# University of Mississippi

Department of Physics and Astronomy

Physics 402: Electromagnetism II

Syllabus

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Spring 2023

Accessing homeworks/exams will be through Blackboard.

## Location and time

Classes are Monday, Wednesday, and Friday from 15:00 to 15:50 in Lewis Hall room 109. Office hours are Monday 14:00 to 15:00 in Lewis Hall 211A.

## Text

We will closely follow the book "Introduction to Electrodynamics" by David Griffiths, covering chapters 6–12. The definitive reference, at a higher level, is Jackson's "Classical Electrodynamics."

## Course goals and learning outcomes

This is the second half of a standard course on electromagnetism in the undergraduate curriculum for physics.

Key concepts (time permitting): magnetic fields in media • going from electrostatics to electrodynamics • mutual and self inductance • Maxwell's equations • conservation laws • waves in general and electromagnetic waves • energy and momentum in the electromagnetic field • reflection, transmission, absorption, and dispersion • waveguides • potential formulation and gauge transformations • special relativity and relativistic EM.

Goals: Reinforce understanding of electrostatics and magnetostatics; understanding of Maxwell's equations and interactions with matter, and relevance to physical systems; learning tools of waves; applying multivariate and vector calculus and special mathematical tools (e.g. multipole/Legendre expansion); introduction to special relativity. These goals are to enhance students' mathematical reasoning, critical thinking, and analytical reasoning.

## Evaluation

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| Grade type: | Letter grade A–F |
| Grade ranges (subject to change): | A = 88% and up<br>B = 75% – 87%<br>C = 65% – 74%<br>D = 55% – 64%<br>F = < 55% |
| Grade breakdown (subject to change): | 50% homework (top 10 contribute), 20% midterm, 30% final |

## Homework, tests, and final exam

Homework assignments will be announced via Blackboard and they must be turned in by midnight on the due date. Homeworks may be handed in to my office or submitted as PDFs or JPGs via the course web site. Homework must be easy to read: please clearly write down your name and the problem set number, do not use a red pen.

## Attendance

There is no strict attendance requirement, but you are strongly advised to attend class. Attendance has a strong correlation with performance. It is recommended that you read the book sections in advance and come ready to participate. If you miss an exam or cannot turn in homework, please inform the instructor beforehand and get a doctor's note if applicable. Absences from tests count as zeros, unless they are justified. If you must be absent during a test for a University sponsored event, you must discuss this with the instructor before the test date.

If you need to isolate due to contracting COVID-19 at any point this semester, you must do so, and email the instructor as soon as possible. We will work with you to help you continue your progress in the course. In your email, state how long you expect not to attend class. We can work together to establish a plan for completing the necessary work. You will have access to your texts and the course content. More information on isolation protocols can be found here. Follow the most up-to-date guidance from the CDC.

## Academic Integrity

Violations of the University's policy of academic integrity will result in a failing grade and other disciplinary actions. A student with a documented case of plagiarism or cheating in this course will receive a failing grade for the course and may face disciplinary action by the University, including expulsion. In particular, do not turn in problem set solutions copied from online or a solutions manual. Copying solutions does nothing to enhance your learning. If this occurs then you will get an automatic zero for the problem set. It if happens more than once, it will be reported to the chair of the department.

## Disability Access and Inclusion

The University of Mississippi is committed to the creation of inclusive learning environments for all students. If there are aspects of the instruction or design of this course that result in barriers to your full inclusion and participation, or to accurate assessment of your achievement, please contact the course instructor as soon as possible. Barriers may include, but are not necessarily limited to, timed exams and in-class assignments, difficulty with the acquisition of lecture content, inaccessible web content, and the use of non-captioned or non-transcribed video and audio files. If you are approved through SDS, you must log in to your Rebel Access portal at https://sds.olemiss.edu to request approved accommodations. If you are NOT approved through SDS, you must contact Student Disability Services at 662-915-7128 so the office can: 1) determine your eligibility for accommodations, 2) disseminate to your instructors a Faculty Notification Letter, 3) facilitate the removal of barriers, and 4) ensure you have equal access to the same opportunities for success that are available to all students.

## Classroom Health Requirements

If students test positive for COVID-19 at any health care facility, they must report it to the Student Health Center (here or call 662-915-7274) and they must follow directions from the healthcare provider and isolate. Students with COVID-19 should seek medical attention by a healthcare provider and contact their instructor to let them know that they will be missing class due to a health-related issue.

## Other

If a change in the syllabus becomes necessary during the semester, it will be discussed in class and then posted on Blackboard. This website will also contain up-to-date information on the class schedule, homework assignments and complementary material.

## Schedule (subject to change)

| Week | Date | Lecture # | Topic | Homework |
|---|---|---|---|---|
| 1 | January 23 (M) | 1 | introduction & review of Phys 401 | |
| | January 25 (W) | 2 | magnetization §6.1[1] | |
| | January 27 (F) | 3 | field of magnetized object §6.2 | |
| 2 | January 30 (M) | 4 | $\vec{H}$ field §6.3, linear media §6.4 | PS1 due |
| | February 1 (W) | 5 | EMF §7.1 | |
| | February 3 (F) | 6 | EMF §7.1 | |
| 3 | February 6 (M) | 7 | Induction §7.2 | PS2 due |
| | February 8 (W) | 8 | Induction §7.2 | |
| | February 10 (F) | 9 | Maxwell's equations §7.3 | |

[1] §$n.m$ refers to section $m$ of chapter $n$ of the book "Introduction to Electrodynamics" by Griffiths.

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| | February 13 (M) | 10 | Maxwell's equations §7.3 | PS3 due |
| 4 | February 15 (W) | 11 | charge and energy §8.1 | |
| | February 17 (F) | 12 | charge and energy §8.1 | |
| | February 20 (M) | 13 | momentum conservation §8.2 | PS4 due |
| 5 | February 22 (W) | 14 | momentum conservation §8.2 | |
| | February 24 (F) | 15 | waves in 1D §9.1 | |
| | February 27 (M) | 16 | waves in 1D §9.1 | PS5 due |
| 6 | March 1 (W) | 17 | waves in vacuum §9.2 | |
| | March 3 (F) | 18 | midterm exam | |
| | March 6 (M) | 19 | waves in vacuum §9.2 | |
| 7 | March 8 (W) | 20 | waves in media §9.3 | |
| | March 10 (F) | 21 | waves in media §9.3 | |
| | March 13 (M) | — | no class — Spring break | |
| 8 | March 15 (W) | — | no class — Spring break | |
| | March 17 (F) | — | no class — Spring break | |
| | March 20 (M) | 22 | absorption and dispersion §9.4 | |
| 9 | March 22 (W) | 23 | absorption and dispersion §9.4 | PS6 due |
| | March 24 (F) | 24 | waveguides §9.5 | |
| | March 27 (M) | 25 | waveguides §9.5 | |
| 10 | March 29 (W) | 26 | potential formulation §10.1 | PS7 due |
| | March 31 (F) | 27 | potential formulation §10.1 | |
| | April 3 (M) | 28 | distributions §10.2 | |
| 11 | April 5 (W) | 29 | distributions §10.2 | PS8 due |
| | April 7 (F) | — | no class — good Friday | |
| | April 10 (M) | 30 | field of point charges §10.3 | |
| 12 | April 12 (W) | 31 | field of point charges §10.3 | |
| | April 14 (F) | 32 | dipole radiation §11.1 | |
| | April 17 (M) | 33 | dipole radiation §11.1 | PS9 due |
| 13 | April 19 (W) | 34 | point charges §11.2 | |
| | April 21 (F) | 35 | point charges §11.2 | |
| | April 24 (M) | 36 | special relativity §12.1 | PS10 due |
| 14 | April 26 (W) | 37 | special relativity §12.1 | |
| | April 28 (F) | 38 | relativistic mechanics §12.2 | |
| | May 1 (M) | 39 | relativistic mechanics §12.2 | PS11 due |
| 15 | May 3 (W) | 40 | relativistic electrodynamics §12.3 | |
| | May 5 (F) | 41 | relativistic electrodynamics §12.3 | |
| | May 11 (Th) | — | final exam 4pm – 7pm | |