Course Type	Course Code	Name of Course	L	T	P	Credit
DC (Hons)	**NCSH404**	**RANDOMIZED ALGORITHMS**	3	1	0	4

Course Objective

To provide fundamental knowledge about randomized algorithms, their design paradigms, probabilistic analysis, proof of correctness, and complexity measurement.

Learning Outcomes

Upon successful completion of this course, students will:

- Understand the fundamentals of randomized algorithms and probabilistic analysis.
- Learn different paradigms of designing randomized algorithms.
- Acquire in-depth knowledge about proving correctness and analyzing expected complexity.
- Explore the role of randomness in complexity theory and practical applications.

Unit No.	Topics to be Covered	Lecture+ Tutorial	Learning Outcome
1	**Introduction to Randomized Algorithms:** Definition, Types (Las Vegas, Monte Carlo), Examples (Randomized QuickSort, Min-Cut Algorithm), Advantages of Randomization	6+2	Understanding randomized algorithms and their classification.
2	**Basic Probability Review:** Probability Spaces, Expectation, Linearity of Expectation, Conditional Probability, Markov's Inequality, Chebyshev's Inequality (along with examples/applications)	6+2	Understanding probability fundamentals for analyzing randomized algorithms.
3	**Randomized Graph Algorithms:** Randomized Min-Cut, MST and All Pair shortest path algorithms	5+2	Understanding how randomness is applied in graph algorithms.
4	**Probabilistic Method:** Linearity of Expectation, First and Second Moment Methods, Maximum Satisfiability, The Lovasz Local Lemma, The method of conditional probabilities	6+2	Understanding how probabilistic techniques can prove existence results.
5	**Markov Chains and Random Walks:** 2-SAT example, Markov Chains, Stationary Distribution, Random Walk	6+2	Learning about Markov chains and random walks and their connection with randomness
6	**Algebraic Techniques:** Hashing, Fingerprinting, Randomized algorithms for Polynomial Identity Testing, Perfect Matching, Primality Testing	6+2	Exploring applications of algebra in randomized algorithms and applications of randomness in algebraic problems
7	**Computational Complexity:** Complexity Classes (RP, BPP, ZPP), Brief introduction to derandomization, pseudo-random generators (PRGs) and Expanders	7+2	Understanding how randomness fits in complexity theory.
			Total: 42 (L) + 14 (T)

Text Book:

1. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms", Cambridge University Press.

Reference Books:

1. Michael Mitzenmacher and Eli Upfal, "Probability and Computing: Randomized Algorithms and Probabilistic Analysis", Cambridge University Press
2. Stasys Jukna, "Extremal Combinatorics With Applications in Computer Science", Springer Nature