PHYS171L-005: General Physics II Lab
Spring 2017: January 9–May 12
F 3:00 PM–5:50 PM, Room: STB 209

Version 1: January 10, 2017 (subject to change)

Professor:	Kathy Cooksey, Ph.D., STB 219; `kcooksey@hawaii.edu`; 808-932-7195
Office Hours:	W 9–9:50 PM & 2–3 PM, F 11–11:50 AM, and by appointment
Website:	Laulima ASTR-181-001 (HIL.13467.SP17)

Course Description:

A required laboratory supplement for PHYS 107 and 171; presents illustrative experiments in electricity, magnetism and optics.
Pre-requisite: PHYS 107 or 171 (either of which can be taken concurrently).

Email, Textbook, and Website:

- UHH considers email and Laulima an official form of communication; students are responsible for receiving and returning information in a timely manner.
- The professor will email students at their `hawaii.edu` accounts only.
- The Laulima course website is listed under PHYS-171L-005 (HIL.13488.SP17). This site will be the hub for all course information.

Section Rules (supplements or supersedes PHYS171L Course Syllabus):

- Students must respect and support their peers' learning, which means helping each other with difficult concepts but not just giving the answer.
- Students need to convey (either in person, by email, through an intermediary, or somehow) to the professor questions, comments, and concerns about the course.
- Students are required to read the lab manuals and view videos before the lab period and bring any pre-lab assignments to class (usually a table for data or a pre-formatted spreadsheet).
- Students more than 15 minutes late to class will not be permitted to participate in that day's lab. Students with understandable issues with this (e.g., another class very far away, mobility problems, etc.) must discuss the situation with the instructor.
- There will be a limited number of make-up lab opportunities. A student may only make up a lab for which s/he is excused.
  - If a student must miss a class for a reasonable reason, s/he must email the professor before the start of class time.
  - If a student were unable to email in advance due to extreme circumstances, s/he should contact the professor as soon as possible. Such instances will be judged on a case-by-case basis.
    - In such (and similar) situations, the student is strongly encouraged to contact Student Services (info below). Student Services are liaisons between students and instructors, when Life adversely impacts Academics. If Student Services intervenes on a student's behalf, the instructor will work to accommodate any missed content and points.
- It is required for the students to conduct the lab experiment to submit a lab report. Students need to sign the attendance sheet each class.
- The lab reports are due in a week, whether there is a lab or not.
- Late lab reports are only accepted within 24 hr of the due date and time, for 75% of the credit.

- The lowest lab grade will be dropped.
- Students must calculate the desired quantity—as soon as they have sufficient data—as a test of the experimental setup and process and discuss with the instructor.
- All references (e.g., websites, books other than the official course textbook, etc.) used to complete assignments must be cited, including numbers, techniques, facts, etc.
- Group work is encouraged in lab and for reports. However, all submitted work must be the original work of the student with reference to any partner(s).
- Students are responsible for their own learning, which includes preparing for class, submitting work, asking questions, and seeking additional help.
  - The majority of college students use instructors' office hours and/or tutoring services (e.g., Kilohana; info below).
  - Office hours are good times to get individualized help from the expert (i.e., the instructor), and office hours are part of the instructor's job.

Good-to-Know about the Professor:

- She enjoys teaching and wants to be better at it, and she really cares about helping students be better. These aspects combined mean she is on the students' side; trust in that and knowledge that she is receptive to feedback will smooth over rough patches.
- She chooses teaching techniques based on physics-education research to support student learning as best as possible. This means she has one or more reasons for nearly every component of and action in a course. She'll gladly motivate these choices whenever necessary or asked.
- Her primary goal is to help students improve *how* they learn with the logic that if students learn how to learn, they can master any content. The related goal is to focus on transferrable skills so that time and effort spent for the class yield benefits beyond the course and semester.
- Generally, she does not answer questions directly. A student making connections and constructing a solution her- or himself will ingrain the answer more effectively, and the professor facilitates the process by asking leading questions. Since the motivation is to help the students, they should embrace and engage with this process. (It is also a transferrable skill to discuss ideas and answer questions on the fly.)
- She thinks no single resource is comprehensive, so the expectation is that the student will have to work with the professor, the lab manuals and videos, the PHYS171 textbook, and the wealth of material available on the internet.
- The expectation is that a course requires 2–3 hr outside-of-class time per credit per week. Hence a 15-cr semester equals 30–45 hr per week (i.e., a full-time job).
- She generally responds to email 24-to-48 hours after receipt. If the matter is urgent, the student should call (office voicemail is automatically emailed) or stop by her office (her generally weekly schedule is on her homepage: `http://www2.hawaii.edu/~kcooksey`).

Specific to PHYS171L:

- When a lab leads the lecture, the professor takes the time to work through the fundamental physics with the lab groups that need or request it.
- She has a strong focus on the lab reports as a learning tool[1] and an assessment.
- She expects students to make a good faith effort to conduct the experiment from the materials provided but knows they will need help. She will help upon request but may also intercede.

[1] See "The Writing Revolution" in *The Atlantic* (Oct 2012): `http://www.theatlantic.com/magazine/archive/2012/10/the-writing-revolution/309090/`.

Campus-wide Information

Disability Support: Any student with a documented disability who would like to request accommodation should contact the Disability Services Office—Student Services Center, E215; 932-7623 (V), 932-7002 (TTY), `uds@hawaii.edu`—as early in the semester as possible.

Advising: Advising is a very important resource designed to help students complete the requirements of the University and their individual majors. Students should consult with their advisor at least once a semester to decide on courses, check progress towards graduation, and discuss career options and other educational opportunities provided by UH Hilo. Advising is a shared responsibility, but students have final responsibility for meeting degree requirements.

Kilohana Academic Success Center: The KASC provides academic support opportunities for all UH Hilo students that foster their development into independent, self-motivated learners. Students who visit Kilohana have access to subject-specific and academic skills tutoring from UHH students selected for their academic achievement and dedication to helping others succeed. Kilohana is located on the lower level of the Mookini Library and on the web at `http://hilo.hawaii.edu/kilohana/`.

Human Rights: The University of Hawai'i at Hilo prohibits discrimination in its education programs based on race, national origin, color, creed, religion, sex, age, disability, veteran status, sexual orientation, gender identity or associational preference. If at any time during class you feel uncomfortable about what is being talked about, or feel that your human rights have been violated, please feel free to leave the room. However, the professor asks that you confer with her as soon as possible about what happened so that appropriate action can be taken if necessary to avoid future problems. If you are uncomfortable speaking with the professor about your concern, please contact Kalei Rapoza (`kaleihii@hawaii.edu`), Interim EEO/AA Director, at 932-7626.

UH Hilo Title IX Policy: The University of Hawaii is committed to providing a learning, working and living environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. If you or someone you know is experiencing any of these, the University has staff and resources on your campus to support and assist you. Staff can also direct you to resources that are in the community. Here are some of your options:

> If you wish to remain anonymous, speak with someone confidentially, or would like to receive information and support in a confidential setting, contact: • UH Hilo Counseling Services: SSC, room E-203, 932-7465; • UH Hilo Medical Services: Campus Center, room 212, 932-7369; and/or • Hawai'i Island YWCA, 935-0677.
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> If you wish to report an incident of sex discrimination or gender-based violence including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, or stalking as well as receive information and support,[†] contact: • Libby Bailey, Title IX Coordinator, 932-7818, `libby.bailey@hawaii.edu`; • Jennifer Stotter, Director of the Office of Equal Opportunity & Deputy Title IX Coordinator, 932-7641, `jstotter@hawaii.edu`; and/or • Kalei Rapoza, Interim Director of Human Resources, 932-7626, `kaleihii@hawaii.edu`.
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> [†]Please note that you do not have to file a report with the University to receive institutional support or assistance.

As a member of the University faculty, the professor is required to immediately report any incidence of sex discrimination or gender-based violence to the campus Title IX Coordinator. Although the Title IX Coordinator and professor cannot guarantee confidentiality, the student will still have options about how the case will be handled. The goal is to make sure the student is aware of the range of options available and has access to the necessary resources and support. For more information regarding sex discrimination and gender-based violence, the University's Title IX resources and the University's Policy, Interim EP 1.204, go to: `http://www.hawaii.edu/titleix`.

Student Conduct: Students are expected to follow the University of Hawai'i at Hilo Student Code of Conduct available at the following URL: `http://www.uhh.hawaii.edu/catalog/student-conduct-code.html`.

PHYS171L-005: Lab Report Guide

Student's Name
Names of Partner(s)

1. Abstract

- Big picture summary of the physics principle(s) explored in the lab.
- Brief description of the experimental setup, the variables, and the data/measurements actually collected.
- Summary of the student's results with the ranges of actual numbers (e.g., means, experimental values) in comparison with the expected/theoretical values.
- Statement(s) about whether the students' results were accurate and precise or not, with quantified evidence (e.g., N_σ and fractional error or percent error, discussed below).
- *Assessment:* Would a science-literate person who knows nothing about the experiment understand:
  (a) why the experiment was done?
  (b) what was done?
  (c) what the results were?
  (d) what was concluded?

2. Introduction

- More details on the big picture of the physics principle(s) relavant to the experiment.
- All in the student's own words.
- *Assessment:*
  (a) Does the student show s/he understands the physics background and motivation?
  (b) Are the important equations derived or at least introduced?
  (c) Are the variables defined? (See the Statistics Interlude below for how variables are introduced.)
  (d) Is it clear what will be expected/theoretical values and what will be experimental?

3. Procedure

- Brief re-statement of the steps and techniques required to complete the experiment.
- Highlighting of the crucial steps (e.g., calibration or fitting of a function to get the data).
- Explanation if the implemented procedure deviated from the lab manual.
- All in the student's own words.
- Written in first person (e.g., "we did") or passive voice (e.g., "it was done").
- *Assessment:*
  (a) Are the crucial steps explained?
  (b) Is it clear what data/measurements were taken?

4. Raw Data

- Present all data recorded during the experiment, typically in a well-organized table with informative headers, appropriate units, and uncertainties, if applicable.
- The Raw Data table may include Derived Data columns (described in the next section) so as not to needlessly duplicate.
- *Assessment:*
  (a) Is the table clearly labeled with informative headers and units?
  (b) Is the information consistent with what was discussed in the Introduction and Procedure sections?
  (c) Do the raw data agree with the partner's?

5. Derived Data, Calculations, and Error Analysis

- Presentation of a complete example calculation or description of what software and which of its formula/functions were used to perform the calculations.
- For multiple measurements of the same quantity: calculation/presentation of the mean (μ ["mu"]) and sample standard deviation (σ ["sigma"]).
  - *Statistics interlude:*
    - The mean is calculated as $\mu = \frac{1}{\mathcal{N}}\sum_{i=1}^{\mathcal{N}} x_i$, where $\mathcal{N}$ is the total number of measurements, x_i, that are summed (that is the $\sum_{i=1}^{\mathcal{N}}$ notation). It has the same units as x_i.
    - The sample standard deviation is calculated as $\sigma = \sqrt{\frac{1}{\mathcal{N}-1}\sum_{i=1}^{\mathcal{N}}(x_i-\mu)^2}$. It has the same units as x_i and μ.
    - The sample standard deviation is different from the population standard deviation (which is divided by just $\mathcal{N}$ and not $\mathcal{N}-1$. It is the responsibility of the student to verify whatever software formula s/he uses to compute the "standard deviation" returns the sample standard deviation.
    - The mean, μ, and sample standard deviation, σ, are measured from the experimental data. Thus, assuming Gaussian statistics, roughly 68.3% of the experimental measurements should fall within $\mu-\sigma$ and $\mu+\sigma$ (AKA $\mu\pm\sigma$); roughly 95.4% should fall within $\mu\pm 2\sigma$; and roughly 99.7% within $\mu\pm 3\sigma$. Therefore it is *not* useful to compare the spread of the experimental measurements with the experimental mean, μ, and its sample standard deviation, σ.
    - It *is* useful to compare the experimental mean with the expected/theoretical value. It is also appropriate to use the experimental sample standard deviation to quantify accuracy and precision, detailed below.
- Assess accuracy and precision:
  - "Accurate" is typically defined as $N_\sigma = \left|\frac{theor-\mu}{\sigma}\right| \leq 3$, which means in 99.7% of the experiments, the experimental mean is within $\pm 3\sigma$ of the expected/theoretical value.
  - "Precise" generally means $\frac{\sigma}{|\mu|}\cdot 100\% \lesssim 10\%$.
  - If there were no standard deviation, the results are assessed to be accurate if the percent error is $\left|\frac{theor-exp}{theor}\right|\cdot 100\% \lesssim 10\%$.
- Discussion of converting and/or canceling units, as appropriate.
- *Assessment:*
  (a) Is there an example calculation with appropriate units shown? If not, was the software procedure adequately described?
  (b) Is the derived results presented clearly with appropriate/reasonable significant figures?
  (c) Are the expected/theoretical results presented along with the derived results?
  (d) Is it clear what the units are?

6. Conclusion

- Brief re-statement of the big picture physics background and the specific purpose of the experiment.
- Brief re-summary of what was done (e.g., what data were collected).
- Synthesis of the experimental and theoretical results, which includes summarizing the results (numerically).
- Comments on accuracy and precision.
- Discussion of what was actually learned, in particular what might have caused errors if the experiment did not convincingly show the physical phenomenon.
- *Assessment:*
  (a) Does the Conclusion demonstrate that the student thought about the experiment and its purpose?
  (b) Is the Conclusion consistent with the evidence?

7. References

- If any sources besides the lab manuals, videos, or course textbook were used, they are cited here. Citing a work does not mean it can be plagiarized.
- *Assessment:*
  (a) Does this section exist? Even with "None" or "N/A" only.
  (b) If some of the writing seems suspicious (i.e., plagiarized) and an internet search confirms some significant overlap, is that source cited here?

General requirements:

- The whole report should be typed (unless writing-in equations) and in one document.
- Physical quantities nearly always have units, and the units should always be provided.
- It should be written in the past tense, unless stating a fact that is true beyond the scope of the report (e.g., "Newton's second law is $F = ma$.")
- The subject should be "we" when it applies to all partners and "I" when it is important to highlight what the author of the report did. Science papers are always first person plural (e.g., "we did"), third person (e.g., "the authors did"), or passive voice (e.g., "it was done"). The lab reports should only use first person plural or passive voice.
- This is formal writing, so there are no contractions (e.g., use "do not" instead of "don't").
- The report is reasonably well-written, meaning it was spell-checked and read through aloud to polish the most awkward sentences.
- The word "data" is plural (e.g., "data were recorded") and "datum" is singular (e.g., "datum was recorded").