

MAT 514—Theory of Numbers—Summer I 2021

Catalog Course Description: This course covers divisibility, linear congruences, the Chinese Remainder Theorem, Euler’s phi function, primitive roots, and quadratic reciprocity. Additional topics may include public-key cryptography, Diophantine equations, continued fractions, and the distribution of primes. Pre/Co requisites: MAT 514 requires a prerequisite of MAT 200 or equivalent.

Class Meetings: Mon and Wed 6:00–10:00 pm EDT via Zoom Meeting ID 973 3396 0125 with passcode 598537. A direct link is provided on the course D2L page.

Instructor: Scott Parsell sparse11@wcupa.edu, UNA 175, 610-436-3465.

Office Hours: Mon and Wed 5:00–6:00 pm EDT or by appointment, via the above Zoom meeting ID.

Textbook: There is no required textbook for the course. A set of lecture notes by Scotty P (with accompanying videos) will be used as the main reference, and free texts by Stein, Crisman, and Vaughan are provided for supplemental reading. Other good references are *Introduction to Number Theory* by Erickson and Vazzana, *Beginning Number Theory* by Robbins, and *A Friendly Introduction to Number Theory* by Silverman (see the bibliography below).

D2L: Lecture notes, concept quizzes, problem sets, tests, project ideas, grades, and other course materials will be posted on WCU’s “Desire 2 Learn” website at <https://d2l.wcupa.edu>. The D2L course page consists of four modules covering core topics, plus a fifth module setting up a structure for independent study.

Course Student Learning Outcomes: Students completing MAT 514 will be able to:

CSLO 1. Apply the Euclidean Algorithm to obtain results about divisibility and primes. (Assessed via Module 1 concept quiz, problem set, and test.)

CSLO 2. Solve linear congruences and systems thereof. (Assessed via Module 2 concept quiz, problem set, and test.)

CSLO 3. Perform modular exponentiation using Euler’s Theorem, and apply the results to public-key cryptography. (Assessed via Module 3 concept quiz, problem set, and test.)

CSLO 4. Determine whether a number is a primitive root or a quadratic residue for a given modulus. (Assessed via Module 4 concept quiz, problem set, and test.)

CSLO 5. Read, digest, and explain number theoretic concepts both verbally and in writing. (Assessed via problem sets, tests, and final independent study project.)

CSLO 5 will be assessed in all Quizzes, Tests, and Problem Sets.

Concept Quizzes: Each of the four core modules contains a concept quiz to check your understanding of basic facts and ideas, and to help you prepare for the problem sets and tests. You are encouraged to use the notes on D2L to help you as you take these. You have an unlimited number of attempts to re-take these quizzes, and the highest score is kept.

Problem Sets: Each of the four core modules has a set of problems that require written solutions to be uploaded to D2L Assignments. You may discuss the problems with other students, but your solutions **must be written up independently and in your own words**. Copying solutions from another student without acknowledgment constitutes academic dishonesty. All

solutions must be written in complete sentences using correct mathematical notation and must contain enough detail so that one of your classmates could read and follow the arguments.

Module Tests: Each of the four core modules has a test containing some problems similar to the Concept Quizzes and some similar to the Problem Sets. For these you may use any of the resources linked from D2L, a basic calculator, and your own written notes. However, collaboration is not allowed, and use of external websites, apps, software, Chegg-like resources, tutors, etc. is prohibited. You have two attempts at each test, timed at 60 minutes each, and the higher score is kept. Solutions to written response will be scanned and uploaded within the D2L quiz. Target deadlines for the module tests are 6/4, 6/11, 6/18, and 6/25.

Independent Study: Towards the end of the course, you'll be asked to think about what you've found interesting so far and to select topics beyond the core modules for further investigation. If your interests overlap with those of your classmates, you may elect to work in small groups for portions of this phase. We will work together to design a customized plan of study and problem-solving, culminating in a class presentation during the final week and a write-up summarizing your investigations. The presentation and write-up will be done individually, even if you work with others on some of the material. Depending on the substance of the project, you may propose various weights for this part of the course in your final grade (see below). A rubric for evaluating the independent study will be provided once we agree on its scope.

Grading Scheme: Grades are based on four concept quizzes (10%), four problem sets (20%), four module tests (40%), and a final independent study project (30%). A letter grade will be assigned based on performance in the course, according to the following scale:

Grade	Quality Points	Percentage equivalents	Interpretation
A	4.00		Superior graduate attainment
A–	3.67		
B+	3.33		Satisfactory graduate attainment
B	3.00		
B–	2.67		
C+	2.33		Attainment below graduate expectations
C	2.00		
C–	1.67		
F	0	< 70%	Failure

Refer to the Graduate Catalog for description of NG (No Grade), W, and other grades.

Attendance Policy: Regular attendance is expected at all sessions; if you cannot attend, please let me know. If you miss class, you are responsible for getting caught up by reading the notes and watching the relevant videos.

Class Schedule: The last day to withdraw from the course is **Friday, June 18**. The due dates for the modules should be viewed as weak upper bounds; it is best to make progress much earlier to permit an informed independent study choice and to allow time to work on that phase.

Monday class		Wednesday class		Friday deadlines	
		6/2	Divisibility and and Primes	6/4	Module 1 due (CSLO 1)
6/7	Linear congruences	6/9	Systems of linear congruences	6/11	Module 2 due (CSLO 2)
6/14	Euler's Theorem and phi function	6/16	RSA cryptography Ind study overview	6/18	Module 3 due (CSLO 3)
6/21	Primitive roots Ind Study meetings	6/23	Quadratic reciprocity Ind Study meetings	6/25	Module 4 due (CSLO 4) Presentation outline due
6/28	Presentations	6/30	Presentations	7/2	Ind Study write-up due

Bibliography:

- M. Erickson and A. Vazzana, *Introduction to Number Theory*, Chapman and Hall/CRC, 2007.
- N. Robbins, *Beginning Number Theory*, 2nd edition, Jones-Bartlett, 2005.
- J. Silverman, *A Friendly Introduction to Number Theory*, 4th edition, Pearson, 2012.

University Policies

Academic Integrity & Personal Integrity: It is the responsibility of each student to adhere to the university's standards for academic integrity. Violations of academic integrity include any act that violates the rights of another student in academic work, that involves misrepresentation of your own work, or that disrupts the instruction of the course. Other violations include (but are not limited to): cheating on assignments or examinations; plagiarizing, which means copying any part of another's work and/or using ideas of another and presenting them as one's own without giving proper credit to the source; selling, purchasing, or exchanging of term papers; falsifying of information; and using your own work from one class to fulfill the assignment for another class without significant modification. Proof of academic misconduct can result in the automatic failure and removal from this course. For questions regarding Academic Integrity, the No-Grade Policy, Sexual Harassment, or the Student Code of Conduct, students are encouraged to refer to the Department Graduate Handbook, the Graduate Catalog, the Ram's Eye View, and the University website at www.wcupa.edu

Accommodations for students with disabilities: West Chester University is committed to providing equitable access to the full WCU experience for Golden Rams of all abilities. Students should contact the [Office of Educational Accessibility \(OEA\)](#) to establish accommodations if they have had accommodations in the past or if they believe they may be eligible for accommodations due to a disability, whether or not it may be readily apparent. There is no deadline for disclosing to OEA or for requesting to use approved accommodations in a given course. However, accommodations can only be applied to future assignments or exams; that is, they can't be applied retroactively. Please share your letter from OEA as soon as possible so that we can discuss accommodations. If you have concerns related to disability discrimination, please contact the university's ADA Coordinator in the [Office of Diversity, Equity, and Inclusion](#) or 610-436-2433.

Excused absences policy: Students are advised to carefully read and comply with the excused absences policy, including absences for university-sanctioned events, contained in the WCU Graduate Catalog. In particular, please note that the "responsibility for meeting academic requirements rests with the student," that this policy does not excuse students from completing required academic work, and that professors can require a "fair alternative" to attendance on those days that students must be absent from class in order to participate in a University-Sanctioned Event.

Inclusive Learning Environment and Anti-Racist Statement: Diversity, equity, and inclusion are central to West Chester University's mission as reflected in our [Mission Statement](#), [Values Statement](#), [Vision Statement](#), and [Strategic Plan: Pathways to Student Success](#). We disavow racism and all actions that silence, threaten, or degrade historically marginalized groups in the U.S. We acknowledge that all members of this learning community may experience harm stemming from forms of oppression including but not limited to classism, ableism, heterosexism, sexism, Islamophobia, anti-Semitism, and xenophobia, and recognize that these forms of oppression are compounded by racism.

Our core commitment as an institution of higher education shapes our expectation for behavior within this learning community, which represents diverse individual beliefs, backgrounds, and experiences. Courteous and respectful behavior, interactions, and responses are

expected from all members of the University. We must work together to make this a safe and productive learning environment for everyone. Part of this work is recognizing how race and other aspects of who we are shape our beliefs and our experiences as individuals. It is not enough to condemn acts of racism. For real, sustainable change, we must stand together as a diverse coalition against racism and oppression of any form, anywhere, at any time.

Resources for education and action are available through WCU's [Office for Diversity, Equity, and Inclusion \(ODEI\)](#), DEI committees within departments or colleges, the [student ombudsperson](#), and centers on campus committed to doing this work (e.g., [Dowdy Multicultural Center](#), [Center for Women and Gender Equity](#), and the [Center for Trans and Queer Advocacy](#)). Guidance on how to report incidents of discrimination and harassment is available at the University's Office of Diversity, Equity and Inclusion.

Reporting incidents of sexual violence: West Chester University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to comply with the requirements of Title IX of the Education Amendments of 1972 and the University's commitment to offering supportive measures in accordance with the new regulations issued under Title IX, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred to the person designated in the University Protection of Minors Policy. Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at: [The sexual misconduct reporting page](#).

Emergency Preparedness: All students are encouraged to sign up for the University's free WCU ALERT service, which delivers official WCU emergency text messages directly to your cell phone. For more information, visit www.wcupa.edu/wcualert. To report an emergency, call the Department of Public Safety at 610-436-3311.

Electronic Mail Policy: It is expected that faculty, staff, and students activate and maintain regular access to University provided e-mail accounts. Official university communications, including those from your instructor, will be sent through your university e-mail account. You are responsible for accessing that mail to be sure to obtain official University communications. Failure to access will not exempt individuals from the responsibilities associated with this course.