when determining the efficiency of an algorithm is measured by
- a) counting microseconds  
b) counting number of key operations  
c) counting number of statements  
d) counting kilobyte of algorithm.

- ix) The tight bound for building max heap is
- a)  $O(n)$                                       b)  $O(\log n)$   
c)  $O(n \log n)$                                       d) none of these.
- x) BFS of a graph  $G = (V, E)$  has running time
- a)  $O(|V| + |E|)$                                       b)  $O(|V|)$   
c)  $O(|E|)$                                       d) None of these.

**GROUP - B****( Short Answer Type Questions )**

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

- Find the best and worst case complexity of Quick sort.
- State master's theorem and find the time complexity for the following recurrence :  $T(n) = 2T(n^{\frac{1}{2}}) + \log n$
- 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.

5. Solve the following recurrence relation using generating function  $a_n = 6a_{n-1} - 11a_{n-2} + 6a_{n-3}$  for  $n \geq 3$  with initial condition  $a_0 = 1$ ,  $a_1 = -1$  and  $a_2 = 1$ .
6. Discuss Job Sequencing with Deadlines with an example.

**GROUP - C****( Long Answer Type Questions )**

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

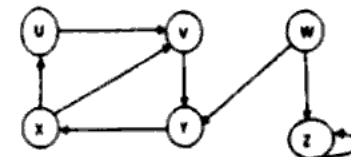
7. a) Consider the evaluation of the product of  $n$  matrices :

$$M = M_1 * M_2 * \dots * M_n.$$

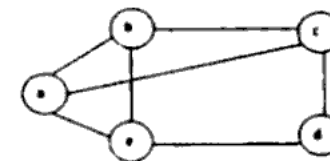
Assuming that the multiplication of a  $p * q$  matrix by a  $q * r$  matrix requires  $pqr$  scalar multiplications. Write a dynamic programming algorithm for ordering this multiplication with minimum cost. Explain the algorithm in brief.

- b) Critically comment on "Greedy strategy does not work for the 0-1 knapsack problem for all time".

- c) What do you mean by non-deterministic algorithms ? 7 + 5 + 3
8. a) State the general Knapsack problem. Write a greedy algorithm for this problem and derive its time complexity.
- b) Write an algorithm to find out minimum spanning tree of a graph. Discuss its time complexity. (2 + 6) + 7
9. a) Describe the Depth first search algorithm for a given graph and explain its time complexity.



- b) Write the algorithm for graph colouring problem.
- c) Apply backtracking technique to solve the 3-colouring problem for the following graph.



5 + 5 + 5

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10. 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) Explain the max-flow min-cut theorem with an example.  $2 + 2 + 2 + 2 + 7$
11. Write short notes on any *three* of the following :  $3 \times 5$   
a) Vertex Cover Problem  
b) Recursion Tree  
c) Heap Creation Technique  
d) Approximation schemes  
e) Asymptotic notation.
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