

Physics 8021: Advanced Electrodynamics

Fall 2023

Tuesday/Thursday 11am-12:30pm
Stevenson 6-638

Instructor: Alex Lupsasca, alexandru.v.lupsasca@vanderbilt.edu

Topics: Special relativity, relativistic field theories, gauge invariance, Maxwell's equations, conservation laws, time-independent phenomena, multipole expansions, electrodynamics and radiation theory, radiation from rapidly-moving accelerating charges, scattering and diffraction, and macroscopic averaged fields and propagation in matter.

Prerequisites: Undergraduate electromagnetism (at the level of Griffiths), first-semester undergraduate quantum mechanics (at the level of Griffiths or Townsend), and strong familiarity with multivariable and vector calculus.

Course website: <https://brightspace.vanderbilt.edu/d2l/home/445861>

Textbook: The official textbook for the course is *Classical Electrodynamics* by John Jackson (third edition). While it is a standard text and makes for an excellent reference, it is not exactly a friendly textbook. We will closely follow the more pedagogical lecture notes by Dr. Jacob Barandes, who has kindly agreed to share them in draft form while they await publication.

Homework: Homework (60%) will be assigned weekly on Tuesdays and will be officially due at the beginning of class on the following Tuesday, but students have a two-day grace period and can hand in their homework at the beginning of class on the next Thursday instead. Students may take advantage of this two-day grace period as many times as needed, no questions asked.

In fairness to other students, late homework will not be accepted beyond the two-day grace period, but one homework grade will be dropped automatically at the end of the course in a manner that maximizes the students overall homework grade.

Collaboration is permitted and even encouraged. However, students must write or type up their own homework sets with their own answers and hand them in individually, as well as list all their collaborators on every homework assignment. To receive full credit, you must *clearly and legibly* explain your reasoning and *fully simplify* your answers. Use of the Internet for general reference purposes is permitted provided that students cite all external resources they use, but students are not permitted to look up specific exercises or solutions on the Internet or elsewhere.

Use of L^AT_EX is encouraged, as well as Mathematica, especially to simplify formulas or to calculate rote integrals. Source code for any Mathematica calculations should be attached.

Final exam: At the end of the semester, there will be one 48-hour take-home final exam (40%), to be dropped off in person in my office. Use of personal lecture notes, homework sets, the official course textbook (Jackson), scientific hand calculators or equivalent computer software, and the course website are permitted, but collaboration of any kind is not. Students are also not permitted to use other textbooks, other students' lecture notes, Mathematica or other scientific or symbolic computing software, or the Internet beyond the course website.