
A FIRST COURSE IN ABSTRACT ALGEBRA

Second Edition

JOSEPH J. ROTMAN

*University of Illinois
at Urbana-Champaign*

PRENTICE HALL, Upper Saddle River, New Jersey 07458

Contents

Preface to the First Edition	vii
Preface to the Second Edition	xi
Chapter 1 Number Theory	1
1.1. Induction	1
1.2. Binomial Coefficients	17
1.3. Greatest Common Divisors	36
1.4. The Fundamental Theorem of Arithmetic	58
1.5. Congruences	62
1.6. Dates and Days	73
Chapter 2 Groups I	82
2.1. Functions	82
2.2. Permutations	97
2.3. Groups	115
Symmetry	128
2.4. Lagrange's Theorem	134
2.5. Homomorphisms	143
2.6. Quotient Groups	156
2.7. Group Actions	178
2.8. Counting with Groups	194
Chapter 3 Commutative Rings I	203
3.1. First Properties	203
3.2. Fields	216
3.3. Polynomials	225
3.4. Homomorphisms	233
3.5. Greatest Common Divisors	239

Euclidean Rings	252
3.6. Unique Factorization	261
3.7. Irreducibility	267
3.8. Quotient Rings and Finite Fields	278
3.9. Officers, Fertilizer, and a Line at Infinity	289
Chapter 4 Goodies	301
4.1. Linear Algebra	301
Vector Spaces	301
Linear Transformations	318
Applications to Fields	329
4.2. Euclidean Constructions	332
4.3. Classical Formulas	345
4.4. Insolubility of the General Quintic	363
Formulas and Solvability by Radicals	368
Translation into Group Theory	371
4.5. Epilog	381
Chapter 5 Groups II	385
5.1. Finite Abelian Groups	385
5.2. The Sylow Theorems	397
5.3. The Jordan-Hölder Theorem	408
5.4. Presentations	420
Chapter 6 Commutative Rings II	437
6.1. Prime Ideals and Maximal Ideals	437
6.2. Unique Factorization	445
6.3. Noetherian Rings	456
6.4. Varieties	462
6.5. Gröbner Bases	480
Generalized Division Algorithm	482
Gröbner Bases	493
Hints to Exercises	505
Bibliography	519
Index	521