

Math 131: Foundations of Mathematics

Department of Mathematics — College of Science — King Saud University

First Semester: 1447–1448 (August 2026 – December 2026)

Course Information

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Course Overview

This class is designed to teach students how to read and write mathematics effectively. It provides the essential foundations required for advanced mathematics courses.

Textbook

Mathematical Proofs: A Transition to Advanced Mathematics, Fourth Edition, by Chartrand, Polimeni, and Zhang.

TOPICS TO BE COVERED

Chapter 1: Sets

- 1.1 Describing a Set (p. 14)
- 1.2 Subsets (p. 18)
- 1.3 Set Operations (p. 23)
- 1.4 Indexed Collections of Sets (p. 27)
- 1.5 Partitions of Sets (p. 31)
- 1.6 Cartesian Products of Sets (p. 33)

Chapter 2: Logic

- 2.1 Statements (p. 38)
- 2.2 Negations (p. 41)
- 2.3 Disjunctions and Conjunctions (p. 43)
- 2.4 Implications (p. 45)
- 2.5 More on Implications (p. 49)
- 2.6 Biconditionals (p. 53)
- 2.7 Tautologies and Contradictions (p. 57)
- 2.8 Logical Equivalence (p. 60)
- 2.9 Some Fundamental Properties of Logical Equivalence (p. 62)
- 2.10 Quantified Statements (p. 65)

Chapter 3: Direct Proof and Proof by Contrapositive

- 3.1 Trivial and Vacuous Proofs (p. 82)
- 3.2 Direct Proofs (p. 85)
- 3.3 Proof by Contrapositive (p. 89)
- 3.4 Proof by Cases (p. 94)
- 3.5 Proof Evaluations (p. 98)

Chapter 4: More on Direct Proof and Proof by Contrapositive

- 4.1 Proofs Involving Divisibility of Integers (p. 105)
- 4.2 Proofs Involving Congruence of Integers (p. 131)
- 4.4 Proofs Involving Sets (p. 117)
- 4.5 Fundamental Properties of Set Operations (p. 120)
- 4.6 Proofs Involving Cartesian Products of Sets (p. 122)
- 14.3 Limits of Functions (p. 378)

Chapter 5: Existence and Proof by Contradiction

- 5.1 Counterexamples (p. 127)
- 5.2 Proof by Contradiction (p. 131)
- 5.3 A Review of Three Proof Techniques (p. 138)
- 5.4 Existence Proofs (p. 170)
- 5.5 Disproving Existence Statements (p. 177)

Chapter 6: Mathematical Induction

- 6.1 The Principle of Mathematical Induction (p. 152)
- 6.2 A More General Principle of Mathematical Induction (p. 162)
- 6.3 The Strong Principle of Mathematical Induction (p. 170)

Chapter 9: Equivalence Relations

- 9.1 Relations (p. 224)
- 9.2 Properties of Relations (p. 226)
- 9.3 Equivalence Relations (p. 230)
- 9.4 Properties of Equivalence Classes (p. 235)
- 9.5 Congruence Modulo n (p. 239)
- 9.6 The Integers Modulo n (p. 245)

Chapter 10: Functions

- 10.1 The Definition of Function (p. 251)
- 10.2 One-to-one and Onto Functions (p. 256)
- 10.3 Bijective Functions (p. 259)
- 10.4 Composition of Functions (p. 263)

- 10.5 Inverse Functions (p. 267)

Chapter 11: Cardinalities of Sets

- 11.1 Numerically Equivalent Sets (p. 279)
- 11.2 Denumerable Sets (p. 280)
- 11.3 Uncountable Sets (p. 288)
- 11.4 Comparing Cardinalities of Sets (p. 293)
- 11.5 The Schröder-Bernstein Theorem (p. 296)

Chapter 15: Proofs in Group Theory

- 15.1 Binary Operations (p. 443)
- 15.2 Groups (p. 448)

Grading Policy

Assessment	Weight
Midterm 1	25%
Midterm 2	25%
Tutorial	10%
Final Exam	40%
Total	100%

Exam Dates

- **Midterm 1:** TBD
- **Midterm 2:** TBD
- **Final Exam:** 11/07/1448

Getting Help & Student Advice

- **Office Hours & Support:** You are welcome to attend office hours or schedule an appointment. Do not hesitate to ask questions via email. Do not fall behind—plan to visit during office hours whenever extra support is needed. Collaborative study with classmates is strongly encouraged!
- **Advice for Success:**
 - Writing mathematical proofs is fundamentally different from Calculus.
 - Read the course material before each lecture.
 - Solve as many exercise problems as possible after each class.
 - Write mathematics clearly using proper logic and formal notation.
 - Join or create a study group.