University of Minnesota, Morris
Syllabus for Math 4241, Number Theory
Fall 2017

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Welcome to Mathematics 4241, Number Theory! The goal of this course is to introduce you to a collection of ideas that are in the center of number theory. We meet in Science 3655 on Mondays and Wednesdays, 10:30-11:20. Our text is *Prime Numbers and the Riemann Hypothesis*, by Barry Mazur and William Stein.

The ideas center on two infinite sequences of numbers:

k	p_k	t_k
1	2	14.134725 . . .
2	3	21.022039 . . .
3	5	25.010857 . . .
4	7	30.424876 . . .
$\vdots$	$\vdots$	$\vdots$

Here p_k is the k^{th} *prime number*. You are very familiar with this sequence. For example, it probably wouldn't take you too long to work out that $p_{25} = 97$. Also t_k is the k^{th} *zeta-ordinate*. You probably haven't heard of these t_k at all! The main theme of the course is that these two sequences are intimately related to each other through *Fourier analysis.*

There are many attractive features of our situation, and I like our particular text because it gives each of these features adequate space. One attractive feature is that part of the subject is elementary. Already you can see this from the fact that the familiar sequence of primes is a central concern from beginning to end. Another attractive feature is that much of the math involved is used all throughout science, not just in number theory. For example, the Fourier analysis mentioned above is central to our understanding of light and sound, and many other things. A third attractive feature of our situation is its depth. By their definition, the numbers t_k are complex; the expectation that all of them are real is not proven, and consitutes the famous *Riemann hypothesis.* A fourth attractive feature is its *generalizability.* There are many sequences closely analogous to the t_k which are also important in number theory.

We will go through the book at approximately two sections per day, leaving the last five weeks of the course open for further related topics. A large portion of your homework for a given day will be to carefully read the sections to be discussed in class the next day. I will be *supplementing* the text in many ways in the first ten weeks. I may go into more detail about some mathematical or historical aspect, for example. You can expect to have some individual specific assignments, such as "explain Equation $x.y$ to the class" or "report to the class on how website z illustrates the chapter we just covered." We will be building up a collection of *Mathematica* commands corresponding to all the mathematical material we cover. You will also have some written homework assignments, some involving *Mathematica*, some not.

There will be three tests. All will have an in-class component and a take-home component, the latter involving *Mathematica*. Grades will be computed by the following scheme, with dates corresponding to the in-class component:

Homework including class participation:	30%
Test 1, Wednesday, Sept 27:	20%
Test 2, Wednesday, November 8:	20%
Final, 8:30-10:30, Friday, December 15:	30%

I'll provide a more detailed calendar when we've established a good rhythm for the course. The last five weeks are also not fully decided yet. Possibilities include:

- Techniques for computing the t_k to high precision.
- Modification of the approach of the book to improve convergence.
- The above-mentioned generalizations to different sequences t_k.

There are other possibilities as well. Choices will be made keeping your interests in mind.

I'm generally available to talk immediately before and immediately after class. For longer conversations, I'm looking forward to seeing you in Science 2360 in my office hours

Mondays,	1:00-2:00,
Tuesdays,	10:00-11:00,
Wednesdays,	2:30-3:30,
Thursdays,	12:00-1:00,
Fridays,	10:00-11:00.

(also posted on my homepage `http://facultypages.morris.umn.edu/~roberts`.). There is no extra credit for this course.

Percentage cutoffs are as follows:

		B+	87	C+	77	D+	65
A	95	B	83	C	73	D	60.
A−	90	B−	80	C−	70		

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This course aligns with several components of the UMM Student Learning Outcomes (`http://www.morris.umn.edu/committees/Curriculum/Learning_Outcomes_Approved.pdf`), including problem-solving, written communication, quantitative literacy, technology literacy, and collaboration. University policies which apply to this course are at Part B of `http://policy.umn.edu/education/syllabusrequirements`