

**DEPARTMENT OF MATHEMATICS**  
**MSc Mathematics**

<b>MTE 451</b>	<b>Discrete Mathematics and Applications</b>	<b>3 Credits (36 hours)</b>
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**Course Outcome:** Students will have the knowledge and skills to explain the concepts of Discrete Mathematics and to develop logical thinking and its application to computer science, to enhance one's skills in solving real life problems related to counting, discrete probability by applying various counting techniques, to illustrate applications of Boolean algebra and group theory in designing logic gates and coding theory.

**Course Specific Outcome:** At the end of the course students will have the knowledge and skills to:

- Apply basic number theory concepts like divisibility, modular arithmetic in solving congruences, changing the base of number system and their usage in cryptography.
- Able to solve many real life problems related to counting by the use of special tools like recurrence relations and generating functions.
- Design and simplify the logic gate networks by using lattices and Boolean algebra.
- Apply concept of groups in generating binary coding, decoding and also in error detection and error correction in the binary coding system.

**Unit I - Number Theory and Cryptography:**

Divisibility and Modular Arithmetic, Integer Representations and Algorithms, Primes and Greatest Common Divisors, Solving Congruences, Applications of Congruences, Cryptography.

**(8 Hours)**

**Unit II - Counting Techniques:**

The Basics of Counting, The Pigeon-hole Principle, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Recurrence Relations, Applications of Recurrence Relations, Solving Linear Recurrence Relations, Generating Functions. Principle of Inclusion-Exclusion, Applications of Inclusion-Exclusion.

**(12 Hours)**

**Unit III - Order Relations and Structures:**

Product Sets and Partitions, Relations, Properties of Relations, Equivalence Relations, Partially Ordered Sets, Extremal Elements of Partially Ordered Sets, Lattices, Finite Boolean Algebras, Functions on Boolean Algebras, Boolean Functions as Boolean Polynomials.

**(8 Hours)**

**Unit IV - Groups and Coding Theory:**

Binary Operations Revisited, Semigroups, Products and Quotients of Semigroups, Groups, Products and Quotients of Groups, Coding of Binary Information and Error Detection, Decoding and Error Correction.

**(8 Hours)**

## References

- [1] Kenneth H. Rosen, *Discrete Mathematics and Its Applications*, 7th Ed., Tata Mc-Graw-Hill, 2012.
- [2] Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, *Discrete Mathematical Structures*, 3rd Ed., Prentice Hall, 1996.
- [3] Grimaldi R, *Discrete and Combinatorial Mathematics*, 5th Ed., Pearson, Addison Wesley, 2004.

