Math 221 Topic List

Chapter 2: Proof Techniques
- Direct proof
- Proof by contrapositive
- Proof by contradiction
- Proof by induction (first and second principles)

Chapter 3: Sets, Combinatorics, and Probability
- Basic set theory definitions and notations
- Binary and unary operations
- Countably infinite sets
- Uncountable sets (Cantor’s diagonalization method)
- Multiplication and addition principles
- Inclusion and exclusion
- Pigeonhole principle
- Permutations (with and without repetition; eliminating duplicates)
- Combinations (with and without repetition)
- Basic probability definitions
- Probability distributions
- Conditional probability
- Independent Events
- Random variables
- Expected value
- Pascal’s triangle and Pascal’s formula
- Binomial theorem
Chapter 4: Relations and Functions
- Types of binary relations
- Properties of binary relations (proofs and counterexamples)
- Partial ordering and total ordering
- Hasse diagram
- Equivalence relations
- Equivalence classes
- Partitions and blocks
- Properties of functions (proofs and counterexamples)
- Composition of functions
- Inverses
- Permutation functions
- How many functions?
- Equivalent sets
- Order of magnitude

Chapter 5: Graphs and Trees
- Basic graph theory definitions and notations
- Isomorphisms
- Representations of graphs
- Basic tree definitions and notations
- Huffman codes