General Physics II: administrative information (111–2)

Course General Physics II (basic electromagnetism), Thursdays 13:10–16:00.

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Office hours Wednesdays 16:00–18:00. 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 quizzes (optional). With midterm- and term-exam scores A and B (out of 50 each) and in-class-quiz score C (max 20), the grade is given by $\max[A+B, f(A+B)+C]$, where $f(x) = \{x \text{ if } x < 50, \text{otherwise } 0.6x + 20\}$ (half-up rounding).

Themes and topics

Basic electromagnetism in vacuum (i.e., not in matter). The goal is Maxwell's equations, which contain the laws of electromagnetism and are written in the language "vector calculus."

You begin with **basic vector calculus**: vectors, differentials, and integrals. You learn various **laws of electromagnetism**, where you use (and get accustomed to) vector calculus. You also get used to "**fields**", the most important concept in electromagnetism (and even in modern physics). Finally, you learn **Maxwell's equations**, the monumental achievement in 19th-century physics. You notice that the equations contain the electromagnetic laws you have learned. In parallel, you learn about **electric circuits**: properties of their components and methods to analyze them.

Topics that are not covered (or covered only partially) in this course include: electromagnetic fields in matter, vector calculus in cylindrical/spherical coordinates, and the differential formulation of Maxwell's equations.

Textbook

[SJ] Serway & Jewett, *Physics for Scientists and Engineers (with Modern Physics)*, 10th ed. Cengage Learning. [The course corresponds to Part 4 (Chapters 22–33) in Vol. 2.]

Other references

[Op] Ling et al., *University Physics, Vol. 2*. OpenStax. [Unit 2, free online book; many exercises] https://openstax.org/details/books/university-physics-volume-2

[Du] Holzner, *Physics II For Dummies*. Wiley Publishing. [Part 2, for introductory descriptions]

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

[Wi] Wikipedia. Wikimedia Foundation. [but this is not an 'academic' reference]

Student's goals At the end of this course,

- I am familiar with basic vector calculus; I can integrate vectors in Cartesian coordinate system.
- I can describe/calculate electromagnetic forces between charged objects or electric currents.
- I am used to dealing with fields (electric field $\boldsymbol{E}$ and magnetic flux density $\boldsymbol{B}$).
- 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.
- I can calculate currents or voltages in direct-current and alternating-current circuits.

Schedule

2.16	⟨1⟩ Basic calculus. Coulomb's law.	§1, §22, §B.1–4, §B.6–8 of [SJ]
2.23	⟨2⟩ Vector calculus. Electric field $\boldsymbol{E}$. Gauss's law.	§3, §22–23, §B.5
3.02	⟨3⟩ Gauss's law. Electric potential.	§23–24
3.09	⟨4⟩ Electric potential.	§24
3.16	⟨5⟩ Electric dipole. Capacitor.	§25
3.23	⟨6⟩ Electric current. Power.	§26
3.30	⟨7⟩ Lorentz's equation (introduction)	
4.06	Mid-term exam	
4.13	⟨8⟩ Magnetic flux density $\boldsymbol{B}$. Lorentz force.	§28
4.20	⟨9⟩ Biot-Savart law. Ampère's law. Magnetism.	§29
4.27	⟨10⟩ Faraday's law.	§30
5.11	⟨11⟩ Lorentz's equations. Light.	§33
5.18	⟨12⟩ DC circuit.	§27
5.04	⟨13⟩ Inductance.	§31
5.25	⟨14⟩ AC circuit.	§31–32
6.01	Term exam	
6.08	⟨15⟩ (flexible) e.g., Light and optics, upon students' requests	
6.15	⟨16⟩ (flexible) e.g., Modern particle physics, upon students' requests	

The classes ⟨15⟩ and ⟨16⟩ are not included in the evaluation.

Feb. 16–1: Introduction

- Course, lecturer, office hours, evaluation, and Textbook.
- What to learn?
- Why learn?
- Notes
- In-class quiz 1

On the textbook and references

You can buy the textbook [SJ] with discount: NT$700 for Vol. 2 (NT$1250 for Vol. 1+Vol. 2). A representative of students should contact Mr. Yi Ling Hsu [許益凌] ☎0919–121727, and they will deliver within ∼ 3 days.

i. **[SJ]:** Sho strongly recommends to get [SJ, Vol. 2], especially if you are not going to take more advanced EM classes.

ii. **[Du,Wi]:** When you are lost or confused, it is a good idea to visit them for a "second opinion."

iii. **[Gr]** is a famous and popular textbook, but maybe it is too much for first year students.

iv. **[Op]:** If you do not want to buy [SJ], you may use [Op] (free online book) as your main textbook, but Sho prefers [SJ] for its clear and kind explanation.

v. *The Feynman Lectures on Physics* (Vol. II) is another famous (and very good) textbook, which is now available for free[*1]. However, it is written in a different convention, which often confuses beginners, and thus not recommended here.

vi. If you know/find other good references (especially in Chinese), please introduce them to Sho.

Remarks on notation and convention

- This course uses the SI unit system (see, for example, [SJ, §D], [Du, §2], [Wi]).
- The difference between Sho's and [SJ]'s notation: (You can use either.)
  - vectors: $\boldsymbol{F}$ vs $\vec{\mathbf{F}}$, $\boldsymbol{v}$ vs $\vec{\mathbf{v}}$, etc.
  - Cartesian unit vectors: $\boldsymbol{e}_x, \boldsymbol{e}_y, \boldsymbol{e}_z$ vs $\hat{\mathbf{i}}, \hat{\mathbf{j}}, \hat{\mathbf{k}}$
  - elementary charge: $|e|$ vs e $\quad(= 1.602\,176\,634 \times 10^{-19}\ \mathrm{C})$[*2]
  - Sho may sometimes call $\boldsymbol{B}$ (magnetic field) by its historic name "magnetic flux density."[*3]
- Sho always writes "$\log_{10}$" for base-10 logarithm and *tries to* use "ln" for natural logarithm. Please ask when ambiguous.

[*1] https://www.feynmanlectures.caltech.edu/

[*2] 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 [SJ, 10th ed.], use old versions of the SI, in which the value of $|e|$ was determined by measurements.

[*3] In physics, names are usually unimportant. Pay attention not to the name but to its properties and equations.

Notes (mostly common in Sho's lectures)

- Sho's job is not to teach you physics, but to help students learn physics.[*4] **Learn by yourself**, where you can make use of lectures, books, office hours, etc.
  - It is said that, for a 150 min./week course, students should do 300 min./week self-study. Sho thinks 180 min./week is mandatory (minimum) to catch up with this course.
  - Sho recommends you to read the textbook [SJ] with answering Quick Quizzes, solving Examples by yourselves, and doing some of Problems (such as 1, 4, 7, 10, ...).
- You are very welcome to visit Sho during the **office hours**, but also in any other time. He is willing to help you learn electromagnetism, but also other physics, mathematics, or anything.
  - Sho also welcomes online communications such as Discord if some students volunteer to set up the environment and do moderation.
- During Sho's **lectures**,
  - You are very very very welcome to interrupt Sho when you have questions/comments. Sho's job is not to finish the materials but to help you learn.[*5]
  - Do not chat/talk with other students (except for discussion periods, of course) because Sho is talking with you.
  - Sho does not forbid students to drink water or non-alcoholic beverage or to eat small candies/gums/chocolates. (But they may be forbidden by room- or other regulations.) Do not eat "food" (and drink alcohol) because it will make Sho hungry and unfocused.
  - Sho does not forbid students to use computers, tablets, or smartphones, but at your own risk of disturbing yourself. Do not talk over phones.
- Sho recommends students to take a **photocopy** (or at least a smartphone photo) when they submit reports. The reports are expected to be returned to the students, but may be slightly blurred or catch blots/stain when Sho takes a copy of them with a scanner.
- 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]

[*4] This may well be incorrect, but is Sho's principle. He thinks he is a physicist, researcher, gamer, cyclist, and lecturer (講師), but not a teacher (老師), hence does not teach but does lectures.

[*5] 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.