

**B.Sc. (Physical Sciences/Mathematical Sciences) Semester-IV**  
**with Mathematics as one of the Core Discipline**  
**Category-III**

**DISCIPLINE SPECIFIC CORE COURSE – 4 (Discipline A-4): ABSTRACT ALGEBRA**

**CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**

| Course title & Code | Credits | Credit distribution of the course |          |                     | Eligibility criteria            | Pre-requisite of the course (if any) |
|---------------------|---------|-----------------------------------|----------|---------------------|---------------------------------|--------------------------------------|
|                     |         | Lecture                           | Tutorial | Practical/ Practice |                                 |                                      |
| Abstract Algebra    | 4       | 3                                 | 1        | 0                   | Class XII pass with Mathematics | NIL                                  |

**Learning Objectives:** The primary objective of the course is to introduce:

- Modular arithmetic, fundamental theory of groups, rings, integral domains, and fields.
- Symmetry group of a plane figure, and basic concepts of cyclic groups.
- Cosets of a group and its properties, Lagrange's theorem, and quotient groups.

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

- Appreciate ample types of groups present around us which explains our surrounding better, and classify them as abelian, cyclic and permutation groups.
- Explain the significance of the notion of cosets, normal subgroups and homomorphisms.
- Understand the fundamental concepts of rings, subrings, fields, ideals, and factor rings.

**SYLLABUS OF DISCIPLINE A-4**

**UNIT-I: Introduction to Groups (12 hours)**

Modular arithmetic; Definition and examples of groups, Elementary properties of groups, Order of a group and order of an element of a group; Subgroups and its examples, Subgroup tests; Center of a group and centralizer of an element of a group.

**UNIT-II: Cyclic Groups, Permutation Groups and Lagrange's Theorem (18 hours)**

Cyclic groups and its properties, Generators of a cyclic group; Group of symmetries; Permutation groups, Cyclic decomposition of permutations and its properties, Even and odd

permutations and the alternating group; Cosets and Lagrange's theorem; Definition and examples of normal subgroups, Quotient groups; Group homomorphisms and properties.

**UNIT-III: Rings, Integral Domains and Fields (15 hours)**

Definition, examples and properties of rings, subrings, integral domains, fields, ideals and factor rings; Characteristic of a ring; Ring homomorphisms and properties.

**Essential Reading**

1. Gallian, Joseph. A. (2017). Contemporary Abstract Algebra (9th ed.). Cengage Learning India Private Limited, Delhi. Indian Reprint (2021).

**Suggestive Reading**

- Beachy, John A., & Blair, William D. (2006). Abstract Algebra (3rd ed.). Waveland Press.