Math and Coding II: Administrative Information for 114–2

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

Lecturer Sho Iwamoto [岩本 祥], Department of Physics. iwamoto@g-mail.nsysu.edu.tw

Office hours Tuesdays 14:00–16:00, Fridays 16:00–18:00. 理SC 2006–1.

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

TA Mr. Alfredo Coro, Dept. of Physics. arcoro@g-mail.nsysu.edu.tw
(Office hours: Thursday afternoon upon request, 物理館PH 5010.)

Evaluation Two exams, a coding assignment, and performance. With exam score A (out of $45+35$), coding assignment score B (out of 20), and performance score C ($0 \le C \le 30$ assessed by mini tests and classroom performance), the grade is determined by $A + B + \left(1 - \dfrac{A+B}{100}\right) C$ (half-up rounding).

Themes and topics

An intermediate-level mathematics course designed for physics learners. The course introduces linear algebra, Fourier analysis, basic special functions, and methods of numerical analysis. Rigorous mathematical foundations and detailed proofs are not the focus of this course. Instead, students are expected to be familiar with each topic and understand how to apply it to typical problems.

Prerequisites for this course include a basic understanding of calculus, matrix arithmetic, and ordinary differential equations. The course begins with linear algebra; you focus on the practical handling of matrices, including **eigenvalue problems** and **matrix diagonalization**. After the midterm exam, you learn fundamental ideas of function analysis, in particular **Fourier analysis** and basic **special functions**, as a natural continuation of the fall semester lecture.

The course also introduces fundamental concepts of **numerical analysis**. Students will gain necessary knowledge of numerical methods as well as practical skills using Python.

Textbook

E. Kreyszig, Advanced Engineering Mathematics, 10^{th} 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.
- This lecture covers Chapters 7–8 and some parts of Chapters 5, 11, and 19–21.

Special remarks on Computer environment

No need of bringing a laptop to the lecture, but you need to have a `Python 3.x` ($\ge$ `3.11`) environment on your computer for assignments.

Motivated students are advised to create a GitHub account and challenge enrichment exercises (optional, ungraded), as well as to try using Git and uv[*1] as project management tools. Sho recommends you to install and use Visual Studio Code as the primary editor.

[*1] https://docs.astral.sh/uv/

Student's goals

At the end of this course,

- I can perform basic matrix operations by hand and understand the roles of rank and determinants in linear algebra.
- I can solve simple eigenvalue problems and diagonalization problems by hand.
- I can carry out basic Fourier analysis of functions.
- I am familiar with basic special functions and understand where and why they appear.
- I understand the basic features and limitations of the IEEE-754 floating-point standard.
- I can apply numerical methods to typical problems in linear algebra and related topics.

Schedule

2.23·26	⟨1⟩ Introduction: Logic.	§7.1–7.2
3.02·05	⟨2⟩ Matrices and Linear systems of Equations.	§7.1–7.3
3.09·12	⟨3⟩ Rank and Linear independence.	§7.4–7.5
3.16·19	⟨4⟩ Determinant and Inverse Inverse.	§7.6–7.8
3.23·26	⟨5⟩ Eigenvalue problem.	§8.1–8.2
3.24·02	⟨6⟩ Matrix with special names.	§8.3
4.09	⟨7⟩ Matrix diagonalization.	§8.4–8.5
4.13·16	**Midterm Exam** (exam review on Apr. 16)	
4.20·23	⟨8⟩ Modern programming. IEEE-754 Floating point numbers.	§19.1
4.27·30	⟨9⟩ Basic numerical analysis.	§19.2–19.5, §20.1–20.2
5.04·07	⟨10⟩ Fourier series expansion.	§11.1–11.3
5.11·14	⟨11⟩ Fourier transformation.	§11.8–11.9
5.18·21	⟨12⟩ Gamma function. Review of ODE.	§5.4 (and §1–2)
5.25·28	⟨13⟩ Orthogonal polynomials.	§5.2
6.01·04	⟨14⟩ Bessel function.	§5.4
6.08·11	**Term Exam** (exam review on June 11)	

(1) Introduction of Lecturer and TA

(2) Administrative Information on This Course

- We use Google Classroom for announcements and communication.
- Students with disabilities are encouraged to contact Sho immediately as well as *the student affairs office*[*2]. Special considerations are provided based on their advice.

2.1 Prerequisites and Objectives

2.1.1 Prerequisites

Completion of the required core courses offered in previous semesters.

- Calculus, Essential Coding, Math and Coding I, as well as arithmetic of vectors and matrices.

2.1.2 Objectives

To be familiar with mathematical tools commonly used in physics analyses.

- Linear independence, determinant, rank, fourier transformation, special functions, etc.

To develop the ability to use them in practice. Hand calculation and/or numerical calculation.

- Gauss elimination, diagonalization, hand-calculation of integrals for Fourier analysis, etc.
- Numerical analysis, understanding the limitations and pitfalls of floating-point arithmetic.

2.2 Evaluation and Make-up Principles

- Two exams: mandatory, midterm 45 points, term 35 points.
  - If you have reasons for absence, you must follow *Regulations for Leave Application*[*3]. Otherwise, your grade will be **X**.
- Final coding assignments: mandatory, 20 points.
  - Your grade will be **X** if not submitted by the deadline.
- Performance score: max 30 points, not mandatory. (Some points may be given at Sho's discretion.)
  - All activities are counted[*4], unless they are explicitly marked as "ungraded".
  - Make-up will be provided for official leaves 公假 or COVID-19 if officially applied.[*5]
  - No make-ups for other health problems. Other reasons are on a case-by-case basis.

2.3 Textbook + Notebook

Textbook Required. Printed version seems better, as sometimes a (printed) book is allowed in tests.

Three-notebook strategy (Sho's recommendation)

① Lecture Notebook + ② Workbook + ③ Memory Notes

[*2]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
[*3]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
[*4]The exact weighting is not disclosed, but a substantial part is from mini tests. Attendance may be recorded, but its contribution to the final grade is tiny (less than 2%), since mere presence is not regarded as a meaningful academic achievement. Poor or disruptive attitudes during class may result in a lower evaluation than absence.
[*5]https://sis.nsysu.edu.tw/main.php Indigenous peoples' festival holidays are respected.

2.4 **Lecture** = (Mini Test) + Lecture + (Exercises / Presentations).

- 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).

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.[*6]
- 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. (but not during tests).
  - It will disturb your concentration. It is your own risk.
- 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 $\mathbf{i}, \mathbf{j}, \mathbf{k}$.
- Sho always writes "$\log_{10}$" for base-10 logarithm and *tries to* use "ln" for natural logarithm. Please ask when ambiguous.

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.[*7]

[*6] 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.

[*7] 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.