General Physics Laboratory 165 and 166

Yale Summer Session 2025

Tuesday and Thursday, 1:30-4:30
In-person

Syllabus, v1.0

First, a few comments –

- To help students with registration for Summer 2025 courses, we are posting this draft syllabus (v0), which is a slightly modified version of the final syllabus (v1) used by the PHYS S165/S166 lab courses, in Summer 2024. This should give you a good idea about the structure and philosophy of the Summer 2025 edition of the course, as the two courses will be quite similar, except for the tweaks that we promise to make to improve the course!
- The full list of TFs and Instructors won't be known until later in the spring.
- If you have questions that are not answered by this draft syllabus, please write to me (Prof. Barrett) at `sean.barrett@yale.edu`.
- Thanks for your interest in PHYS S165/S166 lab. We hope to see you in the Summer!

Next, here v0 of the Summer 2025 syllabus—

Physics 165 and 166 is the two-semester General Physics Laboratory course of the Yale University Physics Department. The aim of the course is to teach physical principles and concepts by direct experience, in addition to developing the scientific skills of handling and interpreting numerical data, and learning how to effectively communicate the results of those measurements to others.

For the Summer of 2025, we are delighted to offer the in-person version of the lab, which will once again take place in Sloane Physics Lab, in rooms SPL 39-43. This in-person version rests on the foundation put in place during two recent course overhauls, forced on us by the COVID-19 pandemic. It is very unusual for a course of this size to undergo a complete tear-down/rebuild, let alone two in two years, but this is what we did during the in-person → online-only, and then the online-only → in-person transitions. The labs were greatly improved by the overhauls, and we've made further refinements in the terms since. We look forward to a great summer session with you!

1 Physics S165/S166 Staff

- **Lead Course Instructor (S165/S166)**: Prof. Sean Barrett | `sean.barrett@yale.edu`
- **Course Instructor (S165/S166)**: Prec. Caitlin Hansen | `caitlin.k.hansen@yale.edu`
- **Teaching Fellow (S165 only)**: t.b.a.
- **Teaching Fellow (S166 only)**: t.b.a.

2 PHYS S165/S166 Relies Upon Canvas

Make sure that you can access our course site on Canvas. This is where all information and materials needed to complete PHYS S165/S166 will be posted (as free downloads), and where you will

upload your completed work. Quizzes will be administered over Canvas. The Canvas Calendar shows the plan for the course, and all due dates.

To avoid missing critical information, please check that your Canvas settings will alert you when Announcements are posted, or when Canvas sends you an email.

Send an email to Prof. Barrett <sean.barrett@yale.edu> if you encounter any difficulties, or if you have any questions.

3 Materials

- There is no textbook. Handouts (pdfs) for the lab experiments will be posted in the Files →Lab Handouts folder of our Canvas site. You may want to print them out, as you will need to read them carefully before, during, and after our lab sessions.
- For your lab notebook, use a quad ruled notebook (or quad ruled paper that you keep organized, in a folder). Laboratory notes will be uploaded with lab reports, but you should also keep the original past the end of the course(s).
- Scientific calculator, a ruler, and writing implements.
- Use Logger Pro (a free download) for data analysis. If possible, download a copy to run on your own computer, to enable you to open and work on files after your lab session.
- Recommendation: If you can bring your own laptop to class, please do so. During online-only labs, each student had to have their own computer, and there were clear advantages to that set-up. If this is not possible, don't worry, since each lab station has a desktop (i.e., one iMac for every two students), and you can email completed Logger Pro files to yourself from them.

4 Pre-lab Preparation

Allow at least an hour to prepare for each lab before you arrive.

- **Read the lab handouts.** Look up the concepts you found unfamiliar in a college level physics textbook or use Wikipedia. Review the references listed in the lab handout. In our experience, the time invested in this pre-lab reading will pay dividends as you do the lab.
- **Access the posted materials** The lab handout may mention videos or data files posted on Canvas. Preview any short videos for that lab, which we may also watch during the lab. Consider downloading data files for the lab to your computer. (Note: some videos and data files are only mentioned in the footnotes of the handouts. These are optional resources, which may be helpful to you, but you are not required to use them).
- **Prepare for the QUIZ.** To reward a careful reading of the lab handout, there will be approximately 8 short quizzes, offered through Canvas in the 24 hours prior to the beginning of most lab sessions (consult the Canvas Calendar). They will take less than 5 minutes, and are meant to be easy if you have done the reading.

5 In-person Lab Sessions

- The ten in-person sessions of the course start at 1:30 PM, EDT, on the dates shown in the Canvas course calendar. If there is a quiz (as shown on the Canvas calendar), then take that after you have read the handout, in the 24 hours before the lab session. Be prepared to start the lab at the beginning of each session.

- Lab sessions can be up to three hours long, but we expect that many labs will be completed in less time. Use this extra time to take good notes and to think things through, explore your own questions and make sure you understand not only what you are doing, but *why* you are doing it. This is the best way to prepare for the Lab Practical Exam explained below.
- Each student should actively participate in the Lab sessions. Take advantage of this chance to develop new skills, and to discuss the lab with your fellow students, your TF, and your Instructors. Try to understand all parts of the lab when we are working through it as a group, so you can build on these concepts when working by yourself during the Lab Practical Exam.
- Before leaving each Lab session, ask your TF to check your data, graphs, and analysis for completeness.
- Try to keep your workspace neat and organized, both to be safe and more efficient.
- We plan to hold labs during sessions 1-9, and to hold a Lab Practical Exam during session 10.

6 Lab Practical Exam

We are planning to hold a Lab Practical Exam (LPE) in the last session of the course (consult the Canvas course calendar for specific dates). In contrast to the Lab sessions, the LPE is a solo activity. The details will be announced as we get closer to the LPE. In the meantime, the best way to prepare for an LPE is to be an *active* participant in the lab when working with a partner, during the normal Lab sessions. Make sure that you understand the steps of each lab, and don't hesitate to ask questions. This will help you when you need to work on an LPE by yourself.

7 Assignment Type 1: Quizzes

Quizzes will be run over Canvas. The due date for each Quiz is posted on the Canvas calendar, and in the Quizzes section of the Canvas site. Each Quiz will be available for 24 hours before the corresponding Lab takes place. You should take the Quiz after you have read the handout. Once you start the Quiz, you have 5 minutes to complete it, so make sure that your computer is plugged in and that you have a strong network connection. If you forget to take it, you will earn 0/4 points. It would be a shame to throw these points away, so please make a habit of checking for Quizzes while you prepare for each and every Lab session. The Canvas Quiz system seems to work pretty well, but write to Prof. Barrett if you notice any problems.

8 Assignment Type 2: Lab notebooks and reports

We posted an example of an online lab notebook and report in the Files →Reference Sheets & Useful Info folder of our Canvas site. Keep in mind that your lab notebook (completed during the lab) and your one page report (completed after lab) should be understandable by a person who has not performed the experiment.

Your notebook and report should be uploaded, as a single document, to Canvas.

8.1 Lab notebook

- Record your name, your TF and the date. When you work with partner(s), record their names too.
- Record the apparatus used and/or make a simple drawing of the set-up. Record the instrument settings that you use during a measurement.

- Record a very brief description of your plan during each set of tasks. Make sure that you briefly (0.5-2.5 sentences) introduce each new set of activities, so a reader doesn't have to guess where the next table of data comes from, or how it differs from the last table.
- Record your observations, note any problems encountered, and any decisions made.
- Cross out erroneous data, do not destroy or throw them away. Mistakes happen! Leave them legible and write a short note about why you discarded them.
- Don't use scrap paper. That is what your lab notebook is for! Everything goes in your notebook (or an organizing folder).
- The lab handouts will ask you to include specific graphs in your lab notebook, after you make them in Logger Pro. If you are using an electronic lab notebook, then it is OK to insert the graphs into the body of your e-notebook. You can also use the 'graph appendix' method described next.
- If you are using a hand-written notebook, then it is also OK to collect all of the graphs in one place, as an appendix that follows the scanned pages of your hand-written lab notebook. For example, you could paste screenshots of graphs and images into a single MS Word file as you work. After you have collected all your graphs for the session, they will occupy only a few pages, which will be easy to add to the end of the scanned version of your written lab notebook.
- No matter how you choose to insert tables, graphs, etc., into your notebook, you need to make it EASY for somebody to follow your work as they read your notebook. When you are making a comment about features of a graph, remind us where the graph is located (e.g., above, below, on pg. 11, on pg. 2 of the graph appendix, etc.). Label the graph so it is easier to find it there (e.g., call it Fig. 3, so you can use that label in your comment), and make sure that you add a descriptive title and/or caption near each graph (can be added later, if you forget when making the graph in Logger Pro). A helpful title/caption identifies the specific data and fits are shown in Fig. 3, and also identifies the specific part of the lab you were working on to generate this data.

  NOTE: If you have seven voltage vs. time graphs in a lab, it is insufficient to describe each as a 'voltage vs. time' graph. What is <u>different</u> about your seven V(t) graphs? For example, what did you change before measuring each V(t) trace? Include those experimental details in your title/caption.

8.2 Lab reports

- Lab reports are limited to one page. Scientific writing is succinct. A goal of this course is for you to learn to write precisely while still making an effective argument. You will have to judge what things are important and communicate them efficiently. Tiny fonts and narrow margins are a clear indication that this has not been achieved.
- Insight is an important part of your report. Do you understand what you were doing, or were you merely doing as instructed? Explain what you learned, not just what you did. Demonstrate your understanding by offering plausible sources of error based on physical principles (vague sources like "human error" are not acceptable). Offer possible improvements to your methods and techniques that would help the problems you encountered. Connect the concepts you learned in class to everyday experience, other experiments you've done in this class or even other courses.

- **Lab reports are to be written individually.** Any submissions with plagiarized writing will receive no credit and result in a grade of "F" for the course. Do not use AI tools (like ChatGPT) to write your report.

8.3 Grading rubric for the lab notebooks and reports

Item	Points	Notes
Notebook	16	Can it be followed by someone who has not done the experiment, but has access to the course materials?
Data	18	Was the required data taken? Is it presented in an organized and readable way?
Analysis	18	Discussion of results and answers to specific questions posed in the lab handout.
Summary	6	Is the lab report summary cohesive and concise? Were all the important topics covered and well communicated?
Insight	2	Demonstrate a deeper understanding and synthesis of the physical concepts by connecting to examples not specifically mentioned in the handout or by discussing plausible sources of error or experimental improvements *based on sound physical principles*.
Total	60	Lab reports comprise 60% of the total course grade.

9 Assignment Type 3: Lab Practical Exam

- We are planning to hold a Lab Practical Exam (LPE) in the last session of the course (consult the Canvas course calendar for specific dates).
- In contrast to the Lab sessions, the LPE is a solo activity. The best way to prepare for it is by *actively* working with your partner(s) in the Lab sessions.
- The details will be announced as we get closer to that week.

10 Submit Assignments to Canvas by Due Date

You will need to upload your assignments to Canvas.

1. Due date of the lab notebook and lab report: upload this as a single file to Canvas, **by no later than 11:59 PM, 3 days after each lab session**. For a Tuesday lab session, upload your work to Canvas before midnight on Friday. For a Thursday lab session, upload your work to Canvas before midnight on Sunday. Canvas will be enforcing late penalties automatically, so to avoid losing points due to last-minute WiFi issues, tell yourself that the deadline is actually 10 PM, and treat the gap between 10-11:59 PM as the 'grace period'.
    - Exception #1 for due date of the lab notebook and report: The last lab of the term will not require a report, so you can upload it before you leave the session, although the due date on the Canvas course calendar is a day later.
2. Due date of the LPE: same day as your LPE, details to be announced.

11 Late Submissions, Special Rules for Summer 2025

It is always in your best interest to submit all Assignments by no later than the Due Date. The labs cover many different topics in a short time, and it gets much harder to do your best work if you fall behind. Thus, for in-person PHYS S165/S166, the policy is to penalize late submissions by -15% per day late (weekends count too!)

In the Summer of 2025, Canvas will automatically implement this policy for Assignment Type 2 (Labs). Specifically, the policy is to penalize late submissions by -15% per day late (weekends count too!) On Canvas, uploading even 1 second late is the same as 23 hours late, so don't wait until the last possible moment. Note also that Canvas only counts the last upload, so re-uploading to add one figure 2 days after the due date costs you -30%, which is not a good trade-off. **Bottom line: upload all parts of your submission before the due date, and don't re-upload tiny changes after the due date!**

As always, let us know if you have any questions or concerns.

12 Lab Attendance and Make Ups

Attendance is mandatory. Due to the rapid pace and logistics of the course, you must attend each of the lab sessions (consult the Canvas course calendar for dates). Contact Prof. Barrett as soon as possible if last-minute issues prevent attendance, so we can figure out how to proceed.

In general, the Yale Summer Session requires courses to end on schedule: any work that is incomplete on the final day of classes can be made up only with the permission of the Instructor and the written permission of the Dean of Yale Summer Session (this permission must be requested prior to the last day of class).

13 Course Grades

Your final course grade will be weighted as follows:

Lab Reports	60%
LPE	25%
Quizzes	15%

14 Policy on SAS Letters

Students who are approved for academic accommodations should send their Summer 2025 accommodation letter to `sean.barrett@yale.edu` by the end of the first week of each summer session (YSS A or YSS B). Please note, while we acknowledge some students may not be approved for accommodations until later in the term, we cannot guarantee testing accommodations will be available beyond the date indicated. Please feel free to email me to set up a time to discuss any questions you may have regarding your accommodations. Students who wish to inquire about accommodations should contact Student Accessibility Services at `sas@yale.edu` or complete an Accommodations Request Form at https://sas.yale.edu/students/forms.

15 Lab Topics for Each Course (subject to modifications)

PHYS S165	PHYS S166
A-Galileo's Pendulum	1-Lab Equipment
B-Uncertainties	2-Simple Signals
C-Accelerated Motion	3-Signal Reconstruction and Coupled Oscillators
D-Terminal Velocity	4-Forced Damped Oscillators
E-Collisions	5-Charge, Capacitors, and Exponential Decay
F-Simple Harmonic Motion	6-Circuit Elements and the Circulatory System
G-Rotation	7-Electromagnetic Induction and EKGs
H-Gyroscope	8-RLC circuits
I-Radioactivity	9-Geometric Optics
K-Fluids and Gas Laws	10-Diffraction