

## Course Syllabus

# MATH 110 (Introduction to Number Theory)

Summer 2023 • MW 1:00 PM - 4:30 PM

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**Instructor** Xu Gao ([xgao26@ucsc.edu](mailto:xgao26@ucsc.edu))

**Lectures** The lectures will be **online**.

**Office Hours** By appointment. (Reach out me if you have any questions.)

**Textbook** We will follow *An Illustrated Theory of Numbers* by Martin H Weissman, focusing on Chapters 1 – 8. See [the book page](#) for more information on this book.

**Learning Outcomes** By the end of this course, you will be able to:

1. Familiarize yourself with fundamental concepts, ideas, and problems in number theory that play essential roles in modern mathematics.
2. Develop a deep understanding of the role of theorems, proofs, and counterexamples, and recognize their significance in mathematical reasoning.
3. Enhance your problem-solving skills through the exploration and application of various number theory techniques and strategies.
4. Cultivate the ability to communicate mathematical ideas clearly, concisely, and precisely through discussions, written assignments, and math writing practices related to number theory.
5. Acquire proficiency in using basic L<sup>A</sup>T<sub>E</sub>X formatting for mathematical notation, equations, and proofs, as it is an integral part of the course.

**Course Schedule** The following is a tentative course schedule.

| Week   | Topic                                   | Textbook      |
|--------|---|---------------|
| Week 1 | Linear Diophantine Equations            | Chapter 0 – 1 |
|        | Prime Numbers                           | Chapter 2     |
| Week 2 | Rational and Algebraic Numbers          | Chapter 3     |
|        | The Modular Worlds and Modular Dynamics | Chapter 5 – 6 |
| Week 4 | Assembling Modular Worlds               | Chapter 7     |
|        | Quadratic residues                      | Chapter 8     |

**Course Elements** This course consists of the following components:

- 1. Lectures (recorded)** They serve as the main learning materials for this course.
  - Recorded videos of the lectures will be uploaded to Canvas for students to access at their convenience.
  - **Mandatory quizzes** will be integrated into the lectures to assess understanding and encourage active learning.
  - Quizzes will be **graded** either by completion or with unlimited attempts.
- 2. Supplementary Materials** Along with the recorded lectures, additional materials relevant to each lecture will be provided.
  - These materials include historical notes, terminology explanations, online resources, and additional content that may not be fully covered in the lecture.
  - You are encouraged to explore these materials and use them as **references** in your assignments, exams, and essays.
- 3. Glossary** Throughout the course, you will maintain a glossary of terms and results that you find difficult to digest or wish to remember.
  - Add **your thoughts** on them, and whenever possible, include examples as well.
  - Submit your glossary as a **PDF** file to **Gradescope** before the **Final week**.
  - The glossary can be used as an index to resources for solving exam problems.
- 4. Exercises** Attached to each lecture and some supplementary notes, there will be short questions named **exercises** for practice and self-assessment.
  - Exercises are **not mandatory**: they will not be collected or graded.
  - However, they are highly recommended as they help reinforce understanding of lecture topics and practice important methods.
  - The difficulty of exercises is between quizzes and homework problems.
- 5. Homework** There will be a total of **four** weekly homework assignments.
  - Collaborative discussions with peers are encouraged. However, you must write the solutions **in your own words** and **acknowledge collaborators**.
  - Homework is expected to be typed using **L<sup>A</sup>T<sub>E</sub>X**.
  - Pay close attention to **clear** and **well-reasoned** writing.
  - **References** used in homework answers should be listed (either manually or using BibTeX). Immediate problem-solving resources should be avoided.
  - Submissions should be compiled into a **PDF** file and uploaded to **Gradescope**.
  - The specific grading policy will be determined by the TA.

**6. Exam** There will be one **take-home** final exam.

- The final exam will consist of approximately 6–8 problems and is estimated to take around 3–4 hours to complete.
- It will be released at the **beginning of the last week** and due at the **end of the session**.
- Only results (theorems/lemmas/propositions/examples) provided during the lectures or in the homework are allowed for reference.
- Solutions should be **handwritten** on the exam paper. You can upload either a **scanned copy** or an **annotated PDF** file.
- Before submitting the final exam, ensure that your solutions are **well-reasoned**, and your writing is **clear** and **legible**.
- If you have any questions, please reach out to me or the TA for assistance.

**7. Essay** The ability to present mathematical reasoning in a clear and organized manner through mathematical writing is a skill that requires training. This is also one of the objectives of this course.

- In the middle of the course, you will be provided with a **sample essay**. Your task is to complete it by filling in the missing steps or details.
- Afterward, you need to choose a topic related to number theory and **write your own essay**, following the format of the provided sample.
- Essays are expected to be typed using **L<sup>A</sup>T<sub>E</sub>X**.
- The purpose of the essay is to practice mathematical writing. While originality is not a requirement, it is essential to adhere to academic integrity, write clearly, and acknowledge collaboration and references.

**8. Discussion Sections** Discussion sections will provide students with an opportunity to ask questions, review challenging concepts, and engage in collaborative problem-solving.

- These sessions will be conducted by the TA.
- For further details, please consult with the TA.

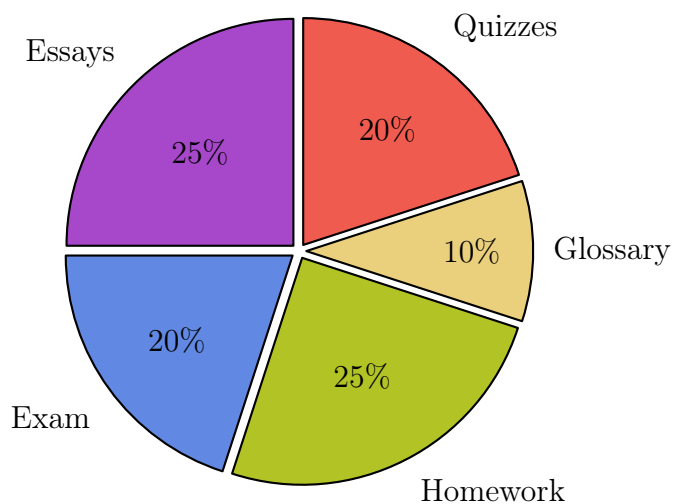
**9. Communication** Feel free to contact me if you have any questions or concerns.

- Please reach out to me primarily through **Canvas** messages. If you prefer to email me, please start the subject line with “**Math110**”.
- Provide as much information as possible regarding the topic you wish to discuss.
- I will respond within 24 hours on weekdays, but please note that weekend delays may occur. Also, remember to check Canvas for any **updates**.
- **Don’t hesitate to reach out.**

**10.  $\LaTeX$**   $\LaTeX$  is widely used for mathematical writing, and you will need basic  $\LaTeX$  skills for this course.

- To get started, take a look at the `.tex` files I provide you. You can upload them to online  $\LaTeX$  editors like [Overleaf](#) or import them into a local editor.
- For anything beyond the provided files, you can use online resources such as [Tex Stack Exchange](#), [Overleaf knowledge base](#), and  [\$\LaTeX\$  wikibook](#). Simply search for what you need on these platforms.

**Grade** The grade will be based on five parts:



The final score will be **curved with a norm distribution** and then translated to letter grades using the following grading scheme.

| Total scores | Grade |
|--------------|-------|
| $\geq 98$    | A+    |
| 90 – 97      | A     |
| 88 – 89      | A–    |
| 85 – 87      | B+    |
| 78 – 84      | B     |
| 75 – 77      | B–    |
| 70 – 74      | C+    |
| 60 – 69      | C     |
| 55 – 59      | C–    |
| 40 – 54      | D     |
| $< 40$       | F     |

To pass the course, your letter grade should be at least C.

## Summer Deadlines

| Deadlines           | Session 1          | Session 2             |
|---------------------|--------------------|-----------------------|
| Add/Swap            | Thursday, June 29  | Thursday, August 3    |
| Drop                | Monday, July 3     | Monday, August 7      |
| Request "W" Grade   | Sunday, July 16    | Sunday, August 20     |
| Change Grade Option | Sunday, July 23    | Sunday, August 27     |
| Grades Due          | Thursday, August 3 | Thursday, September 7 |

Please remember that it is your responsibility to drop or withdraw from the course. Non-attendance or non-payment will not automatically result in withdrawal. Dropping the course before the deadline will entitle you to a full-tuition refund. However, choosing to withdraw will result in a W grade being posted, and full tuition will be charged without a refund. Please note that no drop or withdraw requests will be accepted at the end of the sessions.

For questions about dropping, requesting a W grade for a course, or withdrawing from the summer sessions, email [summer@ucsc.edu](mailto:summer@ucsc.edu).

**Academic Integrity** All members of the UCSC community benefit from an environment of trust, honesty, fairness, respect, and responsibility. You are expected to present your own work and acknowledge the work of others to preserve the integrity of scholarship. For the full policy and disciplinary procedures on academic dishonesty, refer to the [Academic Misconduct page](#) at the Division of Undergraduate Education.

**Accessibility (DRC)** UC Santa Cruz is committed to creating an academic environment that supports its diverse student body. If you are a student with a disability who requires accommodations to achieve equal access in this course, please submit your Accommodation Authorization Letter from the Disability Resource Center (DRC) to me privately during my office hours or by appointment, preferably within the first two weeks of the quarter. At this time, I would also like us to discuss ways we can ensure your full participation in the course. I encourage all students who may benefit from learning more about DRC services to contact the DRC by phone at 831-459-2089 or by email at [drc@ucsc.edu](mailto:drc@ucsc.edu).

**Tutoring and Learning Support** At [Learning Support Services \(LSS\)](#), undergraduate students build a strong foundation for success and cultivate a sense of belonging in our Community of Learners. LSS partners with faculty and staff to advance educational equity by designing inclusive learning environments in Modified Supplemental

Instruction, Small Group Tutoring, and Writing Support. When students fully engage in our programs, they gain transformative experiences that empower them at the university and beyond.

**CAPS (Counseling and Psychological Services)** The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. See [the CAPS page](#) for more information.

**Title IX and Care Advisory** UC Santa Cruz is committed to providing a safe learning environment that is free of all forms of gender discrimination and sexual harassment, which are explicitly prohibited under Title IX. If you have experienced any form of sexual harassment, sexual assault, domestic violence, dating violence, or stalking, know that you are not alone. The Title IX Office, the Campus Advocacy, Resources & Education (CARE) office, and Counseling & Psychological Services (CAPS) are all resources that you can rely on for support.

Please be aware that if you tell me about a situation involving Title IX misconduct, I am required to share this information with the Title IX Coordinator. This reporting responsibility also applies to course TAs and tutors (as well as to all UCSC employees who are not designated as “confidential” employees, which is a special designation granted to counselors and CARE advocates). Although I must make that notification, you will control how your case will be handled, including whether you wish to pursue a formal complaint. The goal is to make sure that you are aware of the range of options available to you and that you have access to the resources you need.

Confidential resources are available through [CARE](#). Confidentiality means CARE advocates will not share any information with Title IX, the police, parents, or anyone else without explicit permission. CARE advocates are trained to support you in understanding your rights and options, accessing health, and counseling services, providing academic and housing accommodations, helping with legal protective orders, and more. You can contact CARE at (831) 502-2273 or [care@ucsc.edu](mailto:care@ucsc.edu).

In addition to CARE, these resources are available to you:

- If you need help figuring out what resources you or someone else might need, visit the [Sexual Violence Prevention & Response \(SAFE\) website](#), which provides information and resources for different situations.
- [Counseling & Psychological Services \(CAPS\)](#) can provide confidential counseling support. Call them at (831) 459-2628.
- You can also report gender discrimination and sexual harassment and violence directly to the University’s [Title IX Office](#), by calling (831) 459-2462 or by using their [online reporting tool](#).

- Reports to law enforcement can be made to the UC Police Department, (831) 459-2231 ext. 1.
- For emergencies, call 911.

**Report an Incident of Hate / Bias** The University of California, Santa Cruz is committed to maintaining an objective, civil, diverse, and supportive community, free of coercion, bias, hate, intimidation, dehumanization, or exploitation. The Hate/Bias Response Team is a group of administrators who support and guide students seeking assistance in determining how to handle a bias incident involving another student, a staff member, or a faculty member. To report an incident of hate or bias, please use the following form: [Hate/Bias Report Form](#).

**Religious Accommodation** UC Santa Cruz welcomes a diversity of religious beliefs and practices, recognizing the contributions differing experiences and viewpoints can bring to the community. There may be times when an academic requirement conflicts with religious observances and practices. If that happens, students may request reasonable accommodation for religious practices. The instructor will review the situation to provide reasonable accommodation without penalty. You should first discuss the conflict and your requested accommodation with your instructor early in the term. You may also seek assistance from the [Dean of Students office](#).