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PHYSICS 1372

Electromagnetic Theory

Term 2184 (Spring 2018), class# 11180

- Instructor: Dr.S. (Prof. Vladimir Savinov, a.k.a. dr.s.)
- Office: Allen Hall, 402 (note that office hours are normally conducted elsewhere).
- Office hours: time and location will be announced in class, on CourseWeb and via e-mail. Also, I will usually be available right after class in the hallway outside Allen Hall, 105. I will NOT be available right before class, even for quick questions. Office hours are conducted in group environment (unless you are the only student who came to office hours). I do not do individual tutoring. Please make an effort to be there at the time when office hours start. If you show up late, you could miss an important discussion (possibly, related to your question(s)!).
- Phone#: (412) 624-9042 (NOT a good way to get in touch with me, but leaving a msg (if you really have to) should be OK).
- e-mail (THE best way to contact me): vps3@pitt.edu
  Note that when an e-mail is sent to me using non-Pitt SMTP servers, it could be lost or get stuck in a filter I have no control over and can't do much about. Note that I do not check my junk e-mail folder at Pitt, all e-mail stuck there is deleted automatically. Note that I will be communicating with class using students' e-mail addresses in **pitt.edu** domain. It is your responsibility to make sure you read e-mail sent to you at **pitt.edu** regularly and none of the information is missed. All e-mails sent to class will also be posted/archived on CourseWeb.
  To conclude: (1) to send me an e-mail, use Pitt's SMTP server in your e-mail client (or just use web browser to access your e-mail at Pitt) and (2) when you have questions for me please send these to me at vps3@pitt.edu.
- Lectures: M,W,F 10:00am-10:50am, Allen Hall 105. Occasionally, lectures may be canceled/rescheduled.
- Textbooks: I will use a combination of two textbooks:

  Classical Electromagnetic Radiation by Mark. A. Heald and Jerry B. Marion, 3rd edition, Dover, 2012 and

  Introduction to Electrodynamics by David J. Griffiths, 4th edition, Pearson, 2012. (please do not use Griffiths's 3rd edition for this class!).

- Besides the main two textbooks, I most strongly advise you to read (at least from time to time) *The Feynman Lectures on Physics* (available online at Caltech-supported web site) and *Electricity and Magnetism* by Edward M. Purcell and David J. Morin, 3rd edition, Cambridge University Press, 2013.

Course Description

In previous class (Phys1351) you learned the basic concepts developed to describe electromagnetic phenomena. You extensively employed vector calculus to solve problems in electrostatics and magnetostatics using Poisson's and Laplace's equations and associated boundary conditions. You were introduced to electrodynamics and Maxwell's equations and solved numerous problems describing electromagnetic phenomena. The importance of symmetries (and how to take advantage of their presence) was repeatedly emphasized. In this class you will learn about Poynting's theorem, Maxwell stress tensor, energy, momentum and angular momentum of the fields; electromagnetic waves, their propagation and radiation theory; the potential formulation and gauge transformations. We will also investigate electromagnetism in the context of Einstein's theory of relativity. If time permits, other topics could also be discussed. This course will serve as a bridge between Phys1351 and the class (usually based on Jackson's famous *Classical Electrodynamics*) that you would take as a first-year graduate student.

The lectures will be based on material from Heald & Marion and Griffiths (with additional material introduced in class, as needed), and many homework problems will be from the texts or based on them. In addition, there may also be assignments on relevant material from outside the books. It would be a very good idea to have regular access to the textbooks.

I requested copies of the three (above, *i.e.* excluding *The Feynman Lectures on Physics* (which is available online)) textbooks to be placed on reserve at Bevier Engineering Library in Benedum Hall. Of course, you can always buy textbooks from Pitt's bookstore or online. Textbook information for Griffiths can be found at publisher's web site, or/and at amazon.com. Griffiths's textbook's ISBN-13: 978-0321856562, ISBN-10: 0321856562. Textbook information for Heald & Marion can be found at Dover's web site, or/and at amazon.com. Heald & Marion's textbook's ISBN-13: 978-0486490601, ISBN-10: 0486490602.

I will cover, very generally, most (if not all) material from Heald & Marion's chapters 4 through 9 and 14 (which roughly correspond to Griffiths's chapters 8 through 12), inclusive. Working knowledge of Phys1351, Classical Mechanics (Phys1331), vector and differential calculus / equations is assumed and expected. It would be useful to read the textbooks before and after class. You will have to do a sizeable body of independent work outside class. You will be responsible for all material from chapters (partially or fully) discussed in class (unless I tell you otherwise).

Attendance

Attendance is expected, will be monitored and may end up being a part of your grade. If you do not plan to attend lectures, please meet with me to discuss this matter. I expect you to explain your (if regular) absence from class to me. Class attendance is a prerequisite for attending office hours. Students are most strongly advised to take (at least some) lecture notes during class and

to study their notes later in the day / same week. If you can't reproduce calculations performed in class or/and in the books, this would be a clear sign of having trouble with class material. If you miss a class because of some unfortunate circumstances, it is your responsibility to catch up by studying the textbooks, by asking other students to share their notes with you and by attending office hours to ask questions about assigned problems and to clarify material in the textbook and/or presented in class.

CourseWeb

Up to date information about class, including assignments and complementary materials, will be regularly posted on CourseWeb (a.k.a. Blackboard). You can access CourseWeb at http://courseweb.pitt.edu (use your Pitt network computer account and password to log in). I will be updating class information on CourseWeb regularly.

Homework Assignments

Homework will be assigned (announced electronically on CourseWeb) regularly. You are strongly encouraged to discuss homework problems with other students (though **copying** other people's work and/or from online sources is, of course, strictly forbidden). Note that your grader is your instructor (that's me, dr.s.). When you turn in your assignment (do so in class, or leave it under the door to my office, or in the box on my office door on the day when it's due, but please NEVER leave it for me on the 1st floor of Allen Hall / *i.e.* do not leave it in my mailbox!), show all your work. Do not skip intermediate steps. Do not try to save paper/trees. Your pictures/plots/sketches should be large size. Do not turn in your scratch paper. Be neat. Do not e-mail your work to me (unless I request you to do so). Make it easy for me to figure out what you have done. Show ALL steps, do NOT assume that some of the steps are "obvious" or "trivial". When I am not able to understand what you have done, this would count against you. When working on problems together with other students please indicate the names of your group's members (students often don't realize that sharing such info is to their benefit). Attend office hours. Take notes in class. Solutions to homework problems will be posted on CourseWeb.

Grading Scheme and Other Details

There will be two midterm exams and one comprehensive (*i.e.*, cumulative) final exam. Midterms dates will be announced at a later time, but no later than two weeks before the actual exam. The final exam date is set by the university (see `http://www.registrar.pitt.edu/assets/pdf/2184_EXAMS.pdf`), and it is currently scheduled on Thursday, Apr. 26, between 8:00am and 9:50am. The location of final exam will be announced at a later time. You should be aware of the University Final Exam Conflict Accommodation Procedure outlined in this document (you may also need this form). The final grade will be determined by your attendance and homework (both together ∼20%), mid-term exams (∼25% each), and final exam (∼30%). If you have any questions / need anything clarified, please contact me at vps3@pitt.edu.

Supplementary References

I requested to place copies of the two main textbooks (and a copy of Purcell & Morin's excellent text) on reserve at Bevier Engineering Library in Benedum Hall.

I would also like to recommend these additional books (just for your reference) that are not on reserve but probably should be:

- *Classical Electrodynamics* by W. Greiner, a volume in a series of textbooks introducing German-speaking students to theoretical physics (translated).
- *Div, Grad, Curl, and All That: An Informal Text on Vector Calculus (Fourth Edition)* by H. M. Schey, as it is called, it's an informal (and excellent) introduction to vector calculus.
- *Vector and Tensor Analysis with Applications (Dover Books on Mathematics)* by A. I. Borisenko (Author), I. E. Tarapov (Author) and Richard A. Silverman (Translator), this book contains excellent examples for those who want to master vector calculus and beyond.
- *The Classical Theory of Fields, Fourth Edition: Volume 2 (Course of Theoretical Physics Series)* by L.D. Landau and E.M. Lifshitz, if you want to have it the hard way.

Special and/or Unexpected Circumstances and Emergencies: Should such arise, please follow the following protocol: first take care of your emergency and/or unexpected circumstances and then, when you have time, send me an e-mail outlining your circumstances and the nature of your emergency. All such events will be handled on a case-by-case basis. Generally, do not rely on oral communications with me, any request / explanation of some situation / any commitment must be communicated electronically. Generally, no "I" or "G" grades will be assigned in this class. All work for this course should be completed before the end of this term.

Religious Observances and Class Activities: In case your religious observances conflict with class activities / tests / homework assignments due dates and such, please alert me to such possible conflicts as soon as possible (preferably, in advance).

Special Accommodations for Disability: If you have a disability that requires special testing or other accommodations, you should notify both the instructor and Disability Resources and Services (DRS) as early as possible in the term. You may be asked to provide documentation of your disability to determine the appropriateness of accommodations. Disability Resources and Services is located in the William Pitt Union, Room 140. If needed, please call (412) 648-7890 (voice) or (412) 383-7355 (TTY) to schedule an appointment with them. A comprehensive description of the services provided by DRS can be obtained at their web site.

Academic Integrity: All students (and the instructor) in this course are expected to follow the University of Pittsburgh Academic Integrity Code. If you are not aware of the specifics, you should obtain a copy of the Academic Integrity Code from the Dietrich School of Arts and Sciences Dean's Office, 140 Thackeray Hall, or look up this info online at their web site. Violations of the Academic Integrity Code by a student may result in a zero score for an examination/homework/other or/and a failing grade for the entire course.