



**ABSTRACT ALGEBRA**  
21:640:451, 452 (3 credits, 3 credits)

**COURSE DESCRIPTION:**

Elementary set theory; fundamental structures of algebra, including semigroups, groups, rings, and fields; homomorphisms and isomorphisms; factor group, rings of residue classes, and other factor structures.

**PREREQUISITE:**

21:640:238 (Foundations of Modern Math), or 21:640:350 (Linear Algebra), or permission of instructor.

**TEXTBOOK:**

"A First Course in Abstract Algebra," (7<sup>th</sup> edition), by John B. Fraleigh, published by Addison Wesley.

**DEPARTMENT WEB SITE:** <http://www.ncas.rutgers.edu/math>

**THIS COURSE COVERS THE FOLLOWING CHAPTERS AND SECTIONS:**

**Chapter 0:**

- 0.1 Mathematics and proofs
- 0.2 Sets and relations
- 0.3 Mathematical induction
- 0.4 Complex and matrix algebra

**Chapter 1: Binary operation**

- 1.1 Isomorphic binary structures
- 1.2 Groups
- 1.3 Subgroups
- 1.4 Cyclic groups and generators

**Chapter 2: Groups and Cosets**

- 2.1 Groups of permutation
- 2.2 Orbits, cycles and alternating groups
- 2.3 Cosets and Lagrange Theorem
- 2.4 Direct product and finitely generated Abelian groups

**Chapter 3: Homomorphisms**

- 3.1 Homomorphisms
- 3.2 Factor groups
- 3.3 Factor group computation and simple groups
- 3.4 Series of groups

Chapter 5: Rings and Fields

- 5.1 Rings and fields
- 5.2 Integral domains
- 5.3 Fermat's and Euler's Theorem
- 5.4 The field of quotients
- 5.5 Rings of polynomials
- 5.6 Factorization of polynomials over a field

Chapter 6: Factor rings and Ideals

- 6.1 Homomorphisms and Factor rings
- 6.2 Prime and maximal ideals

Chapter 7: Factorization

- 7.1 Unique factorization domains
- 7.2 Euclidean domains
- 7.3 Gaussian integers and norms

Chapter 8: Extension fields

- 8.1 Extension fields
- 8.2 Vector space
- 8.3 Algebraic extension
- 8.4 Geometric construction
- 8.5 Finite field

Chapter 9: Galois theory

- 9.1 Automorphism of fields
- 9.2 Isomorphism extension theorem
- 9.3 Splitting field
- 9.4 Separable extension
- 9.5 Totally inseparable extension
- 9.6 Galois Theory
- 9.7 Illustration of Galois theory
- 9.8 Cyclotomic extension
- 9.9 Insolvability of quintic

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