Indian Institute of Information Technology, Allahabad

Department of Information Technology

<u>**Course Syllabus**</u>

1. Name of the Course: **Discrete Mathematical Structures**

2. LTP structure of the course: 3-1-0

3. Objective of the course: This is an introductory *course* on *discrete mathematics and structures*. Students will learn: some fundamental mathematical concepts and terminology.

4. Outcome of the course: On completion of this course, students will be able to explain and apply the basic methods of discrete (non-continuous) mathematics in Computer Science. They will be able to use these methods in subsequent courses in the design and analysis of algorithms, computability theory, software engineering, and computer systems.

5. Course Plan:

Component	Unit	Topics for Coverage
Compoent 1	Unit 1	• **Methods of Proof:** Proof by contradiction, Proof by induction. Usually in such proofs we prove statements of the kind: For all n, n ≥ 0, P(n) holds. Such a proof has two steps, proving the base of induction, and then proving the induction hypothesis, structural induction. This is applicable for entities or structures which are defined inductively, Proof by proving the contrapositive. **Logic & Proofs:** Introduction to Logic. Propositional Logic, Truth tables, Deduction, Resolution, Predicates and Quantifiers, Mathematical Proofs. Infinite sets, well-ordering. Countable and Uncountable sets, Cantors diagonalization. Mathematical Induction - weak and strong induction.
	Unit 2	• **Sets and Sequences: Data Models:** Finite Sets, Power Set, Cardinality of finite sets, Cartesian Product, Properties of Sets, Vector Implementations of Sets.
Component 2	Unit 3	• **Counting & Combinatorics:** Counting, Sum and product rule, Principle of Inclusion Exclusion. Pigeon Hole Principle, Counting by Bijections. Double Counting. Linear Recurrence relations - methods of solutions. Generating Functions. Permutations and counting. • **Relations & Graphs:** Relations, Equivalence Relations. Functions, Bijections. Binary relations and Graphs. Trees (Basics). Posets and Lattices, Hasse Diagrams. Boolean Algebra.
	Unit 4	• **Algebraic Structures:** Structured sets with respect to binary operations. Groups, Semigroups, Monoids. Rings, and Fields. Vector Spaces, Basis.

6. Text Book: Discrete Mathematics and its Applications, Kenneth H. Rosen, 7th Edition -Tata McGraw Hill Publishers, 2011.

7. References:

• Mathematics for Computer Science, Eric Lehman; F Thomson Leighton; Albert R Meyer, 2010.
• Logic in Computer Science, Huth and Ryan, Cambridge University Press, 2014.