

Topics for Exam 1 Math 42, Fall 2014

General information. Exam 1 will be a timed test of 75 minutes, covering 1.1–1.5, 2.1–2.6, and 3.1–3.5 of the text, as well as the (brief) notes on logic gates. No books, notes, calculators, etc., are allowed. Most of the exam will be based on the homework and quizzes from the above sections. If you can do all of those problems, and you know and understand all of the ideas behind them, you should be in good shape.

As mentioned above, your first priority should be to understand the homework and quizzes and the ideas behind them. Besides the list of topics you should know, below, you should also be familiar with everything specially emphasized in the text. You should also study the Check Yourself problems in 1.3, 1.4, 1.5, 2.2, 2.3, 2.5, 3.2, and 3.5. These are practice problems with answers in the back of the book, and similar problems may well appear on the exam.

Statements of definitions. On at least one question, you will be asked to recite one of the definitions listed below (the italicized words under the **Definition:** headings). This is meant to force you to learn the mathematical terms that you need to learn for the rest of this course and for future courses.

Section 1.3. The sum principle, and how and when it applies. The product principle, and how and when it applies.

Section 1.4. What is a definition, and what is a theorem? How to do a direct proof. (See also Sections 1–6 of Hsu’s proof notes.) How a counterexample works.

Section 1.5. “In or out” theorem (Thm. 1.5.2) and its proof. Pigeonhole principle; generalized pigeonhole principle.

Section 2.2. Idea of a set, examples. (2.2.1) Bracket-slash-bracket definitions of sets (see also Hsu proof notes sect. 6). (2.2.2) **Definitions:** *Subsets, proper set, power sets, complement, $B \setminus A$.* (2.2.3) Proving sets are equal through double-inclusion. (2.2.4) **Definitions:** Union, intersection, disjoint, Cartesian product. (2.2.5) Venn diagrams, pictures of Cartesian products.

Section 2.3. (2.3.1) **Definitions:** *and, or, not, if-then statements.* Truth tables and how to use them. Correspondence between and, or, not, if-then, and \cap , \cup , complement, and \subseteq . (2.3.2) Quantifiers: “For all” versus “there exists”. (2.3.3) Negation of “for all” is “there exists”, and vice versa.

Section 2.5. Definitions: *converse, contrapositive.* Proof by contradiction.

Logic gates. How to draw and use AND, OR, and NOT gates. Idea of combining known gates to make new gates.

Section 3.2. Definitions: *function, map, well-defined, domain, target/target space, image, range, gipo, one-to-one, injective, onto, surjective, bijection, bijective.* Pigeonhole restatement (Hey Hey Hey, p. 61). The Same Size Theorem (Thm. 3.2.8).

Section 3.3 Definitions: *graph, vertices, edges, adjacent, incident, neighbors, loop, multiple edge, degree.*

Section 3.4. Number of functions $f : A \rightarrow B$; number of injective functions $f : A \rightarrow B$.

Section 3.5. Definitions: *walk, path, cycle, length, distance, connected, forest, tree, leaf, simple graph, complete graph, bipartite graph, complete bipartite graph, P_n , C_n , K_n , $K_{m,n}$, regular graph, degree sequence, Petersen graph.*