# HALDIA INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION UNDER MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL)

**Paper Code: PCC-CS 502**

**Paper Name: Design and Analysis of Algorithm**

*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)

**Choose the correct alternatives from the followings:** **15 x 1 = 15**

1. (i) Which asymptotic notation is used to represent the upper bound of an algorithm's time complexity?
a) Big-O (O) b) Omega (Ω) c) Theta (Θ) d) Small-o (o)

(ii) Which sorting algorithm has a worst-case time complexity of O(n log n) and is based on a divide-and-conquer strategy?
a) Bubble Sort b) Insertion Sort c) Quick Sort d) Selection Sort

(iii) Which of the following is not a common algorithm design technique?
a) Greedy algorithms b) Divide and conquer c) Dynamic programming d) Circular reasoning

(iv) Which of the following is an example of a space complexity analysis?
a) O(n) b) Ω(n) c) Θ(n) d) O(1)

(v) In Quick Sort, which element is chosen as the pivot?
a) The first element in the array b) The last element in the array
c) A random element from the array d) The middle element in the array

(vi) Binary Search is an example of a Divide and Conquer algorithm used for
a) Sorting a list of integers b) Finding the shortest path in a graph
c) Searching for a specific element in a sorted array d) Matrix multiplication

(vii) What is Branch and Bound used for?
a) Sorting arrays b) Solving optimization problems
c) Drawing graphs d) Generating random numbers

(viii) Which algorithm is commonly used to solve the 15-puzzle problem using Branch and Bound?
a) Breadth-First Search b) Depth-First Search c) A* algorithm d) Quick Sort

(ix) Which algorithm is often employed to solve the Hamiltonian problem using Backtracking?
a) Dijkstra's algorithm b) Kruskal's algorithm c) Prim's algorithm d) Depth-First Search

(x) What is UNION-FIND used for in Disjoint Set data structures?
a) Finding the intersection of two sets b) Combining two sets into one
c) Determining the difference between two sets d) Sorting elements in a set

(xi) Which Greedy Method application involves selecting jobs with associated deadlines to maximize profits?
a) Minimum Spanning Tree b) Huffman coding
c) Job sequencing with deadlines d) Set manipulation

(xii) What does the acronym "DFT" typically stand for in the context of Schemes (a programming language)?
a) Dynamic Function Types b) Delayed Function Transformation
c) Data Flow Transformation d) Discrete Fourier Transform

(xiii) What is the maximum number of edges in an undirected graph with 'n' vertices?
a) n b) n(n-1)/2 c) n(n+1)/2 d)n^2

(xiv) In a directed graph, if there is a path from every vertex to every other vertex, it is called a
a) Connected graph b) Strongly connected graph c) Bipartite graph d) Tree

(xv) Which of the following is not a property of a graph?
a) Nodes b) Edges c) Weights d) Loops

## Group – B
## (Short Answer Type Questions)

**Attempt any three from the followings:** **3 x 5 = 15**

2. (i) Describe the time complexity of the bubble sort algorithm.
(ii) Calculate the time complexity of the merge sort algorithm. 3+2

3. (i) Explain how Merge Sort works with a step-by-step example.
(ii) Demonstrate the Quick Sort algorithm on an unsorted array. 2+3

4. (i) What is the Eight Queens problem, and what is its objective?
(ii) Explain how Backtracking can be applied to solve the Eight Queens problem. 2+3

5. (i) What is the basic idea behind the Greedy Method in algorithm design?
(ii) Explain the concept of making locally optimal choices in the Greedy Method. 2+3

6. (i) Define the P class in computational complexity theory.
(ii) What is the significance of the class NP in computational complexity? 2+3

## Group – C
## (Long Answer Type Questions)

**Attempt any four from the followings:** **4 x 10 = 40**

7. (i) Differentiate between Big-O, Omega (Ω), and Theta (Θ) notations in asymptotic analysis.
(ii) Calculate the Big-O notation for the function f(n) = 3n^2 + 2n + 1.
(iii) How can you use asymptotic notation to compare the efficiency of two algorithms? 3+3+4

8. (i) How does Quick Sort use the Divide and Conquer approach?
(ii) What is the pivot element in Quick Sort, and how is it chosen?
(iii) Explain the worst-case time complexity of Quick Sort and how to mitigate it. 3+3+4

9. (i) Describe the key components of a Branch and Bound algorithm.
(ii) What is the primary goal of the Branch and Bound technique?
(iii) How does Branch and Bound optimize the search process? 4+3+3

10. (i) What are the constraints and rules in the Graph Coloring problem?
(ii) Explain the backtracking approach to find a valid coloring of a graph.
(iii) What is the chromatic number of a graph, and how is it related to coloring? 3+4+3

11. (i) Define a Minimum Spanning Tree (MST) and its significance in graph theory.
(ii) Explain Prim's algorithm for finding a Minimum Spanning Tree.
(iii) Describe Kruskal's algorithm for finding a Minimum Spanning Tree. 3+3+4

12. (i) Compare and contrast BFS and DFS in terms of their traversal strategies.
(ii) How can BFS be used to find the shortest path in an unweighted graph?
(iii) Explain the concept of topological sorting and how DFS can be used for it. 4+3+3