Topics in First Unit: Sets, Relations, and Functions

Sets

1. Sets - Definition
2. Sets -Description and Examples.
3. Subset, Proper subset and not a subset - Definition and examples.
4. Cardinality of Sets.
5. Power Sets.
6. Cartesian Product.
7. Set Operations.
8. Set Identities and Problems.

Relations:

1. Relations - Definitions and Examples.
2. Subset of Cartesian Product.
3. Inverse Relation.
4. Pictorial representation of relations (Finite and Infinite).
5. Composition of relations.
6. Type of relations.
7. Equivalence relations.
8. Equivalence Class.
9. Partial ordering relations.

Functions:

1. Function as Relations.
2. Definition of function.
3. Domain and Range of functions (Algebraically and Graphically).
4. One-One and Onto function (Algebraically and Graphically).
5. Inverse of function.
6. Composition of function.
7. Restriction on Domain.
8. Vertical line test.
9. Piecewise functions.

Topics in Second Unit – Posets, Lattice Theory and Counting

Partially Ordered Sets and Lattice Theory

1. Partial Ordering Relations.
2. Partial Ordered Sets (Poset).
3. Comparable Elements.
4. Noncomparable Elements.
5. Totally Ordered Sets (or) Linearly Ordered Sets (or) Chain.
6. Antichain.
7. Hasse Diagrams of Poset.
8. Supremum and Infimum.
9. Lattice (Definition).
10. Lattice as Poset.
11. Types of Lattices: (a) Bounded Lattice (b) Distributive Lattice (c) Complete Lattice (d) Complemented Lattice.

Counting:

1. The Pigeonhole Principle.
2. Permutations and Combinations.
3. Recurrence relations.
4. Solving recurrence relations.
5. Generating Functions.
6. Inclusion-Exclusion Principle.

Topics in Third Unit – Propositional Logic

Propositional Logic (Introduction to Logic):

1. Proposition.
2. Negation.
3. Conjunction and Disjunction.
4. Conditional Statements.
5. Converse, Contrapositive and Inverse.
6. Biconditional Statement.
7. Tautology, Contradiction and Contingency.
8. De Morgan's Law in Propositional Logic.
9. Equivalence Laws.
10. Logical Equivalence
11. Argument and Validness.
12. Proof Systems.

Topics In fourth Unit - Algebraic Structures

1. Algebraic structures with one binary operation and its properties.
2. Semigroup, Monoid.
3. Group with illustrations.
4. Examples of Groups.
5. Finite group, Infinite group and Abelian group.
6. Verification of Groups.
7. Addition Modulo n and Multiplication Modulo n.
8. Congruence relation is an Equivalence relation.