Maulana Abul Kalam Azad University of Technology, West Bengal

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 $3 \times 5 = 15$

2. Find the best and worst case complexity of Quick sort.

3. State master's theorem and find the time complexity for the following recurrence : $T(n) = 2T(n^{\frac{1}{2}}) + \log n$

4. 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 × 15 = 45

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

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

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".

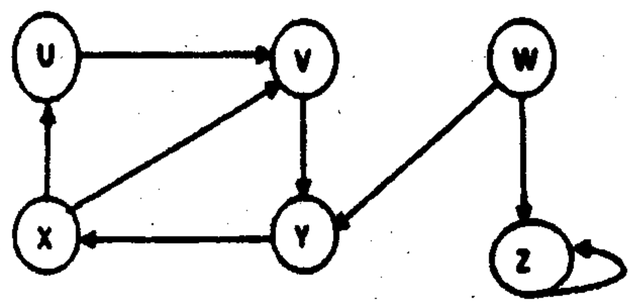
c) What do you mean by non-deterministic algorithms ? 7 + 5 + 3

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.

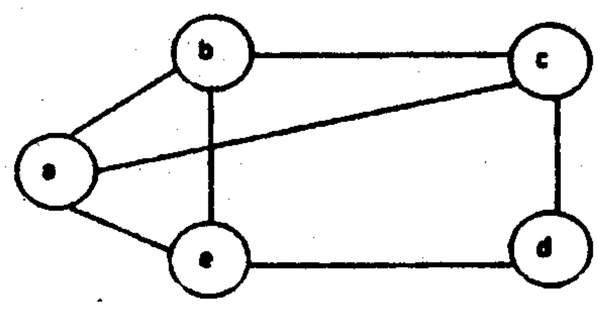
(2 + 6) + 7

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

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 × 5

a) Vertex Cover Problem

b) Recursion Tree

c) Heap Creation Technique

d) Approximation schemes

e) Asymptotic notation.