

# Syllabus: Analytic Number Theory

## MATH 5362 - Fall 2014

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### Instructor Information

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*Office Hours:* Mondays 2:30 pm - 4:30 pm, and by appointment.

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### Course Information

*Classes:* MWF 11:00 am - 11:50 am in Mathematics 115

*Prerequisites:* A basic knowledge of *Elementary Number Theory* (congruences, divisibility results, etc.) is highly desirable. Some knowledge of *Complex Analysis* (in particular, the Residue Theorem) would also be quite helpful, but not essential.

*Textbook:* *Introduction to Analytic Number Theory* by Tom M. Apostol

### Course Description and Purpose

This course is an introduction to Analytic Number Theory at the graduate level. The course will introduce the standard number theoretic tools required to achieve the course's two main aims:

- (1) Prove Dirichlet's Theorem on Primes in Arithmetic Progression, i.e., If  $a$  and  $d$  are coprime integers then the arithmetic progression

$$a, a + d, a + 2d, a + 3d, \dots, a + nd, \dots$$

contains infinitely many primes.

- (2) Give the analytic proof of the Prime Number Theorem, which states that

$$\lim_{n \rightarrow \infty} \frac{\pi(x) \ln(x)}{x} = 1$$

where  $\pi(x)$  is the number of primes less than or equal to  $x$ .

The course will be based on Chapters 2-4, 6, 7, 11-13 of the textbook.

## Course Learning Outcomes

Students will learn to use some basic tools of number theory, including, but not limited to:

- the frequently occurring functions  $\phi(n)$ ,  $\mu(n)$ ,  $\Delta(n)$ ,  $\psi(x)$ ,  $\sigma_\alpha(n)$ ,  $\zeta(s)$  and  $\pi(x)$ ;
- Euler summation, partial summation, ‘big-oh’ notation and the average order of arithmetic functions; and
- Dirichlet characters,  $L$ -series and Euler Products.

By the end of the course, students should have an understanding of the proof of Dirichlet’s Theorem and of the analytic proof of the Prime Number Theorem.

## Learning Assessment

Learning outcomes will be assessed through class participation, homework exercises and a research project.

**Attendance:** Class attendance is mandatory, except in the case of an excused absence (see section below on student absences).

**Homework:** Homework will be assigned throughout the semester as written assignments, usually on a weekly basis. There will be approximately 10 such assignments over the course of the semester. Late homework will not be accepted.

**Research Project:** Students will be required to complete a research project which will be assigned in the first few weeks of the semester. Students will also be required to give a presentation to the rest of the class on the main findings of their project.

## Grading

A student’s overall percentile grade for the course will be calculated based on his/her percentile grade in each of the assessment categories described above, weighted as follows:

- Homework 50%;
- Class attendance 25%; and
- Research project 25%.

Letter grades will then be assigned in accordance with the following correspondence:

- Letter grade A = a percentile grade of 90% or higher
- Letter grade B = a percentile grade of 80% or higher, that is lower than 90%
- Letter grade C = a percentile grade of 70% or higher, that is lower than 80%
- Letter grade D = a percentile grade of 60% or higher, that is lower than 70%
- Letter grade F = a percentile grade lower than 60%

## **Civility In The Classroom**

Texas Tech University endeavors to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

## **Academic Honesty**

The TTU “Code of Student Conduct”, which you should have received when you enrolled in the university, contains a lengthy list of prohibited behaviors, among which is “Academic Dishonesty?”. Please note that cheating and plagiarism (a form of cheating) are included among the actions that are subject to disciplinary action. Cheating will not be tolerated in this course. A student who is caught cheating will receive a grade of 0 on the exam, paper, or exercise. Awarding of a grade of F for the course is also a possible penalty. In addition, the incident of academic dishonesty will be reported to the Dean of the appropriate academic college for such disciplinary action as they see fit to administer.

Plagiarism: “The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work” The Random House College Dictionary, revised edition. New York: Random House, 1975, p. 1014.

“1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” Student Affairs Handbook, Texas Tech University, Lubbock, Texas, 1998-99, p. 22.

Plagiarism and cheating are not tolerated and will result in a grade of 0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

## **Accommodation Of Students With Disabilities**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor’s office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

## **Student Absences**

**Observation Of Religious Holy Days:** A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

**Officially Approved Trips and Excused Absences:** A student who misses an examination or is unable to complete an assignment due to an officially approved trip or an excused absence (e.g. illness) will be allowed to make-up the missed examination or assignment within a reasonable timeframe thereafter. Students should notify the instructor of any such absences as soon as is possible. The student should be able to provide official evidence to support the reason for their absence (e.g. a doctor's note in the case of illness).

**Unexcused Absences:** Make-up of examinations or assignments will not be allowed in the case of unexcused absences.