Final Exam, December 13, 10:00-11:50, PSF 208

- Logic.
  - Operators (especially implication).
  - Predicates and quantifiers.
  - Propositional equivalence.

- Methods of proof.
  - Direct and indirect proofs.
  - Proof by contradiction.

- Sets and functions.
  - Notation in set theory, cardinality of sets, power set.
  - Operations on sets, generalized unions and intersections.
  - Functions: injective, surjective, bijective.
  - Image and pre-image of a function.
  - Strictly increasing and decreasing functions.
  - Ceiling and floor functions.

- Algorithms.
  - Searching algorithms: linear search, binary search.
  - Sorting algorithms: bubble sort, sorting by simple insertion.
  - Complexity of algorithms.

- Asymptotic notation.
  - Showing that \( f(x) = O(g(x)) \) using \( C \) and \( k \).
  - Showing that \( f(x) \) is not \( O(g(x)) \).
  - Properties of \( O \)-notation.

- Number theory.
  - Division, prime numbers, modulo operation, and modulo relation.
– Euclidean algorithm, correctness and the Lame’s Theorem.
– Algorithms for change of basis.

• Sequences and summations.
  – Arithmetic and geometric progressions.

• Mathematical induction.
  – Identities, inequalities, other statements that can be proved using induction, Fibonacci numbers.

• Recursive definitions.

• Counting.
  – Permutations and combinations, basic inclusion-exclusion principle.
  – The Pigeonhole Principle with applications.
  – Binomial Theorem.

• Advanced Counting.
  – Modeling with recurrence relations.
  – Solving linear recurrence relations.
  – Divide-and-conquer recurrence relation.