

**DESIGN & ANALYSIS OF ALGORITHMS  
(INFO 2202)**

**Time Allotted : 3 hrs**

**Full Marks : 70**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

**Group – A  
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) To implement Dijkstra's shortest path algorithm on unweighted graphs so that it runs in linear time, the data structure to be used is  
(a) Queue (b) Stack (c) Heap (d) B-Tree
- (ii)  $\Omega$ -Notation provides an asymptotic  
(a) upper bound  
(b) lower bound  
(c) one that is sandwiched between the two bounds  
(d) none of these.
- (iii) We use dynamic programming approach when  
(a) It provides optimal solution  
(b) The solution has optimal substructure  
(c) The given problem can be reduced to the 3-SAT problem  
(d) It's faster than Greedy.
- (iv) Which type of best first search algorithm was used to predict the closeness of the end of path and its solution?  
(a) Greedy BFS (b) Divide and Conquer  
(c) Heuristic BFS (d) Combinatorial.
- (v) 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.
- (vi)  $\sum_{i=0}^n i^3 = ?$   
(a)  $\theta(n^3)$  (b)  $\theta(n^4)$  (c)  $\theta(n)$  (d)  $\theta(3)$ .

**B.TECH/IT/4<sup>TH</sup> SEM/INFO 2202 (BACKLOG)/2023**

- (vii) Dijkstra's Algorithm is used to solve \_\_\_\_\_ problems.  
(a) all pair shortest path (b) single source shortest path  
(c) network flow (d) sorting
- (viii) The travelling salesman problem can be solved in  
(a) Polynomial time using dynamic programming algorithm  
(b) Polynomial time using branch-and-bound algorithm  
(c) Exponential time using dynamic programming algorithm or branch-and-bound algorithm  
(d) Polynomial time using backtracking algorithm.
- (ix) Which of the following is false in the case of a spanning tree of a graph G?  
(a) It is tree that spans G (b) It is a subgraph of the G  
(c) It includes every vertex of the G (d) It can be either cyclic or acyclic.
- (x) Heap sort is found to be very efficient  
(a) with regard to storage requirement  
(b) in time consumption  
(c) regarding overheads involved  
(d) none of the above.

**Group - B**

2. (a) State master's theorem and find the time complexity for the following recurrences:  
(i)  $T(n) = 2T(n/2) + 1$   
(ii)  $T(n) = 4T(n/3) + n$ .
- (b) Write an algorithm of merge sort and deduce its' time complexity.  
 **$(2 + 2 + 2) + (4 + 2) = 12$**
3. (a) Using divide and conquer method solve the following set of unsorted elements using quicksort algorithm.  
23 11 25 79 66 39 77 89
- (b) Deduce the time complexity of Binary Search.
- (c) Derive the lower bound for comparison sort is  $O(n \lg n)$ .  
 **$6 + 3 + 3 = 12$**

**Group - C**

4. (a) What is backtracking? Using permutation tree explain the graph colouring problem and find out the possible no of solutions.
- (b) Write down Ford-Fulkerson algorithm to enhance the maximum flow of a flow graph.  
 **$(2 + 6) + 4 = 12$**

5. (a) Write an algorithm of DFS and compare it's time complexity with BFS.  
(b) Explain bidirectional search with an example.

**(6 + 2) + 4 = 12**

**Group - D**

6. (a) Write short notes of the following: **(3 × 4) = 12**  
(i) Fractional knapsack problem  
(ii) Travelling salesman problem  
(iii) All pairs shortest path.
7. (a) Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is {25, 15, 20, 10, 30} also show the number of multiplication of different length of matrices.  
(b) What is Spanning Tree? Compare between Prim's and Kruskal's algorithm.

**7 + (2 + 3) = 12**

**Group - E**

8. (a) Write short notes of the following: **(3 × 4) = 12**  
(i) Clique decision problem  
(ii) Approximation algorithm  
(iii) Branch and Bound method.
9. (a) Write a non deterministic algorithm to search an element X on A[1:n] where  $n \geq 1$ .  
(b) Explain how you attempt to solve 15-puzzle problem using Branch and Bound strategy.

**4 + 8 = 12**

