Course Information

Course: PHYS 333 Fall 2020
Electromagnetic Theory I

Instructor: Katharina Vollmayr-Lee
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mostly not under Covid-19:
152 Olin
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Classes: MWF 11:30 am – 12:22 Olin 255

Office Hours: M 4 – 5 pm, Tu 11 am – 12, W 8:30 – 9:30 am, Thu 2 – 3 pm, F 1:30 – 2:30 pm
https://bucknell.zoom.us/j/97270545774
Meeting ID: 972 7054 5774

Webpage: For updated information on our course, see the webpage
http://www.eg.bucknell.edu/~kvollmay/phys333_f2020/

Text: David J. Griffiths, *An Introduction to Electrodynamics*, Fourth Edition.

Objectives: Classical electromagnetism is one of the core subjects in any education in physics. Even though the main structure of the theory has been codified in just a few equations for over 100 years, the field is still interesting, relevant, and the subject of ongoing research. Everyone in this course has had some exposure to electricity and magnetism, but this is a rich subject, and you can study it at deeper and deeper levels. If you continue on in physics, there is another course in electromagnetism at Bucknell, PHYS 334, and you would probably take two more courses on it in graduate school.

This is as much a course in applied vector calculus and partial differential equations as it is a course in electromagnetic theory. Therefore the techniques you will learn, have applications beyond electromagnetism. We will not be studying "useful" device-oriented electronics like some of you did last spring in PHYS 235. Rather, you will be learning about the properties of abstract (but very real!) vector fields that are described by Maxwell's equations (the crown of this course). The unification of electricity and magnetization (and optics, for that matter) into a single (beautiful !) theory which can be described in a few equations represents one of the pinnacles of achievement in theoretical physics.

Goals: For more general learning goals for physics, astronomy, and biophysics, see

`http://coursecatalog.bucknell.edu/collegeofartsandsciencescurricula/areasofstudy/physicsandastronomy/#goalstext`

For our course the following goals apply:

- "Be able to solve quantitative problems that require an understanding of the fundamental principles in each of the major areas of physics. Show a working knowledge of how a broad array of physical phenomena can be explained using these fundamental concepts."
- "Use critical thinking skills to formulate and solve quantitative problems."

or more specific, the learning goals for this course are that by the end of this course you should be able to:

- Explain the qualitative meaning of the differential vector calculus operations (divergence, gradient, curl) and to apply them appropriately
- Explain the fundamental theorems of vector calculus (Stokes Theorem, the divergence theorem, the gradient theorem) and to apply them appropriately
- Employ both integral and differential forms of Gauss's Law and Ampere's Law in problem solving.
- Identify qualitatively and quantitatively how electrical phenomena are modified in matter
- Write down Maxwell equations, explain their qualitative meaning and solve them in special cases.

Course Structure: This course will be interactive, and therefore it will be *essential that you come prepared to class*. For each reading assignment you will have to submit a **journal entry**. The purpose of these journal entries is to encourage you to do the reading and to spend class time most effectively. Your journal entry should reflect that you have done the reading and can contain any or all of the following: a summary, comments on what part of the reading was most difficult, easy, and interesting, or general comments about the course. I encourage your feedback. These journal entries will be due 10 am on the day of the class. However, it would be extremely helpful if you could get them to me earlier, to give me time to incorporate your feedback into the lecture planning.

There will be **homework assignments** for each class both for you to be continuously involved with the class material and for me to get feedback on your understanding of the class material. Homework assignments will be due 11 am (before class). You will upload a pdf-file of your homework on gradescope (https://www.gradescope.com). I will randomly decide for each problem (based on a tossed die!) whether I grade it (1/2 of the time) or whether you self-grade it. I will provide guidelines for the self-grading, and solution sets for each homework set.

Usually I will start the class with a brief summary of the last class. Then the course material will be discussed in lecture form, and will be practiced in the form of in-class problems for which **you** will be using your white board.

Courses during Covid-19: Circumstances under Covid-19 hit each one of us with varying degrees. I would like for each one of us to be patient with each other. Please feel free to contact me, via email, or in your journal entry, if Covid-19 impacts your course work, so that I can accomodate, and also in case you would like me to simply listen.

If you develop any Covid-19 symptoms do not come to class. Contact student health. If you are in quarantine, please contact me immediately, so that you can continue remotely. Our class is set up for including remote student(s).

During in-person class you are required to wear a mask (covering nose and mouth). Please do social distancing at all times. Practice patience when entering and exiting classrooms. Please be mindful also in out of classroom settings and consider the potential impact of our behavior on others.

For remote participation, be present, avoid multi-tasking. Feel free to remind me, in case during class e.g. I forget to point the camera on the blackboard in use, or in case you try to say something. I will also learn as we go, how to do in-person and remote teaching synchronously. Also, any other concerns, please feel to share with me via email, or via the journal entry.

Grading: Since the course structure relies on you coming to class prepared, it is important that you work steadily on the reading with journal entries and homework assignments. For this reason, journal entries are due 10 am before class and will *not* be accepted late. Scoring of the journal entries will be on a 2-point scale. You will be able to drop two of your lowest journal entry scores. The journal entries count 5% towards your grade.
Homework will take a considerable amount of your time and is intended to give you plenty of practice. **No late homework will be accepted!** This is because the solution sets will already have been distributed, and because the goal is for you to be working on the problems while we are discussing the material. You will get to drop your lowest two homework grades. You are encouraged to work together on the homework, but you must write up your solutions individually. There will be three in class exams and a cumulative final. Attendance is required.

Reading Assignments	5 %
Homework Assignments	30 %
Exam 1	15 %
Exam 2	15 %
Exam 3	15 %
Final	20 %

Accommodations: If you have a disability that may have some impact on your work in this class and for which you may require accommodations, please contact me and please contact the OAR at OAR@bucknell.edu; 570-577-1188 or complete the Disability Accommodation Request form (https://bucknell-accommodate.symplicity.com/public_accommodation/). The OAR will coordinate reasonable accommodations for students with documented disabilities.

Inclusive: We will strive for an inclusive classroom as described in The Bucknell University Solidarity Creed
`https://bucknellian.net/53883/news/solidarity-ceremony-calls-for-change/`
"As a member of this community, I will respect the diversity of all individuals, including, but not limited to, their sex, gender, identity, expression, race, ethnicity, age, class, citizenship, sexual orientation, nationality, socio-economic status, religion, physical ability and mental ability," the creed reads in part. "I will commit to educating myself about cultures, identities and experiences other than my own."

and as described in Bucknell's Diversity, Equity, And Vision & Statement
`https://www.bucknell.edu/life-bucknell/diversity-equity-inclusion`

Course Syllabus

Dates	Topic	Reading
Aug. 17/19/21	Vector Fields and Vector Calculus	§1.1 – 1.3
Aug. 24/26/28	Vector Calculus and Delta Functions	§1.4 – 1.6
Aug. 31, Sept. 2/4	Electrostatics: Coulomb's Law, Gauss's Law	§2.1 – 2.2
Sept. 7/9/11	Electrostatics: Potential, Work, Energy	§2.3 – 2.5
Sept. 14	Catchup and Review	
Sept. 16	Exam I	
Sept. 18/21/23	Electrostatics Math Techniques: Laplace's Equations, Method of Images	§3.1 – 3.2
Sept. 25/28	Electrostatics Math Techniques: Separation of Variables, Multipole Expansion	§3.3 – 3.4
Sept. 30, Oct. 2/5	Electric Fields in Matter: Polarization	§4.1 – 4.2
Oct. 7/9/12	Electric Fields in Matter: Displacement and Dielectircs	§4.3 – 4.4
Oct. 14	Catchup and Review	
Oct. 16	Exam II	
Oct. 19/21/23	Magnetostatics: Lorentz Force, Biot-Savart Law	§5.1 – 5.2
Oct. 26/28	Magnetostatics: Ampère's Law, Vector Potential	§5.3 – 5.4
Oct. 30, Nov. 2	Magnetic Fields in Matter: Magnetization	§6.1 – 6.2
Nov. 4/6	Magnetic Fields in Matter: Auxiliary Field H, Permeability	§6.3 – 6.4
Nov. 9	Catchup and Review	
Nov. 11	Exam III	
Nov. 13/16	Electrodynamics: Faraday's Law	§7.1 – 7.2
Nov. 18/20	Electrodynamics: Maxwell's Equations	§7.3
TBA	FINAL	