Catalog Description:
4580-4581 includes group theory, ring theory, vector spaces over arbitrary fields, and field theory.

Prerequisite:
C- or better in 3345, or 3345H and C- or better in 2568 or 2568H or 5520H

Purpose:
Math 4580-4581 constitutes a two-semester sequence on abstract algebra, intended to introduce students the main concepts of this subject area. Focused on groups, rings and fields, this course gives the students a deep understanding of these three basic algebraic structures, and provides a good foundation for more specialized work. A significant goal of the course is to improve mathematical reasoning and proof writing.

Math 4580 presents special classes of groups, group actions on sets, vector spaces, and field theory that concludes with elements of Galois theory. The course places these topics in their historical context where possible.

Text:

Tom Judson, *Abstract Algebra: Theory and Applications*
https://aimath.org/textbooks/approved-textbooks/judson/

4580 Topics List (Chapters from Judson book):

1. **Preliminaries**
1.1. A Short Note on Proofs
1.2. Sets and Equivalence Relations

2. **Integers**
2.1. Mathematical Induction
2.2. The Division Algorithm

3. **Groups**
3.1. Integer Equivalence Classes and Symmetries
3.2. Definitions and Examples
3.3. Subgroups

4. **Cyclic Groups**
4.1. Cyclic Groups
4.2. Multiplicative Group of Complex Numbers

5. **Permutation Groups**
5.1 Definition and Examples
5.2 Dihedral Groups

6. **Cosets and Lagrange Theorem**
6.1. Cosets
6.2. Lagrange Theorem

9. **Isomorphisms**
9.1. Definition and Examples
9.2. Direct Products

10. **Normal Subgroups and Factor Groups**
10.1. Factor Groups and Normal Subgroups

11. **Homomorphisms**
11.1. Group Homomorphisms

16. **Rings**
16.1. Rings
16.2. Integral Domains and Fields
16.3. Ring Homomorphisms and Ideals
16.4. Maximal and Prime Ideals (optional)

17. **Polynomials**
17.1. Polynomial Rings
17.2. The division Algorithm (optional)
17.3. Irreducible Polynomials (optional)