Math 108 - Introduction to Abstract Mathematics
Spring 2019 Quarter

Basic Information

Instructor: Maria Gillespie, mgillespie@math.ucdavis.edu
Office: 2145 Mathematical Sciences Building (MSB)

Course web page: http://math.ucdavis.edu/∼mgillespie/Math108Spring19.php

Class times and location:
Section B01: MWF 9-9:50am, Hart 1150; Discussion Thurs 5:10-6:00pm, Wellman 115, TA Wencin Poh (wpoh@ucdavis.edu)
Section B02: MWF 9-9:50am, Hart 1150; Discussion Thurs 6:10-7:00pm, Wellman 115, TA Jun-da Sheng (sheng@math.ucdavis.edu)
(Please attend the class you are registered for so that we can ensure there is enough space.)

Office hours:
Prof. Gillespie: Mon, Wed 10-11, 2145 Math Sciences Building (MSB)
Wencin Poh: Tues 3-4, 3129 Math Sciences Building (MSB)
Albie Sheng: Thurs 4-5, 2204 Math Sciences Building (MSB)

Midterm Exam:
Friday, May 3, 9-9:50am (in class)

Final Exam Schedule:
Monday, June 10, 8:00 - 10:00 AM, Location TBA

Books:
Eggen, Smith, St. Andre, *A Transition to Advanced Mathematics*, 8th Ed.
Also my lecture notes: http://math.ucdavis.edu/∼mgillespie/math108spring19/LectureNotes.pdf

Goals and Topics

In this course we will introduce the rigorous foundations of abstract mathematics. The goal of this course is for participants to come away with:

- Familiarity with the language of mathematics; improved ability to read advanced math texts

- Understanding of what a mathematical proof consists of, and how to verify that one is correct

- Plenty of practice with various methods of mathematical proof

- LaTeX typesetting skills and good proof writing style

In particular, we will aim to cover formal logic and natural deduction, methods of proof such as induction and contradiction in practice, set theory and functions, bijections and cardinality, combinatorial proofs, and the basics of abstract algebra (groups, rings, and fields).

The course will roughly follow the order this material is covered in the textbook, *A Transition to Advanced Mathematics*. However, **the course will also rely heavily on the instructor's lecture notes online and the material covered in class**, which will sometimes cover additional material that is not in the textbook. It is important to attend all lectures and discussion sections in order to learn all of the relevant material.

Grades and Policies

The following table summarizes how the coursework will be graded.

Activity	Percent of Grade	Date
Homework	35%	Due Fridays in class
Midterm	30%	May 3
Final exam	35%	June 10

Homework policies: Homework will be posted each Friday and will be due the following Friday in class. The problems will be proof-based, and full work should be shown. Two of the problems will be randomly selected per week to be graded. Collaboration and discussion among your peers is encouraged in solving the homework problems, but each student must write or type up their own solutions themselves, without simply copying from another student's work.

No late homework will be accepted under any circumstances. A missed homework assignment is counted as a zero. In order to account for the possibility of an illness or other unexpected emergency, your lowest homework grade will be dropped when computing your final homework average.

Exam policies: The midterm will be an in-class exam. The final exam will be comprehensive, on all the material covered during the course. No books, notes, or Internet access will be allowed on any exam. Non-programmable calculators are permitted but will probably not be very helpful.

In the case that an emergency arises (with proof, such as a doctor's note) that causes a student to miss a midterm exam, a make-up midterm exam or project will be offered to that student in place of the exam. There will be no way to make up a missed final exam, and if an emergency does arise for the final then the student should petition for a grade of Incomplete.

If you have questions on the grading or wish to request a re-grade of a certain problem, you should bring your graded exam (or homework) to your TA's office hours.

Bonus points: A separate, informal Bonus Points score, **having no impact on grades whatsoever**, will be tallied for each student throughout the class. Students can earn Bonus Points through answering the bonus problems on the homework correctly, going above and beyond on the term project, or writing a particularly clever proof for one of the homework problems. There will be a brief Bonus Points awards ceremony on the last day of class.

SDC policy: Any student with a documented disability (e.g. physical, learning, psychiatric, vision, hearing, etc.) who needs to arrange reasonable accommodations must contact the Student Disability Center (SDC). Faculty are authorized to provide only the accommodations requested by the SDC. If you have any questions, please contact the SDC at 530/752-3184 or sdc@ucdavis.edu.

Tentative Schedule of Topics

- Apr 1: Introduction, Formal Axiom Systems

- Apr 3: Propositional Logic 1 - Truth tables and statements

- Apr 5: Propositional Logic 2 - Rules of Inference

- Apr 8: Propositional Logic 3 - More Rules of Inference and Formal Proofs (Preparation: Read sections 1.4 and 1.5 of textbook and pages 7-9 of Supplementary Lecture Notes)

- Apr 10: Introduction to Quantifiers (Read section 1.3 of textbook)

- Apr 12: Proofs with Quantifiers (Read Supplementary Lecture Notes pages 10-13, sections 1.6 and 1.7 of textbook)

- Apr 15: Peano Axioms for the natural numbers (Read pages 16, 17 in Lecture Notes)

- Apr 17: Induction! (Read section 2.4 of textbook)

- Apr 19: More Induction: strong induction, inducting starting at later values, etc (Read section 2.5 of textbook)

- Apr 22: Set Theory 1: Basic notions, proofs of set equality, subsets, power sets (Read section 2.1 of textbook)

- Apr 24: Set Theory 2: Intersection, union, complement, Venn diagrams (Read section 2.2 of textbook)

- Apr 26: Relations 1: Cartesian product and equivalence relation (Read sections 3.1, 3.2)

- Apr 29: Relations 2: Partitions (Read sections 3.3, 3.4)

- May 1: Relations 3: Orders and partial orders (Read section 3.5)

- May 3: Midterm

- May 6: Functions 1: What is a function? (Read sections 4.1, 4.2, section 9 of Supplementary Lecture Notes)

- May 8: Functions 2: Injective, surjective, bijective (Read section 4.3)

- May 10: Functions 3: Composition, inverse functions, restriction (Read section 4.4)

- May 13: Cardinality 1: What is cardinality, different infinite cardinalities, Cantor's theorem (Read sections 5.1, 5.2, 5.4, section 10 of Supplementary Lecture Notes)

- May 15: Cardinality 2: Counting basics, combinatorial interpretations (Read section 11 of lecture notes)

- May 17: Combinatorial Proofs 1: Counting in Two Ways (Read section 12 of lecture notes, section 2.6 of textbook)

- May 20: Combinatorial Proofs 2: Bijections (Read section 13 of lecture notes)

- May 22: Combinatorial Proofs 3: Inclusion/exclusion

- May 24: Groups 1: Definition and examples, symmetric group (Read sections 6.1, 6.2 of textbook)

- May 27: Memorial Day Holiday

- May 29: Groups 2: Permutation groups and symmetry groups (Read section 14 of Lecture Notes)

- May 31: Groups 3: Subgroups and order (Read section 6.3)

- June 3: Groups 4: Cosets and Lagrange's theorem

- June 5: Groups 5: Rings and Fields