2CSE60E18: Discrete Mathematics [3 0 2 3 1]

Learning Outcomes:

After learning the course the students should be able to:

□ Construct mathematical arguments using logical connectives and quantifiers.
□ Verify the correctness of an argument using propositional and predicate logic and truth tables.
□ Demonstrate the ability to solve problems using counting techniques and combinatorics in the context of discrete probability.
□ Solve problems involving recurrence relations and generating functions.
□ Use graphs and trees as tools to visualize and simplify situations.
□ Perform operations on discrete structures such as sets, functions, relations, and sequences.
□ Construct proofs using direct proof, proof by contraposition, proof by contradiction, proof by cases, and mathematical induction.
□ Apply algorithms and use definitions to solve problems to prove statements in elementary number theory.

<u>SYLLABUS</u>

Unit No.	Topics	Lectures (Hours)
1	**Sets and propositions** combination, finite, uncountably infinite and infinite sets, mathematical induction, principles of inclusion and exclusion, propositions	**3**
2	**Permutations, combinations, discrete probabilities** rules of sums and products, permutations, combinations, generation, discrete probability, conditional probability, information	**3**
3	**Relations and functions** relational model of data bases, properties of binary relations, equivalence relation, partitions, partial ordering, lattices, chains and antichains, functions and pigeon-hole principle	**4**
4	**Graphs** Basic terminology, multi- and weighted graphs, paths, circuits, shortest path, Eulerian path, Travelling Salesman problem, factors of a graph, planar graphs	**5**
5	**Trees** trees, rooted trees, path length, prefix codes, binary search trees, spanning trees and cut-sets, minimum spanning trees, transport networks	**5**

6	**Finite-state machines** FSM as models of physical systems, equivalent machines, FSM as language recognizer	**4**
7	**Analysis of algorithms** time complexity of algorithms, example of shortest path algorithm, complexity, tractable and non-tractable problems	**4**
8	**Computability and Formal languages** Russel's paradox and non-computability, ordered sets, languages, phrase structured grammars, types of grammars and languages	**4**
9	**Recurrence relations** linear recurrence relations with constant coefficient, homogeneous, particular and total solutions, generating functions, sorting algorithms, matrix multiplication	**3**
10	**Discrete numerical functions** manipulations of numerical functions, asymptotic behavior, generating functions, combinatorial problems	**3**
11	**Group** groups and sub-groups, generators, evaluation of powers, cosets, Lagrange's theorem, permutation group and Burnsides theorem, group codes, isomorphism, automorphism, homomorphism, normal subgroups, rings, integral domains and fields, ring homomorphism, polynomial rings and cyclic codes	**4**
12	**Lattices and Boolean algebras** Lattices and algebraic systems, principle of duality, properties of algebraic systems, distributive lattices, boolean algebras, uniqueness, boolean functions and expressions, propositional calculus	**3**

Text Books:

1. "Elements of Discrete Mathematics", C.L. Liu, 2nd Ed., McGraw-Hill

Reference Books:

1. "Modern Applied Algebra", Birkoff and Bartee, McGraw-Hill, CBS.
2. "Discrete Mathematics - A Unified Approach", Stephen A. Wiitala, Computer Science Series,McGraw- Hill.