Advanced Algorithms – Lecture Plan (36 Lectures)

S. No.	Unit No.	Content	Total Lectures
1	Unit 1	**Foundations**: Review of analysis, Complexity Classes (P, NP, NP-Hard), Reductions, Cook–Levin & Classic NP-complete Problems	10
2	Unit 2A	**Exact Methods for NP-hard**: ILP basics, Branch & Bound, Cutting Planes, SAT Solvers, CSPs	5
3	Unit 2B	**Approximation Algorithms**: Performance ratios, Vertex Cover, Set Cover, Facility Location, TSP, Scheduling	5
4	Unit 2C	**Heuristics / Metaheuristics**: Greedy heuristics, Local Search, Simulated Annealing, Tabu Search, Genetic Algorithms	5
5	Unit 3	**Advanced Graph Algorithms**: Flows, Matchings, Min/Max Cut, Randomized Algorithms, Streaming, Graph Partitioning,	6
6	Unit 4	**Recruitment-Oriented & Cutting-Edge Topics**: Divide & Conquer (FFT, Strassen), DP on Graphs, Game Theory, Parameterized Complexity, Quantum Algorithms	**5**

Prerequisites

- Solid background in **Data Structures and Algorithms** (sorting, searching, graphs, DP, greedy).
- Familiarity with **Discrete Mathematics** (sets, relations, logic, graphs, combinatorics).
- Knowledge of **Computational Complexity basics** (Big-O, Ω, Θ notations).
- Comfort with **Programming in C++/Java/Python** for algorithm implementation.
- Basic linear algebra and probability helpful for approximation & randomized algorithms.

References

1. **Vazirani, V.** – *Approximation Algorithms* (Springer).
2. **Cormen, Leiserson, Rivest, Stein (CLRS)** – *Introduction to Algorithms*.
3. **Arora & Barak** – *Computational Complexity: A Modern Approach*.
4. **Kleinberg & Tardos** – *Algorithm Design*.
5. **William Cook** – *In Pursuit of the Traveling Salesman* (applied perspective).
6. **Papadimitriou, C.** – *Computational Complexity*.
7. Selected recent research papers/tutorials from **FOCS/SODA/STOC** for advanced topics.