

Mathematical Physics and Numerical Methods 2

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|--------------------------|--------------------------------------|--|------------------|-------------------|
| Course Name | Course type (credit/hours) | Elective course(3/3) | Course code | G074 |
| | Target students Division/major/grade | Physics/Sophomore | Opening semester | 2021 2ND SEMESTER |
| | Class time and classroom | Mon D(Seong337)Thu D(Seong337) | English Grade | A(100%English) |
| Reference to this course | Prerequisite courses | Math 1, Math 2, Mathematical Physics and Numerical Methods 1 | | |
| | Related basic courses | Physics 1, Physics 2 | | |
| | Recommended concurrent courses | | | |
| | Related advanced courses | Electromechanics 1, Electromechanics 2, Quantum Mechanics 1, Electromechanics 2, Statistical Mechanics | | |

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|--------------------|-----------------------|---------------|--|------------------|---|--|
| Instructor | Name (title/division) | | Jun Won Rhim(Assistant Professor, Physics) | | | |
| | Office Room Number | Woncheon 420호 | Office phone Number | 2579 | e-mail | |
| | Office hours | | | Homepage address | https://sites.google.com/view/ajou-cmtg | |
| Teaching Assistant | Name (title/division) | | | | | |
| | Office Room Number | | Office phone Number | | e-mail | |

1. Introduction

This course teaches the mathematical methods essential in various subjects of physics and engineering (quantum mechanics, electromagnetism, solid state physics, thermodynamics, statistical mechanics, AI computational physics, quantum information, etc.).

This course is for the students who already attended the Mathematics 1, 2, and Mathematical Physics and Numerical Methods 1.

Topics include Fourier series, Fourier transform, various differential equations, calculus of variations, tensor analysis, special functions, complex functions, and probability and statistics. We deal with some basic numerical analysis regarding Fourier transform and ordinary differential equations.

2. Course Objectives

Through this class, I learn mathematical languages to understand the various subjects of physics and engineering that I will learn in the higher grades.

3. Class types and activities

Mathematics is said to be the language of physics. For example, the Schrödinger's equation for quantum mechanical wave functions of elementary particles, Maxwell's equations for electromagnetic waves, and Newton's equation of motion for the classical particles, are all described by the mathematical language called the differential equations. When calculating the quantum mechanical energy levels and natural frequencies of a wave, an eigenvalue problem of a matrix must be solved, which is dealt with in the Linear Algebra Part. In order to effectively obtain the electric and magnetic fields in space when charges and currents are given, various techniques related to integration and vector analysis are required. In addition to this, there are various mathematical techniques necessary to understand physics accurately and deeply, such as complex analysis, special functions, infinite series, and Fourier transforms.

This course focuses on learning these mathematical techniques and their possible physical applications. Since the main goal is to learn the language necessary for physics, rigorous mathematical proofs are avoided if possible.

Through this course, students may gain the foundation for the understanding of the cutting-edge disciplines of physics and basic knowledge about the production and processing of data required in the research.

4. Teaching Method

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|--|---|
| <input checked="" type="checkbox"/> lecture | <input type="checkbox"/> discussion and debate |
| <input type="checkbox"/> team project(presentation and case studies) | <input type="checkbox"/> experiments(role-playing,etc) |
| <input type="checkbox"/> designing and production | <input type="checkbox"/> on-site learning(on-site training) |
| <input type="checkbox"/> others | |

5. Support Systems in Use

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|--|---|---|
| <input checked="" type="checkbox"/> AjouBb | <input type="checkbox"/> automatic recording system | <input type="checkbox"/> web-based assignment |
| <input type="checkbox"/> cyber lecture | <input type="checkbox"/> online content | |
| <input type="checkbox"/> class behavior analyzing system | <input type="checkbox"/> others | |

6. Teaching Tools

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|--|---|---|
| <input type="checkbox"/> PBL(Problem Based Learning) | <input type="checkbox"/> CBL(Case Based Learning) | <input type="checkbox"/> TBL(Team Based Learning) |
| <input type="checkbox"/> UR(Undergraduate Research) | <input type="checkbox"/> FL(Flipped Learning) | <input type="checkbox"/> DSAL(Data Science Active Learning) |
| <input type="checkbox"/> others | | |

7. Knowledge and ability required for taking this course

Basic knowledge on the level of Mathematics 1 and 2, and Mathematical physics and Numerical Methods 1.

8. Method of Evaluation

| Evaluation Item | The Number of Times | Evaluation Proportion | Remarks |
|-----------------|---------------------|-----------------------|---------|
| Attendance | | | |
| midterm exam | 1 | 50 | |
| final exam | 1 | 50 | |
| quiz | | | |
| presentation | | | |
| discussion | | | |
| homework | | | |
| etc | | | |
| study hours | | | |

9. Textbook and supplementary material

| Main/Sub | Title (Web-site) | Writer | Publisher | Publication year |
|----------|---|--------------|-----------|------------------|
| Main | MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES | MARY L. BOAS | Wiley | |

10. Class system and Class shedule

In this subject, Fourier series and Fourier transformations are the first to be learned. This will then be applied when solving the next topic, the equation of phase differentiation, numerically. As a year of differential equations, special functions will be dealt with in depth, and series of special functions will also be dealt with. The next goal will be to deal with partial differential equations when there are naturally more variables. Finally, the knowledge learned in Mathematical Physics 1 and 2 deals with complex functional interpretations that will be used comprehensively, and then deals with probability-related topics in preparation for statistical mechanics subjects.

< Class Schedule >

* language : K-korean, E-English

| Weeks | Topics | language | Instructor | Teaching Method | Evaluation Method | Matter to be prepared |
|-------|---|----------|--------------|-----------------|-------------------|-----------------------|
| 1 | Fourier series | E | Jun Won Rhim | | | |
| 2 | Fourier transform | E | Jun Won Rhim | | | |
| 3 | Ordinary differential equations | E | Jun Won Rhim | | | |
| 4 | Ordinary differential equations | E | Jun Won Rhim | | | |
| 5 | Numerical methods for ordinary differential equations | E | Jun Won Rhim | | | |
| 6 | Calculus of variations | E | Jun Won Rhim | | | |
| 7 | Tensor analysis | E | Jun Won Rhim | | | |
| 8 | Special functions | E | Jun Won Rhim | | | |
| 9 | Special functions | E | Jun Won Rhim | | | |
| 10 | Series solutions of differential equations | E | Jun Won Rhim | | | |
| 11 | Series solutions of differential equations | E | Jun Won Rhim | | | |
| 12 | Partial differential equations | E | Jun Won Rhim | | | |
| 13 | Partial differential equations | E | Jun Won Rhim | | | |
| 14 | Functions of a complex variable | E | Jun Won Rhim | | | |
| 15 | Functions of a complex variable | E | Jun Won Rhim | | | |
| 16 | Probability and statistics | E | Jun Won Rhim | | | |

11. Other items of notification