Course number	U-LAS10 10024 LE55		
Course title (and course title in English)	Quest for Mathematics II-E2 Quest for Mathematics II-E2	Instructor's name, job title, and department of affiliation	Research Institute for Mathematical Sciences Senior Lecturer,UEDA FUKUHIRO
Group	Natural Sciences	Field(Classification)	Mathematics(Foundations)
Language of instruction	English	Old group	Group B
Number of credits	2		
Number of weekly time blocks	1	Class style	seminar (Face-to-face course)
Year/semesters	2025 • First semester		
Days and periods	Thu.4	Target year	All students
Eligible students	For all majors		

[Overview and purpose of the course]

You might have heard of the following expression from Gauss (1777-1855): "Mathematics is the queen of sciences and number theory is the queen of mathematics. She often condescends to render service to astronomy and other natural sciences, but in all relations she is entitled to the first rank."

What is number theory? At the most basic level, it is the study of the properties of the integers Z={..., -2, -1, 0, 1, 2, ...}.

In this course, we will study certain topics in elementary number theory, including (but not limited to) divisibility, congruences, quadratic reciprocity, and arithmetic progressions. Some abstract algebra will be introduced in class as a tool of number theory.

[Course objectives]

The class is meant to help students of all disciplines improve their knowledges in number theory. Moreover, students will improve their communication skills in English via oral discussions and presentations.

[Course schedule and contents)]

Below is the contents and schedules of the course. Some of these topics may be assigned to the students for their presentations. The lectures and presentations, as well as their orders, may be modified, depending on students' backgrounds and understanding of the course materials. The instructor will provide corrections and comments on students' presentations.

(1) Introduction (Week 1)
-Some basics in set theory and logic, motivating examples and conjectures, remarks on the course materials.

(2) Divisibility (Weeks 2-4)
-The division algorithm, prime numbers;
-The fundamental theorem of arithmetic.

(3) Congruences (Weeks 5-8)
-Congruence relations;
-Fermat's theorem and Euler's generalization;
-The Chinese Remainder theorem, Hensel's lemma;

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(4) Quadratic reciprocity (Weeks 9-12)
-Legendre symbols, the reciprocity law;
-Binary quadratic forms;
-Gaussian integers, two squares theorem.

(5) Arithmetic progression (Week 13-14)
-The Jacobi symbols;
-Equivalence of binary quadratic forms.

Total：14 classes, 1 Feedback session

[Course requirements]

There are no formal prerequisites for the class. Some familiarity with mathematical proofs (e.g. as one sees in Calculus and Linear Algebra) will be helpful, but not required.

[Evaluation methods and policy]

The evaluation consists of three weighted parts:

- Discussion performance in class (20%).

- Presentation (60%): Each student reviews a mathematical topic assigned by the instructor.

- Report (20%): An essay on the topic of presentation.

[Textbooks]

A. Weil 『Number Theory for Beginners』 （Springer）ISBN:9781461299585（E-book available at Kyoto U library）
Ivan Niven, Herbert Zuckerman, and Hugh Montgomery 『An Introduction to the Theory of Numbers』 （Wiley）ISBN:9780471625469（This book is thorough）
Jean-Pierre Serre 『A Course in Arithmetic』 （Springer）ISBN:9780387900407（E-book available at Kyoto U library）

[References, etc.]

（References, etc.）
Kenneth Ireland and Michael Rosen 『A Classical Introduction to Modern Number Theory』 （Springer）ISBN:9780387973296（This book may be helpful to the students who have studied modern algebra systematically.）
J. S. Milne 『Algebraic Number Theory』 （This lecture note may be helpful to the students who have studied modern algebra systematically.）

[Study outside of class (preparation and review)]

Along with preparation and review, students are encouraged to form study groups.

[Other information (office hours, etc.)]

[Essential courses]