

<b>Course number</b>		U-LAS10 10025 LE55					
<b>Course title (and course title in English)</b>	Mathematical Description of Natural Phenomena-E2				<b>Instructor's name, job title, and department of affiliation</b>	Graduate School of Engineering Senior Lecturer, ISLAM, A K M Mahfuzul	
	Mathematical Description of Natural Phenomena-E2						
<b>Group</b>	Natural Sciences			<b>Field(Classification)</b>	Mathematics(Foundations)		
<b>Language of instruction</b>	English			<b>Old group</b>	Group B	<b>Number of credits</b>	2
<b>Number of weekly time blocks</b>	1	<b>Class style</b>	Lecture (Face-to-face course)		<b>Year/semesters</b>	2025 • First semester	
<b>Days and periods</b>	Tue.2		<b>Target year</b>	Mainly 1st year students	<b>Eligible students</b>	For science students	
<b>[Overview and purpose of the course]</b>							
<p>Mathematics is a powerful tool. Mathematics helps us to understand nature better. Mathematics helps us to solve different problems elegantly. However, mathematics is not just calculation. The beauty of mathematics lies in abstraction. If you understand mathematics, you can describe mathematics using your own language. For example, the base of the natural logarithm <math>e</math> has a particular value of "2.718...". We all know that. But can you answer why <math>e</math> has such a value without using strict mathematical definitions? This course aims at developing a solid understanding of several mathematical concepts. The focus will be on deepening understanding 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 solving those problems.</p>							
<b>[Course objectives]</b>							
<ol style="list-style-type: none"> <li>1. To understand the relationship between scientific observation and mathematics</li> <li>2. To learn why and how most physical phenomena can be expressed using differential equations</li> <li>3. To understand the origin of basic mathematical concepts such as the basis of the natural logarithm <math>e</math>, complex numbers, etc.</li> <li>4. To learn how to solve the differential equations numerically.</li> </ol>							
<b>[Course schedule and contents)]</b>							
<ol style="list-style-type: none"> <li>1. Introduction to ordinary differential equations [2 weeks] <ol style="list-style-type: none"> <li>1-a) Basic definitions and concepts</li> <li>1-b) Some basic theory</li> <li>1-c) Applications</li> </ol> </li> <li>2. Different types of natural phenomena [2 weeks] <ol style="list-style-type: none"> <li>2-a) Diffusion-type</li> <li>2-b) Hyperbolic-type</li> <li>2-c) Elliptic-type</li> <li>2-d) Experiments to show different types of natural phenomena</li> </ol> </li> <li>3. Review of calculus [3 weeks] <ol style="list-style-type: none"> <li>3-a) Exponential and logarithmic functions</li> <li>3-b) The base of the natural logarithm, <math>e</math></li> </ol> </li> <li>4. Introduction to partial differential equations [1 week]</li> </ol>							
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## Mathematical Description of Natural Phenomena-E2(2)

### 5. Techniques to solve differential equations [4 weeks]

- 5-a) First-order differential equations
- 5-b) Second-order differential equations
- 5-c) Series solutions
- 5-d) Numerical methods

### 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 deeper understanding.

## [Other information (office hours, etc.)]

Students are welcome to contact me personally to discuss their problems.