MATHEMATICAL FOUNDATION FOR COMPUTER SCIENCE

Code: CS31111CS	Course Type: Core	Semester: I
Evolution Scheme (TA-MSE-ESE): 20-30-100	Total Marks: 150	L-T-P (Credits): 3-0-0 (3)

Pre-Requisites: Discrete Mathematics, Basic Linear Algebra, Probability Theory.

Course Objective: To develop mathematical foundations, formal reasoning, discrete structures, and probabilistic techniques for computational problem-solving, algorithm design, system modeling, and advanced computer science research applications.

Course Outcomes: At the end of the course, the student will be able to

CO-1	Apply formal logic and proof techniques to analyze computational problems and algorithms
CO-2	Utilize discrete structures such as graphs, combinatorics, and relations in modeling and solving computer science problems
CO-3	Apply linear algebra concepts in computational systems including machine learning and network analysis
CO-4	Model uncertainty and optimize computational systems using probability theory and mathematical optimization techniques

Course Articulation Matrix:

PO	PEO-1	PEO-2	PEO-3	PEO-4	PEO-5
CO-1	3	2	1	-	-
CO-2	3	2	1	-	1
CO-3	3	2	-	-	3
CO-4	3	2	1	1	-

1 - Slightly; 2 - Moderately; 3 – Substantially

Syllabus:

Unit-1: Mathematical Logic and Proof Techniques

Propositional and predicate logic, normal forms, inference rules, proof techniques including induction, contradiction, and contrapositive, recurrence relations and their solutions, asymptotic notations and complexity analysis.

Unit-2: Discrete Structures and Graph Theory

Sets, relations, functions, equivalence relations and partial orders, graph theory concepts including connectivity, trees, shortest paths, spanning trees, combinatorics including permutations, combinations, generating functions, applications in algorithms.

Unit-3: Linear Algebra for Computing

Vector spaces, linear transformations, eigenvalues and eigenvectors, matrix decomposition techniques (LU, QR), applications in PageRank, computer graphics, and machine learning models.

Unit-4: Probability and Optimization

Probability spaces, random variables, expectation, common distributions, Markov chains, queuing models, linear programming, convex optimization basics and applications in computer science.

Learning Resources:

Text Books:

1. Discrete, Kenneth H. Rosen. "Mathematics and its Applications." Higher Education. 4th edition. McGraw-Hill (2007).
2. Strang, Gilbert. Linear algebra and its applications. 2012.
3. Ross, Sheldon M. Introduction to probability models. Academic press, 2014.