

Math 310: Introduction to Mathematical Proof

Department of Mathematics
Millersville University

Catalog Description: Emphasizes mathematical reasoning and communication of mathematical ideas both orally and in writing. Symbolic logic. Techniques of mathematical proof. Algebra of sets, binary relations and functions. Infinite sets, both countable and uncountable.

Prerequisites: Math 211, ENGL 110. This is a 3-credit course, which may be taken for General Education credit (W).

Objectives: Students will:

Demonstrate an understanding of mathematical logic.

Compose mathematical proofs involving abstract mathematical structures that:

- articulate ideas clearly in writing
- demonstrate the ability to determine an appropriate method of proof
- demonstrate understanding of inferences or causalities in “if ... then” statements
- reference previous definitions and theorems in their writing of proofs
- improve as the semester progresses.

Write a minimum of 2500 words of revisable prose.

Course outline:

I. Logic

Logical connectives
Truth tables
Tautologies and logical equivalence
Conditionals and biconditionals
Quantifiers

II. Proof techniques

Direct proof

Conditional proof
Proof by cases
Existence proofs
Induction
Counterexamples

III. Functions

Functions
Composition and inverse
Injective, surjective, and bijective functions

IV. Set theory and cardinality

Sets
Counting
Cardinality
Set algebra
Set proofs

IV. Relations

Binary relations
Equivalence relations
Divisibility and modular arithmetic
Partitions
Order relations

V. Miscellaneous topics

Inequality proofs
Binary operations

Textbooks: Richard Hammack, *The Book of Proof* (2nd edition). Self-published, freely available: 2013.

Gary Chartrand, Albert Polimeni, and Ping Zhang, *Mathematical Proofs* (2nd edition). Pearson Education, 2008.

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