INSTRUCTOR
Max Jodeit, Jr., Vincent Hall 258, 625-3855, jodeit@math.umn.edu
Office Hours: 1:30–2:20pm, MWF, or by appointment.

TEXT
Principles of Mathematical Analysis, by Walter Rudin

MATERIAL COVERED
We'll begin with an *ad hoc* Chapter 0, devoted to finding your present mathematical "location." For example, do you know basic logic? Do you know what a quantifier is? Is it safe to *assume* you know all you need to know about the integers? Most important: **do you know what a proof is?**

We shall then begin at the beginning, and try to complete Chapter 7 this semester. That may be an ambitious goal.

We need to cover just over 5 pages, on average, for each "lecture" session (there will be some overlapping!). Our speed will depend on your need to ask extra questions, see more examples, or fewer. What you'll be asked to read "for next time" will be adjusted constantly. Tentative reading for the next week will be given each "Friday." The reading for the first 4 lectures is Chapter 1. Be sure to read all the Exercises, and read at least 4 new pages before each lecture, whether they are to be covered or not. You will probably have to make *many* readings of each page!

GRADING

There will be homework, Special Problems, 2 Tests, and a Final Exam. *Tentative* **test dates** are Oct 6 and Nov 10. Each Test may involve material covered in lecture up to the Test. Thus, you are responsible for material covered in the lectures!

Your grade in this course will reflect what you did in it, not your ability or potential. It is very important, then, for you to be able to put your work on paper, under time pressure. If you have problems taking tests, there are people on campus who might be able to help you overcome them. Ask about it at an office hour!

You'll have a GPA grade for each Test, your homework, the Special Problems and the Final. The weighting of the grades, though subject to change, is, at present: 12% for each Test, 22% for homework, 20% for Special Problems, and 34% for the Final. Grades will perhaps amount to 80-85% for A, 65-70% for B, 50-55% for C, 40-45% for D. By following the description below, you can "track" your grade as the course progresses.

Each grading item will have "Gradelines" assigned to it. For example, if the B gradeline is 70, the A gradeline is 85, and your score is 80, then your GPA grade, G, for that item is $G := 3 + \frac{80-70}{85-70}$ "=" 3.67. Here, (G is rounded to 2 places after "."). In other words, your GPA grade is a B plus $2/3$ of the way between B and A. Your GPA grade, G, on *any* grading item is computed using your score on it, and numbers g (the grade corresponding to the highest gradeline smaller or equal to your score), glb (the highest gradeline smaller or equal to your score), gla (the lowest gradeline greater than your score):

$$G = g + \frac{\text{your score} \quad - glb}{gla - glb},$$

where glb is the gradeline just below your score, gla is the next gradeline - above your score and g is the grade number: 5 for a 100% score, 4 for the A gradeline, 3 for B, etc. If your score falls on a gradeline, then $G = g$. If your score is 100% on a Test, your $G = 5$.
When the G's are combined with their weights and added, the total is your GPA grade for the course. If that total is within 0.1 of an integer, your grade is "borderline." Case-by-case decisions are made, in borderline cases, whether to award the higher or the lower grade. An important factor then is the direction your grades have taken at course's end!

Be sure to talk to me in advance if you have to miss a Test! If you do and don't make arrangements in advance, your G for that Test is zero!

If, for documented reasons beyond your control, you're passing and you can't complete the course, the grade you have up to that point "stays with you" as part of an Incomplete; all I's must be issued according to department guidelines.

Scholastic Conduct
Please read the (appropriate for you) notices in the IT Bulletin, the CLA Bulletin, and so on. You are encouraged to work with others in understanding what problems say, setting up solutions, and so on, but you must submit as YOUR work only what YOU have written up yourself. If you get ideas from a reference or from someone else, GIVE CREDIT! Do not simply copy another person's work. Graders will be asked to bring answers that look alike to my attention.

What is the course all about?
First of all, Math 5615 is *proof oriented.* This means that the lectures consist of Definitions, Theorems, Proofs, Examples, Questions (for you to answer then and there), and your questions too. These courses are also "graduate-study preparation courses." In some disciplines outside mathematics this material is prerequisite.

The homework, Tests, and Special Problems all involve *proving* some *mathematical* statement. Sometimes these proofs are routine or tedious or even tough exercises in making appropriate changes in material from the text or lectures. For examples, see Exercises 1–5 of Chapter 1. Many, however, are demanding – they require you to think deeply and call up all your resources of imagination and creativity. Examples may be Exercises 6, 7, and 19 in Chapter 1. These are the ones that are rewarding!

We could spend a semester on the construction of the real number system, starting with some Set Theory and the Peano Postulates for the Natural numbers 0, 1, 2, . . . , and I wish we could. But we will discuss the real numbers in class as part of our Chapter 0, as well as cover the material in Chapter 1 fairly quickly. Perhaps you will find out some things new to you there, such as the fact that there are many, many more real numbers than there are rational numbers, and that there are just as many integers as there are rational numbers. The most important feature of the real number system is the Completeness Axiom. You won't find the Completeness Axiom called that in the text; it is called "the least-upper bound property" in Definition 1.10. The point of Chapter 1 is that every non-empty set of real numbers that is bounded above has a least upper bound that is a real number. This prosaic-sounding statement is false when "real" is replaced by "rational." This dull definition is the engine that generates the real numbers that we need, on demand! It gives us square roots, cube roots, limits of increasing sequences that are bounded above, points where maxima and minima occur, and even the simple fact that the integers, when viewed as a subset of the reals, are not bounded above (the Archimedean Property). The complex number system and n-space are here too.

Beginning with Chapter 2, we use the point of view of *metric spaces,* which may be very new to you. But we shall be using subsets of the real number system, or "the real line," as our main, though not only, examples. This is what is done in the text. Your instructor will often point to the differences you will find later in multi-dimensional and non-metric situations. Much of what we do in multi-dimensional situations does involve using one-dimensional intuition as a guide! It is very important for you to learn well all the definitions in this chapter! Open and closed sets, boundary points, compact sets, and many more will be set out for you. It is not obvious at first what these concepts are good for. Some can even be avoided entirely by those who study only what happens in $\mathbb{R}^n$, the "space" of "n-tuples" of real numbers! But that avoidance is bought at the price of a shallower understanding.

In Chapter 3, we return to the comfortable realm of sequences of numbers, and proceed to fill in some important corners and gaps you probably have. The important concepts of "limsup" and "liminf" are introduced here. You know that a bounded sequence need not converge (don't worry if you really don't; we'll cover that too); did you know that every bounded sequence has a finite "least upper limit" and a finite "greatest lower limit?" These are, respectively, its "limsup" and "liminf." It is fun to realize that a sequence of real numbers converges if and only if its "limsup" and "liminf" are equal to each other. We will go beyond the text by covering all sorts of multiple series – carefully and completely.

In Chapter 4 we return to your first few weeks of Calculus, and "do it over." There was nothing wrong about your first course in Calculus. It was "roughed in," which is all most people need. But you will need more, and we give it here.

This is enough of introduction for now. The material in this text is seldom referred to in the mathematicas journals. That is in a way a testimony its excellence, known to working mathematicians as "baby Rudin:" Everyone who might read an advanced mathematics paper on any subject that uses Analysis is expected to know what is in here! There are several excellent texts by Professor Rudin. This one is regarded with great affection.