Course number	U-LAS70 10002 SE50				
Course title (and course title in English)	ILAS Seminar-E2 :Encounters with modern arithmetic（現代整数論との出会い） ILAS Seminar-E2 :Encounters with modern arithmetic	**Instructor's name, job title, and department of affiliation**	Research Institute for Mathematical Sciences Senior Lecturer,UEDA FUKUHIRO		
Group	Seminars in Liberal Arts and Sciences	**Number of credits**	2	**Number of weekly time blocks**	1
Class style	seminar (Face-to-face course)	**Year/semesters**	2024・First semester	**Quota (Freshman)**	15 (15)
Target year	Mainly 1st year students	**Eligible students**	For all majors	**Days and periods**	Thu.5
Classroom	36, Yoshida-South Campus Academic Center Bldg. North Wing			**Language of instruction**	English
Keyword	Galois theory / polynomials / modern algebra				

[Overview and purpose of the course]

It is a classical question from centuries ago whether a quintic (or of higher degree) polynomial equation is solvable in terms of its coefficients, with only use of the usual operations (addition, subtraction, multiplication, division) and application of radicals (square roots, cube roots, etc). It was French mathematician E. Galois who proposed the correct framework for such a question, the answer to which turns out to be negative in general. Nowadays, the theory of Galois has become an essential part of modern abstract algebra.

The so-called "fundamental theorem of Galois theory" is commonly considered as the summit of a course in (undergraduate) abstract algebra, which usually takes a year to complete. In this half-year course we start from the beginning of abstract algebra, with emphasis on the concepts and examples that shall help us reach Galois theory.

It is worth mentioning that abstract algebra has also found applications in science and engineering, e.g. in cryptography.

[Course objectives]

We will learn the basic concepts and theorems in group theory, ring theory, field theory, and Galois theory. As an application, we shall also be able to determine which polynomial equations are solvable in radicals.

[Course schedule and contents)]

We intend to cover a big chunk of modern algebra in a condensed and interesting way, to make it accessible to most undergraduate students. Both concepts and examples will be emphasized.

Below is the plan and contents of the course. (The lectures, as well as the order of the lectures, may be modified, depending on students' background and understanding of the course materials.)

- Set Theory [1 week]:
  Notion of sets, mappings, mathematical induction, Zorn's lemma.

- Group theory [3-4 weeks]:

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Definition and examples of groups, homomorphisms, abelian groups, Sylow's theorem.

- Ring theory [3-4 weeks]:
Definition and examples, ideals, Euclidean domains, PIDs, UFDs, polynomial rings.

- Field theory [2-3 weeks]:
Definition and examples, field extensions, polynomials, finite fields.

- Galois theory [2-3 weeks]:
Galois extensions, roots of unity, solvability.

Total: 14 classes and 1 feedback

[Course requirements]

It is helpful to know basics in linear algebra, but not required.

[Evaluation methods and policy]

The evaluation consists of the following weighted parts:

- 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]

D. Dummit and R. Foote 『Abstract Algebra』 （Wiley; 3rd edition）ISBN:9780471433347
There is no need to purchase the textbook in advance. The details will be explained in the first class.

[References, etc.]

（References, etc.）
Other supplemental materials will be introduced during the classes.

[Study outside of class (preparation and review)]

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

[Other information (office hours, etc.)]