PHYSICS 350 – ELECTRICITY AND MAGNETISM

Fall Semester 2020 TR 10:30–11:45 Online
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, 4th ed.,* Cambridge University Press, 2017

Course website: https://laulima.hawaii.edu → PHYS-350-001 [MAN.71440.FA20]

Grade distribution:

Weekly Homework:	50%
Midterms/Quizzes:	M1(10%) / M2(10%) / Q(10%)
Final Examination:	20%

Grade assignment:

A+	90 >	B+	76–82	C+	62–68	C–	40–52
A	82–90	B	68–76	C	52–62	D/F	< 40

Online format: Due to University requirements for mitigating the COVID-9 pandemic, PHYS 350 will be conducted entirely online, not in the classroom. I will hold all lectures at the regularly scheduled times (TR 10:30–11:45 HST) via live Zoom meetings. While you are strongly encouraged to attend every class, all lectures will be recorded and posted on Laulima, and my lecture notes (composed during class) will be saved in pdf format and uploaded after each lecture, so you needn't worry if you can't attend a particular class. (I will use an app called Notability for writing out the lecture notes, in a blackboard-style format, which will be screen-shared during the Zoom meeting.)

- Prior to each class, Zoom meeting details will be posted under the **Announcements** tab on the Laulima website.
- After each class, videos and lecture notes will be available under the **Resourses** tab on the Laulima website.

Homework: Weekly homework is to be submitted by the specified date and time by uploading solutions to Laulima. You are welcome to write out your homework by hand, in which case you can upload scans or smart-phone photos. Certainly, word-processor or LaTeX formats are also most welcome. Quizzes will be administered directly on Laulima, and all exams (midterms and final) will be at-home.

- Homework assignments will be available under the **Resourses** tab on the Laulima website.
- Homework solutions will be submitted under the **Assignments** tab on the Laulima 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 per problem (out of 10). 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 anything about a problem for which you lost points, you may consult with me to go over any questions you may have.

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Office Hours: The schedule for 'office hours' will be determined during the first week of class, and they will be held as live Zoom meetings. However, if you can't make office hours, or if you ever have any questions at any time, I am very responsive via email.

COURSE OUTLINE

Dates	**Topics**	**Chapter**
8/25–9/8	introduction; status of electrodynamics; review of vector analysis; vector differential calculus; vector integral calculus; the Dirac delta function	1
9/10–9/24	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
9/29–10/8	Laplace's equation; boundary conditions and uniqueness theorems; method of images; separation of variables; multipole expansion; monopoles and dipoles	3
October 1	*Midterm Exam #1*	
10/13–10/22	electric fields in matter; polarization; dielectrics and induced dipoles; field of polarized objects; the electric displacement **D**; linear and nonlinear dielectrics; permittivity	4
10/27–11/5	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 5	*Midterm Exam #2*	
11/10–11/17	magnetic fields in matter; magnetization; torques and forces on magnetic dipoles; the auxiliary field **H**; magnetic media; permeability	6
11/19–12/3	the electromotive force; electromagnetic induction; Faraday's law; Maxwell's correction to Ampere's law; Maxwell's equations in vacuum and in matter	7
12/8–12/10	problems; review	
Dec 14–18	*Final Exam Week*	

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