Mathematics Bachelor with 2 Core Disciplines (Sem I)
DSC-I: Elements of Discrete Mathematics

Total Marks: 100 (Theory: 75, Internal Assessment: 25) **Examination:** 3 Hrs.
Workload: 3 Lectures, 1 Tutorial (per week) **Credits:** 4

Course Objectives: Students are introduced to the important concept of order (or partial order) and related properties. The course includes the notion of a lattice which is also a step towards abstract algebra. Students are taught the concept of Boolean algebra and its applications to minimizing a Boolean polynomial and switching circuits, which has further applications in computer science.

Course Learning Outcomes: This course will enable the students to:

i) Understand the basic concepts of sets, relations, functions, and induction.
ii) Understand mathematical logic and logical operations to various fields.
iii) Understand the notion of order and maps between partially ordered sets.
iv) Minimize a Boolean polynomial and apply Boolean algebra techniques to decode switching circuits.

Unit 1: Sets, Relations and Functions

Sets, Propositions and logical operations, Conditional statements, Mathematical induction, Relations and equivalence relation, Equivalence classes, Partial order relation, Partially ordered set, Hasse diagrams, Chain, Maximal and minimal elements, least and greatest elements, Least upper bound, Greatest lower bound, Zorn's lemma, Functions and bijective functions, Functions between POSETS, Order isomorphism.

Unit 2: Lattices

Lattice as a POSET, Lattice as an algebra and their equivalence, Bounded lattices, Sublattices, Interval in a lattice, Products and homomorphism of lattices, Isomorphism of lattices; Distributive, Complemented, Partition and pentagonal lattices.

Unit 3: Boolean Algebra and Switching Circuits

Boolean algebra, De Morgan's laws, Boolean expressions, Truth tables, Logic diagrams, Boolean functions, Disjunctive normal forms (as join of meets), Minimal forms of Boolean polynomials, Quine Mc-Cluskey method, Karnaugh maps, Switching circuits, Applications of switching circuits.

References:

1. Rudolf Lidl, & Gunter Pilz (2004). *Applied Abstract Algebra* (2nd ed.). Undergraduate text in Mathematics, Springer (SIE), Indian Reprint.
2. Bernard Kolman, Robert C. Busby, & Sharon Cutler Ross (2009). *Discrete Mathematical Structures* (6^{th} ed.). Pearson education Inc., Indian reprint.

Additional Reading:

i. Rosen, Kenneth H. (2017). *Discrete Mathematics and its applications with combinatorics and Graph Theory* (7th ed.). McGraw Hill Education.