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 $n$th 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 $\sigma$.
- Define independent random variables $X$ and $Y$.
- State and use Bienaymé’s Formula.
- Compute $E(X)$ and $V(X)$ in some simple cases.