Mathematics 250
Spring, 2003

Instructor: Michael Rogers
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Hours: **MWF 10:30–12:00, MW 3:30–5:00.**

Textbooks:

G. Exner, *An Accompaniment to Higher Mathematics*, 1997.
E. Landau, *Foundations of Analysis*, 1978.

These two are in the bookstore. Buy them.

C.F. Gauss, *Disquisitiones Arithmeticae*, 1801. English Edition, 1966.

This book is not in the book store. It will be made available to the students by a means yet to be determined.

References on Reserve:

Eggen, Smith, St. Andre, *Transition to Advanced Mathematics*.
Galovich, *Doing Mathematics: An Introduction to Proofs and Problem Solving*.

These two cover much of the content not in Landau. They contain valuable examples and exercises. You should consult one or the other from time to time throughout the course.

Courant and Robbins, *What is Mathematics?*

A broad selection of mathematics. A classic introduction to mathematics. It covers much of what we cover and introduces much else.

Pólya, *How to Solve It*.

A book on how to solve (math) problems, including proofs. Referred to in Exner frequently. Worth a look. There are several copies in the library.

Priestley, "Clean Writing in Mathematics," pp. 413–420 in *Calculus: An Historical Approach.* (On reserve under Math 111.)

A nice, short introduction to how mathematics should be written.

Gillman, *Writing Mathematics Well*.

Another text on writing mathematics. In particular, chapters 3, 4, and 5 apply to this course.

Course Content: Mathematics 250 is a survey of basic mathematics with a focus on proving. The course will cover elements of the propositional calculus, the predicate calculus, and techniques of proof (including mathematical induction); sets and the set-theoretical development of basic mathematical objects (relations, functions, operations); and introductions to the fields of combinatorics, number theory, group theory, and analysis.

Course Goals: The overall goal is to prepare the student for higher mathematics as well as possible in a semester. If you do take higher mathematics courses, I would appreciate feedback about how well this goal was met.

At the end of the course, the student should achieve the following process goals: to read and apply a complicated definition; to produce an example of a thing defined; to read and understand proofs; to understand what needs to be proved in a statement; to apply various strategies for proving a statement; to create simple proofs; to write a proof cogently. And the student should achieve the follow content goals: to understand the propositional and predicate calculi; to know the basic definitions in the fields of set theory, number theory, group theory, and analysis.

Use good style: Thoughts are expressed by sentences: just so in mathematics. **All work must be in complete sentences.** There are references on reserve in the library to aid the student (see above).

Coursework: Problems will be assigned and collected for credit. To receive full credit the work must be correct and **done alone**; the student will have the opportunity to revise their work until it is correct. The problems are the major component of the course.

Homework exercises will be assigned. These are for the benefit of the student and will not be collected.

Sometimes the student will have to prepare a proof for presentation in class.

Examinations: Two midterm examinations will be given outside class. They will be given around mid February and late March. They will be administered at a time convenient to both the instructor and the students. The dates may be rescheduled at the instructor's discretion.

A cumulative final examination will be given at the time scheduled by the Registrar.

Grading: Grades will be based on the problems collected for credit (45%), the final examination (20%), the midterm examinations (10% each), class presentations (5%), and class participation (10%). These percentages are approximate. This work will be judged in relation to the goals set for the course.

Outline of the Course: Approximately three to four weeks will be spent on chapters I and II of Landau's text and formal logic followed by the first midterm examination. Next, approximately six to seven weeks will be spent on Chapter 4 of Exner's text, combinatorics (handout), the ring of integers (handout), Gauss' text, and permutations. This will be followed by the second midterm examination. The last three to four weeks will be spent on chapters III through V of the *Foundations of Analysis*, cardinality, and an introduction to analysis. Chapters 1–3 of Exner's text will be read concurrently during the first four or five weeks.

How to Use the Texts:

You have not encountered a text like Exner's text in any of your mathematics courses so far. It is an *accompaniment* to mathematics. Its purpose is not to teach you any particular mathematics so much as to teach you how to read and create mathematics. Take its suggestions, methods, and points of view and apply to the other things we read and do. It has exercises grouped according to following subjects: calculus, set theory, graph theory, group theory, and occasionally linear algebra, and higher analysis (beyond calculus). You should be able to do the exercises involving just calculus. When we start set theory, you should be able to do the ones involving set theory. The rest you can save for another course.

Landau's and Gauss' texts, aside from teaching us the logical development of the number systems of mathematics, provide proofs to study and to mimic. Coming up with your own proofs depends on the one hand on insight and creativity and on the other on experience. That experience is comprised of proofs you have read and proofs you have created yourself. Most students in this course have a little experience of both, but usually not much. Landau gives us one kind of experience. We will read about 200 proofs in Landau. Study them and notice the patterns. Humans by nature are good imitators. When trying to create your own proof, imitating someone else's success on a similar problem is a good place to start.

The texts by Eggen, Smith, and St. Andre and by Galovich are more like typical textbooks. Assignments may be given from time to time out of them, or it may be recommended that you read certain passages. Their content overlaps with the course to a great extent, so you may find it beneficial to refer to them whenever you need another explanation, example, or homework exercise.

The Honor Code of Oxford College applies to all work submitted for credit in this course. By placing your name on such work, you pledge that the work has been done in accordance with the given instructions and that you have witnessed no Honor Code violations in the conduct of the assignment.