Course number	U-LAS10 10025 LE55		
Course title (and course title in English)	Mathematical Description of Natural Phenomena-E2 Mathematical Description of Natural Phenomena-E2	**Instructor's name, job title, and department of affiliation**	Graduate School of Engineering Senior Lecturer,ISLAM, A K M Mahfuzul
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	2024・First semester		
Days and periods	Tue.2	**Target year**	Mainly 1st year students
Eligible students	For science students		

[Overview and purpose of the course]

Mathematics is a powerful tool to understand nature and solve different problems. Usually, high-school level textbooks only teach problem-solving techniques. However, the beauty of mathematics lies in understanding the phenomena that the mathematical concepts represent. For example, why the base of the natural logarithm e has a particular value of "2.718⋯", what exactly is the complex number, etc. This course aims at developing a solid understanding of several mathematical concepts. Therefore, the focus will be on developing knowledge through experimenting and simulating different natural phenomena. Through this course, students will learn how various natural phenomena, such as the vibration of a structure, wave propagation, fluid dynamics, and so on - can be described in differential equations. They will also learn how to solve these physical problems using different techniques. At the end of the course, students will be confident in developing mathematical models of different problems they face and effectively solve those problems.

[Course objectives]

1. To understand the relationship between scientific observation and mathematics
2. To learn why and how most physical phenomena can be expressed using differential equations
3. To understand the origin of basic mathematical concepts such as the basis of the natural logarithm, e, and complex numbers
4. To learn how to solve the differential equations

[Course schedule and contents)]

1. Introduction to differential equations [2 weeks]
   1-a) Basic definitions and concepts
   1-b) Some basic theory
   1-c) Applications
2. Different types of natural phenomena [2 weeks]
   2-a) Diffusion-type
   2-b) Hyperbolic-type
   2-c) Elliptic-type
   2-d) Experiments to show different types of natural phenomena
3. Review of Calculus [3 weeks]
   3-a) Derivative rules, implicit differentiation, inverse functions, etc.
   3-b) Exponential and logarithmic functions
   3-c) The base of the natural logarithm, e

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4. Ordinary and partial differential equations [1 week]
5. Techniques to solve differential equations [4 weeks]
   5-a) First-order differential equations
   5-b) Second-order differential equations
   5-c) Series solutions
6. Complex number [2 weeks]
   6-a) What is the number?
   6-b) Two-dimensional number
   6-c) Applications of complex numbers
7. Examinations [1 week]
8. Feedback [1 week]

[Course requirements]

None

[Evaluation methods and policy]

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

[Textbooks]

Instructed during class
- Instructed during class
- Handouts distributed in class and uploaded to website prior to class

[References, etc.]

（References, etc.）

Stanley J. Farlow 『An Introduction to Differential Equations and Their Applications』
Stanley J. Farlow 『Partial Differential Equations for Scientists and Engineers』

[Study outside of class (preparation and review)]

Preparation and review are required. Handouts will be provided. Sample programs using Python will be provided to simulate different phenomena. Students are encouraged to run the programs and visualize the phenomena to have a deep understanding.

[Other information (office hours, etc.)]

Students are welcomed to contact personally to discuss their problems. An appointment is required via e-mail.