Physics 431

Fall 2012 Semester

Electricity and Magnetism

Logistics

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Lecture Time and Location	T-R, 8:10 – 9:25, Nielsen 306
Office Hours	Immediately after class, or by appointment, in my office

Why study Electricity and Magnetism

Electricity and Magnetism (PHY 431-432) is one of the core courses of the undergraduate physics major. In a nutshell, this course develops a mathematically rigorous theory of the electromagnetic field. Since it forms a sound basis for later instruction in quantum mechanics and other subjects, the study of Electricity and Magnetism is of fundamental importance for the professional formation of physicists and engineers.

Prerequisites

The course and text presume a familiarity with calculus and calculus concepts (vectors, vector, differential and integral calculus), linear algebra (matrices, determinants etc.), differential equations. A basic knowledge of electricity and magnetism at the level of physics freshman courses is also expected. A background in these topics is highly recommended and is necessary for success in the course. This does not mean you must be the world's expert. But you should have either taken these classes and retain some basic understanding, or you should get textbooks and teach yourselves as needed.

General Course Description - Manifesto

The course will treat the following main subjects: Electrostatics in vacuum, Electrostatics in matter, Electric currents, Magnetostatics in vacuum, Magnetostatics in matter.

With respect to introductory physics courses, the study of Electricity and Magnetism is here pursued rigorously using advanced mathematical techniques (both analytical and numerical/computational).

Course Objectives

- **Gain deeper understanding of Electricity and Magnetism**. Consolidate the understanding of fundamental concepts in Electricity and Magnetism more rigorously as needed for further studies in physics, engineering and technology.

- **Advance skills and capability for formulating and solving problems**. Expand and exercise the students' physical intuition and thinking process through the understanding of the theory and application of this knowledge to the solution of practical problems.

- **Increase mathematical and computational sophistication**. Learn and apply **advanced mathematical techniques** and methods of use to physicists in solving problems. Develop some capabilities for **numerical/computational methods**, in order to obtain solutions to problems too difficult or impossible to solve analytically.

Class preparation and protocol – How we will work

This course consists of several components: lectures, reading assignments in the textbook, suggested exercises/problems assigned from the textbook and or by me, homework problems sets. The material you will be expected to learn and will be tested on during the exams will be taught to you as part of all of these course components.

Reading the relevant chapter or sections for each week's lectures (i.e. Reading Assignments) and working out the assigned examples/exercises/problems are a compulsory and vital part of the course. I stress the importance of "reading" the textbook and/or any material that I will assign for reading. "Reading" does not mean just reading, but rather carefully working your way through all the parts of the textbook, including all of the examples. You must read the textbook carefully and assimilate the concepts, work through the derivations of the equations, follows and work out the examples, and then test your knowledge by doing exercises and problems. This is what "reading" means and this is the meaning of the word in this course. I will expect you to come to class having done the readings and prepared to discuss suggested examples/exercises/problems from the textbook and/or provided by me. You do not have to turn in the solutions to these examples/exercises/problems, but be conscientious and do as many of them as you can. The lectures will NOT repeat the material in the textbook, but will be used to discuss the course material in a variety of ways. Some lectures will follow the textbook, some other will discuss topics not covered in the textbook, and/or discuss them in a different manner. Thoroughly reading the book and working on the suggested examples/exercises/problems will allow us to spend class time discussing physics rather than communicating the details. I will likely not have time to present every detail of every subject in class. I will expect you to learn both concepts and calculation methods.

It is extremely important to keep up with the work, since the material builds on itself. Each day, preview the topics for the next class; after class, study the topics in detail and work on the suggested examples/exercises/ problems.

Material not contained in the textbook or presented in a different way will be provided for you, either via the web or in hard copy form. Make sure to check the web the evening before class. Have a copy of the material on your desk when you attend class. By doing so, instead of spending your time copying from the board, you can think about the material as it is presented.

Computing

Computational methods and scientific computer programming will be used occasionally in problem solving. Some Homework problems will require numerical solution and, for these, you will have to make use of a numerical software package. As decided by the Undergraduate Committee, we will use MATLAB, which is available on the departmental PCs in Nielsen 512 and some PCs in Nielsen 203. You may download MATLAB and any of the toolboxes to a UT owned computer and/or a personally owned computer. For more information on MATLAB, and how to acquire the software, please visit the OIT MATLAB web page at http://oit.utk.edu/matlab. I will not have time to teach you extensively the use of Matlab and/or programming in Matlab. There are many textbooks on Matlab, I suggest **"Getting started with MATLAB", by Rudra Pratap, Oxford**, or "**A guide to MATLAB, for beginners and experienced users**", by B. R. Hunt, R. L. Lipsman, J. M. Rosenberg, Cambridge.

Textbook and Supplementary References

The textbook (available at the UT Bookstore) is

- **"Introduction to Electrodynamics," by David J. Griffith, Pearson/Addison Wesley**

The following textbooks are recommended as supplements to the course text. Use them when the discussion of a topic in the textbook seems unclear, or in need of further elaboration, or for a different perspective. I have listed the books in order of increasing difficulty.

Junior level Texts:

any book adopted for classes such as PHY 135-136 or the like, such as

- **Young and Freedman, University Physics**
- **Knight, Physics for Scientists and Engineers**
- **Halliday, Resnick, Walker, Fundamental of Physics**

Senior level Texts (* = particularly recommended)

- **"Foundations of Electromagnetic Theory", by John R. Reitz, Frederick J. Milford and Robert W. Christy**
- **"The Electromagnetic Field", by Albert Shadowitz (*)**
- **"Electromagnetic Fields", by Roald K. Wangness**

Advanced Texts (Graduate Level)

- **"Classical Electrodynamics", by J. D. Jackson**
- **"Classical Electrodynamics", by W. Greiner (*)**

Mathematical background:

for linear algebra and ordinary differential equations,

- **"Introduction to Linear Algebra and Differential Equations", by John W. Dettman, Dover Publications**

for differential and integral calculus

- **"Vector and Tensor Analysis", by A. I. Borisenko and I. E. Tarapov, Dover**
- **"Introduction to Vector and Tensor Analysis", by Robert C. Wrede, Dover**
- **"Introduction to Vector Analysis", by Harry F. Davis and Arthur D. Snider**
- **"Div Grad Curl and all that", by H. M. Schey**

Contacting the Instructor

I prefer personal contact to e-mail contact, and therefore encourage you to come to office hours. If you cannot make my office hours, we can schedule an appointment. As another alternative, I am going to be in my office most of the time, if you show up chances are that I might see you, unless I am really in the middle of something. Call me in the office to check. **Anyhow, I strongly encourage you to come and see me.**

As a general rule, I do NOT address homework problems by e-mail. On the other hand, if you have a personal emergency, e-mail is fine.

Announcements, Lecture Notes, Course Material and Course Updates

Lectures and Blackboard are my primary modes of communication with the class. Announcements, Lecture Notes, Course Material, Homework, solutions to Homework and Course Updates including definite dates for exams etc. will be posted on Online@UT (Blackboard, Bb for short). Please note that it will be your responsibility to be aware of the content of any communication taking place in class, be it an announcement or anything related to the course material, in case you are not present. You are required to have an official UT email address (name@utk.edu or name@tennessee.edu) and read announcements on Bb and your email on a daily basis. Information that cannot be transmitted to you during the lectures or on Blackboard, or any personal communication, will be given to you via email.

Attendance Policy

I expect participation in class, not just attendance. This takes the form of answering questions I pose to you collectively, as well as asking questions. Although attendance and participation do not have a precise weight in the grade, they are highly recommended and most likely essential for a successful completion of the course. Some lectures will follow the textbook, some other will discuss topics not covered in the textbook, and/or discuss them in a different manner, so it is in your best interest to attend class and participate. If you are not present in class, it will be your responsibility to be aware of the content of any communication taking place in class, be it an announcement or anything related to the course material.

Homework

In addition to the suggested examples/exercises/problems, there will be problem sets for which you will have to write out full solutions. Your homework grade will be based on the scores of these problem sets.

In preparing solutions, you should follow the general scheme of the problem solving framework introduced in introductory physics courses: draw a diagram when feasible; define variables; describe the physical principles being employed; write out a full mathematical solution; evaluate and comment your result. When writing solutions keep in mind that there is also a large difference in sketching a solution and writing up a solution so that someone can read it. As with much writing, keep your audience in mind, and be clear!. Clearly state the issue or problem, outline the tools needed, and proceed providing information when needed.

I generally encourage students to work together as far as homework is concerned. The goal is to use homework as one of the most effective ways of assimilating the material. Do not take advantage of the work of other people, and do not let anybody take advantage of your own work: efforts should be shared. You must write up your own solutions to the homework problems. In other words, do NOT just copy someone else's solution since this constitutes plagiarism and will have grave consequences. Some problems will require numerical solution and, for these, you will have to make use of a numerical software package. Please refer above to **Computing** regarding this issue.

There will be approximately 8 - 10 problem sets. You will be notified on Bb when the HW is available. **Homework will always be collected at the beginning of the class session**, with due date specified on the HW itself and communicated in Bb when the HW is made available. Please note the following policies, which are quite strict:

No extensions or make-up problem sets will be given. If there are extremely serious circumstances supported by proper documentation, exception to this policy may be considered at my discretion.

Due dates and time for HW are firm. Problem sets turned in late will be assessed on the basis of the following policy:

1 day late: 75% of maximum score

2 days late: 50% of maximum score

3 days late: automatic grade of zero.

"1 day late" is defined as any time after the due date and time of the beginning of class session. This includes five minutes late. The course policy is quite strict in this regard. Note that I post all assignments at least one week in advance. Please plan ahead.

Each problem will be graded on a 0 - 4 scale (0 = no work, 1 = poor, 2 = fair, 3 = good, 4 = excellent), or on a 0 – 8 scale if worth more points (0 = no work, 2 = poor, 4 = fair, 6 = good, 8 = excellent). Solutions to the HW will be either handed out in class or posted on Bb.

NB.: A point is a point: this means that different HW sets might have different total scores, and your total score will be given by the sum of the points that you will collect.

Questions regarding the HW problems may be asked in lecture or during office hours, NOT by email. For each HW set, I will make available for you a Forum in Bb where you can discuss among yourself.

Midterm and Final Exam

There will be one Midterm Exams (1 hour-long) and one comprehensive, Final Exam (2 hours-long). All of the exams will cover material covered in class, homework, and reading assignments. The Final Exam will be comprehensive, i.e. you will be tested on the whole material covered in class, homework, and reading assignments during the whole semester.

For the exams you are required to bring a pencil and a non-programmable pocket calculator. In particular, no laptops, cell phones or other means of communication, backpacks, etc. are allowed. You can leave any personal effects in class when you will take the exams.

The exams are closed book. You will receive a handout containing information on Physical Constants, Units, selected tables of physical properties, and selected mathematical and physics formulas. The handouts will be posted on Blackboard before the exams.

Students are expected to perform all work in conformance with the University policies regarding Academic Honesty. In particular, all work submitted by a student during the exams is expected to represent his/her own work. Violation of the Academic Honesty policies will result in disciplinary actions according to the University rules.

Grading

The semester Grade will be based on the following Weighted Average:

Homework	=	**40%**
Midterms	=	**25%**
Final Exam	=	**35%**

Please note: **Ordinarily make-up exams will NOT be given. Missing the Final Exam is very serious and may well result in failure of the course.** However, if there are extremely serious circumstances supported by proper documentation, a make-up for Midterms and/or Final exam may be considered at my discretion.

Appeals

You are welcome to discuss the grading of a given assignment, be it homework, Midterm or Final Exam. Appeals must be dropped in my mailbox, with a brief explanation of the issue. Any appeal will be entertained if it is raised no later than one week after the date on which the graded Exams/HW are made available for return to the class. After this "appeal period" of one week, exam grades will be considered final and will not be altered.

For students with disabilities

Any student who feels s/he may need an accommodation based on the impact of a disability should contact me privately to discuss specific needs. I will then contact the Office of Disability Services at 865-974-6087 in Hoskins Library to coordinate reasonable accommodations for students with documented disabilities.

Cheating and Plagiarism will not be tolerated.

Cheating will not be tolerated. Everyone must have an equal chance to do well. The penalty for cheating on any aspect of this course will be an "**F**" for the course. This includes writing on your exam after I have announced it is ended, or any other unfair advantage taken over other students. No outside materials are permitted on any exam, except those provided by the instructor.

Plagiarism of any kind will not be tolerated. Working together on homework does not count as plagiarism. A line by line copy of another student's homework does. If you use a source (book, articles, internet material etc.), you must quote it. Use of a source without citation is plagiarism.

Cheating and/or plagiarism cases found to be in Violation of the Academic Honesty policies will result in disciplinary actions according to the University rules, without exception.

Highly Recommended Suggestions: How will I likely do well in this class?

- **Read this Syllabus carefully**, in particular, the Class Preparation and Protocol, and Homework sections.
- **Work hard from the very beginning**. It will get difficult rapidly. We will go at a relatively fast pace. I will be a "tough" instructor who will give you a challenge; you should plan several hours per week of work.
- **Come to class prepared** in order to be able to make the best possible use of the lecture. Read the material in advance (reading Assignments), work out the suggested examples/exercises/problems, follow my suggestions in class. (Refer to what described in Class Preparation and Protocol).
- It is never too early (or too late) to start being clear about what you understand and what you do not. **Question your own understanding by trying it out on new situations**.
- **Come to class prepared. If something is not clear, interrupt me in class immediately. Ask a lot of questions**. Remember that if you do not understand something, chances are neither do most of your classmates, so it is likely not an obvious question. Remember: the worst question is the one you do not ask. If you do not ask questions, I will assume that you all understand perfectly and continue at a fast pace.
- **If you have difficulties, see me right away**. Do not wait until you are completely lost and there is no hope of catching up. Everything will only get more and more difficult. You cannot afford to not understand any concept. In physics every new concept relies crucially on the previous ones.

- **Work on the HW sets from the very beginning**. The HW sets are supposed to teach you the material by creating situation from which you can get out only by thinking. They are not supposed to be easy to solved, so I expect you to struggle on them. You will never learn how to ski if you are scared of falling. Minimize frustration! Try hard on a problem, but if everything fails, go on to other problems and return to the question later. Do not hesitate to contact me if you are stuck with a HW problem.
- **Be clear!** When you write solutions to HW, exams etc., be clear! In preparing solutions, follow the general scheme of the problem solving framework as described in the Homework section.
- **Keep a sheet of paper with useful formulae** so you can quickly answer questions such as, what is the spherical coordinate area element? Spend some time in remembering most of these formulas.
- **Work on examples/exercises/problems and HW sets in a way to re-create the conditions of an exam**. Put an effort in remembering the key steps, the equations etc. The exams are closed books, practice for it! If you will take the GRE one day, you have to remember everything, no notes will be allowed, so start practicing now. Avoid use of computational aids to solve analytical homework problems, as this will cause you to perform poorly on exams.
- You can work together on homework, but **your success in the course will depend on how much time you spend in reading, work out the suggested examples/exercises/problems, and write out solutions to the HW sets**. If you copy homework from other students, from past years, or off the web, and you do not even think about it, that is a recipe for failure.
- **Focus more on understanding than on grades.** The best scientists and engineers are not necessarily the ones who got A's. The best scientists and engineers are the ones who understand the problems they solve and think about them creatively. If you do assimilate the material and understand it, the grades will reflect this.