Electricity and Magnetism Laboratory

PHYS 301 LB Fall 2019

Thursdays, 1:00 - 2:50 PM

* This laboratory will give you experience with a number of significant experiments in electricity and magnetism. Due to the nature of the experiments, it is expected that most labs will span more than one lab period. You must complete your notebook data/analysis/*etc*. entry for a given lab one week after the final lab meeting for that lab.

* Lab documentation will be posted to *Canvas;* each lab will have its own module corresponding to the lab number (see below).

* Please show up on time to lab and use your time wisely (lateness will result in a deduction of attendance points; your partner needs you present!). Expect to devote some time outside our normal lab period to this course. Several hours per week on data acquisition and analysis beyond our regular meeting time is typical. You will be given a keypad code so that you will have after-hours access to SCIC 128, SCIC 131, and SCIC 137. Please be responsible and careful with your use of our facilities!

* You will need a quad-ruled laboratory notebook (National 43-475 quad-ruled laboratory notebook or equivalent) for taking notes on apparatus setup, experimental design, comments, data, analysis, and discussion/conclusions. Feel free to use a lab notebook from a previous course, as long as it has a significant number of free pages.

* Each laboratory experiment that you carry out should be recorded in detail in your lab notebook. The notebook will serve as a record of what you have done while you are doing it; each time you work on the lab you should have a notebook entry with date and time. Before leaving each of the scheduled lab sessions (generally, two each week), you turn in your lab notebook to the supervising professor so that he can score it using the *daily lab notebook checklist* (see below). You are, of course, likely to work outside the regularly scheduled lab times and, so, should have lab entries for those times as well.

* Record everything in your notebook (including any data file names and any bad data or mistakes). Your notebook should describe the process that you undergo in your studies - *i.e*., it should provide narrative, an outline of the theory involved, a thorough explanation of the experimental techniques, sketches/printouts of all graphs/spreadsheets/Maple code, and discuss conclusions that you draw from your results. Clearly define all of your variables and describe your work in a concise, logical, & chronological format. All graphs should be in proper form (*i.e*., labeled axes (with units), title). All laboratory experiment entries should begin with a brief outline of the purpose of the experiment and end with a concise and informative conclusion. Conclusions should be concise and complete. A good conclusion will always recap the results, including uncertainties, and include a discussion of how the uncertainties relate to your expectations. None of the mathematical models that we will use will be perfect ˝or complete! Spend some time in thought about the effects of neglected variables on your results and discuss them in your conclusions. A grading rubric for your notebook entries is provided below.

* Data analysis should be done with a spreadsheet, Logger Pro, Maple, MATLAB, or other computer-based data analysis package. All measurements must include uncertainty estimates. All uncertainty analysis should be carried out under the formalism described in of **Experimentation: An Introduction to Measurement Theory and Experiment Design** by D.C. Baird. The complete uncertainty computations should be carried out and reported in your lab notebook. Diagrams in your notebook may be hand-drawn, if desired, but must be well-labeled, with proper references if necessary. All graphs must be computer generated and pasted into your lab notebook. Save a soft copy of all spreadsheet work and computer-generated data for each lab, in the event that we request it to examine your data analysis. Backup all of your data religiously!

Course Grading:

The final grade for the course will be distributed between attendance (5%), the lab notebook daily checklist (10%), the lab notebook (65%), Laboratory Project Proposal (5%), and the Laboratory Project (15%; 5% of this for the Formal Laboratory Writeup) .

Laboratory Schedule for Fall 2019:

Begin date	Lab #	Experiment	Duration
05 Sept†	1	Electrostatics (SCIC 128)	2 weeks
19 Sept†	2	Coulomb Balance (SCIC 128)	2 weeks
03 Oct†	3	Determination of ε_o and μ_o (SCIC 137)	2 weeks
17 Oct†	4	Slinky Solenoid and Helmholtz Coils (SCIC 137)	2 weeks
31 Oct†	5	Electron deflection in electric and magnetic fields (SCIC 128)	2 weeks
14 Nov	6	Lab Project	2 - 3 weeks

† The first five labs will be on a two week rotation (see below). Each lab will be allotted two weeks.

Lab Groups and Rotations

Lab Group

A	Melvin	Jackson
A	Christian	Smith
B	David	Fahs-Brown

Lab Group Rotation

	Lab01	Lab02	Lab03	Lab04	Lab05
5-Sep	A, B				
12-Sep	A, B				
19-Sep		A	B		
26-Sep		A	B		
3-Oct		B	A		
10-Oct		B	A		
17-Oct				A	B
24-Oct				A	B
31-Oct				B	A
7-Nov				B	A
14-Nov	projects	projects	projects	projects	projects
28-Nov	projects	projects	projects	projects	projects
5-Dec	projects	projects	projects	projects	projects

Lab Notebook Daily Checklist: You must turn in your lab notebook at the end of each laboratory session. The lab notebooks will be evaluated after every lab period based on the following criteria:

Overall		No issues	Some issues	Significant issues	
A 1	Is the overall arrangement of the material (narration, tables, graphs, figures, etc.) arranged coherently? Is there sufficient blank space between portions to make it clear? Is it obvious how different portions of the lab book relate to each other? Are the entries chronological (are you taking notes as you work through the experiment)? Is the entry dated?	2 pts	1 pt	0 pts	
Data through tables and graphs					
B 1	Are table columns appropriately labeled, including units?	2 pts	1 pt	0 pts	N/A
B 2	Are numerical results provided with the appropriate number of significant digits? Are uncertainties of all measurements provided? Does the precision of the uncertainty match that of the quantity that it reflects?	2 pts	1 pt	0 pts	N/A
B 3	Are plot axes labeled, with units? Does each plot have an appropriate title? Are plots arranged and formatted to best display the scientific information (instead of the using the default settings)? Is data zoomed appropriately. Is the scale appropriate?	2 pts	1 pt	0 pts	N/A
B 4	Are all data presented, or only the last, best data set? Leaving out poor data sets can sometimes lead the reader to have to recreate experiments that won't work. "Failed" experiments are worth recording numerically.	2 pts	1 pt	0 pts	N/A
Diagrams					
C 1	Are diagrams detailed enough to understand the equipment placement? Are diagrams large enough and neat enough to use for discussing results with others? Are diagrams fully labeled, including using variables where appropriate that match labels and variables elsewhere in the lab book?	2 pts	1 pt	0 pts	N/A

***Lab Notebook Grading Rubric*:** At the end of each lab experiment, your complete laboratory entry will be evaluated using the rubric below. Laboratory entries must be complete and ready to be graded when the notebook is turned in after the first session for the following lab experiment (when notebooks are turned in for the lab notebook daily checklist for that lab). [For example: Suppose you do Lab01 for our first two lab meetings. After each of those two lab meetings, you will turn in your notebook and the *Lab Notebook Daily Checklist* will be applied to it; you can pick up your notebook the following morning. On our third lab meeting, you will begin the next new lab (say Lab02). After that lab meeting, the *Lab Notebook Daily Checklist* will be applied to that day's entry for Lab02 and the *Lab Notebook Grading Rubric* will be used to grade Lab01.]

Lab Grading Rubric		Points
1	Name + partner(s) names, date, experiment number (e.g., A2), title, and brief objective.	1.0
2	Narrative • explanation of experimental plan • complete narrative throughout the write-up explaining various steps, sources of data, etc. • diagrams of all apparatus/models included and briefly described • all appropriate variables defined and used consistently • data and physics should be woven into this narrative	2.0
3	Data • consistently quantitative • equations, numbers with units and uncertainties throughout • predictions clearly confirmed or denied, based on uncertainty analysis • results and conclusions based on data	2.5
4	Use of Physics • complete outline of the theoretical models; predictions are justified with physical theory • clearly presented results with appropriate uncertainties • computer code or spreadsheets used for calculations • results are reasonably accurate & interpreted with theory to clear, appropriate conclusions	3.0
5	Summary/Conclusion • summary of results (using correctly reasoned physical principles), including an explicit statement of any numerical results, with uncertainties • discuss shortcomings of the mathematic modeling of the experiment, problems with the experimental setup, and suggestions for changes/improvements to the lab • reasonable rationale are given for all discrepancies (justified by specific evidence).	1.5
	Total	10.0

Electricity and Magnetism Laboratory Project:

The final three weeks of the semester will be devoted to a *Lab Project* of your own design, based on ideas you glean from articles in the *American Journal of Physics*. You must submit a formal proposal for your project to me by 5:00 PM on 17 Oct 2019. This proposal must include an abstract, clear goals, an outline of procedure, timetable for all relevant tasks, a detailed parts list, and, if appropriate, division of labor (for group projects). Please note the "clear goals" requirement! Think in terms of making a specific, quantitative measurement that you can compare to a well-thought-out physical model. You may work in pairs, but a clear rationale and division of labor must be outlined in your proposal (in other words, you must justify *why* the project needs two people!).

Please carefully think through your prospective project and run your ideas past me before this date so that I can help determine whether your proposal is reasonable and do-able, given our resources. The formal time for beginning your *Lab Project* work will be 14 Nov 2019. The following lab sessions (21 Nov and 05 Dec, if needed) will be devoted to your project. You are free to begin earlier, if you wish. Keep a meticulous record of all your project activities in your lab notebook. A detailed lab report in *American Journal of Physics* format (see course web page for details) will be due on 06 Dec 2019 along with your complete lab notebook.

Lab Project Proposal Template:

Proposal is due via email by 5:00 pm on 17 Oct 2019 in MS Word format. Use filename PHYS301L.xyz.docx *where* xyz *are your initials.*

Abstract: Short and concise.

Goals: You MUST have a clear goal as to what exactly you intend to measure and to what theory you are going to compare your result. Make sure your goals are realistic. Make sure you understand the theory behind your project. Make sure that the apparatus, if it involves design and construction, is do-able in the three week time frame.

Outline of procedure: Make sure the requirements for obtaining your measurement(s) are reasonable for the time frame of the project (three weeks).

Timetable for all relevant tasks: When will you carry out each aspect of your project. Build in time for tinkering in case things do not go as originally planned!

Detailed parts list: Include any in-house equipment and any items that must be ordered. Keep in mind that we have a very limited budget. Some items may need to be ordered well in advance of the time for beginning your project. For any items you intend to order, list the source and cost (including postage) for the parts.

Division of labor (For group projects; you must make a strong case for why this project requires more than one person and the various roles that the participants will play.)

Bibliography: Must include at least one article from *The American Journal of Physics*; a *.pdf* of the article must be attached to this proposal.

Manchester University Essential Information

Title IX student conduct reporting requirement

Manchester University is committed to fostering a safe community where the infinite worth of all individuals is respected. Title IX and institutional policy prohibit discrimination on the basis of sex and gender identity. Consequently, sexual misconduct- including harassment, domestic and dating violence, sexual assault, and stalking - is also prohibited at Manchester. Faculty, staff and administrators encourage anyone experiencing sexual misconduct, dating/domestic violence, or stalking to talk to someone about what happened, so they can get the support they need and Manchester University can respond appropriately.

If you wish to speak confidentially with a Manchester employee/on-campus representative about an incident of sexual misconduct, please contact:

MU Counseling Services (260-982-5306)

MU Health Services (260-982-5306)

MU Campus Pastor (260-982-5243)

North Manchester Campus Victim Advocate (260-563-4407)

CARE Initiative (260-982-5027)

Off-campus resources include the following:

Hands of Hope (Service to North Manchester Campus-24/7 Hotline 260-563-4407)

Fort Wayne Sexual Violence Treatment Center

(Service to both Fort Wayne & North Manchester Campuses-24/7 Hotline 260-423-2222)

YWCA of Northeast Indiana (Domestic Violence & Sexual Violence: 260-447-7233)

Individuals who wish to file a report of sexual misconduct should contact the Title IX Coordinator (260-470-5721) or/and Manchester University Campus Safety (260-982-5999).

For questions about institutional policies and procedures regarding sexual misconduct, please contact the Title IX Coordinator. To make a police report, contact the North Manchester Police Department (260-982-8555) or Fort Wayne Police Department (260-472-1222).

You can learn more about Title IX and survivor support at the following websites:
https://www.manchester.edu/about-manchester/university-priorities/title-ix &
https://www.manchester.edu/student-life/care-initiative/care-intitiative-home.

** Manchester University strives to uphold privacy and confidentiality as much as possible and only shares information received with those who have a need to know in order to respond. Individuals who desire anonymity in discussing and seeking assistance about sexual misconduct should contact and/or be referred to a confidential employee.**

Student disability and reasonable accommodation policy

Manchester University, in compliance with federal guidelines, is committed to assuring students with disabilities equal access to programs and activities however, it is the student's responsibility to self-disclose the disability. Students who feel they may need an accommodation based on the impact of a disability should contact Mia Miller, the Disability Support Coordinator, to establish eligibility and to coordinate reasonable accommodations. Students whose accommodation requests are approved will be provided with confidential letters to deliver to their professors. Each letter verifies the disability and documents the need for auxiliary aids and services and/or academic adjustments/accommodations. Students are encouraged to meet with each professor early in the semester to discuss academic implications as they relate to each specific course and to request appropriate accommodation. The Disability Support Services office is in the Success Center (second floor of the Jo Young Switzer Center) and can be reached by phone at 260-982-5888 or 260-982-5499 to schedule an appointment.

Medical emergency evacuation schedule

Students should speak to the instructor immediately if (1) they may require medical attention during class, or (2) they have a disability, chronic condition, or a temporary injury that may limit or affect their ability to evacuate the classroom/building in an emergency. The student and the instructor should discuss the student's specific needs and the types of precautions that should be made in advance of such an event. In the event of a fire or other situation requiring emergency evacuation, students with ambulatory disabilities are to go with or without assistance to the nearest stairwell area. Faculty and staff will assist with evacuation management efforts until such time as the Campus Safety and/or Police and Fire Departments arrive on the scene to assist in student evacuation from the building. Elevators are not to be used for evacuation by any persons.

Students who need special arrangements in the event of an evacuation should also register with Mia Miller in the Success Center as early as possible in the semester to help facilitate the provision of needed emergency assistance.