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.)