

Foundations of Mathematics (Math 131)
Department of Mathematics - College of Science - King Saud University
Second Semester: 1447 (January , 2026 – June, 2026)

Course Details

Name of the course coordinator: Dr. Majed Almubark

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Outline of the course: This class is designed to teach students to write and read mathematics. It provides the foundation needed for almost all higher level mathematics classes.

Recommended Book: Mathematical Proofs: A Transition to Advanced Mathematics, Fourth Edition, Chartrand/Polimeni/Zhang.

TOPICS TO BE COVERED:

Chapter1: Sets

1.1 Describing a Set 14

1.2 Subsets 18

1.3 Set Operations 23

1.4 Indexed Collections of Sets 27

1.5 Partitions of Sets 31

1.6 Cartesian Products of Sets 33

Chapter2: Logic

2.1 Statements 38

2.2 Negations 41

2.3 Disjunctions and Conjunctions 43

2.4 Implications 45

2.5 More on Implications 49

2.6 Biconditionals 53

2.7 Tautologies and Contradictions 57

2.8 Logical Equivalence 60

2.9 Some Fundamental Properties of Logical Equivalence 62

2.10 Quantified Statements 65

Chapter3: Direct Proof and Proof by Contrapositive

3.1 Trivial and Vacuous Proofs 82

3.2 Direct Proofs 85

3.3 Proof by Contrapositive 89

3.4 Proof by Cases 94

3.5 Proof Evaluations 98

Chapter4: More on Direct Proof and Proof by Contrapositive 105

4.1 Proofs Involving Divisibility of Integers 105

4.4 Proofs Involving Sets 117

4.5 Fundamental Properties of Set Operations 120

4.6 Proofs Involving Cartesian Products of Sets 122

Chapter5: Existence and Proof by Contradiction

5.1 Counterexamples 127

5.2 Proof by Contradiction 131

5.3 A Review of Three Proof Techniques 138

Chapter6: Mathematical Induction

6.1 The Principle of Mathematical Induction 152

6.2 A More General Principle of Mathematical Induction 162

6.3 The Strong Principle of Mathematical Induction 170

Chapter9: Equivalence Relations

9.1 Relations 224

9.2 Properties of Relations 226

9.3 Equivalence Relations 230

9.4 Properties of Equivalence Classes 235

9.5 Congruence Modulo n 239

9.6 The Integers Modulo n 245

Chapter 10: Functions

10.1 The Definition of Function 251

10.2 One-to-one and Onto Functions 256

10.3 Bijective Functions 259

10.4 Composition of Functions 263

10.5 Inverse Functions 267

Chapter 11: Cardinalities of Sets

11.1 Numerically Equivalent Sets 279

11.2 Denumerable Sets 280

11.3 Uncountable Sets 288

11.4 Comparing Cardinalities of Sets 293

11.5 The Schröder-Bernstein Theorem 296 (only Theorem 11.20 without the proof)

Chapter 14: Proofs in Calculus

14.1 Limits of Sequences 365

14.3 Limits of Functions 378

Chapter 15: Proofs in Group Theory

15.1 Binary Operations 400

15.2 Groups 405

15.3 Permutation Groups 411

Chapter 16: Proofs in Ring Theory

16.1 Rings

16.2 Elementary Properties of Rings

Getting help: You are welcome to attend my office hours. Do not hesitate to schedule an appointment at a different time, if needed. You can also email me questions. Do not get left behind! – Be prepared to allow time in your schedule for some visits to my office, when needed. Also, you are encouraged to collaborate with your classmates.

Mark Distribution:

Date of Exams

MT1: 25

Wednesday 25-February-2026

MT2: 25

Wednesday 22-April-2026

Tutorial: 10

Final: 40

Sunday 7-June-2026

Some Advices for Students:

- _ Math Proofs is very different from Calculus.
- _ Read course materials before each class.
- _ Do as many problems as possible after each class. DO NOT FALL BEHIND.
- _ Write mathematics clearly and with proper notation.
- _ Join a study group if possible.