

PHYS 281L Experimental Techniques in Physics: Syllabus

The University of North Carolina at Chapel Hill

Spring Term, 2021

Contents

General Information	2
Instructor Information	2
Course Meetings	2
Course Goals	3
Assignments and Due Dates	3
Required Course Materials	4
Grading Policy	4
Attendance and Late Assignment Policy	5
Honor Code Policy and Plagiarism	6

General Information

Short Description: This course explores modern physics experiments, techniques, and data analysis to prepare students for research and advanced laboratory work. Assignments include written and oral reports with peer review.

Audience: PHYS 281L is designed for physics majors, and is required for the Physics B.S. and most Physics B.A. options. Students are encouraged to take this course in their second year following the introductory sequence, and are required to take it prior to PHYS 481L (Advanced Laboratory). Assuming the prerequisites are met, the course is also open to non-majors seeking to improve their scientific experimentation and communication skills.

Prerequisite: PHYS 119, or permission from the instructors

Course Website: <https://sakai.unc.edu/portal/site/phys281-sp21>

Syllabus Changes: The instructors reserve the right to make changes to the syllabus, including due dates. These changes will be announced as early as possible.

Experimental Physics during a Pandemic: In order to learn how to use scientific equipment, we are firm in our belief that it is best to get experience turning the knobs and flipping the switches with your own hands. Many parts of this course may be taught and learned quite successfully remotely, but in order to gain an understanding of how experimentalists work, how to approach and handle equipment, and how to conduct a measurement, we are hoping to have some in-person meetings. As such, we have developed the following plan to prioritize both safety and learning:

If the university allows in-person instruction to begin, the instructional delivery method for this course will be Face-to-Face/Hybrid. Lectures will be held remotely via Zoom, while most labs will be held in person in Phillips Hall (see details in the “Course Meetings” section below). All course meetings will be synchronous, meaning that you will need to come to class (whether virtually or in person) at the course meeting time listed on ConnectCarolina. In order to minimize the amount of contact, each 2 or 3-person group will work in a separate lab room, and physical distancing will be strictly enforced. ***Students will never be required to attend any course meeting in person.*** If the need arises, students who cannot come to lab may collaborate remotely with their group. For more details on attendance requirements see the “Attendance and Late Assignment Policy” below).

That said, if instructions stays remote for the duration of the term, all hope is not lost! See Ben’s website for some examples of how the class will be adapted for remote learning.

Instructor Information

	Prof. Sean Washburn	Ben Levy
Sections	Lab Section 403/Lecture Section 601	Lab Section 402/Lecture Section 601
Email	sean@physics.unc.edu	levyb@unc.edu
Zoom Link:	https://unc.zoom.us/my/seanuncphysics	https://unc.zoom.us/my/benphysics
Office Hours	Fridays 10-11 am, or by appointment	Monday & Tuesday 1-2 pm, or by appointment

Course Meetings

Emphasis is placed on cooperative learning amongst peers rather than an instructor-centered environment. The “core” of the course comprises 8 laboratory experiments, and each will be completed by a group of 3 students working as a team. Lecture sessions will include material and interactive activities designed to

build data and uncertainty analysis skills needed for the labs. Due to the high percentage of group work, attendance for all meetings is required, *however, even if in-person instruction begins during the semester, students are still free to attend remotely if needed (see the “Attendance and Late Assignment Policy”).*

Lectures*: Thursdays 9:30 - 10:20 am via Zoom

Labs: Students are split into two lab sections, each of which meets once weekly. If you forgot which section you enrolled in, please check ConnectCarolina.

- Section 402: Tuesdays 5:00 - 7:50 pm via Zoom OR in various rooms in Phillips Hall if in-person instruction begins
- Section 403: Wednesdays 2:30 - 5:20 pm via Zoom OR in various rooms in Phillips Hall if in-person instruction begins

A complete daily [course calendar](#) may be found [here](#), or in the sidebar of the Sakai site.

*Lectures are known as “recitations” on ConnectCarolina. These terms may be used interchangeably here.

Course Goals

In PHYS 281L, students will

1. Learn to operate and implement *tools and techniques* used by experimental physicists in their research. Students will learn to take measurements with devices such as Vernier calipers, oscilloscopes, and Michelson interferometers, and to quantify the uncertainties associated with these measurements.
2. Put the *scientific process* into practice by forming hypotheses, designing experiments, taking and analyzing data relevant to the experiment, and using this data to form concrete, well-supported conclusions.
3. Use *written and oral communication skills* to form persuasive arguments aimed at convincing peers of the significance of findings.
4. *Contribute to the success of their group* by sharing ideas and problem solving approaches.

Assignments and Due Dates

All assignments and due dates are listed in the assignments section of Sakai, and on the [course calendar](#).

Lab Reports: Students will work in groups of 2 or 3 to complete 8 laboratory experiments. The experiments will be organized into two rotations: “A” and “B.” During the first half of the course, groups will rotate through the four A labs (A-I, A-II, A-III, and A-IV). During the second half of the course, new groups will be formed, and students will rotate through the four B labs (B-I, B-II, B-III, and B-IV). Following each lab, students will write a lab report detailing their findings using the typesetting language L^AT_EX. Details on lab report content expectations may be found in the [Lab Report Guidelines](#) document on Sakai. Two of the lab reports will be completed individually, while the other six will be completed as a group.

For group reports, a draft version is due at 7 pm on the night before the final version due date. Final versions (group or individual) are due 30 minutes before the start of the next lab via Sakai.

Warmups: Prior to each lab, students will read through the lab manual and answer four short essay questions on an online warmup questionnaire (available via the assignments section of Sakai). The questions will be designed to promote careful reading of the manual which will, in turn, lead to more expedient experimentation. Warmup grades will account for 5% of each lab report grade, and will be based on the thoughtfulness of the responses.

Due 30 minutes before the start of the next lab via Sakai

Chalk Talks: Students will give a single 3-5 minute “chalk talk” on their findings for one particular lab. The goals of chalk talks are to test and hone oral presentation skills, and to share knowledge with classmates so that future labs are easier for everyone. More information may be found in the [Chalk Talk Assignment](#) document on Sakai.

To be presented at the beginning of the next lab via Zoom

Peer Review: For two of the lab reports, students will have the opportunity to review a lab report by peers and to have their own report reviewed by others. Students will work individually and later as a group to provide feedback. Authors will then revise their reports, and the second draft will be the version graded by the instructors. Peer review grades will be assigned based on the quality of the feedback provided.

Peer review will occur via Zoom during lab time (in place of an experiment) on the day the report is due

Homework: Six homework assignments will be given throughout the course. Each assignment is designed to teach a new technical skill such as a programming language, or to reinforce concepts learned during lecture. More details may be found in the assignments section of Sakai.

Generally due 30 minutes before the start of the next lab via Sakai

Final Project: Students will be given an imaginary budget, and as groups will be asked to redesign one of the labs they have completed in the course for fully-remote instruction. Students will present their proposal in groups before a panel of judges (acting as “lab managers”) during the final exam period (*no separate final exam will be given*).

Both sections will present at the same time during the last week of classes: 5:00 - 7:00 pm on Tuesday 5/4.

Required Course Materials

No textbook is required for this course, although several will be provided by the instructor for use as reference material. Several pieces of software will be required, all of which are made available by the university free of charge (or are freeware), and some are available in web-based environments as well. These include Zoom, MATLAB, Logger Pro, Microsoft Excel, and a L^AT_EX editor. Installation instructions will be provided when needed. An internet connection capable of reliable videoconferencing is also required. Please monitor your email and the course Zoom channel.

Grading Policy

Assignments will be graded and posted to the Sakai gradebook as quickly as possible. Final numerical course grades will be obtained by taking a weighted average of individual assignment grades, with category weights given as follows:

- 55%: Lab Reports
- 20%: Final Project
- 10%: Homework Assignments
- 5%: Chalk Talk
- 5%: Peer Review Assignments
- 5%: Participation

The final letter grade will be assigned by comparing the numerical grade with the following list. Numerical grades will be rounded to the nearest integer using traditional mathematical rounding (e.g. 89.49 → 89, and 89.50 → 90), and then a letter grade will be assigned.

≥ 93:	90-92:	87-89:	83-86:	80-82:	77-79:	73-76:	70-72:	67-69:	60-66:	<60:
A	A-	B+	B	B-	C+	C	C-	C+	D	F

Note: All final course grades will be posted to ConnectCarolina within 72 hrs of the final project presentation. At that point, all grades are final and cannot be changed except for instances of clerical errors.

Attendance and Late Assignment Policy

Students are expected to attend all lecture and lab sessions. If and when in-person instruction begins, students will have the option to attend remotely when needed. Specifically, anyone who is feeling even slightly sick, suspects they have been exposed to COVID-19, or was in a high-risk situation for COVID-19 will be required to stay home and attend the lab via Zoom. If and when in-person instruction begins, labs will be treated as in-person-first, but your instructors will do their best to ensure an equitable experience for those who occasionally have to stay home. The added benefit of getting to work with scientific equipment directly is incentive enough to encourage students who can do so safely to attend labs in person.

Separately, if you cannot attend a course meeting at all (not in person AND not remotely), then the following applies: In cases of illness, UNC sanctioned absences, or other emergencies, students may request their absence be excused by emailing or otherwise communicating with their instructors as soon as possible in order to provide documentation. Acceptable forms of documentation include (but are not limited to) a letter from a doctor, dean, or coach.

- Labs missed due to an unexcused absence cannot be made up, resulting in an automatic grade of 0 on the lab report.
- Labs missed due to an excused absence must be made up promptly. If necessary, a time will be scheduled to make up the lab outside of class. If a student misses a lab, *they will receive no credit for the group lab report unless the lab is made up.*

Unexcused absences may additionally count against a student's participation grade. Excused absences will not count against a student's grade, but missing an excessive number of classes may result in an Incomplete or other alternative action.

If you are sick, do not feel as though you need to be a "hero!" Consult with a medical professional and send your instructor an email when you can. The instructors will work with you once you are feeling better to make up missed course components.

Students are expected to turn in all assignments by the due date posted on Sakai. In order to both encourage on-time submission and to prevent unforeseen events from having an outsized impact on students' grades, late assignments will be accepted, but will receive a grading penalty.

- Unexcused late assignments will receive a grading penalty of 10% of the original assignment point value. The penalty will increase by 10% for every additional 24 hour period until the assignment is turned in. For example, an assignment due on Monday at 1 pm and turned in on Wednesday at 2 pm will receive a 30% deduction. Two types of assignments carry exceptions to this rule:
 - Exception 1: *Unexcused, late warmup questionnaires* will not be accepted after the beginning of lab and will receive 0 points.
 - Exception 2: *Draft versions of group lab reports* will receive a 5 point deduction if received between the due date and 7 am the next morning, and a 10 point deduction after that.
- Students who receive an excused absence may be given a due date extension by the instructors if an assignment was difficult or impossible to complete because of the absence. The instructors will work with the student in order to agree upon a new due date. If necessary, group lab report due dates may be extended for the entire group. No grading penalty will be applied.

Honor Code Policy and Plagiarism

The Honor code and the Campus Code, embodying the ideals of academic honesty, integrity and responsible citizenship, have for over 100 years governed the performance of all academic work and student conduct at the University. Acceptance by a student of enrollment in the University presupposes a commitment to the principles embodied in these codes and a respect for this significant University tradition. Your participation in this course is with the expectation that your work will be completed in full observance of the Honor Code.

Academic dishonesty in any form is unacceptable. A breach in academic integrity, however small, strikes destructively at the University's life and work, undermining the community's intrinsic commitment to respect and mutual trust. If you have any questions about the Honor Code, please consult with someone in the Office of the Student Attorney General or the Office of the Dean of Students.

Students are expected to abide by the Honor Code in all classroom activities and assignments. Collaboration is explicitly allowed and encouraged in class and on assignments that are designated as group submissions. Discussion with other students prior to submitting individual assignments is also permitted. Graded assignments for which the instructors restrict the types of aid permitted must be submitted without any aid not explicitly authorized by the instructors.

According to the Oxford English Dictionary, *Plagiarism* is “the action or practice of taking someone else’s work, idea, etc., and passing it off as one’s own.” Plagiarism is a violation of the UNC honor code, and is not allowed or tolerated in PHYS 281L. Failure to abide by this standard may result in zero credit on the assignment in question, an honor court violation, or other disciplinary action.

In courses centered around problem sets and exams, the rules are simple: do not copy other peoples' answers. Avoiding plagiarism becomes more nuanced in courses such as PHYS 281 where the emphasis is on group work and writing. For guidance, the following (non-exhaustive) list contains some examples of plagiarism that you will need to avoid:

- Copying *text or figures* from an on-line or print source, lab manual, or peer into your lab report without attribution is plagiarism. If you want to include a figure or particularly trenchant line of text that you did not create, *you must cite it*.
- Copying text or figures from an on-line or print source, lab manual, or peer, *and changing a few words or graphical elements* before pasting it into your work is also plagiarism. You are free to use any sources you want in building your argument, but be sure to put away those sources when you start writing so as to avoid copying (or nearly copying) the language.
- Using *ideas* that you did not come up with in your work without proper citation may also be plagiarism, unless the ideas fall under the category of “general knowledge.” For example, if your classmate shows you that a certain obscure equation on page 745 of an old textbook may be used to analyze your data, both the classmate and the textbook should be cited. On the other hand, if your classmate reminds you that you can use the quadratic formula to solve a quadratic equation, no citation is needed as the quadratic formula and its applicability are general knowledge. If you are confused whether or not something is “general knowledge,” it probably is not! If you are still unsure, please ask your instructors.
- In this class you are strongly encouraged to provide help for each other on any and all assignments. Collaboration is an important part of education in general, and the scientific process in particular. That said, avoid putting yourself in situations in which your work may be copied, as this could reflect negatively on you. For example, if you finish your assignment early and share it with a classmate prior to the due date, be aware that your classmate could plagiarize your work. In this situation, your instructors may have no choice but to blame both of you equally. To avoid this, ask to see your classmate's completed work in return for sharing yours, or simply offer to help them directly rather than sharing your work.