

DISCRETE MATHEMATICS

Math 245

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Suggestions for Preparing for the Final Exam

I. Understand fundamental logic:

- Truth tables for \wedge , \vee , \implies , xor.
- Be able to show logical equivalence using a truth table.
- Know some important equivalences
(Thm. 1.1.1 and $p \implies q \equiv \sim p \vee q$ and $p \implies (q \vee r) \equiv (p \wedge \sim q) \implies r$).
- Know how to negate a statement (Important!).
- Pay particular attention to quantifiers, existential (\exists) and universal (\forall).

II. Know the basics of set theory!

- Definitions of subset, intersection, union, set difference, complement.
- Definitions of power set, Cartesian product, partition.
- Be able to prove one set is a subset of another.

III. Know the basics of number theory.

- The definition of *divides* and divisibility properties.
- Be able to state and use the Quotient-Remainder Theorem.
- Be able to state and use the Unique Factorization Theorem.
- Know the classic proofs by contradiction
 - \sqrt{p} is irrational for p prime.
 - The sum of a rational number and an irrational number is irrational.

IV. Functions and relations.

- Know the definitions: Relation, inverse of a relation, function.
For functions: injective (one-to-one), surjective (onto) and bijective.
- Be able to determine when a relation is a function, and if so, when it is injective, surjective, or bijective.
- Be able to work with lists, tables, arrow diagrams and formulas to define relations.
- Be able to find the inverse of a bijective function (e.g. $f(x) = 2x + 7$).
- Give examples of functions satisfying various properties
(7.3 #4-10 (2nd Ed.) 7.2 #5-14 (3rd Ed.)).

V. Relations on a set.

- Know how to use a table, a list of elements or an arrow diagram (also called a directed graph) to represent a relation on X . (The arrow diagram is different from that for a relation from X to Y).
- Verify or prove that a relation R is reflexive (ditto for symmetric, transitive, antisymmetric, an equivalence relation, or a partial order).
- For a relation R on A , be able to find the smallest relation containing R which is symmetric (ditto for reflexive, transitive, an equivalence relation, a partial order).
- Know the standard examples of equivalence relations (mod n , 10.3.10 and exercises 10.3 #18, 19, 22, 23 3rd Ed., 10.3 #15, 16, 19, 20 2nd Ed.).
- Know the standard examples of partially ordered sets: \leq for the integers (or rationals) divides on the integers; $\mathcal{P}(A)$ for a set A ; D_n ; (10.5 #16, 17, 18, 19, 20, 21 both Eds.).
- Draw Hasse diagrams for a poset. Find minimal and maximal elements of a poset.

VI. Know the basics of recursion and induction!

- State the well-ordering principle.
- State the principle of induction.
- Be able to use summation and product notation.
- Find the first several terms of a sequence given the initial terms and the recurrence formula.
- Know the formulas for the following sums:
 - The sum of a geometric sequence.
 - The sum of the first n integers.

VII. Know how to prove by standard induction! (I won't test strong induction.)

- Use full sentences.
- State the predicate.
- Prove the base step.
- State the assumption for the inductive step.
- Do the inductive step.

VIII. Know how to count!

- Know the inclusion-exclusion formula and be able to apply it and use a Venn diagram to illustrate.
- Know the 4 ways to choose and the formulas for 3 of them (I won't test "order unimportant, repetition allowed").
- Poker hands (I will describe the hand, and I may give you a strange deck or strange hand).