

MA291: Introduction to Higher Mathematics

Baker University — Spring 2023

Course Outline

Each of the following comes from the textbook *Mathematical Proofs: a Transition to Advanced Mathematics* (Fourth Edition) by Gary Chartrand, Albert D. Polimeni, and Ping Zhang.

Exam 1: Sets, Relations, and Functions

- §1.1: Describing a Set
- §1.2: Subsets
- §1.3: Set Operations
- §1.4: Indexed Collections of Sets
- §1.5: Partitions of Sets
- §1.6: Cartesian Products of Sets
- §9.1: Relations
- §9.2: Properties of Relations
- §9.3: Equivalence Relations
- §9.4: Properties of Equivalence Classes
- §9.5: Congruence Modulo n
- §10.1: The Definition of a Function
- §10.2: One-to-One and Onto Functions
- §10.3: Bijective Functions
- §10.4: Composition of Functions
- §10.5: Inverse Functions

Exam 2: Logic and Basic Proof Techniques

- §2.1: Statements
- §2.2: Negations
- §2.3: Disjunctions and Conjunctions
- §2.4: Implications
- §2.5: More on Implications
- §2.6: Biconditionals
- §2.7: Tautologies and Contradictions
- §2.8: Logical Equivalence
- §2.9: Fundamental Properties of Logical Equivalence
- §2.10: Quantified Statements
- §2.11: Characterizations of Statements
- §3.1: Trivial and Vacuous Proofs
- §3.2: Direct Proofs
- §3.3: Proof by Contrapositive
- §3.4: Proof by Cases
- §5.1: Counterexamples
- §5.2: Proof by Contradiction
- §5.3: Review of Three Proof Techniques
- §5.4: Existence Proofs
- §5.5: Disproving Existence Statements

Exam 3: Proofs in the Wild

- §4.1: Proofs Involving Divisibility of Integers
- §12.1: Divisibility Properties of Integers
- §6.1: The Principle of Mathematical Induction
- §6.3: The Strong Principle of Mathematical Induction
- §12.2: The Division Algorithm
- §4.4: Proofs Involving Sets
- §4.5: Fundamental Properties of Set Operations

- §13.1: The Multiplication and Addition Principles
- §13.3: The Pigeonhole Principle
- §13.4: Permutations and Combinations