

**B.Tech. II (CSE) Semester – III**  
**DISCRETE MATHEMATICS**  
**MA221**  
**(MATHEMATICS - III)**

Scheme

L	T	P	Credit
3	1	0	04

**1. Course Outcomes (COs):**

**At the end of the course, the students will be able to**

CO1	acquire knowledge of sets, group and functions, graphs.
CO2	apply group theory, relations and lattice.
CO3	analyse functions, counting and based on mathematical logic.
CO4	evaluate formal verification of computer programmes.
CO5	design solutions for various types of problems in different disciplines like information security, optimization, mathematical analysis.

**2. Syllabus**

• **INTRODUCTION (04 Hours)**

Set Definition, Finite and Infinite Sets, Equality of Sets, Disjoint Sets, Family of Sets, Types of Sets, Operations on Sets, Algebra of Sets, Cardinality of a Set, Venn Diagrams, Multisets, Cartesian Product, Principle Inclusion and Exclusion, Functions as a Set, Domain and Co-domain, Image, Range, Types of Functions, Equal and Identity Functions, Invertible Functions, Composition of Functions, Application of Functions in Computer Science Areas.

• **GROUP THEORY (08 Hours)**

Basic Properties of Group, Groupoid, Semigroup & Monoid, Abelian Group, Subgroup, Cosets, Normal Subgroup, Lagrange's Theorem, Cyclic Group, Permutation Group, Homomorphism & Isomorphism of Groups, Basic Properties, Error Correction & Detection Code.

• **RELATION & LATTICES (05 Hours)**

Definition & Basic Properties, Graphs Of Relation, Matrices Of Relation, Equivalence Relation, Equivalence Classes, Partition, Partial Ordered Relation, Posets, Hasse Diagram, Upper Bounds, Lower Bound, GLB & LUB Of Sets, Definition & Properties Of Lattice, Sub Lattice, Distributive & Modular Lattices, Complemented & Bounded Lattices, Complete Lattices & Boolean Algebra.

• **MATHEMATICAL LOGIC AND PROGRAM VERIFICATION (05 Hours)**

Induction, Propositions, Combination Of Propositions, Logical Operators & Propositional Algebra, Equivalence, Predicates & Quantifiers, Interaction of Quantifiers with Logical Operators, Logical

Interference & Proof Techniques, Formal Verification of Computer Programs (Elements of Hoare Logic).

• **COUNTING AND RECURRENCE RELATION** (05 Hours)

First Counting Principle, Second Counting Principle, Permutation, Circular Permutations, Combination, Pigeonhole Principle, Recurrence Relations, Linear Recurrence Relations, Inclusion And Exclusion, Generating Functions.

• **BASICS OF GRAPHS** (05 Hours)

Graph Definition, Graph Representation, Basic Concepts Of Finite & Infinite Graph, Incidence & Degree, Isomorphism, Subgraph, Walk, Path & Circuits, Cliques, Cycles and Loops, Operations On Graphs, Connected Graph, Disconnected Graph & Components, Complete Graph, Regular Graph, Bipartite Graph, Planar Graphs, Weighted Graphs, Directed & Undirected Graphs, Connectivity Of Graphs.

• **GRAPHS ALGORITHMS** (10 Hours)

Flows, Combinatorics, Euler's Graph, Hamiltonian Paths & Circuits, Activity Planning and Critical Path, Planar Graphs: Properties, Graph Coloring, Vertex Coloring, Chromatic Polynomials, Edge Coloring, Planar Graph Coloring, Matching and Factorizations: Maximum Matching In Bipartite Graphs, Maximum Matching In General Graphs, Hall's Marriage Theorem, Factorization; Networks: Max-Flow Min-Cut Theorem, Menger's Theorem, Graph and Matrices.

Tutorials will be based on the coverage of the above topics separately (14 Hours)

(Total Contact Time: 42 Hours + 14 Hours = 56 Hours)

3. **Tutorials:**

- 1 Examples using different set operations
- 2 Examples of defining groups and studying properties
- 3 Examples on formal verification and applying different functions
- 4 Examples of mathematical logics and relations
- 5 Examples of recurrence and counting

4. **Books Recommended:**

1. Rosen K.H., Discrete Mathematics and Its Applications , 6/E, MGH, 2006.
2. Liu C.L., Elements of Discrete Mathematics , MGH, 2000.
3. Deo Narsingh., Graph theory with applications to Engineering & Computer Science , PHI, 2000.

*Handwritten signature and date:*  
21/07/2020