

Information on Physics Labs

General Information: Physics lab courses at Yale are NOT linked to the lecture courses. They operate as wholly separate, graded 1/2 credit classes. While these labs will expose you to some basic concepts of physics, their primary objective is to give you experience and expertise in laboratory tools and techniques. This includes quantitative measurement strategies, data analysis using computational tools (computers, software), experimental design and, under normal circumstances, experience with commonly encountered laboratory equipment and instrumentation.

There are two separate physics lab tracks at Yale that are briefly described below. You should choose the one that best meets your goals, requirements, and interests. If you have further questions after reading this and the Canvas course pages (which have much more information) about which lab you should take, we recommend consulting your advisor or the DUS of Physics. Physics lab courses do not need to be taken concurrently with any lecture class, though many students opt for this approach, with many also enrolling in lab after completing their physics lecture course.

Physics 165La and Physics 166Lb - General Physics Lab I and II

This is our two semester Fall/Spring physics lab sequence primarily for life-sciences majors. If you are or have taken Physics 170/171 or Physics 180/181 and are majoring in a life science, you may prefer this course (though you can take Physics 205/206 instead). Physics 165 revolves around a weekly physics lab experiment covering a concept from the first semester of an introductory physics course, while Physics 166 focuses on topics from the second semester. Some lab topics may be covered in lecture, but there is no coordination between the lab content and the content of the particular lecture class you may be taking. Students are assessed on the quality of their laboratory participation and preparation, their laboratory notebooks, and final practical exam.

Physics 205L and Physics 206L - Modern Physics Lab I and II

This is our two semester sequence (both courses run Fall AND Spring, every year) primarily but not exclusively for engineering and physical science majors. If you are, or have taken Physics 180/181, 200/201 or 260/261 you may prefer (and we recommend) this sequence, though you can take it even if enrolled in Physics 170/171. In Physics 205, you will perform a variety of experiments designed to train you in experimental design, data collection, analysis (with Python), and display, and the use of modern research grade measurement tools. Our objective is to give you the ability to work successfully in a research laboratory and to be prepared for our advanced laboratory course: Physics 382. Physics 205 revolves around weekly activities. You are assessed on, pre-lab work, lab notebooks and a final project. **There is no practical exam.** Physics 206 will be radically different for fall 2020 due to Pandemic. See COVID-19 specific information below.

Preference Selection: To register your choice for a particular laboratory section of either Physics 165, 205 or 206, be sure to participate in preference selection which runs from August 7th to the 12th (see links below). Registering your preference will give you the best chance of getting the section of your choice. This process only registers your section preference, you still need to add the particular course to your worksheet. Do not register a preference for more than one lab course.

Physics 165: <https://students.yale.edu/ocs-preference/select/select?id=19486>

Physics 205: <https://students.yale.edu/ocs-preference/select/select?id=19492>

Physics 206: <https://students.yale.edu/ocs-preference/select/select?id=19495>

If you miss preference selection you must wait until August 17th to pick a section through OCS.

COVID-19 CHANGES TO PHYSICS LABORATORY CLASSES

FALL SEMESTER 2020

Physics 165La - General Physics Lab I will be an entirely online course. Students will not be attending in person and do not even need to be located on campus. Normally, students carry out their experiments in the Yale Physics Department, in rooms SPL 39-43. Unfortunately, this will not be possible in the fall of 2020. Necessity is the mother of invention, and we will bring PHYS165/166 to you, wherever you are, with more bells on and whistles too.

To make the best of this challenging situation, we are continuing our course redesign for the fall, given our experiences in the online spring of PHYS166 2020 and the summer of PHYS S165/166. We will continue the video delivery of *professional* experimental data taking, but we will provide you with a "skeleton kit": A collection of objects and instructions which can be used to reproduce all (nearly) of the experiments done in SPL39-43 in the PHYS165/166 sequence.

Physics 205 - Modern Physics Measurement I will be an entirely online course. As such, students will not have access to the suite of equipment that is normally available. However, we will be covering most of the important course objectives using other means. The Fall 2020 course objectives are that students will be able to:

- Design and carry out an experiment, report results, and quantify uncertainties
- Record observations in a lab book in an organized, complete and ethical manner
- Make use of computers and a notebook programming environment to acquire, analyze and display data.
- Develop skills necessary for more advanced laboratory courses (Physics 206 and Physics 382)

Lab sections will take place at the following times (Tu-Thu, 1:30pm-4:30pm; Fri, 9:00am-Noon) via Zoom. During lab, students will interact synchronously with the instructor, TF and peers. There will be a mix of presentation, group activity and discussion. The semester will be divided into three different modules:

- Module 1: Introduction to data, data analysis, manipulation, collection and presentation
 - How to handle uncertainties
 - How to import, manipulate, analyze and display data
- Module 2: Sensors, Collecting Data and Conducting Experiments with iOLab
 - How to use the iOLab sensor device (provided)
 - Collecting data using iOLab
 - Applying tools from Module 1 to collected data
- Module 3: Self Directed Investigation
 - Selecting, designing and carrying out an experiment of your choosing
 - Making changes to your experimental design/technique to improve your data
 - Analyzing, and presenting your experiment and its results

We encourage you to carefully review the syllabus when it becomes available on the Canvas course web site, which will hopefully be soon.

Physics 206 will be an entirely online course and will be different in **MAJOR WAYS** from previous versions of the class. This is because we cannot replicate the intensive hands-on, apparatus-centered components using a remote instruction model. In its place, we will be offering Physics 206 as a computational physics class combined with a seminar on important historical experiments and their importance in terms of current forefront research. If your objective in taking this course was specifically to gain experience in conducting

complex experiments, doing sophisticated data analysis, and learning scientific apparatus, we encourage you to delay taking this course. We hope to offer the standard 206 curriculum in the spring 2021 semester.

When it becomes available on the Canvas course site, we encourage you to carefully review the syllabus for the particular lab you are interested in. It will have much more detailed information.