Physics 211: Laboratory in Electronics, Waves and Optics

Course administration will be run through Moodle. Please see the Moodle page for all laboratory instructions and supplementary readings.

The Physics 211 laboratory has two main objectives: (1) to introduce you to basic skills in electronics, optics and thoughtful experimentation; and (2) to give you a chance to experience, firsthand, some of the phenomena involving oscillations, waves and optics that are central to Physics 213 and indeed all of physics. You will also learn to analyze and evaluate experimental data, and to communicate your findings effectively.

PREREQUISITES
You must have completed Physics H106, H102, B201, or the equivalent with lab. Physics 213 must be taken either concurrently or before this course.

INSTRUCTORS
Suzanne Amador Kane
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Paul Thorman
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LAB – 1 meeting/week most weeks
Section 01: Thursdays 1:15-4:00 pm in H206.
Section 02: Fridays 1:15-4:00 pm in H206.

No class Sept 7 or 8 (first week of classes), Oct 19/20 (fall break), or Nov 23/24 (Thanksgiving Break). The final meetings on Dec 14/15 will be used for any makeup sessions that are necessary.

LAB REQUIREMENTS
1. Before each week’s lab, you are expected to read the lab manual posted on Moodle, read or watch any assigned supplementary materials, and answer any pre-lab questions. Pre-lab questions will be checked by instructors at the beginning of each lab. It is not only rude to your lab partner to be unprepared—you will also likely struggle to finish within the lab period. Any lack of preparation will be evident to your instructors and will negatively impact your grade.
2. You are expected to **attend every lab session in full and complete reports for every lab.**
3. You **must read your email regularly** to stay informed about deadlines, scheduling issues and other matters.

### LAB SCHEDULE

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Activity</th>
<th>Due Date</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>9/7 &amp; 8</td>
<td>First week of classes</td>
<td>Register for sections</td>
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<tr>
<td>Week 2</td>
<td>9/14 &amp; 15</td>
<td>DC Circuits</td>
<td>written report</td>
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<tr>
<td>Week 3</td>
<td>9/21 &amp; 22</td>
<td>RC charging/discharging; oscilloscopes &amp; function generators</td>
<td>written report + check-out</td>
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<tr>
<td>Week 4</td>
<td>9/28 &amp; 29</td>
<td>RC Filters</td>
<td>written report</td>
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<tr>
<td>Week 5</td>
<td>10/5 &amp; 6</td>
<td>Inductance and Resonance</td>
<td>Short written report</td>
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<tr>
<td>Week 6</td>
<td>10/12 &amp; 13</td>
<td>Semiconductor Devices: Diodes and Transistors</td>
<td>oral report</td>
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<tr>
<td>Week 7</td>
<td>10/19 &amp; 20</td>
<td>Fall Break – no lab</td>
<td>No work due</td>
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<tr>
<td>Week 8</td>
<td>10/26 or 27</td>
<td>Operational Amplifiers</td>
<td>check-out lab</td>
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<tr>
<td>Week 9</td>
<td>11/2 or 3</td>
<td>Standing Waves and Normal Modes OR Torsional Oscillators</td>
<td>written report</td>
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<tr>
<td>Week 10</td>
<td>11/9 &amp; 10</td>
<td>Standing Waves and Normal Modes OR Torsional Oscillators</td>
<td>written report</td>
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<tr>
<td>Week 11</td>
<td>11/16 &amp; 17</td>
<td>Geometrical Optics I</td>
<td>check-out lab</td>
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<tr>
<td>Week 12</td>
<td>11/24 &amp; 25</td>
<td>Geometrical Optics II</td>
<td>check-out lab</td>
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<tr>
<td>Week 13</td>
<td>12/1 &amp; 2</td>
<td>Fourier Optics</td>
<td>oral report</td>
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<tr>
<td>Week 14</td>
<td></td>
<td>Makeup sessions, as necessary</td>
<td>All work due by 5pm 12/15</td>
</tr>
<tr>
<td>Finals</td>
<td></td>
<td>No lab</td>
<td>All work due by 5pm 12/15</td>
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### DUE DATES

Before each week’s lab, you are expected to read the lab manual posted on Moodle, read or watch any assigned supplementary materials, and answer any preliminary questions.

All written lab reports are due by 4pm the second Monday after the lab was performed—see Moodle for the exact due date (and note that no work is due during Fall Break).
• You must turn in reports using the Dropbox labeled Physics 211 next to KINSC L105 OR to one of the instructors in person.

• We DO NOT accept lab reports by email.

• DO NOT turn in lab reports under or on your instructors’ doors.

Oral reports must be completed by the date posted on Moodle for your section. You should schedule a date and time for the oral report before leaving lab.

Fall Break: No reports are due during Fall or Thanksgiving Breaks. See Moodle for due dates for labs performed the week before breaks.

Finals Period: No labs or labwork is due during finals period.

LATE POLICY
Lab reports turned in without an excused absence after the due date will be penalized. A deduction of 25% will be applied to reports turned in up to one week late, and an additional deduction of 25% will be applied to reports more than one week late. We will accept late reports through the end of Finals (noon, Dec. 22).

Contact your instructors as soon as possible if you need an extension due to illness or other serious problems of the sort that warrant a Deans excuse.

You may take advantage of TWO free 1-week extensions this semester; just send your instructors an email saying you are taking this extension. Each one-week extension can only apply to one lab assignment—it cannot be split between two or more.

ABSENCES
If you are unable to attend a laboratory session for any reason (except illness or circumstances warranting a Dean’s excuse) or if you wish to leave early for any reason, you must let the instructors know of your request in advance. You must inform your instructors of all potential conflicts with athletics—any other commitments—at the beginning of the semester so we can decide on a suitable plan for the semester. Scheduling make-up laboratories for unexcused absences is at the discretion of the instructors.

GRADING
There are 11 lab exercises this semester. In addition, your instructors will weigh your preparation, hands-on work and understanding during the laboratory
sessions in assigning final grades. Failure to complete a lab or to complete a report will result in a disproportionate impact on your grade. All labs will be graded on a 4.0 scale using the following criteria. The course grade posted on Moodle will reflect your current course grade as a result. Assuming you completed all the hands-on parts of lab:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>4.00</td>
<td>Strong report throughout: well-written, all aspects of analysis and scientific understanding well-done; any issues extremely minor.</td>
</tr>
<tr>
<td>3.7</td>
<td>got all main points with only minor points of understanding somewhat off or minor issues in complete explanations.</td>
</tr>
<tr>
<td>3.3</td>
<td>all of the methods and lab report are essentially correct; may have a few minor errors, one missing analysis or minor lack of understanding</td>
</tr>
<tr>
<td>3.0</td>
<td>mostly correct; a few mistakes or poorly-written up or analyzed parts.</td>
</tr>
<tr>
<td>2.7</td>
<td>more correct and well-done than not.</td>
</tr>
<tr>
<td>2.3</td>
<td>completed the hands-on lab and took all the data but wrote or delivered a poor quality report; major section(s) of the lab missing, although the parts that were completed and written up are fine.</td>
</tr>
<tr>
<td>≤ 2.0</td>
<td>Much of the labwork and reporting was substandard and not at an acceptable level of quality and effort.</td>
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LAB REPORT FORMATS

The written report format is meant to limit your writing to only the amount required for us to judge the quality of your work and scientific understanding. Don't repeat material already contained in the lab manual. This report must be a typed document, but any figures or plots can be hand-drawn. We appreciate that these are complex lab manuals, so we will include a rubric for each on Moodle to help you know what to emphasize in your write-ups for each lab.

- Use the standardized cover sheet to give your name, your lab partner's name, the lab title and the date you performed the lab. DO NOT INDICATE YOUR NAME OR THAT OF YOUR LAB PARTNER ELSEWHERE IN THE REPORT. This is so we can grade each report in a totally anonymous fashion for fairness.
- Consult carefully the grading rubrics for each lab. These will help you focus on the main scientific points as you prepare your report.
- You should record in your lab notebook an answer to each question in the boxed exercise or underlined portion of the lab manual. Each underlined question in your lab manual needs to be answered clearly in your written or oral report. The rubric for each lab provides a handy way to check that you have done everything required.
- Each response should be clearly labeled (Exercise 3, Experiment 2b, part A, etc.) to indicate which section of the lab material you are addressing.
- Figures such as circuit diagrams, optical designs, or plotted results should be included where requested, with all relevant parameters, units, and error bars defined.
• Pre-lab questions will be checked by instructors at the beginning of each lab period and used during lab. They do not need to be included in the lab report unless this is explicitly asked for.

• Some exercises may be marked to complete via a Moodle quiz. These must be completed before the end of lab period. When you answer an Exercise using a Moodle Quiz, you don’t need to separately include these answers in your report.

• In each section, discuss what the goal of each exercise was and how well the experiment met its stated goals. Don’t oversell your results, or fudge the data if they didn’t agree with theory.

• To get full credit, you must follow the guidelines mapped out in the Moodle documents on data and uncertainty analysis (short version), and plotting and fitting. In particular, you must include all of the requested results in the body of your report (in particular, not only in a spreadsheet, plot or notes).

• In particular, you should not just attach your written notes or a spreadsheet—explain what you found for all measurements using correct formatting and uncertainties. Show the necessary equations for all calculations even if you did the actual computations via Mathematica or Excel.

• Along with your written report, turn in either the original or a copy of your lab notes. These are never a substitute for a properly typed written lab report! We will not grade these, but we will refer to them to be sure you are taking adequate records and to give you advice if you had trouble with the analysis.

Oral reports: For two of the laboratories, you and your partner will prepare and deliver a 30 minute long oral lab report together. We expect and grade on equal contributions from each lab partner. You should prepare all of the material you usually would for a short written report, but in the form of a brief Powerpoint presentation with at most 8 slides. We will also ask you questions that we can discuss.

• Give your talk a title and an overview slide where you explain the outline of your talk
• Throughout, use short bullet points, not full, wordy sentences.
• State the main goals of each part of your experiment first
• Experimental procedure: Explain how you performed the experiment (including any ways you changed the manual’s procedure), using images from the lab report, your own figures or images from the web or other sources (but give credit for any images from other sources)
• Present your main experimental findings both in words and numerically, arranged by experiment. Include all measured quantities with error bars (explain their meaning) and All plots and fits (see Moodle document on this topics).
• Answer all questions and points in the rubric.
• Comment on all of your experimental results and how well they did or did not agree with the predicted behavior from the observations and equations.
• Conclude with a summary of your results and what you learned.

Check-out labs: For some exercises, you will be checked-out of lab by one of your instructors, who will quiz you on the points covered in the lab exercises. You should take notes for these labs just as you would for a written or oral report. You do not need to turn anything further in after being check-out of lab.

ACCOMMODATIONS FOR DISABILITY
Haverford College is committed to supporting the learning process for all students. Please contact one of your instructors as soon as possible if you are having difficulties in the course. There are also many resources on campus available to you as a student, including the Office of Academic Resources (https://www.haverford.edu/oar/) and the Office of Access and Disabilities Services (https://www.haverford.edu/ads/). If you think you may need accommodations because of a disability, please contact Sherrie Borowsky, Coordinator of Accommodations, Office of Access and Disability Services at hc-ads@haverford.edu. If you have already been approved to receive academic accommodations and would like to request accommodations in this course because of a disability, please meet with one of the instructors privately at the beginning of the semester (within the first two weeks if possible) with your verification letter.

HONOR CODE MATTERS
During the laboratory session, you do all of the work together with your partner. This includes setting up the experiment, taking the data, analyzing them, and reaching conclusions. Both partners must be involved in every phase. The data will generally be recorded in a single copy that may be duplicated for the use of the other partner.

It is very important that you get started on your report as soon as possible after completing the lab -- don’t wait for a few days and then get started! If you start promptly on the report, the material will be fresh in your mind, and if you run into trouble, you will have time to consult with other students in the course or with the course instructors.

You and your partner may work together on the graphs, and hand in identical graphs provided you work together in producing each graph. It is a violation of the Honor Code to turn in a graph that you did not participate in creating. You are encouraged to talk with your partner, other students in the class, and your instructors about the interpretation of your results and about the questions on the lab report form; you need not note such discussions explicitly. You may choose to consult with someone outside the course; you must describe any such consultation explicitly at the end of your report.
You must do all writing independently for all lab reports. This means in particular that the exercises, discussions, and conclusions should be in your own words and the product of independent effort. You must not consult another student’s report (either from this course or another) as you write your own, since this can lead to paraphrasing of the other person’s thoughts instead of thinking on your own. (You may consult notes that your partner made during the lab period.) You may not copy or paraphrase extensively from any source--there are no exceptions (not for Wikipedia, non-copyrighted materials, Creative Commons licensing, etc.) You must give citations for all short quotations or paraphrases from other sources.

All of the data contained in your report must be the result of the work that you and your partner did together in the laboratory. This means that, even if your data doesn’t correspond with what you think is the “right answer”, you must still report the data you actually observed. You must not use data from a different group, unless you are explicitly given permission to do so by your instructor. You must not report theoretical results as if they were the experimental data that you took. (That is, you may not generate “experimental data” using an equation that you think describes what you should have measured.) If you must leave lab early, you may not use data that your partner took after you left without first getting permission from your instructor. These are just a few examples. It is a violation of the Honor Code to falsify data in any way or to present data that you did not take as if it is your own. If you believe that your data are in error, or if you are unable to collect the required data (for example because of equipment malfunction), you must discuss the problem with your instructor. It is important to do this well in advance of the report due date. In such a case, your instructor will make arrangements that allow you to complete the lab report without losing any credit.

Finally, any outside sources used in the experiment or write-up other than this manual, including your textbook, should be cited. The important guiding principle of academic integrity is that you must never represent the work of others as your own. Please request clarification from your instructors or Honor Council if you find yourself in any ambiguous situations. Also, consult the Honor Council resources website at: http://honorcouncil.haverford.edu/resources/.