General Physics II: administrative information (112–2)

Course [PHY105E] General Physics II (waves & basic electromagnetism), Wednesdays 9:10–12:00.

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Office hours Mondays and Tuesdays, 15:10–17:10. 理SC 2006–1.

Webpage https://www2.nsysu.edu.tw/iwamoto/gp2.html

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Evaluation Midterm and term exams (mandatory) and in-class activities (optional). With midterm- and term-exam scores A and B (out of 50 each) and in-class-activity score C (max 25), the grade is given by $\max[A+B, f(A+B+C)]$, where $f(x) = 0.62x + 22.7$ (half-up rounding).

> *This course assumes students have taken my course of General Physics 1 (and passed the exams, preferably). If you are a student who wishes to enroll but has not taken my General Physics 1, please contact me before selecting the course. Otherwise it will be difficult to pass the exams.*

Themes and topics

An introductory course to wave mechanics and electromagnetism. The goal is Maxwell's equations (in integral form), which encapsulate the laws of electromagnetism. Additionally, we explore the nature of light, deriving its properties as an electromagnetic wave from Maxwell's equations and understanding it as a classical wave phenomenon.

You are required to have a foundational understanding of mechanics, calculus, and the application of vectors. Based on this knowledge, you first learn **oscillations and waves**: its mathematical description. You then step into electromagnetism. You get used to the concept of **fields**, which is the most crucial in electromagnetism (and even in modern physics), and learn **various laws of electromagnetism**. Finally, you learn **Maxwell's equations**, the monumental achievement in 19th-century physics. You notice that the equations contain not only the electromagnetic laws you have learned but also the electromagnetic waves, known as lights.

Several important topics are not covered in this lecture, which include electric circuits, electromagnetic fields in matter, vector calculus in cylindrical/spherical coordinates, and the differential formulation of Maxwell's equations.

Textbook

Serway & Jewett, *Physics for Scientists and Engineers with Modern Physics*, 10th ed. Cengage Learning.

- You are assumed to have learned Chapters 1–13. We discuss Chapters 15–17 and 22–33.
- We use this book in in-class activities (preferably a physical book rather than an e-book).

Other references

[YF] Young & Freedman, *University Physics*, 15th ed. Pearson.

[Op] Ling et al., *University Physics*, Vol. 1 (Unit 2)[*1] and Vol. 2 (Unit 2)[*2].

[Gr] Griffiths, *Introduction to Electrodynamics*, 4th ed. Cambridge U. Press.

This list is only for informational purposes. Stick to the textbook (Serway & Jewett) at this stage. Some of you will read [Gr] in your future lectures, so you may refer to it for advanced topics.

[*1] https://openstax.org/details/books/university-physics-volume-1
[*2] https://openstax.org/details/books/university-physics-volume-2

Student's goals

At the end of this course,

- I am familiar with line integrals and surface integrals of vectors.
- I can express waves by trigonometric functions and analyze them using calculus techniques.
- I can describe/calculate electromagnetic forces between charged objects or electric currents.
- I am used to dealing with fields (electric field $\vec{E}$ and magnetic flux density $\vec{B}$).
- I can analyze electric potential and relate it to work and potential energy.
- I can use various laws of electromagnetism to calculate forces or fields in simple situations.
- I can explain Maxwell's equations and their relations to electromagnetic laws.

Schedule

2.21	⟨1⟩ Wave and its motion.	§16
2.28	Peace Memorial Day	
3.06	⟨2⟩ Superposition of waves.	§17
3.13	NSYSU Sports Day	
3.20	⟨3⟩ Coulomb's law. Gauss's Law.	§22–23
3.27	⟨4⟩ Gauss's law. Electric potential.	§23–24
4.03	⟨5⟩ Electric potential.	§24
4.10	**Midterm exam**	
4.17	⟨6⟩ Electric dipole. Capacitor.	§25
4.24	⟨7⟩ Electric current. Power.	§26
5.01	⟨8⟩ Magnetic flux density $\vec{B}$. Lorentz force.	§28
5.08	⟨9⟩ Biot-Savart law. Ampère's law. Magnetism.	§29
5.15	⟨10⟩ Faraday's law.	§30
5.22	⟨11⟩ Inductance.	§31
5.29	⟨12⟩ Lorentz's equations. Light.	§33
6.05	**Term exam**	
6.12	⟨13⟩ No Lecture (flexible week)	
6.19	⟨14⟩ Exam review. Modern particle physics. Topics requested by students.	

- **Attendants must learn §15 by themselves before the semester.**
- The flexible week ⟨13⟩ has no lecture, compensating for the "primer essay" duty.[*3]
- The flexible week ⟨14⟩ is not included in the evaluation.
- §27 and §32 (electric circuits) are not covered. Students should learn it by themselves.

[*3] Sho is away for a conference. We may have a make-up class on June 19 (afternoon) upon your request.

(1) On This Course

1.1 Administrative Information → see Page 1 of syllabus.

- We will try using Google Classroom.

1.2 Intentions

- Preparation for electromagnetism (材光/光電's most important course).
  - Mathematics: Vector calculus, in particular, **line integrals** and **surface integrals**.
  - Physics: Wave mechanics. Electromagnetism (only in integral forms, *xyz*-coordinate).
- Assessment of your math, physics, and learning skills you developed in the previous semester.

1.3 Prerequisites

- You have achieved the six goals of Sho's General Physics 1.
- You have the textbook. **Printed is better**, as tablets may be forbidden in some activities.

1.4 Evaluation and Make-up Principles

- Two exams: mandatory, 50 points each.[*4]
  - If you have reasons for absence, you must follow *Regulations for Leave Application*[*5]. Otherwise, your grade will be **X**.
- In-class activities: Max 25 points. Not mandatory. (Some points may be given by Sho's descretion.)
  - Make-up will be provided for official leaves 公假 or COVID-19 if officially applied[*6].
  - No make-up for other health issues. Other reasons are assessed on a case-by-case basis.
- Students with disabilities are encouraged to contact *the student affairs office*[*7]. Special academic accommodations/considerations are provided based on their advice.

Hint: Evaluation is slightly **more demanding** than the previous semester.
For **C**−, get ≥ **59.5** out of 125 (two exams + activity).
If you want **A**−, get ≥ 91.7 out of 125, or get ≥ 79.5 out of 100 (two exams).

1.5 Lecture = activity + lecture (+ homework + primer essay)

- Homework will include "reading assignment" and "primer essay" as the minimal part. You need to read a few sections in advance and answer to "primer essay" by 1am of the lecture day. **The lectures assume you did minimal homework and submitted primer essay.**
- Activity points are given for
  - Submission of primer essay **AND** participation of in-class activity. (both required)
  - Submission of extra homeworks.
- Less "tests" in the activity. Instead, two or three "mini exam" will be held (with prior announcements).

[*4] The midterm exam will cover class ⟨1⟩ to ⟨5⟩ and the term exam will ⟨3⟩ to ⟨12⟩, but an adequate understanding of §1–§13 is required. As a tentative plan, both exams are in closed-book style (no textbook, no notebook, no calculator, no tablet, no discussion), but you will be allowed to bring-in one sheet of paper (maximum A4-sized) as a cheat-sheet.

[*5] 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

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

[*7] 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

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.[*8]
- 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?

1.6 Other Remarks

Scientific remarks

- This course uses the SI unit system.
- The difference between Sho's and Textbook's notation: (You can use either.)
  - Cartesian unit vectors: $\vec{e}_x$, $\vec{e}_y$, $\vec{e}_z$ vs $\hat{\mathbf{i}}, \hat{\mathbf{j}}, \hat{\mathbf{k}}$
  - elementary charge: $|e|$ vs e $\quad (= 1.602\,176\,634 \times 10^{-19}\ \mathrm{C})$[*9]
- Sho always writes "$\log_{10}$" for base-10 logarithm and *tries to* use "ln" for natural logarithm. Please ask when ambiguous.

Administrative remarks

- 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.[*10]

University Principles (Sho's subjective opinion; for reference)

1. We are colleagues. I treat you as an adult.
2. Learn by yourselves. I do not teach you anything. (I am not 老師.)
3. Think what your duty is, and do your own duty.
4. Ask for help. *Our* mental health is very important.

[*8] 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.

[*9] The SI unit system was updated in 2019. Since then, this equation gives the definition of Coulomb "C" and thus this is an exact relation. Most of books, including the textbook (10th ed.), use old versions of the SI, in which the value of $|e|$ was determined by measurements.

[*10] 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.