Course number	U-LAS10 10014 LE55		
Course title (and course title in English)	Mathematical Description of Natural Phenomena Mathematical Description of Natural Phenomena	Instructor's name, job title, and department of affiliation	Graduate School of Engineering Associate Professor,Chang, Kai-Chun

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	Lecture (Face-to-face course)	Year/semesters	2025・First semester

Days and periods	Tue.3	Target year	Mainly 1st year students	Eligible students	For science students

[Overview and purpose of the course]

One of the major reasons of providing this course is the noticeable gap between high school mathematics and college mathematics. The gap has led to a marked decline in the students' ability not only to grasp physical phenomena observed in engineering disciplines but also to explain principles behind the phenomena - e.g. to describe and analyze natural phenomena by means of differential equations.
This course aims at bridging the gap between high school mathematics and college mathematics. Through this course, students learn how the physical phenomena in engineering disciplines - e.g. vibration of a structure, wave propagation, fluid dynamics and so on - are described in differential equations. They also learn how those physical phenomena are solved by differential equations.

[Course objectives]

・To understand the relationship between scientific observation and mathematics.
・To understand how the physical phenomena in engineering disciplines are described in differential equations, as well as how to solve them.

[Course schedule and contents)]

* To achieve the goal, this lecture will cover the following topics.
1. Picture of Calculus, basics of differentiation and integration
2. e, the base of the natural logarithm
3. Complex numbers, exponential function, logarithmic function and trigonometric functions
4. Differential equations and physical phenomena modelling

* The lecture is designed to cover following topics, in detail.

1. Introduction
 - Describing phenomena, input-output system model, etc. [2 weeks]

2. Basics of Calculus
 - Picture of Calculus, derivatives, basic rules, chain rule, implicit differentiation, inverse functions and their derivatives, etc. [4 weeks]
 - Exponential and logarithmic functions, their derivatives, characterizations of exponential functions, etc. [2 weeks]

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Mathematical Description of Natural Phenomena(2)

3. Differential equations and phenomenon descriptions
- Radioactive decay, population growth/decay, mixed growth/decay [3 weeks]
- Spring problems, equations of motion, simple harmonic motions, damped vibrations, etc. [3 weeks]

4. Feedback [1 week]

[Course requirements]

None

[Evaluation methods and policy]

Quizzes and exercises (50%) and final examination (50%)

[Textbooks]

Handouts distributed in class or uploaded to PandA

[References, etc.]

（References, etc.）

G. Strang 『Calculus, 2nd ed.』 （Wellesley-Cambridge Press）
W.F. Trench 『Elementary Differential Equations』 （Brooks/Cole）

[Study outside of class (preparation and review)]

Students are expected to spend at least 2 hours on this course for preview and review. More than half of that time is spent preparing for class and doing assignments.

[Other information (office hours, etc.)]

Any inquiry to the instructor: chang.kaichun.4z{at}kyoto-u.ac.jp. (replace {at} with @)