PHYS 3034

Electricity and Magnetism II

Spring 2024-25

Venue	L1:	Mon 13:30–14:50 & Fri 9:00–10:20	Room 5510
	T1:	Mon 12:00–12:50	Room 5508

Instructor Bradley A. FOREMAN
Room 4473
Tel.: 2358-7527
e-mail: phbaf@ust.hk

IA CHU Shek Kit 朱碩傑
Room 4469
Tel.: 2358-7528
e-mail: phskchu@ust.hk

Office hours By appointment

You are welcome to come to my office at any time. I may be busy, but we can always set up an appointment to meet later.

Prerequisite PHYS 3033 (Electricity and Magnetism I) or PHYS 3053 (Honors EM I)

It will be assumed that you have already learned the basic theory of electrostatics, magnetostatics, and electrodynamics up to the introduction of Maxwell's equations (i.e., the first 7 chapters of the textbook).

Course Plan The core material includes the following topics:

- Review of Maxwell's equations
- Conservation laws
- Electromagnetic waves
- Potentials and fields
- Radiation
- Electrodynamics and relativity

If time permits, we may cover some additional material on topics such as

- Waveguides
- Antennas
- The principle of least action in relativistic electrodynamics

Learning Outcomes

At the conclusion of this course, students should be able to apply the basic principles of electrodynamics in order to solve problems about the behavior of systems containing moving electrical charges coupled to time-varying electromagnetic fields.

In particular, students should be able to:

1. Derive the conservation laws for various physical quantities from Maxwell's equations.
2. Calculate the behavior of electromagnetic waves in vacuum, in matter, and in waveguides.
3. Solve problems in electrodynamics using scalar and vector potentials.
4. Calculate the radiation fields of electric and magnetic dipoles and of moving point charges.

5. Use the special theory of relativity to describe the dynamics of fields and particles moving at relativistic velocities.

Students should also be able to present their solutions to such problems using concise but clearly reasoned and well-justified arguments.

Textbook

David J. Griffiths, *Introduction to Electrodynamics*, 4th ed. (Pearson, 2013; Cambridge University Press, 2017)

Reference books

The lecture material from Griffiths will occasionally be supplemented by material from other textbooks, some of which are:

D. K. Cheng, *Field and Wave Electromagnetics*, 2nd ed. (Addison-Wesley, 1989) [an undergraduate engineering text useful for practical applications]

M. A. Heald and J. B. Marion, *Classical Electromagnetic Radiation*, 3rd ed. (Thomson, 1995) [at a level between Griffiths and Jackson]

J. D. Jackson, *Classical Electrodynamics*, 3rd ed. (Wiley, 1999) [the standard postgraduate textbook]

L. D. Landau and E. M. Lifshitz, *The Classical Theory of Fields*, 4th ed. (Pergamon, 1975) [another good postgraduate-level book]

Course information

All course announcements, homework assignments, and other course materials will be posted at the PHYS 3034 site on Canvas (https://canvas.ust.hk/).

If you have any questions or comments, you are encouraged to discuss them with me, the IA, and your classmates in the Discussion forum on Canvas.

Assessment and grading

This course will be assessed using criterion referencing and grades will not be assigned using a curve. Detailed rubrics for each assessment task will be provided separately, outlining the criteria used for evaluation.

Category	Contribution to Course Grade
Online Discussion	10%
Homework	20%
Midterm Exam	30%
Final Exam	40%

The midterm exam will be held on Saturday 22 March 2025 at 9:00–11:00.

Homework assignments will normally be assigned once a week on Canvas, to be turned in one week later, by uploading files into Canvas. Graded problem sets will be returned to you in the same way. Late assignments will be marked down by 10% per day.

To avoid difficulties due to large file sizes, please scan your handwritten homework assignments into black and white PDF files (i.e., do not submit any JPG photographs). There are many mobile apps that can be used for this.

The purpose of the assignments is to give you problem-solving experience for the exams. It is therefore in your best interests to work out all of the problems yourself, focusing on learning problem-solving techniques rather than memorizing solutions. You may certainly cooperate on problems if you wish. However, such cooperation should be limited to discussing the basic issues involved, and the papers you hand in should definitely be your own rendition of the solutions and verifiably *not* a copy of someone else's.

Final Grade Descriptors

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of the principles of electricity and magnetism. Exhibits expertise in problem-solving and can explain fundamental concepts clearly at a deep level.
B	Good Performance	Shows good knowledge and understanding of the principles of electricity and magnetism. Exhibits competence in problem-solving and can explain fundamental concepts thoroughly.
C	Satisfactory Performance	Possesses adequate knowledge of the principles of electricity and magnetism. Exhibits competence in dealing with familiar problems and can explain most fundamental concepts at a basic level.
D	Marginal Pass	Has threshold knowledge of the core subject matter and limited problem-solving ability. Limited ability to explain fundamental concepts at the most elementary level.
F	Fail	Demonstrates insufficient understanding of the subject matter and lacks the necessary problem-solving skills.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within ten working days of the due date (i.e., within two weeks if there are no holidays). Feedback on assignments will include comments on strengths and areas for improvement. Students who have further questions about the feedback including marks should consult the TA or instructor within five working days after the feedback is received.

AI Policy

You are welcome to use generative AI tools such as ChatGPT during the learning process, although you should bear in mind that they often give wrong answers to physics questions. Asking questions in this way about the homework problems will be treated the same as discussing homework problems with your classmates. It is allowed, but you should apply some critical thinking to the answers you receive, and when you write up your final solutions, you must do it entirely on your own. You will be better off if you try as hard as you can to solve the homework problems without any help, because this will give you much better

preparation for the exams. In the exams, you will be required to solve problems without any help from other people or from generative AI tools.

Classroom discussion

I like to encourage a lively public discussion and debate in my lectures. If there is anything in the lectures that you don't understand, or if you have any questions or comments at any time, please don't hesitate to raise your hand and ask me (or send in Chat questions via Zoom). In fact, if you contribute to the discussion you will be awarded **bonus points**, which will be added to your grade at the end of the semester and may **increase your grade** by as much as 5%. You will *never* be penalized for asking questions (or for not asking questions); the only possible effect is to *increase* your grade. Extra points will be awarded for anyone who finds a mistake in my lecture material and tells me about it during the lecture.

Online discussion

Ten percent of your grade will be determined by your level of participation in the online Discussion forum in Canvas. You can get up to 10% just by posting one nontrivial[1] question, comment, or answer every week in the forum. The actual amount depends on the level of your contribution, with more credit awarded for substantial contributions. If you post more than once per week, a maximum of one additional post can be carried over and used in other weeks.

If the forum is running as intended, most questions should be answered by your fellow students. The IA and course instructor will only intervene when a wrong answer seems to be accepted or when no students are able to provide a complete answer. The Discussion forum should be used to discuss questions that arise as you are trying to understand the course materials, not to seek (or give) help on solving the homework problems. Of course, questions are likely to arise as you are trying to solve the homework problems, but you should formulate your question in terms of general concepts rather than the details of a particular problem.

The purpose of the discussion forum is to have people talking to each other about questions that are of interest to them, not to have ChatGPT talking to itself about questions that are of interest to no one. Therefore, credit will not be awarded for questions or answers that show obvious signs of being generated by AI. One obvious sign is a long perfectly written essay that introduces lots of ideas we have not talked about in lecture without any definitions. Another is that both questions and answers tend to be very boring.

If you introduce any new concepts that we have not talked about previously, you must define everything clearly so that other students can understand. You must also cite any sources you used to find the information presented in your post, whether it is an AI tool, a web page, a journal article, or a book. Presenting ideas of others as if they were your own is called plagiarism, which is a violation of academic integrity.

[1] Nontrivial means, in part, that the question or comment should be about physics, not about how the course is run.

Academic Integrity

In this course, you are expected to adhere to the university's academic integrity policy. You are also expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.