

Physics 513, Autumn Quarter 2020

Prof. Leslie J Rosenberg, Department of Physics, University of Washington

General information:

Physics 513, the first course in graduate electrodynamics

Textbook: J.D. Jackson, "Classical Electrodynamics," third edition

Because the campus is largely closed due to COVID-19, this entire course is on-line throughout the quarter. Zoom lectures for the course are Tuesdays & Thursdays 11:00-12:20 Pacific time. The lectures aren't recorded, but lecture notes will typically be posted on this web site. The first lecture is Thursday, October 1.

Join the on-line Zoom lectures at URL <https://washington.zoom.us/j/99341867892> (you'll need your UWnetID credentials, then enter the Zoom "SSO" of "washington" or "washington.zoom.edu" depending on your system).

Course Instructor:

Prof. Leslie J Rosenberg

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Office Hours Thursdays 12:30 via Zoom URL <https://washington.zoom.us/j/99341867892> (you'll need your UWnetID credentials, then enter the Zoom "SSO" of "washington" or "washington.zoom.edu" depending on your system) or by appointment.

Telephone: (206) 221-5856

TAs/graders:

Kyle Aitken kaitken@uw.edu

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Useful Information:

- [Readings, Lectures and Exams](#)
- On-Line Lecture Notes
 - [Phys513-AUT20-lecture_01oct20.pdf](#)
 - [Phys513-AUT20-lecture_06oct20.pdf](#)
 - [Phys513-AUT20-lecture_08oct20.pdf](#)

[Phys513-AUT20-lecture_13oct20.pdf](#)

[Phys513-AUT20-lecture_15oct20.pdf](#)

[Phys513-AUT20-lecture_20oct20.pdf](#)

[Phys513-AUT20-lecture_22oct20.pdf](#)

[Phys513-AUT20-lecture_27oct20.pdf](#)

[Phys513-AUT20-lecture_29oct20.pdf](#)

[Phys513-AUT20-lecture_03nov20.pdf](#)

[Phys513-AUT20-lecture_05nov20.pdf](#)

[Phys513-AUT20-lecture_10nov20.pdf](#)

No lecture 12nov20

[Phys513-AUT20-lecture_17nov20.pdf](#)

[Phys513-AUT20-lecture_19nov20.pdf](#)

[Phys513-AUT20-lecture_24nov20.pdf](#)

No lecture 26nov20

[Phys513-AUT20-lecture_01dec20.pdf](#)

[Phys513-AUT20-lecture_03dec20.pdf](#)

[Phys513-AUT20-lecture_08dec20.pdf](#)

[Phys513-AUT20-lecture_10dec20.pdf](#)

- Special Lectures

[Reciprocity property of the Green's function.](#)

- Homework

[Homework 1 \(Due October 12; note submission instructions on assignment\).](#)

[Homework 1 solutions](#)

[Homework 2 \(Due October 19; note submission instructions on assignment\).](#)

[Homework 2 solutions](#)

[Homework 3 \(Due October 26; note submission instructions on assignment\).](#)

[Homework 3 solutions](#)

[Homework 4 \(Due November 2; note submission instructions on assignment\).](#)

[Homework 4 solutions](#)

No homework 5

[Homework 6 \(Due November 16; note submission instructions on assignment\).](#)

[Homework 6 solutions](#)

[Homework 7 \(Due November 23; note submission instructions on assignment\).](#)

[Homework 7 solutions](#)

No homework 8

[Homework 9 \(Due December 7; note submission instructions on assignment\).](#)

[Homework 9 solutions](#)

No homework posted the last week of class.

- Midterm-1 exam information.

The midterm exam will be posted here on Friday, November 6, at 4pm Pacific time. You should spend 1 hour and 20 minutes working on the exam. It's due via email on Monday, November 9, at 4pm Pacific time. Points will be deducted for late submission. The exam contains more detailed submission instructions. The exam is open-book; you may refer to Jackson, your lecture notes and this web site.

The exam could potentially include any of the material in lectures, special lectures, homework and the text through section 4.3. [Take-home mid-term exam 1.](#)

Email-submission instructions:

1. Scan your solutions as a single PDF file, one page per problem

2. Name your file midtermI-*lastname*.pdf
3. Attach your file to an email
4. ... with subject line midtermI-*lastname*
5. Send the email to ljrosenberg@phys.washington.edu

Exam statistics: Average 71.4, st.deviation 18.8, min. 3, max. 98.

- "Final"-exam information.

The final exam (more properly, midterm-2 exam) will be posted here on Thursday, December 10, at 4pm Pacific time. It's due via email on Friday, December 11, at 4pm Pacific time. The exam contains more detailed submission instructions. Points will be deducted for late submission. The exam is open-book; you may refer to Jackson, your lecture notes and this web site. The exam could potentially include any of the material in lectures, special lectures, homework and the text through section 6.3.

[Take-home mid-term exam 2.](#)

Email-submission instructions:

1. Scan your solutions as a single PDF file, one page per problem
2. Name your file midterm2-*lastname*.pdf
3. Attach your file to an email
4. ... with subject line midterm2-*lastname*
5. Send the email to ljrosenberg@phys.washington.edu

Exam statistics: Average 71.6, st.deviation 16.9, min. 7, max. 100.

Recent course news:

- [12Nov2020 11:00] No lecture or office hours today. Sorry for the late notice.
- [28Sep2020 9:00] The first class day is Thursday, October 1. Zoom lectures are Tuesdays and Thursdays, see above.

Lecture Instructor's Comments

Welcome to Physics 513, the first of a three-quarter sequence of graduate classical electrodynamics. This is a wonderful topic, it's challenging and stimulating. I think it's the most enjoyable and edifying course in the Physics graduate curriculum. Electrodynamics is crucial for understanding the underpinnings of the physical and biological sciences. It's also essential for modern technology. Going forward in your career, a familiarity with Jackson chapters 1-16 will allow you to converse sensibly with your colleagues.

There are many ways to approach electrodynamics. Roughly speaking, there's the formal approach (starting with the Lagrangian of electrodynamics) of Landau and Lifshitz and the historical approach (starting with electric charges and electrostatics) of Jackson. We'll use Jackson's text "Classical Electrodynamics". You might want more details or other topics than found in Jackson, or perhaps you'd like an alternative approach, and I assure you there are many approaches. In which case you might want to look at, e.g., Panofsky and Phillips "Classical Electricity and Magnetism". Two very good, very readable, books for some of the more formal aspects of the classical field theory but with fewer applications are Landau and Lifshitz "The Classical Theory of Fields" and "Electrodynamics of Continuous Media". Another nice thing about Landau and Lifshitz "Fields" is halfway through the text, General Relativity enters rather

seamlessly. There's a movement in teaching graduate electrodynamics to present the topic in the language of differential forms, but we won't do so. However, if you're interested in this approach, a good introduction is Misner, Thorne and Wheeler "Gravitation" chapter 2. A slightly more elementary but very good graduate electrodynamics text is Slater and Frank "Electromagnetism". Most homework problems in this course, and indeed the majority of homework problems in most texts, are adapted from Smythe, "Static and Dynamic Electricity", a challenging text with an archaic and hard-to-read notation; Smythe adapted the problems in that text from a compilation of Oxford University graduate exam problems. A more modern electrodynamics text is Zangwell, "Modern Electrodynamics", it has good reviews, but I haven't yet gone through it in detail. It also has some new problems. There's no perfect text, and every text has gems scattered throughout.

Mathematical methods are interspersed throughout the course as needed, Jackson is good about introducing the necessary mathematics background. For a math refresher, there are many suitable texts, e.g., Dennery and Krzywicki "Mathematics for Physicists". I think the gold standard of mathematical physics texts are the two volumes of Morse and Feshbach, "Methods of Mathematical Physics".

That said, for the first quarter we'll follow Jackson's text somewhat closely.

Syllabus The syllabus for 513 starts with chapter 1 in Jackson, the beginnings of electrostatics. With luck, this quarter we'll be able to get through chapter 5, magnetostatics. We'll follow the text in more or less the text ordering, though we'll sometimes supplement Jackson's presentation with added material. See above for a link to the readings and lectures. Try to read the relevant text and added material before class; this will take time but there's a big payoff in understanding. Alas, I've found in teaching this course the syllabus readings become out of sync with the lectures, so you'll have to pay attention.

Grading 40% of your grade is assigned to the midterm exam, 40% to the "final" (second midterm) exam, 20% to the homework.

- **Midterm and "final" exam:** There will be a midterm exam and a "final" exam (more properly a second midterm exam). Both are take-home exams. Exams are to be your own work; you aren't permitted to collaborate with any other person.
- **Note that there are no make-up exams or make-up homework.** Students with outside professional, service, or career commitments (i.e. military service, professional conference presentation, etc.) conflicting exactly with the exam dates must contact the instructor in the first two weeks of the quarter to establish alternate procedures. I'm quite flexible in this regard but you'll need to contact me beforehand. Students who miss an exam or homework due to illness should contact the instructor as soon as you're reasonably able to discuss alternate procedures. Except for debilitating illness or other crisis, students who miss an exam or homework without making prior arrangements with the instructor will get a zero for that score. Except for illness and circumstances noted above, a final grade of 0.0 may be assigned to any student who misses a midterm or final exam.

- **Homework:**

Lecture homework will generally be assigned and collected weekly. Typically, homework is assigned Monday afternoon (Pacific time) and is due via email the next Monday afternoon (Pacific time). The assignments contain more submission details. The graders will consider neatness and logic of presentation, points will be deducted for lack of either. Words help in explaining your solution. Briefly, if your homework is a messy, incoherent scrawl, the graders

won't evaluate your homework. I strongly encourage you to work collaboratively, but your submitted work must be your own. A typical assignment has four problems. One problem is straightforward (at the Griffiths level), two are at the Jackson level, and one is more challenging. Typically, not all problems are graded. I typically post solutions on the due-day, I welcome comments and corrections to the solutions and clever alternate approaches.

- **Communication:**

For administrative issues, it's best to contact me via email. But, for physics questions, I discourage email (unless the question answer is of the "yes/no" variety). Physics is best discussed at Zoom office hours. Also, don't hesitate to make a Zoom appointment to talk with me at other times.

- **Misconduct:**

Academic misconduct is a serious offense. See <https://www.washington.edu/cssc/facultystaff/academic-misconduct/> for policy and reporting procedures. The above grading description applies only to students who uphold academic integrity; grades will be lowered, possibly to zero, for students found to have engaged in academic misconduct. There could also be other sanctions. Respectful conduct is expected of all, see <https://www.washington.edu/studentconduct/>. Students are encouraged to bring any instances of problematic behavior to the attention of the instructor and to contact SafeCampus (206-685-7233 anytime) with concerns for yourself or others.

- **Religious Accommodations:**

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (<https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/>). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (<https://registrar.washington.edu/students/religious-accommodations-request/>).