

PHYS 431L Fall 2019

Modern Physics Laboratory

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Office hours: Monday, Tuesday: 9:30-10:30 am.

Textbooks You will not need to purchase a textbook for this class.

Course description (from the registrar)

Laboratory course intended for physics majors. Purpose is to acquaint the student with some of the phenomena and experimental techniques of atomic and modern physics. Error analysis and advanced data fitting technique are included.

Prerequisite: You must have completed PHYS 324 & PHYS 330L with a grade of C or higher.

Course Overview

Since this lab is the last experimental course in the curriculum the main objective of this course is to provide an experience closer to a real-life workplace or graduate school. Unlike your previous laboratory courses, in this class we will challenge you by asking you to design and carry out the experiments independently. All the required equipment will be at your disposal in good working order. You will be given a brief outline of the subject as well as supporting materials, but it will be your own responsibility to design and assemble the experimental set up and decide on the correct data acquisition procedure. Some of the supporting material provided will be write-ups from other universities for similar experiments. There is also a plethora of information available at your fingertips. Therefore, it will be of the utmost importance that you come to the lab prepared. The instructor will be there to answer your questions and make sure that you are capable of performing the experiment in a safe and proper manner.

As in any lab course, we will place a lot of emphasis on the correct recording and handling of the experimental errors. You will have to include uncertainties for all the measured quantities and use standard error propagation techniques to find the error associated with the measurements reported in your lab report.

Learning Objectives:

To be successful in the course by the end of the semester you should be able to.

1. Design and carry out laboratory experiments using modern techniques
2. Analyze experimental data properly
3. Prepare professional-level laboratory reports and oral presentations

Course grade

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

Your percentage score will be calculated as follows:

- Pre-labs (4): 3% each
- Initial experiment reports (4): 2% each
- Final experiment reports for 2-week labs (4): 13% each
- Project proposal: 3%
- Final project report: 15%
- 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:

score > 90 : A

score > 80: B

score > 70: C

score > 60: D

score < 60 : F

Course management

I will use **Blackboard** to post course announcements, reading assignments and homework assignments, and post grades.

Calendar of assignments

Just to keep everything straight there is a calendar with all assignments marked posted on Blackboard.

Course Requirements

Lab Notebook

You are required to obtain and use a standard laboratory notebook for this course. The UMBC bookstore sells lab notebooks, and they can also be obtained online or at many office-supply stores. 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.

I may ask to go through your lab notebook at any time during the semester. 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.

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 (11.59pm) before you are scheduled to begin the experiment. Pre-lab reports must be submitted electronically to the course Blackboard site.

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 perform.

Before you perform the experiment, the instructor will discuss your pre-lab with you to make sure that there are no issues that will compromise your safety or prevent you from completing the work. You will not be allowed to carry out the lab if the instructor believes that you are not

prepared to perform the experiment safely. You may be allowed to perform a make-up experiment later, if you demonstrate at that point that you are prepared.

Lab 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. Late reports will be accepted only in the case of a documented issue or problem.

Initial reports are due **the Tuesday (by 11:00 am)** after the experiment or project is complete. The instructor will provide high-level comments either on Blackboard or via email by the Thursday after the reports are received. You will then have until **the following Tuesday (by 11:00 am)** to revise your report and turn in the final version.

Make-up labs will be given only in the event of a documented issue or problem. You must notify the instructor as soon as possible if you are going to miss a lab or have missed a lab because of an unexpected issue. Going out of town for a recreational trip is not a valid reason for requesting a make-up.

After completing all the experiments, you will have the opportunity to re-submit a revised version for one of your lab reports, with the score for the revised report replacing the score for the initially submitted report. Redoing all or part of the experiment is allowed but not required. A week will be available before the projects are started to redo the experiment, if desired, or to make up any experiments that were missed (for a valid reason) earlier in the semester. Make-up lab reports are due the Thursday after this make-up week.

SafeAssign

In addition to the written lab report, all reports must be electronically submitted to the course blackboard site where SafeAssign will be used to check for plagiarism. Reports must be uploaded to Blackboard before turning in the hardcopy. If you submit a late lab report, the report must be uploaded to Blackboard on the same day the report is turned in. Failure to upload your lab report to Blackboard will result in a score of 0 for that lab.

Project Proposals and project report

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

- A project title and list of group members
- An explanation of the goals of the project
- An explanation of why these goals are important or interesting
- A brief overview of the scientific theories and principles underlying the project
- A step-by-step outline of the planned experimental approach, including an estimate of the time required to complete each step
- A list of the laboratory equipment that will be used, and a list of any additional materials, supplies, equipment, or other resources that will be required
- A summary of any special hazards that may be encountered in the experiment and any other safety considerations

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 **Monday (11:59 pm) of the week of these discussions**. Proposals must be submitted electronically to the course Blackboard site. Project reports are due on **Dec 4th, 2019 (11:59 pm)**. Presentation slides (PowerPoint) are due on **Dec 5th, 2019 (11:00 am)**.

During the course of a project, it often becomes clear that changes to the plan are necessary. This is fine, as long as you discuss any major changes with the instructor.

Oral Presentation

At the end of the semester, each student in the course will give a fifteen-minute presentation on the project 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.

Incompletes

Please read carefully the catalog statement on acceptable grounds for an incomplete. The only grounds for obtaining an incomplete in this course is failure to complete the project and final presentation due to illness. Since, according to the catalog, you must be doing "qualitatively satisfactory" work in order to qualify for an incomplete, you must have at least completed the four laboratory reports, with a grade of C or better up to the time you took sick. If you are given an "Incomplete", it can be removed by completing the missed assignments (lab and presentation) in the following semester's PHYS 431L course.

Note: Do not register for PHYS431L again; just make arrangements with the instructor to attend the appropriate sessions.

Academic Integrity

By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, consult the UMBC Student Handbook, the Faculty Handbook, or the UMBC Policies section of the UMBC Director.

Student Disability Services (SDS)

UMBC is committed to eliminating discriminatory obstacles that may disadvantage students based on disability. Services for students with disabilities are provided for all students qualified under the Americans with Disabilities Act (ADA) of 1990, the ADAAA of 2009, and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that would allow students to have equal access and inclusion in all courses, programs, and activities at the University.

If you have a documented disability and need to request academic accommodations, please refer to the SDS website at sds.umbc.edu for registration information and to begin the process, or alternatively you may visit the SDS office in the Math/Psychology Building, Room 212. For questions or concerns, you may contact us through email at disAbility@umbc.edu or phone (410) 455-2459.

Disclosures of Sexual Misconduct and Child Abuse or Neglect

As an instructor, I am considered a Responsible Employee, per [UMBC's Policy on Prohibited Sexual Misconduct, Interpersonal Violence, and Other Related Misconduct](http://humanrelations.umbc.edu/sexual-misconduct/umbc-resource-page-for-sexual-misconduct-and-other-related-misconduct/) (located at <http://humanrelations.umbc.edu/sexual-misconduct/umbc-resource-page-for-sexual-misconduct-and-other-related-misconduct/>). While my goal is for you to be able to share information related to your life experiences through discussion and written work, I want to be transparent that as a Responsible Employee I am required to report disclosures of sexual assault, domestic violence, relationship violence, stalking, and/or gender-based harassment to the University's Title IX Coordinator.

As an instructor, I also have a mandatory obligation to report disclosures of or suspected instances of child abuse or neglect (www.usmh.usmd.edu/regents/bylaws/SectionVI/VII150.pdf).

The purpose of these reporting requirements is for the University to inform you of options, supports and resources; you will not be forced to file a report with the police. Further, you are able to receive supports and resources, even if you choose to not want any action taken. Please note that in certain situations, based on the nature of the disclosure, the University may need to take action.

If you need to speak with someone in confidence about an incident, UMBC has the following Confidential Resources available to support you:

The Counseling Center: 410-455-2472

University Health Services: 410-455-2542

(After-hours counseling and care available by calling campus police at 410-455-5555)

Other on-campus supports and resources:

The Women's Center, 410-455-2714

Title IX Coordinator, 410-455-1606

Additional on and off campus support and resources can be found at:

[http://humanrelations.umbc.edu/sexual-misconduct/gender-equitytitle-ix/.](http://humanrelations.umbc.edu/sexual-misconduct/gender-equitytitle-ix/)