Math and Coding II: Administrative Information for 113–2

Course [PHYS222] Mathematics and Coding on Physics II, Mon. 13:10–15:00 & Thu. 16:10–17:00.

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Office hours ♠TODO:TBD♠

Webpage https://www2.nsysu.edu.tw/iwamoto/physmath2.html

TA ♠TODO:TBA♠

Evaluation Two exams (mandatory), final coding assignment (mandatory), and performance score (optional). With exam scores A (out of 40 + 30), final coding assignment score B (out of 30), and performance score C (max 30), the grade is given by $A + B + \left(1 - \frac{A+B}{100}\right) C$ (half-up rounding).

Themes and topics

An intermediate-level mathematics course designed for physics learners. We will cover linear algebra, Fourier analysis, and methods of numerical analysis. Prerequisites for this course include a foundational understanding of calculus, matrix arithmetic, and ordinary differential equations.

After reviewing the basics of matrices, you first learn **linear algebra** with an emphasis on practical handling of matrices and **eigenvalue problems**. You then learn fundamentals of function analysis, particularly **Fourier analysis**.

Additionally, the course introduces fundamental concepts in **numerical analysis** and basic numerical methods for mathematical problems such as ordinary differential equations. Students will gain theoretical knowledge in numerical analysis as well as practical coding skills in Python, using the contemporary Python ecosystem.

This course does not cover the mathematical foundations of each topic. Instead, students are expected to be familiar with the topics and develop an appreciation of their usefulness.

Textbook

E. Kreyszig, Advanced Engineering Mathematics, 10th ed. Taiwan custom version, Wiley (2018).

- Sho will often refer to it during the lecture, assuming you all have the textbook ready.
- You are assumed to have learned Chapters 1–2 and 9–10. We discuss 7–8, 11, and 19–21.

Special remarks on Computer environment

We are going to use `Python 3.x` ($\geq$ `3.9`) and GitHub Classroom. Students need **a GitHub account** and a computer that can run `Python 3`. In addition, you are recommended to install and use Visual Studio Code as the primary editor. Further instructions are given during the lectures.

Student's goals

At the end of this course,

- I am familiar with matrix calculation. In particular, I know why rank and determination are important and can calculate them by hand.
- I can diagonalize simple matrices.
- I can perform Fourier analysis of functions.
- I understand the basic property of IEEE-754 floating point numbers.
- Utilizing Python and online resources, I can numerically solve problems in linear algebra, basic differential equations, or other topics learned in the previous semesters.

Schedule

2.17·20	⟨1⟩ Matrices and vectors.	§7.1–7.3
2.24·27	⟨2⟩ Linear systems of Equations.	§7.3–7.4
3.03·06	⟨3⟩ Rank.	§7.4–7.6
3.10·13	⟨4⟩ Determinant. Inverse.	§7.7–7.8
3.17·20	⟨5⟩ Eigenvalue problem.	§8.1–8.2
3.24·27	⟨6⟩ Matrices with special names.	§8.2–8.3
3.31	⟨7⟩ Diagonalization and bases.	§8.4–8.5
4.07·10	**Midterm Exam** (exam review on Apr. 10)	
4.14·17	⟨8⟩ Numeric linear algebra.	§20.1–20.2
4.21·24	⟨9⟩ IEEE-754 floating point numbers.	§19.1
4.28·01	⟨10⟩ Basic numerical analysis.	§19.2–19.5
5.05·08	⟨11⟩ Review of ODEs.	(§1–2)
5.12·15	⟨12⟩ Numerics for ODEs.	§21.1–21.3
5.19·22	⟨13⟩ Fourier series expansion.	§11.1–11.3
5.26·29	⟨14⟩ Fourier transformation.	§11.8–9
6.02·05	**Term Exam** (exam review on June 5)	
6.09·12	⟨15⟩ Review on complex numbers. Basic group theory.	§13.1–3
6.16·19	No class (alternative learning period)	

(1) Introduction of Lecturer and TA

(2) Administrative Information on This Course

- We use Google Classroom for official announcements and general communication.
- We use GitHub Classroom for coding assignments.
- Students with disabilities are encouraged to contact *the student affairs office*[*1] for assistance. Special academic accommodations/considerations are provided based on their advice.

2.1 Prerequisites and Goals

Prerequisites: Previous mandatory courses (Calculus, Essential Coding, and Math and Coding I)

- Foundational understanding of matrix arithmetic. Basic calculus and vector calculus.
- Ordinary differential equations and special functions.
- Beginner-level coding skill in Python. Python edit-and-run environment on your computer.

Goals: Skills in solving mathematical problems appearing in physics. By hand and numerically.

① Understand the concepts and application: rank, determinant, eigenvalues, Fourier series, ...

② Get used to hand calculation: Gauss elimination, diagonalization, integrals for Fourier analysis, ...

③ Learn how to solve it numerically using Python, avoiding the floating-number traps.

2.2 Evaluation and Make-up Principles

- Two exams: mandatory, midterm 40 points, term 30 points. No make-up.
  - If you have reasons for absence, you must follow *Regulations for Leave Application*[*2]. Otherwise, your grade will be **X**.
- Final coding assignments: mandatory, 30 points.
  - Your grade will be **X** if not submitted by the deadline.
- Performance score: optional, max 30 points. (Some points may be given by Sho's discretion.)
  - All of your activities are counted.[*3]
  - Absence will be made-up for official leaves 公假 or COVID-19 if officially applied[*4].
  - No make-up for other health issues. Other reasons are assessed on a case-by-case basis.

2.3 Textbook

- Required. **Printed is better than e-book**, as using tablets may be sometimes forbidden.

[*1] 學務處諮商與健康促進組（特教生服務）https://ccd-osa.nsysu.edu.tw/p/412-1091-24059.php

[*2] 學生考試請假及補考辦法 https://oaa.nsysu.edu.tw/var/file/3/1003/img/1296/acade_rule_09.pdf

[*3] Although attendance is recorded, it has almost no impact on the grade. Just showing up is not considered a good achievement. For example, attending with a bad attitude may be assessed worse than not attending.

[*4] Apply on https://sis.nsysu.edu.tw/ . Indigenous peoples' festival holidays are respected.

2.4 Lecture = (mini tests) + lecture + problem solving (exercises).

- Sho expects you did the (minimal) homework before the lecture and have the textbook ready.
- Two or three mini-tests are planned in this semester (Monday 13:10).
- Sho recommends two-notebook strategy for this course:
  ① Lecture notebook: Summarize on this notebook what Sho says/writes in lectures.
  ② Exercise notebook: Solve problems on this notebook (in-class exercises, homework, etc.).

Lecture rules

Principles: (1) We are colleagues, so we create lecture together.
(2) You are adult, so you can do anything except for disturbing me.
Conflicts between students are to be solved by students.

- **You must interrupt Sho** if you have questions/comments.[*5]
- You can drink water/non-alcoholic beverage or eat small candies/gums/chocolates (as long as room-regulation allows).
- In principle, you can use computers, tablets, smartphones, etc.
  - It will disturb your concentration. It is your own risk.
  - It may be forbidden in some activities.
- Do not eat "foods." Do not drink alcohol.
- Do not talk over phones.
- **[VOTE]** Should we kick-out students who are talking with others during lectures?

2.5 Other Remarks

Scientific remarks

- The difference between Sho's and Textbook's notation: (You can use either.)
  - Matrices and vectors: $A, B, C, ..., \vec{a}, \vec{b}, \vec{c}, ...$ vs $\mathbf{A}, \mathbf{B}, \mathbf{C}, ..., \mathbf{a}, \mathbf{b}, \mathbf{c}, ...$
  - Cartesian unit vectors: $\vec{e}_x, \vec{e}_y, \vec{e}_z$ vs $\mathbf{i}, \mathbf{j}, \mathbf{k}$.

Administrative remarks

- If you want to use **ChatGPT** etc., read Sho's Guideline for Using Generative AI.
- You are very welcome to visit Sho during the **office hours**, but also in any other time.
- High-quality homework submissions from you might be shared with (but only with) people in this lecture, where your name will be hidden.
- Sho is extraordinarily strict against **plagiarism**.
  - Please read NSYSU's *Guidelines for Students' Academic Ethics and Handling of Cases in Violation of the Academic Ethics*. The guidelines, in particular Article II (3), (4), and (6), are taken into account when Sho evaluates students' reports or exam/quiz answers.[*6]

[*5] You should think this is **your duty** in all university lectures. Our job is not to finish the materials but to help you learn. Furthermore, you can help other students by asking questions! When you have questions, usually others have the same one (and it is Sho's fault). It also helps Sho, because Sho can improve the lecture.

[*6] An example: Imagine you are writing a report. If you "use" some books or others' reports, you must write so. If you had a discussion with others, you must write so.