

Spring 2019

Math 507 - Advanced Theory of Numbers

MWF 13:10 - 14:00 pm

SPRK 212

Instructor: Sheng-Chi Liu

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Office Hours: MWF 10:10 -11:10 am and by appointment.

Textbook: *Multiplicative Number Theory*, third edition, by H. Davenport.

Instructor's web page: <http://www.math.wsu.edu/faculty/scliu>

Number of credits: 3

Prerequisites: Math 401, 402, 421, 441 or equivalent.

Course Description: This is an introductory graduate course in analytic number theory which studies the arithmetic properties of numbers via analytic techniques. In modern cryptography, it is desired to find large primes. Gauss conjectured that the number of primes up to x should be asymptotically $x/\log x$, which is known as the prime number theorem. The distribution of primes is deeply related to Riemann's zeta function. In particular, the Riemann hypothesis gives the best estimate of the distribution of primes. More generally, the distribution of primes in arithmetic progressions is related to the Dirichlet L -functions. In this course, we will study these relations and the analytic properties of Riemann's zeta function and the Dirichlet L -functions in detail. We will also introduce the connection between the theory of Riemann zeta function and random matrix theory from physics.

Grading Policy: The components contributing to your grade in the course are weighted as follows: attendance and class participation (30%), homework(40%), and class presentations(30%).

Your letter grade will be determined as follows:

%	Grade
[90, 100]	A
[87, 90)	A-
[83, 87)	B+
[80, 83)	B
[77, 80)	B-
[73, 77)	C+
[70, 73)	C
[67, 70)	C-
[63, 67)	D+
[60, 63)	D
[0, 60)	F

Weekly Schedule:

- Week 1:** Arithmetic functions
- Week 2:** Riemann zeta function and the prime number theorem
- Week 3:** Dirichlet characters and Gauss sums
- Week 4:** Dirichlet L -functions and its analytic properties
- Week 5:** Dirichlet's class number formula
- Week 6:** Primes in arithmetic progressions
- Week 7:** Zeros of zeta function and L -functions in the critical strip
- Week 8:** Zero-free regions for zeta function and L -functions
- Week 9:** Zero density estimates
- Week 10:** The gaps between primes
- Week 11:** Siegel's theorem
- Week 12:** The prime number theorem for arithmetic progression
- Week 13:** The Polya-Vinogradov inequality
- Week 14:** The sieve methods
- Week 15:** The Bombieri's theorem

Homework: There will be regular homework assignments. It is fine for students to work together on finding solutions for these problems. However, each student must write up the solutions on his or her own. Consulting web sites or other problem solution sources (other than the textbook) is not allowed.

Learning outcomes: Students will have a better understanding on the modern development of number theory and its connection with other fields.

Absences: Making up missed work (including exams, homework, etc) will be arranged only with prior approval or in case of illness documented by a doctor's note. If you miss a lecture, you are responsible for obtaining lecture notes from another student. You are also responsible for determining if any announcements were made.

Students with Disabilities: Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call your campus resource to schedule an appointment. All accommodations MUST be approved through the campus resource. For more information contact a Disability Specialist on your campus: Pullman or WSU Online: 509-335-3417, Washington Building 217, Access.Center@wsu.edu, accesscenter.wsu.edu

WSU Academic Integrity: Academic integrity is the cornerstone of higher education. As such, all members of the university community share responsibility for maintaining and promoting the principles of integrity in all activities, including academic integrity and honest scholarship. Academic integrity will be strongly enforced in this course. Students who violate WSUs Academic Integrity Policy (identified in Washington Administrative Code (WAC) 504-26-010(3) and -404) will receive fail the course, will not have the option to withdraw from the course pending an appeal, and will be reported to the Office of Student Conduct. Cheating includes, but is not limited to, plagiarism and unauthorized collaboration as defined in the Standards of Conduct for Students, WAC 504-26-010(3). You need to read and understand all of the definitions of cheating: <http://app.leg.wa.gov/WAC/default.aspx?cite=504-26-010>. If you have any questions about what is and is not allowed in this course, you should ask course instructors before proceeding. If you wish to appeal a faculty member's decision relating to academic integrity, please use the form available at conduct.wsu.edu.

Safety and Emergency Notification: Classroom and campus safety are of paramount importance at Washington State University, and are the shared responsibility of the entire campus population. WSU urges students to follow the Alert, Assess, Act, protocol for all types of emergencies and the Run, Hide, Fight response for an active shooter incident. Remain ALERT (through direct observation or emergency notification), ASSESS your specific situation, and ACT in the most appropriate way to assure your own safety (and the safety of others if you are able).

Please sign up for emergency alerts on your account at MyWSU. For more information on this subject, campus safety, and related topics, please view the FBI's Run, Hide, Fight video and visit the classroom safety page provost.wsu.edu/classroom-safety.