Math 109 Winter 2010: Mathematical Reasoning
MWF 12-12:50pm, WLH 2113
Professor D. Rogalski

1. CONTACT INFORMATION

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Class web site: *www.math.ucsd.edu/~ drogalsk/109.html*. Check here for announcements, homework assignments, schedule of lectures, and other information.

Office hours: TBA, will be posted on website

Section Leader: James Berglund (6414 AP&M)

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Meeting Times: W 3-3:50pm, 4-4:50pm WLH 2110

Office hours: TBA, will be posted on website

● **Course description**

Math 109 is intended to prepare you for the upper-division math courses required of math majors. In it, you will learn basic concepts including properties of integers, set theory, functions, and counting. You will also learn techniques and conventions for writing proofs in higher mathematics. Learning to write good proofs does not happen overnight, or even in a single quarter, and you may find it frustrating at first. By the end of the course, the goal is for you to achieve a basic facility with proof writing, which you can then build on and improve in subsequent courses.

● **Prerequisites**

The prerequisite is either Math 20F or Math 31AH, both of which cover linear algebra. However, linear algebra is not used in this course, but rather the prerequisite is there to make sure you have enough experience in computationally-oriented courses in order to better appreciate the more theoretical material in Math 109. The most important prerequisite is an interest in abstract mathematics and a willingness to work hard. If you want to take this course and do not have the prerequisite, come see me and we can discuss it.

● **Waitlist**

The upper limit of 25 students per section will not be expanded. Students low down on the waitlists will almost surely not be added to the course, and even students at the top of the waitlists have no guarantee they will get in. While typically a few of the currently enrolled students will choose to drop the course at some point, conceivably this might not happen until after the first midterm. I advise students on the waitlist to enroll for Professor Gross's lecture of Math 109 instead. If you cannot take Professor Gross's lecture because of a time conflict, then remember that Math 109 is offered every quarter.

• **Textbook**

The textbook is *An introduction to Mathematical Reasoning* by Peter J. Eccles. While I think this book is good, I will not always follow the book exactly in terms of order of topics or notation. With material at this level, it is very helpful for you to see difficult concepts (at least) twice, once in class and once in your reading. Sometimes I may also omit from the lectures some less important details or proofs and leave it to you to learn them from your reading. Thus I think it is crucial that you both attend lecture and read the book. The book was chosen partially because it is a softcover and its price is reasonable, so I strongly recommend that you buy a copy.

• **Homework**

Homework will be assigned weekly, and due in class on Fridays. Late homework will not be accepted, but the lowest homework score will be dropped. Thus if a short illness or other commitment causes you to miss one homework, it is not a problem since that will just be your dropped score.

The most important part of the course is the homework. *In my experience, students that do little or no homework fail the course.* You cannot truly learn how to write proofs just by watching others, but have to practice doing it yourself. Along with more straightforward problems designed to solidify the basic definitions and concepts, the homework will contain some problems which I expect you to find difficult and are meant to challenge you. It is OK if you don't always figure all of these out, but after the homework is due you should then figure out how to do the problems you missed by talking with a friend, or asking me or your TA in section or office hours. *Solution sets to assigned homework problems will not be provided.* The book does have useful problem sections at the end of each chapter which contain more straightforward problems. You should work through as many of these problems as possible, as you read the text. The solutions to these problems are in the back of the text, so you can use these as a check on your understanding.

Some of you may have gotten in the habit in lower division courses of waiting until the day before a homework set is due to start it. That is a very bad strategy in this course, because the exercises in this course will demand more creative thinking than the typical exercise in a more computationally-oriented lower division course. Thus I think it is crucial that you begin the homework early, and work on it all week, not all in a spurt. I think you will find that if you get stuck on a difficult problem and come back to it later, you may have new ideas for how to approach it.

• **Writing Proofs**

Mathematical writing is still writing, just of a special kind. You should treat your proofs as you would very short essays for an English class. In particular, you should write in full sentences, with good grammar, and what you hand in should not be a first draft. Here is my suggested strategy for producing good homework write-ups (I still do something like this myself when I write papers.) Once you think you have figured out how to do a problem, first write out a draft solution. Often in the process of doing this, you will realize there may be minor gaps in your idea you have to fix. In the draft solution, you can cross things out, start again, insert paragraphs, etc. Once you are satisfied, you can create a neat, organized write-up of your final solution.

The idea of writing a proof is to convince someone else that what you claim is true really is; understanding why it is true yourself is only part of the process. A wandering, disorganized proof, even if it seems to contain some of the right ideas, will receive no credit if the argument cannot be followed. Because improving your proof writing is such a major part of the course, looking over the comments on your homework provided by the grader is very important to help you figure out what needs improvement.

- **Exams**

There will be 2 in-class midterms on Monday January 25 and Monday February 22. The final exam will be Wednesday March 17 from 11:30am-2:30pm. Bluebooks will not be needed; adequate room will be provided on the exam paper for your answers. No books, notes, calculators, phones, or other aids may be used during exams. The final exam will be cumulative.

- **Office Hours**

Both I and your TA will have several office hours a week where we will be available for your questions. These will be announced later and posted on the website. If on an occasional basis you need to see one of us and can not make a scheduled office hour, please e-mail one of us to set up an appointment.

- **Grading**

Your final average will be calculated as follows: Homework 20%, Midterm 1 15%, Midterm 2 15%, Final Exam 50%. Then your grade will be at least as good as the grade given by the following standard scale:

97	93	90	87	83	80	77	73	70	60
A+	A	A-	B+	B	B-	C+	C	C-	D

The final grading scale will likely be more lenient ("curved") depending on the class average.

- **Collaboration and Academic Honesty**

You are welcome to discuss the homework problems with other students at the stage when you are still formulating ideas. This may be especially useful if, for example, you are confused about definitions or what the problem is asking. The write-up you hand in should be your work alone in your own words, however, and should be written while you are by yourself. While it is also OK to seek hints from classmates that have figured out problems where you have a mental block, you will learn the most if you think about these problems hard on your own first and don't give up too quickly.

Copying or paraphrasing the finished writeup of a homework problem in whole or in part from a classmate or from any other source such as the internet, and then handing it in as your own work, constitutes academic dishonesty. As usual, copying from or talking with a classmate during an exam, or using books, notes, calculators, phones or any other aids during an exam are also not allowed. I will not hesitate to bring charges of academic dishonesty if necessary in such cases.

2. Tentative Syllabus

We will cover a large portion of the text. The following is a suggested outline of what we will cover when, and will almost surely change. A more current schedule will be announced in class and posted on the website.

1/4/10 Statements and connectives, truth tables. (Chap. 1)
1/6 Implications, arithmetic, first proofs. (Chap. 2-3)
1/8 Methods of Proof. (Chap. 3-4)

1/11 Proofs by induction I. (Chap. 5)
1/13 Proofs by induction II. (Chap. 5)
1/15 Set theory I. (Chap. 6)

1/18 Martin Luther King Day—**NO CLASS**
1/20 Set theory II. (Chap. 6)
1/22 Quantifiers. (Chap. 7)

1/25 **EXAM I**.
1/27 The Division theorem. (Chap. 15)
1/29 The Euclidean algorithm. (Chap. 16)

2/1 Consequences of the the Euclidean algorithm. (Chap. 17)
2/3 Linear diophantine equations. (Chap. 18)
2/5 Functions I. (Chap. 8-9)

2/8 Functions II. (Chap. 8-9)
2/10 Functions III. (Chap. 8-9)
2/12 Congruence of integers. (Chap. 19)

2/15 President's Day—**NO CLASS**
2/17 Equivalence relations I (Chap. 22)
2/19 Equivalence relations II (Chap. 22)

2/22 **EXAM II**.
2/24 Prime numbers (Chap. 23)
2/26 Counting finite sets (Chap. 10-11).

3/1 The binomial theorem (Chap. 12)
3/3 Number systems. (Chap. 13)
3/5 Counting infinite sets I. (Chap. 14)

3/8 Counting infinite sets II. (Chap. 14)
3/10 Catchup or special topic
3/12 Catchup or special topic

3/17 (Wed) Final exam, 11:30am–2:30pm.