

Discrete Mathematics (*Math 210*) Common Topics List

APPROVED: September 14, 2009

This course should serve as an introduction to mathematical proofs. Therefore, proofs are emphasized over computation.

1. Propositions and Connectives

- (a) Truth Tables
- (b) Logical Equivalences
- (c) Logical Operators
- (d) Tautologies and Contradictions
- (e) Predicates
- (f) Quantifiers—Universal, Existential
- (g) De Morgan's Laws

2. Sets and Connectives

- (a) Set Notation
- (b) Power Sets
- (c) Cartesian Products
- (d) Union
- (e) Intersection
- (f) Countable and uncountable sets; diagonalization. (Note: A finite set is countable. Defining *Denumerable* is optional (means countably infinite)).
- (g) Cardinality
- (h) De Morgans Laws and other set identities
- (i) Set Identities

3. Methods of Proof

- (a) Direct
- (b) Contrapositive
- (c) Contradiction
- (d) Induction
- (e) Cases
- (f) Prove Existence and Uniqueness

4. **Integers**

- (a) Divisibility
- (b) Primes
- (c) Fundamental Theorem of Arithmetic
- (d) Division Algorithm
- (e) Euclidean Algorithm
- (f) gcd and writing the gcd of two numbers as an integer linear combination of the numbers, lcm
- (g) Modular Arithmetic and Equivalence

5. **Relations**

- (a) Transitive, Symmetric, Reflexive, Antisymmetric Properties
- (b) Equivalence Relations–Classes/Partitions

6. **Functions**

- (a) Domain, Range, Pre-image
- (b) One-to-one, Onto, Bijections
- (c) Compositions
- (d) Inverse Functions

7. **Counting Techniques**

- (a) Combinations, Permutations
- (b) Product and Sum Rules
- (c) Principle of Inclusion and Exclusion
- (d) Binomial Theorem, Pascals Triangle and relations to combinations

8. **Optional Topics**

- **Sets and Connectives**

- 1. Membership Tables
- 2. Symmetric Difference

- **Methods of Proof**

- 1. Using Combinatorial Arguments

- **Integers**

1. Basic Sequence and Summation Notation
2. Linear Congruences
3. Chinese Remainder Theorem
4. Multiplicative Inverses in Modular Arithmetic

- **Relations**

1. Closure
2. Matrix Representations of Relations

- **Functions**

1. Recursive Definitions

- **Counting Techniques**

1. Pigeonhole Principle
2. Counting Onto Functions

- **Partial Orders**

1. Hasse Diagrams
2. Max, Min, glb, lub, Lattices

- **Graphs**

1. Relations representations
2. Undirected and Directed Graphs
3. Circuits, Paths
4. Connectivity
5. Adjacency Matrix, Incidence Matrix
6. Multigraphs
7. Euler Circuits and Paths

(Updated: Nov 28, 2012, item 2f.)