Course number	U-LAS70 10002 SE50				
Course title (and course title in English)	ILAS Seminar-E2 :The Life and Work of Albert Einstein（アルバート・アインシュタインの生涯と業績） ILAS Seminar-E2 :The Life and Work of Albert Einstein	**Instructor's name, job title, and department of affiliation**	Research Institute for Mathematical Sciences Assistant Professor,Helmke, Stefan		
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**	2025・First semester	**Quota (Freshman)**	15 (15)
Target year	Mainly 1st year students	**Eligible students**	For all majors	**Days and periods**	Tue.5
Classroom	04, Yoshida-South Campus Bldg. No. 1			**Language of instruction**	English
Keyword	Non-euclidean geometry / curvature / relativity				

[Overview and purpose of the course]

In spite of what the title of this seminar may suggest, its main objective is to study the developments of geometry during the 19th century, which culminated in Einstein's general theory of relativity in the early 20th century. At this early time, the only experimental fact confirming Einstein's theory was the abnormal orbit of mercury. Shortly after, the bending of light in the gravitational field of the sun was also confirmed. We will develop the geometric tools necessary to understand those phenomena and also gravitational waves, whose recent discovery received the Nobel price in physics of the year 2017.

[Course objectives]

The aim of this course is to understand the interaction between mathematics and the natural sciences and to engage in English discussions on a scientific topic.

[Course schedule and contents)]

The exact contents of the seminar is flexible and may depend on special interests of the students. But the topics to be covered will be essentially as follows.

The first four weeks we will study Einstein's special theory of relativity and its historical background. This includes a brief introduction to multidimensional calculus, electrodynamics and the four dimensional Minkowski space.

The following five weeks will be devoted to the developments of differential geometry, beginning with the notion of curvature of a plane curve due to Huygens and Newton in the 17th century,
followed by Euler's definition of principal curvatures of a surface embedded into space, Gauss's intrinsic geometry of a surface and finally Riemann's concept of a manifold and its curvature. Parallel,
we will also study the idea of Non-Euclidean geometry which developed during the same period of time and which turned out to be related to the above and of some importance for Einstein later.

We will then just need two more weeks to understand the basic ideas of the general theory of relativity, i.e. the equivalence principle and Einstein's field equations.

Continue to ILAS Seminar-E2 :The Life and Work of Albert Einstein（アルバート・アインシュタインの生涯と業績）(2)↓↓↓

ILAS Seminar-E2 :The Life and Work of Albert Einstein (アルバート・アインシュタインの生涯と業績) (2)

The last three weeks we will study the following applications of the general theory of relativity:
1. The mercury orbit and bending of light, 2. Simple cosmological models and 3. Gravitational waves.

[Course requirements]

None

[Evaluation methods and policy]

The evaluation is based on a presentation, which will be given during the class.

[Textbooks]

Not used

[References, etc.]

（References, etc.）
Introduced during class

[Study outside of class (preparation and review)]

The students will be asked to prepare a short presentation.

[Other information (office hours, etc.)]

No particular office hour, but students can make arrangements after the class or by email.

[Essential courses]