PHYSICS 350 – ELECTRICITY AND MAGNETISM

Fall Semester 2025 TR 10:30–11:45 MSB 307
Instructor: Eric B. Szarmes (szarmes@hawaii.edu)
Office: Watanabe Hall, Room 212; *Office hours:* to be announced

Course Description: Electrodynamics occupies a unique position in the physics curriculum. Of the four fundamental forces, it alone governs – together with the principles of quantum mechanics – *all* of the local physical interactions of everyday life. It also presents students with their first example of a fully developed and self-consistent field theory. This course develops the fundamentals of classical electrodynamics as embodied in Maxwell's equations, the Lorentz force law, and the constitutive relations describing static and time-varying electric and magnetic fields in vacuum and in matter. The treatment also develops and utilizes the mathematical tools of vector differential and integral calculus, special functions, and the techniques of mathematical physics. The course is designed to emphasize the rich mathematical and physical content of the electromagnetic field, and to provide a solid foundation for more advanced study.

Textbook: David J. Griffiths, *Introduction to Electrodynamics, 5th ed.,* Cambridge University Press, 2024

Course website: https://lamaku.hawaii.edu/d2l/home/64354

Grade distribution:

Weekly Homework:	40%
Quizzes/Midterms:	Q(15%) / M1(15%) / M2(15%)
Final Examination:	15%

Grade assignment:

A+	90 >	B+	75–80	C+	60–65	C–	40–50
A	80–90	B	65–75	C	50–60	D/F	< 40

In-class lectures: In Fall 2025, the format of PHYS 350 will consist of in-class lectures. The complete lecture notes for each class will be made available on Lamaku prior to each class, and during the class itself I will discuss selected features of the topics covered.

Periodic quizzes will be administered in class. All exams (midterm exams and the final exam) will be take-home exams and submitted on Lamaku.

- Prior to each class, lecture notes will be made available in the **Class Notes** module on the Lamaku website.

Homework: Weekly Homework is to be submitted by the start of class on the specified date by uploading solutions in pdf format to Lamaku. You are welcome to write out your homework by hand (legibly!), in which case you can upload scans or smart-phone photos *after converting to pdf*. Of course, word-processor or LaTeX formats are also most welcome and, indeed, encouraged.

- Homework assignments will be posted and submitted through the **Assignments** tab on the Lamaku website.

Corrections: Up until one week after any problem set is returned to you, you may submit corrections to any problem on that problem set, together with the original problem set, for up to 3 points (out of 10) **per problem**. Corrections must be done on the original problem set (written directly on the original writeup for small corrections) or on a separate page (attached to the original problem set for longer corrections) as needed. If you are not sure where you made your original error, or have trouble understanding why you may have lost points, please meet with me to discuss any questions you may have.

Late Fee Policy: I encourage you to complete and submit all homework, even if it is late! The goal of the course is to learn the material, and the problem sets are designed to help with this. But it is also true that it is easy to fall behind, and equally important to keep up.

To encourage you to submit your homework on time, I will charge a late fee of 2 points per day. Thus, submission on the due date after start of class is 2 points reduction, submission

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one day later is 4 points reduction, etc. For modestly late homework, I don't think this is too great, but obviously becomes more serious the later the homework. I will not let any late fees reduce your score to less than 50% of your raw score.

If you submit corrections, then the additional 3 corrections points (per problem) are applied to the original score, not the late fees.

Late homework will not be accepted after one calendar week past the due date, nor after the last day of instruction.

Office Hours: The schedule for regular office hours will be determined during the first week of class. For convenience, these are typically held over Zoom. However, if you are unable to attend office hours, or if you prefer to meet in person, I am happy to make separate arrangements.

COURSE TOPICS AND OUTLINE

Dates	**Topics**	**Chapter**
8/26–9/9	introduction; status of electrodynamics; review of vector analysis; vector differential calculus; vector integral calculus; the Dirac delta function	1
9/11–9/25	electrostatics; the electric field **E**; Coulomb's law; divergence and curl of electrostatic fields; electric potential; work and energy in electrostatics; properties of conductors	2
9/30–10/9	Laplace's equation; boundary conditions and uniqueness theorems; method of images; separation of variables; multipole expansion; monopoles and dipoles	3
October 9	*Midterm Exam #1*	
10/14–10/23	electric fields in matter; polarization; dielectrics and induced dipoles; field of polarized objects; the electric displacement **D**; linear and nonlinear dielectrics; permittivity	4
10/28–11/6	the magnetic field **B;** magnetostatics; the Lorentz force law; forces and currents; the Biot-Savart law; vector properties; Ampere's law; magnetic vector potential	5
November 6	*Midterm Exam #2*	
11/13–11/18	magnetic fields in matter; magnetization; torques and forces on magnetic dipoles; the auxiliary field **H**; magnetic media; permeability	6
11/20–12/4	the electromotive force; electromagnetic induction; Faraday's law; Maxwell's correction to Ampere's law; Maxwell's equations in vacuum and in matter	7
12/9–12/11	course review	
Dec 15–19	*Final Exam Week*	