WisB321 - Getaltheorie (Elementary Number Theory)

Course Information

Instructor and Course Meeting Information

Instructor: Dr. Lola Thompson
E-mail: l.thompson@uu.nl
Class Sessions:
Tu 13:15 - 17:00 (Kantine Minnaert)
Th 9:00 - 12:45 (Kantine Minnaert)
Appointments: I am always happy to discuss any questions that you may have over e-mail. If you need to discuss something in depth and would like to meet, please send me an e-mail at least 24 hours in advance.
TAs: Sebastián Carrillo Santana, Justin Uhlemann, Bjorn Kiezebrink

Course Objectives

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

- Build up the basic theory of the integers from a list of axioms
- Improve your written and oral communication skills
- Compose clear, precise mathematical proofs
- Learn to work collaboratively

Course Structure

This course will be taught using an Inquiry-Based Learning (IBL) model. The format will be very different from that of a typical math course. In particular, there will be very few lectures and no assigned reading. A typical class period will consist primarily of working on problems in small groups. Rather than being presented with neatly-packaged theorems and proofs, in this course you will be asked to devise your own conjectures and then prove them for yourself!

Textbook

There is no textbook for this course. In fact, students will write their own number theory textbooks over the course of this block... (for more info, see the "Textbook Project" section)

Is WisB321 right for me?

- The official pre-requisites for WisB321 are Linear Algebra, Group Theory, Ring Theory, and Galois Theory. That said, this will be a self-contained course and we will not be using any specific concepts from your prior coursework. The main purpose of these pre-requisites is to ensure that students entering the course will have adequate experience with writing mathematical proofs.
- The goal of this course is to discover the major ideas from number theory through carefully-scaffolded worksheets. If you already have a significant background in elementary number theory, then this course may not be ideal for you. It is no fun "discovering" concepts that you have already learned elsewhere!

If you have any concerns about whether WisB321 is an appropriate course for you to take this spring, please speak with me as soon as possible!

Grades

The grades in this course will be calculated as follows*:

	Weight
Class Participation	15%
Hand-in Exercises	25%
Quiz #1	15%
Quiz #2	15%
Textbook Chapter Proposal	5%
Final Textbook Project	25%

*If you have already taken this course at Utrecht University, you may be offered alternative assessments.

Class participation

Class participation is essential in a course of this nature. When you miss class, you are not only affecting your own progress in the course but you are also causing your working group to be short one member. Your class participation grade (worth 15% of your course grade) will be calculated using the following formula:

- Group work (10 points)
- Textbook proposal peer feedback (5 points)

Attendance: Each student is granted three "unexcused" absences. After that, each additional absence will result in a 1 point deduction from your Group Work grade. There is no need to e-mail me to explain an unexcused absence. If you have a prolonged illness, or if you have another conflict that will cause you to miss more than three classes, please contact me so that we can discuss appropriate accommodations.

Group work: Working groups will be assigned. They will normally consist of 3-4 students. Groups will be shuffled (approximately) every two weeks. That way, you will have the opportunity to work with many of your classmates by the end of the block. If you are having a serious problem with someone in your assigned group, please contact me ASAP.

Textbook Proposal Peer Feedback: See *Textbook Project* section below.

Homework Assignments

Each problem set contains a Group portion and an Individual portion. The Individual problems are indicated with an asterisk (*) and they will be handed in on Mondays and graded. Students will work on the Group problems in small assigned groups during the lecture period. The Group problems are not to be handed in. However, all students are responsible for all of the material from the problem sets. The problems in this course will build on one another, and you will have a difficult time following the course if you are missing solutions to some of the earlier "scaffolding" problems. Moreover, the quiz questions may come from the Group problems, and your final project will certainly include some proofs from the Group problems. For these reasons, you are strongly encouraged to maintain a journal or LaTeX document that contains all of your problem set solutions. You can always ask for help with the Group problems during the tutorial sessions.

Quizzes

There will be two 45-minute in-class quizzes. These will test your ability to solve routine problems and write short proofs. Some, but not all, of the quiz questions will be taken from the daily problem sets. If you want to perform well on the quizzes, it is strongly recommended that you solve ALL problems on the problem sets, including the ones that are not handed in. Since the quizzes are timed, you will not need to use LaTeX to write up your solutions.

Textbook Project

At the end of the term, you will have the opportunity to (co-)author your own textbook chapter, either on your own or with one other student. This will involve revising a portion of your work from over the course of this block, organizing it so that the ideas build on one another, and inserting appropriate exposition to explain the flow of ideas. Points will be awarded based on a number of criteria, including: mathematical completeness/correctness, clarity of explanations, quality of exposition, organization of content, and inclusion of illustrative examples. When writing your textbook chapter, you should imagine that the intended audience is "Future WisB321 students." In other words, you should explain things on a level that another student who has not taken this course can follow the ideas; you should NOT imagine that the book is meant for your instructor.

A textbook chapter proposal, which includes the topic that you have chosen and a sketch of which theorems will be included, will be due at the beginning of class on June 20th. Students will be placed in groups with other students who are writing complementary chapters. Each group will collectively write a single textbook for our course. On June 20th, you will be provided with an opportunity to hold a conference with your group members to discuss each of your proposals. In order to create the best possible textbook, it is in your best interest to help your group members. To that end, each student will fill out a peer evaluation form with feedback for their classmates. The peer evaluation form is worth 5% of your final grade in order to incentivize you to give thoughtful feedback to help your classmates. That said, your grade on the final Textbook Project will be solely based on what you write in your own individual chapter.

The textbook project must be completely solely by you (and your co-author, if you have one). In other words, you may NOT use ChatGPT or any other resources to generate the text.

Blackboard

Copies of the problem sets will be posted at the beginning of each class period on our course Blackboard site. Go to `http://uu.blackboard.com` to access these materials.

LaTeX

All students will be expected to write up their hand-in exercises using LaTeX. If you are unfamiliar with LaTeX, please contact me as soon as possible. To help everyone improve their LaTeX skills, I will post a number of LaTeX resources on our course Blackboard page. I will also post the .tex files associated with most of our problems sets so that you will be able to figure out how to create number theory-specific symbols. If you do not have LaTeX installed on your computer, you can find a free web-based version at Overleaf: `https://www.overleaf.com`

Course Policies

Academic Honesty

Homework
Each week, your homework assignment will be to finish the problems from the problem sets, and turn in carefully-written solutions to the starred (*) hand-in problems. You are welcome to consult with your class notes, your classmates and the instructor. However, you *may not* consult any textbooks or internet resources – otherwise, you run the risk of ruining the surprise of discovering the course content for yourself. Your experience in WisB321 will be much richer (and your intuition for the subject far greater) if you arrive at the solutions without the aid of a book. You are welcome to work with other students on the hand-in problems. However, each student must write up their solutions independently. In order to avoid falling into the trap of writing up similar solutions, you should put away any notes from discussions with your classmates and re-construct the solutions on your own. You MAY NOT turn in homework that looks substantially similar to something that another person has written (this includes materials created by the instructor). Translating the words of others into another language is also a form of plagiarism.

Quizzes
You are not allowed to consult any source *other than the instructional staff* during the quizzes. In particular, this means that you may not use any of the following to assist you with solving the quiz questions: *calculators, smartphones, laptops, notes, textbooks, Chegg.com, Chat GPT, etc.* You MAY contact the instructor or TAs to ask clarifying questions (e.g, "Should we assume that p is a prime?").

Note: Information about Utrecht University's policies on academic dishonesty can be found here: `https://students.uu.nl/en/practical-information/policies-and-procedures/fraud-and-plagiarism`. Please familiarize yourself with its content. All students are responsible for maintaining the highest standards of honesty and integrity in every phase of their academic careers. The penalties for academic dishonesty can be severe and ignorance is not an acceptable defense.

Disabilities

Some students in this course may have disabilities, including "invisible" disabilities such as chronic diseases and learning disabilities. If you are in need of disability-related learning accommodations, you should contact your studieadviseur as soon as possible. I am also very happy to discuss appropriate accommodations with you if you feel comfortable disclosing information to me (I will keep any information that you do disclose confidential).

Make-up Policy

Homework: Our student TAs make it possible to grade 40+ assignments in the span of a week! In order to avoid overburdening them with special requests, late homework cannot be made up. That said, I understand that everyone has something come up from time-to-time. To that end, I will drop your lowest homework scores at the end of the term. That way, if you do miss an assignment, your grade in the course will not be negatively impacted. If you have a prolonged illness (> 1 week), please contact me so that we can work out reasonable accommodations.

Quizzes: If you know ahead of time that you have an academic conflict with one of our quiz dates, you must make arrangements with me ahead of time to make up the quiz. Should you contract a serious illness or find yourself in an emergency situation, please contact me *immediately* so that we can discuss reasonable accommodations.

Textbook: Your textbook project is your final exam in this course. It will be due on the last Friday of Block 4 at 17:00.

Religious Observances

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in the course, please contact me as soon as possible so that we can discuss appropriate accommodations.

Course Schedule

The following is an estimated schedule for the course. Please note that the quiz dates are tentative.

Lectures	Course Plan	Homework Due
22/4	Introduction; Problem Set #1	Pre-class survey (on Blackboard)
24/4	Problem Set #2	
29/4	Problem Set #3	Hand-in problems from Sets #1 & 2
1/5	Problem Set #4	
6/5	Problem Set #5	Hand-in problems from Sets #3 & 4
8/5	Problem Set #6	
13/5	Problem Set #7	Hand-in problems from Set # 5 & 6
15/5	Problem Set #8	
20/5	Problem Set #9	Hand-in problems from Sets #7 & 8
22/5	Problem Set #10; Quiz #1	
27/5	Problem Set #11	Hand-in problems from Sets #9 & 10
29/5	No Class - Ascension Day	
3/6	Problem Set #12	Hand-in problems from Sets #11
5/6	Problem Set #13	
10/6	Problem Set #14	Hand-in problems from Sets #12 & 13
12/6	Problem Set #15; Quiz #2	
17/6	Special Set*	Hand-in problems from Sets #14 & 15
19/6	Peer Feedback Session	Textbook chapter proposal due
27/6		Textbook chapter due at 17:00

*Possible topics: Pell's equation, cyclotomic polynomials, analytic number theory, cryptography,...