Math 2200-002/Discrete Mathematics
Final Exam Review

Logic and Quantifiers. You need to be able to:

- Make truth tables for compound logical propositions.
- Negate a logical proposition using DeMorgan's Laws.
- Negate a nested quantified expression using DeMorgan's laws.
- Convert English to logical propositions and vice versa.
- Prove logical propositions.

Sets, Functions and Sequences. You need to be able to:

- Take complements of unions and intersections (DeMorgan's Laws).
- Define the operations on sets using logic and quantifiers.
- Find the range of a function.
- Use logic and quantifiers to define injective, surjective, bijective.
- Check whether a function is injective, surjective, bijective
- Sum some basic sequences.
- Find the nth term of a sequence with a recurrence relation.

Number Theory. You need to be able to:

- Prove basic divisibility Theorems.
- Do some modular arithmetic.
- Solve some linear equations mod n.
- Prove the uniqueness of prime factorizations.
- Prove that there are infinitely many primes.
- Prove that $\sqrt{2}$ and $\sqrt{3}$ are irrational.
- Implement the enhanced Euclid's algorithm to solve:

$$am + bn = d = \gcd(m, n)$$

Induction and Well-Ordering. You need to be able to :

- State the principles of basic induction, strong induction and the well-ordered axiom.
- Prove summation formulas using induction.
- Prove that each natural number has a prime factorization.
- Prove the division algorithm.
- Prove that the equation $am + bn = d$ above has a solution.

Counting. You need to be able to:

- State the pigeon-hole principle and use it.
- Solve counting problems.
- Use combinations and permutations to count.
- State and prove the binomial theorem.
- State and use the inclusion-exclusion principle.

Probability. You need to be able to:

- Define sample space, event space and probability distributions.
- Define random variables X, and $E(X)$, $V(X)$ and σ.
- Define *independent* random variables X and Y.
- State and use Bienaymé's Formula.
- Compute $E(X)$ and $V(X)$ is some simple cases.