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1 Course Content and Goals

This course gives an introduction to abstract mathematical thinking, problem solving, and exposition through the study of some interesting and beautiful topics in pure mathematics. By taking it you will:

- Become familiar with various abstract objects and problem solving techniques in higher mathematics.
- Learn how to correctly form mathematical arguments - not just get the right answer to a problem, but to construct a logical argument which proves that a statement is true.
- Learn how to communicate these arguments in way which others can follow clearly, leaving no room for doubt that what you state is correct.
- Engage in an act of discovery and conjecture, intuition and inspiration.
- Occasionally be in a state of confusion or frustration (not because the mathematics you're thinking of is nonsense, but because you gave it sense and now you are trying to see what your creation is up to) - and occasionaly you'll have a breakthrough idea...

This course may differ from earlier mathematics courses which you have taken. Most of the problems will require trying out different approaches and some creativity. You will spend a lot of time thinking about how to present your work so that it is understandable to others. You may also have to struggle with concepts which at first are unfamiliar. As a payoff, you will learn a new language, and, along the way, think creatively through many interesting and beautiful concepts.

2 Course Details

Class Meeting Time. You should be present at each class meeting - MWF at 3PM in 147 Altgeld.

Webpage. Syllabus and other course materials (current homework, reading assignments, office hour schedule and so on) will be posted on the course webpage:
`http://math.illinois.edu/~imilin/math347.html`

Textbook. *Mathematical Thinking: Problem Solving and Proofs, 2nd Edition.* by D'Angelo and West. All reading assignments and most, if not all, homework problems will be drawn from this text.

Office Hours. My office hours *for the first week only* will be Wednesday 4-5PM and Friday 1-3PM. My office is 337, on the third floor of Illini Hall. I am also available by appointment - just email me to schedule a time to meet, or stop by my office anytime and we'll either talk math then or arrange the time. I really encourage you to attend office hours - not just to get help, but also to discuss the course material with other students present. Office hours for the current week will always be prominently posted on the course webpage.

3 Course Requirements and Grading

3.1 Homework Problems

Written problem sets will be assigned weekly, and collected at the end of class each Friday. *The first homework, due Monday 08/31 is the only exception.* Late homework is not accepted, but the lowest homework score will be dropped. You are welcomed (encouraged!) to discuss the homework problems with other students in the class, but you must *write your own solutions.* Any work you have completed with the help of another person should be put away when you write up solutions you are going to submit for grading. Submitted solutions should be written neatly and legibly, using complete mathematical sentences and clear exposition. Write your name and class section prominently on the front page, and, if you are submitting more than one sheet, *please staple your homework.*

Each week only a subset of the problems assigned for that week's homework will be graded, but I will not in advance disclose which ones, and you are expected to submit solutions to all assigned problems. Part of the homework grade is based on the quality of *your exposition,* and standards for what constitutes correct and clear exposition will increase as you progress through the course.

Along with weekly problem sets that you should submit for grading, I may regularly post on the website some suggested practice problems, or some more challenging problems for those students fairly comfortable with the course material. These should serve only as a guideline for extra practice, or extra challenge - you are not expected to turn these in, but are welcome to discuss them with me and among each other.

3.2 Reading Assignments

At the beginning of each week I will list online those chapters from the textbook which are relevant for the week's lectures and homework. You are expected to read those carefully, take notes and work out textbook examples on your own. This should be excellent preparation for problem sets and exams, as well as a good check whether you understood what happened in lecture. Sections on *How To Approach Problems* might be of particular use.

3.3 Exams

There will be three in-class exams (50 minutes each) and a three-hour final exam. The dates are as follows:
Exam 1: Friday 10/02 in class (tentative)
Exam 2: Monday 11/02 in class (tentative)
Exam 3: Friday 12/04 in class (tentative)
Final: Friday 12/18, 1:30 - 4:30 PM

3.4 How to Compute Your Grade

Your final grade will be computed according to the following formula:

- Homework 30%
- Each in-class exam 15%
- Final exam 25%

4 Course Outline

The listing below gives a rough idea of topics we shall cover this semester, as well as the number of days (in parentheses) we'll spend on each topic. This schedule might be modified as the course progresses - we might spend more time on some topics, less on others.

Part I - Elementary Concepts (12 Class Meetings). In this part of the course we set foundations for everything that follows. Basic notions and proof techniques are introduced.

- Chapter 1: Numbers, Sets and Functions (2)
- Chapter 2: Language and Proofs (3)
- Chapter 3: Induction (4)
- Chapter 4: Bijections and Cardinality (3)

Part II - Properties of Numbers (10 Class Mettings). In this part of the course we hone the skills acquired in Part I, using examples drawn from basic combinatorics and number theory. The only way to learn is by doing, and the only way to learn proofs is by proving things!

- Chapter 5: Combinatorial Reasoning (3)
- Chapter 6: Divisibility (2)
- Chapter 7: Modular Arithmetic (3)
- Chapter 8: The Rational Numbers (2)

Part III - Discrete Mathematics (4 Class Meetings). Using proof techniques introduced in Part I and practiced in Part II, we'll try to do some more fun combinatorial examples.

- Chapter 9: Probability (2)
- Chapter 10: Two Principles of Counting (2)

Part IV - Continuous Mathematics (12 Class Meetings). In this part of the course we'll be setting calculus on a firm footing - proving statements about limits, convergence and continuity which you might have encountered in previous math classes, and which you would definitely encounter - in a more general form - in many subsequent math classes you take.

- Chapter 13: The Real Numbers (4)
- Chapter 14: Sequences and Series (4)
- Chapter 15: Continuous Functions (4)