

PHYS 431L

Modern Physics Laboratory

Spring 2021

Laboratory Hours: Tues. 1:00 – 4:50 and Thurs. 1:00 – 3:50,
using Blackboard Collaborate
Instructor: Matthew Pelton
Office Hours: Tues. 11:00 – 12:45, or by appointment
Instructor Webex: <https://umbc.webex.com/meet/mpelton>
E-mail: mpelton@umbc.edu
Text: There is no textbook required for this course.

This course is being taught entirely online this semester. This is very different from the way the course is usually taught, and changes may continue to be made to the course during the semester, based on new conditions, student feedback, etc. All changes will be announced to the class, and the version of this syllabus available on the course Blackboard page will reflect the most recent changes.

Course Objectives

The purpose of this course is to provide a laboratory experience that brings together the physics concepts taught in previous lecture courses. This semester, the experience will be accomplished by having you participate in livestreamed experiments and virtual experiments. You will have succeeded in this course if, at the end of the semester, you are able to do the following:

- Understand how to carry out laboratory experiments using modern techniques
- Analyze experimental data properly
- Prepare professional-level laboratory reports and oral presentations

Course Management

Blackboard will be the main communication tool for this course. All course materials, announcements, and handouts will be posted to the course Blackboard page, and all assignments will be submitted using the Blackboard page. Class meetings will take place using Blackboard Collaborate. It is your responsibility to check the class Blackboard site and keep up to date with the course requirements.

You will need to have the proper technology to be able to participate in this course. The following are the minimum requirements:

- Most of the classes will involve the instructor performing the experiment live, with a group of students connected by Blackboard Collaborate guiding the instructor through the experiment. You will need to be connected to the Bb Collaborate course room during all scheduled course times, with an internet connection reliable enough to enable you to fully participate.

- You need to have a working webcam and will need to have it on during the lab time. The goal is to make the experience as close as possible to an in-person experience, so the use of webcams is required.
- The lab work will be supplemented by simulations, which will require you to be able to run Java in your web browser.
- You will need to be able to submit lab reports and other assignments on Blackboard as PDF files.

Expectations

The lab course takes place Tuesday 1:00 – 4:50 and Thursday 1:00 – 3:50. During both time slots, you will participate in either live-streamed or virtual experiments (there is no lecture component to the course). You are expected to be connected to the Blackboard Collaborate course room, with your webcam active, during the entire scheduled class time.

Performing any real physics experiment requires a great deal of advance preparation. One of the goals of this course is to approach a real research experience, so it is essential that you prepare for experiments ahead of time. This is especially important in the online learning environment: you will be able to learn effectively during the experiments only if you can participate fully, and you will be able to participate fully only if you understand the physics and operational principles of the experiments ahead of time.

There will be brief write-ups provided for each experiment, giving a broad overview of the objectives of each experiment. In addition, you will be provided with resources to help you learn about the experiments as well as manuals for each piece of lab equipment involved. You are expected to thoroughly review the resources provided, so that you are prepared to begin with the experiment when class begins. This does not necessarily mean reading a manual from cover to cover: not all the information in the manual will be relevant for the experiment you are going to be involved in, and the manual doesn't provide information about the particular experiments that will be done. You are encouraged to do your own research and reading to make sure you have all the information needed to understand and perform the experiments.

Course Requirements

For the first part of the semester, you will work on a series of two-week experiments. Some experiments will be done in the lab by the instructor, with a group of students joining by Blackboard Collaborate. The students will tell the instructor what to do and, at the end of the experiment, the instructor will send the acquired data to the students to analyze. The other experiments will be done virtually, either as a remote experiment or as a simulation. During each lab class, there will be one group of students working on a live-streamed experiment and one group of students working on a virtual experiment.

You are encouraged to discuss the science and operation of the experiment with the other members of your group. However, laboratory reports, pre-labs, proposals, and the final presentation are your own work.

In the later part of the semester, you will work individually on term-paper-style projects. These projects will center around a published scientific paper of your choice on a topic related to one of the scientific subjects or measurement techniques covered in the course.

The project report will be an explanation of the results in the paper, the scientific background required to understand the results, and the significance of the results. This explanation will be based on a broader reading of the relevant scientific literature and will be written at a level so that it can be understood by the other students in the course.

Pre-Labs

For each of the experiments, you will be required to hand in a pre-lab report. This report must include the following:

- An explanation of the purpose of the experiment
- A brief overview of the theories and principles underlying the experiment
- An outline of the planned experimental approach

The report should be no more than four pages long. You do not need to include a cover page for your pre-lab.

Pre-labs are due by the end of the day before you are scheduled to begin the experiment. Pre-lab reports must be submitted electronically to the course Blackboard site. Pre-labs are required in order to be allowed to participate in the experiment during class time.

At the beginning of each experiment, one student will be randomly selected to briefly summarize to the class the purpose and background for the experiment that they are about to participate in.

Proposals

Before beginning the project, you will be required to hand in a project proposal. The proposal must include the following:

- The scientific paper that you have chosen for the project
- An explanation of how the paper relates to one of the scientific or technical themes covered in the course
- A brief explanation of the significance of the publication and the underlying scientific theories and principles
- A brief outline of the anticipated content of the project report

The proposal should be no more than five pages long. You do not need to include a cover page for your proposal.

During the week before you begin your project, you will meet with the instructor to go over your proposal, make any changes that may be needed, and plan out your work over the next two weeks. Proposals are due the Friday of the week before these discussions. Proposals must be submitted electronically to the course Blackboard site.

Lab Notebook

You are required to document your work during the experiments. For this online course, either an electronic or a conventional lab notebook can be used.

Practicing scientists often need to come back to their notebooks years later in order to recall the details of the experiments that they did; you should strive to have your notebook entries complete and clear enough to meet this standard. You must make every effort to record and describe *everything* that you're doing. Draw or take pictures. Even if information is

stored in a computer, it should be printed out, as a picture, graph, table, etc., and taped into your notebook. All entries should begin with the date that the entry is made.

It is a good idea to plot your data as you acquire it. This way, you will immediately see where more data is required and if there are any apparent systematic errors that could be fixed. This will slow down the data acquisition somewhat, but it will be much more efficient in the long run than having to come back and start all over again when you find out that the data was problematic or incomplete.

In real-world research, lab notebooks are the official record of the experiment performed and are the primary piece of legal evidence used to settle priority disputes, or if there is an accusation of research misconduct. It is therefore forbidden to alter lab notebook entries, including tearing pages out of the book, or even erasing entries – anything that you don't want to keep should be crossed out with a single line.

At the end of the semester, I will review your lab notebooks. You can earn up to 3% extra credit in the course if you have maintained an exceptionally detailed and well-organized lab notebook.

Reports

A complete laboratory report is required for every experiment and project completed. There is no specific template for the report (apart from the cover page). Rather, the report should be prepared in the format and style of a scientific paper.

There is a separate handout explaining the requirements and expectations for the reports. The handout includes a rubric, which will serve as the basis for grading the reports. Each of the criteria will be evaluated as “Not addressed,” “Novice,” “Intermediate,” or “Proficient,” and the evaluations will serve as the basis of your score on the report. Not all of the criteria will be given equal weight, and the conversion of the evaluations to a score will be based on the instructor's judgment. There is an expectation that your report-writing skills will improve over the semester, so, later in the semester, you will have to get better evaluations in order to get a high score than you do earlier in the semester.

Reports must be submitted electronically to the course Blackboard site. All submitted reports will be scanned for plagiarism using the SafeAssign application. Reports are due the Tuesday after the experiment or project is complete. Late reports will be accepted only in the case of a documented issue or problem.

The instructor will provide high-level comments on Blackboard, and the reports will be distributed to another, randomly selected student in the class for anonymous “peer review.” The reviewing student will provide critiques of the written report, based on the rubric provided. Reviews are due the Thursday after the reports are received and will be returned to students by the next day. You will then have until the following Tuesday to revise your report and turn in the final version.

An interim project report is due a week after beginning the project. The final report will be due the Tuesday after the scheduled time for projects is completed. As for the lab reports, the project reports will be peer reviewed and revised before the final version is submitted. There is a separate handout with additional guidelines for the projects.

After all the experiments are complete, there will be a week where you can revise one of your lab reports. Revised lab reports are due on the Thursday of this make-up week, and the score for your revised report will replace your score for the initially submitted report.

Oral Presentation

At the end of the semester, each student in the course will give a fifteen-minute presentation on one of the projects that they have completed. The presentation will follow the format of a typical research talk given by a scientist in a national conference. There is a separate handout with the guidelines and grading rubric for the presentations. Slides for the presentations must be uploaded to the Blackboard page by the end of the day before the presentations.

Grading

Your final grade will be based on the pre-labs and lab reports for the nine labs during the semester and on the final presentation. There are no exams in the course.

Your percentage score will be calculated as follows:

- Pre-labs (4): 1% each
- Initial experiment reports (4): 1% each
- Final lab reports (4): 14% each
- Project proposal: 2%
- Interim project report: 2%
- Initial project report: 1%
- Final project report: 16%
- Peer reviews (5): 1% each
- Final presentation: 10%
- Lab notebooks: Up to 3% extra credit

At the end of the semester, you must have turned in all the experiment and project reports. If you miss even a single report, you will automatically get a C or lower in the course, regardless of the scores that you got for the other reports.

If you complete all reports, your percentage score will be converted to a letter grade as follows:

- 90% and higher: A
- 80% and higher: B
- 70% and higher: C
- 50% and higher: D
- Below 50%: F