

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

Paper Code : ES-CS401/PCC-CS 404/PCC-CS404/PCC-CSD 402/PCCS404 Design & Analysis of Algorithms

UPID : 004416

Time Allotted : 3 Hours

Full Marks : 70

*The Figures in the margin indicate full marks.**Candidate are required to give their answers in their own words as far as practicable***Group-A (Very Short Answer Type Question)**1. Answer *any ten* of the following :

[1 x 10 = 10]

- (I) State True/False: Approximation ratio is always less than or equal to 1.
- (II) State True/False: $O(2^n) > O(n^2)$ for $n > 3$.
- (III) What is the time complexity of Job Sequencing with Deadline algorithm using Greedy method?
- (IV) Topological sorting is performed on _____ graph.
- (V) State True/False: if $f(n) = 2n^3 + 4n^2$, then $f(n) = O(n^3)$.
- (VI) What is the time complexity of Prim's algorithm using Greedy method? Number of vertex = V.
- (VII) Best case time complexity of Linear search algorithm is _____.
- (VIII) What is the time complexity of Krushkal's algorithm using Greedy method? Number of edge = E.
- (IX) DFS uses _____ data structure.
- (X) Give two examples of Optimization Problem.
- (XI) The worst case time complexity of Heap sort is _____.
- (XII) Space complexity of Merge sort algorithm is _____.

Group-B (Short Answer Type Question)Answer *any three* of the following :

[5 x 3 = 15]

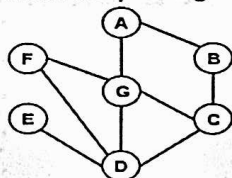
2. (a) Define Little oh (o) notation. [5]
(b) Prove that: $\log n! = O(n \log n)$.
3. (a) Define Optimization Problem and Decision Problem. [5]
(b) Give two examples of Non-Polynomial algorithms.
4. Write down the properties of an algorithm. [5]
5. Find the maximum profit and solution vector of the following fractional knapsack problem: [5]
Profit $P = \{16, 60, 150, 25, 150\}$
Weight $W = \{4, 10, 50, 5, 75\}$
Knapsack Size $m = 44$
6. Find the time complexity of the following recurrence relation using Recursion Tree Method. Clearly mention each steps. [5]

$$T(n) = 3 \times T(n/4) + cn^2$$

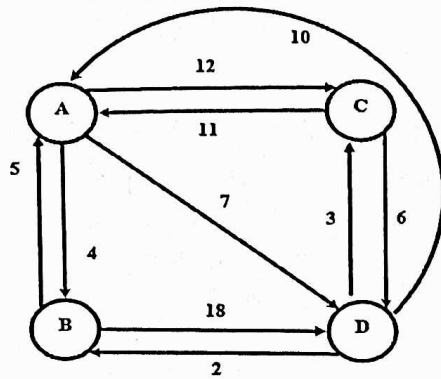
Group-C (Long Answer Type Question)Answer *any three* of the following :

[15 x 3 = 45]

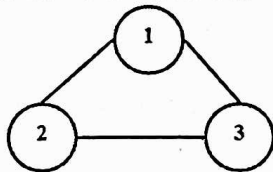
7. (a) Write down an algorithm of Quick Sort. [5]
(b) Derive the best, worst and average case time complexity of your algorithm. [2+3+5]
8. (a) Define Absolute Approximation and Relative Approximation. [4]
(b) What is Vertex Cover Problem? Explain with example. [4]
(c) Write an Approximation algorithm for Vertex Cover problem. [3]
(d) Illustrate your algorithm with the following graph: [4]



9. (a) If $f_1(n) = O(g_1(n))$ and $f_2(n) = O(g_2(n))$, then prove that $f_1(n) + f_2(n) = O(\max(g_1(n), g_2(n)))$. [4]
 (b) If $f_1(n) = O(g_1(n))$ and $f_2(n) = O(g_2(n))$, then prove that $f_1(n) \times f_2(n) = O(g_1(n) \times g_2(n))$. [4]
 (c) Write an algorithm to find the value of x^n , where n is Integral power of 2 In $O(\log n)$ time. [4]
 (d) Show that the time complexity of your algorithm is $O(\log n)$. [3]
10. (a) Write an algorithm to find all Hamiltonian cycles from a graph using backtracking. [4]
 (b) Solve the following Travelling Salesman Problem using Branch and Bound technique. [6]



- (c) What is Bin-Packing problem? [5]
11. (a) Define graph coloring problem. [2]
 (b) Write an algorithm to find all the solutions of graph coloring problem. [5]
 (c) Is your algorithm solvable in polynomial time? Justify. [3]
 (d) Find all the solutions for the following graph using your algorithm. Number of available color is 3. [5]



*** END OF PAPER ***