Chapter 0/1

- abelian
- associativity, commutativity
- equivalence relation: transitive, reflexive, symmetric. equivalence class
- Dihederal group D_{2n}
- Symmetric groups S_n
- Quaternion group
- Generators/relations/presentations
- cycle/decomposition
- Matrix groups: $GL_n(\mathbb{F})$, $SL_n(\mathbb{F})$
- Homomorphism, isomorphism

Chapter 2

- centralizer/normalizer subgroup of subsets
- stabilizer of element
- kernel of group action = $\cap$ stabilizers
- cyclic group theorems (2.3)
- lattice of subgroups

Chapter 3

Quotient Groups

- quotient group
- fiber/kernel/image/coset
- normal subgroup (Thm 3.6)
- partition
- natural projection
- commutator subgroup
- Lagrange Thm
- Cauchy Thm
- index
- Isomorphism Theorems
- diagram commute

Symmetric Groups

- transposition
- alternating groups
- even/odd permutation

Chapter 4: Group Actions

- group action
- kernel, stabilizer subgroup G_a, faithful
- permutation representation, Cayley's Theorem
- orbit, transitive
- $|\mathcal{O}_a| = |G : G_a|$
- left translation
- Corr 5: if p is smallest prime dividing $|G|$, then any subgroup of index p is normal

Chapter 5

- Direct Products
- Theorems of Finitely generated abelian groups
  - invariant factors
  - elementary divisors

Chapter 6

- Free group
- reduced word
- Universal property
- Presentation

Chapter 7

- Ring
- division ring: with $1 \neq 0$, every non-zero element is a unit
- field: commutative division ring
- zero-divisor (cannot be a unit)
- integral domain: commutative ring, $1 \neq 0$, no zero-divisors
- subring

Types of Rings

- Real Hamiltonian Quaternions
- matrix ring
- Polynomial ring $R[x]$: commutative, with 1
- group ring RG: commutative, with $1 \neq 0$
  - $R\mathbb{N} \cong R[x]$

Ring Homo, Ideals

- ring homomorphism, quotient ring
- [left/right] ideal
- product of ideals
- Ring Isomorphism Theorems