

SPRING 2022 — PHYS 122L: SYLLABUS

Place and Time:

Lecture — Tu 1:00-1:50 PM in Physics 101

Lab — Tu or Th 2-4:45 PM in Physics 110

Instructor: Dr. Cody Goolsby-Cole

Email: cagc@umbc.edu

Office Hours: M 12:10-1 PM; W 9:30-10:20 AM; Th 12:30-1:20 PM. Held in Physics Tutorial Center (Physics 226A). Also, feel free to stop by my office (Physics 323) anytime too.

Teaching Assistant: Akram Ibrahim

Email: akramil@umbc.edu

Office Hours: MW 12-1 PM in Physics 110

Course Description: This 3-credit lab course is based on the physical phenomena associated with the PHYS 121-122 lecture-course sequence. The laboratory includes planning a measurement, setting up and working with equipment, and recording data. Students will learn to analyze data, compare theory with experiment, and estimate and report errors. Students will learn to present results in a complete, concise, and clearly written report.

Co-requisite: You must complete PHYS 122/122H with a grade of C or higher or be concurrently enrolled in PHYS 122/122H.

I will assume that you have the Physics background provided by PHYS 121 & 122. We will use concepts from these classes on a daily basis. I will assume that you have a working knowledge of calculus that includes derivatives, and formulas for algebraic and trigonometric functions.

Course Management

I will use Blackboard to manage the course. Assignments, class slides, lab notes, and announcements will be posted on Blackboard. Take a look at the course Blackboard page a day or two before the next lab, or if you suspect that guidance should be available in a given situation, such as inclement weather.

We will also enter your grades into BB so that you will be aware of your standing in the course at any time. It is your responsibility to keep up to date with the course materials and announcements posted on Blackboard.

Course Objectives: The first two weeks of the course will have all the “new material” for the course and you will learn all the necessary theoretical tools you’ll need when performing experiments for the rest of the semester. The learning objectives associated with weeks 1 and 2 are below:

- Explain the difference between systematic and random error
- Explain what instrumental limit error is and calculate it for digital and analog scales
- Report the measured value and uncertainty for a measurement
- Describe how many significant figures are associated with a measured value
- Statistically analysis a data set to determine the mean; standard deviation; standard deviation of the mean; and total uncertainty
- Apply the principles of error propagation to determine uncertainties

- Graph data sets which should include: a title, labeled axes with correct units, error bars, best fit line, and equation for best fit line
- Perform a least squares fit for a data set to determine: slope and y-intercept of best fit line, uncertainty of the measured y-values, and the uncertainties of the slope and y-intercept
- Linearize a data set and perform the same least square fit analysis as above

The rest of the semester will be spent on applying the theoretical principles you learning from PHYS 121/122 to experiments in the laboratory. The learning objectives associated with the experiments are:

- Observe physical phenomena familiar from your lecture courses. Become familiar with the intricacies of working in a lab, such as how to plan a measurement, how to set up and use equipment, and how to take and record data.
- Learn how to analyze your data and compare theory with experiment.
- Learn to present your results in a complete, concise, and clearly written report. (In the real world your work is usually judged by what you write about it: you prepare a report for your manager in industry, a dissertation as a graduate student, a research paper in academia. Fair or not, a badly written reports is dismissed, no matter how great the work itself would be otherwise.)

Required Course Materials:

1. **Introductory Physics Textbook:** No specific one needed, but something you can consult whenever you feel uncertain about the physics principles. Reports with incorrect physics will be harshly downgraded. You must understand what you are doing in the lab and why.
2. **Microsoft Word and Excel:** These programs are available for free to download as a UMBC student. The necessary features are available in any version. If your data evaluation required the use of a spreadsheet, attach it to your lab report. Incorporate only the main results and plots in the main text of the report.
3. UMBC requires all students to be technologically self-sufficient, which entails having a **reliable personal computer** (preferably a laptop with webcam) and **Internet access**. Since UMBC requires all students to have a computer and Internet access, financial aid may be used to meet this requirement. To learn more, students should contact their financial aid counselor at financialaid.umbc.edu/contact. In addition, the Division of Information Technology (DoIT) provides a wealth of resources and support, including tips for getting online and minimum specifications to consider when purchasing a computer (doit.umbc.edu/students)

Course Grade

Type of Assignment	Percentage
Pre-Class Quiz/Class Work	10%
Homework/Lab Reports	80%
Independent Investigation	10%
Total	100%

Percent Range	Letter Grade
89.5% or Above	A
79.5% - 89.5%	B
69.5% - 79.5%	C
59.5% - 69.5%	D
59.5% or Below	F

Your lowest pre-class quiz/class work will be dropped. Your lowest homework or lab report (whichever is lowest) will be dropped too. Each homework and lab report counts equally.

In principle, everyone can earn an A — I don't grade on a curve. This is the absolute grading scale I will use.

“Incomplete” is given only in exceptional cases. In order to be considered for an “I”, you must have completed at least 8 of the 12 assignments and have a C or better at the time of incapacitation.

Course Policies

Homework

Two homework assignments based on the first and second weeks material. Find on BB in the *Week 1 & 2* folder. Expect to spend an average of at least 4-6 hr on each homework assignment. Plan to start early so that you can get help in office hours. Homework counts for a significant chunk of your course grade and *it helps to build essential skills for lab reports*; completing a homework very late or poorly will leave you ill-prepared to achieve passing grades on your lab reports.

For any solution that requires calculation in Excel, include a printout of the results with the main answer circled or highlighted. Include handwritten comments on your printout to make it easier to follow. For other questions, homework solutions can be handwritten, but write clearly and be organized. You are encouraged to collaborate, but eventually each student must have her/his own unique solution.

Pre-Class Quiz/Class Work

Each week you will have a BB quiz to complete preparing you for that week's material. These will be due before class time at 1 PM on Tuesdays and will be made available over the weekend. They will cover material from the lab manual so be sure to read through it before hand. You'll have three attempts per quiz. Feel free to work with each other on the quizzes, but make sure you understand how to think through and approach all the procedures and problems yourself.

Class will take place in Physics 101 on Tuesdays from 1-1:50 PM and will help prepare you for that week's lab. You must wear a mask while in class. In addition to the pre-lab quiz, there will also be work during class time either preparing you for lab that week or assessing your understanding of the previous week's material. Once we start labs, you will be completing a quiz associated with the material for that week's lab during class. You are encouraged to work with each other on the quiz.

Working in the Lab

Lab will be in Physics 110. You must wear a mask while in lab. No food or drink allowed in lab. Ordinarily, you'll work with one lab partner. Be on-time; at the beginning of lab there's typically a ~5 min orientation to the apparatus that you shouldn't miss, plus labs can require the whole lab period.

Late penalties: up to 15 min late: 10%; 15-30 min late: 20%; 30 min+ late: too late to participate (possible makeup lab with appropriate excuse.)

You must record all your raw data and any variations from the standard procedure either on paper or electronically. Submission of your data will be on BB in the folder associated with that week's lab and must be submitted before leaving lab. You'll complete most of your data analysis after lab, but time permitting, get started on it during lab. It's easy to get help and you might realize you missed some data. Email yourselves the Excel file for any analysis that you began.

Lab Reports

To receive full credit for a lab report, you must attend the lab, take data, submit measurements & graphs, and submit an electronic copy of your report on BB. After submitting your electronic copy, it is your responsibility to make sure it has been uploaded correctly and your paper has the proper format. You can review your

submission by going to “My Grades” on BB and clicking on that lab’s lab report. Please don’t email me or the TA lab reports, we will delete these emails upon receipt.

Reports must be typed using a word processor and should conform to the format supplied in the sample lab report. It must be spell-checked and written in clear English. (Publishers return manuscript without review, if language is full of errors.)

You may talk to your classmates and lab partner regarding the lab reports, but each of you must submit your own original text, graphs, analysis, and report. Copying someone else’s work is cheating.

Refer to *Lab Report Grading Guide* under Course Documents in Blackboard for detailed grading criteria. Here are some of the important elements:

- All analysis detailed in the lab manual
- All conceptual questions are answered in the analysis/conclusion
- "Quality of language" means it is objective, precise, and concise (in addition to being proper English). Avoid rambling and vague phrases like "human error"
- Logical organization and flow
- Error evaluation in your report
- Apply what you learned in lecture-- always include error, correct sig figs, etc.
- Describe the error method: "s.d. of mean", "added in quadrature", "I used ___ function in ___ program"
- In the APPENDIX, include error propagation formulas (esp. ones that use partial derivatives). You can also attach Excel tables (printed out or pasted in). If you do some extended analysis, derivations can go here, too.
- ILE can usually be stated once: "All values in this table..."
- Figures and Tables
- No ambiguity-- include labels, captions and units!
- When plotting data, it should come with error bars. This can be individual measurement error, or it can be error from the least squares fit (Z parameter). Always specify.

Late Penalty for Homework and Lab Reports

Homeworks and lab reports can be submitted late with a 5% reduction in score for each day the assignment is late. One day late 5% reduction; two days late 10% reduction; and so forth. The grade of the assignment is rounded up to the nearest integer. Late submissions for other assignments will not be accepted. Assignments over a week late can not be submitted and a grade of zero will be earned.

Resubmissions for Homework and Lab Reports

For one homework assignment and one lab report (excluding the independent investigation lab report), you will be able to resubmit your work for a regrade. Once you receive your assignment back, you will have one week to resubmit. Your resubmission must include all work associated with the assignment and not just those parts that are incorrect. For homework resubmissions, you must include your original submission as well. No late assignments for resubmissions will be accepted. Any late penalties incurred on the original submission will also be incurred on the resubmission, thus if you had a 10% late penalty on your original submission, your resubmission will also incur this same 10% penalty. Your final grade for a resubmission will be the average of your original and resubmitted scores.

Make-up Lab Policy: Deadlines for assignments are firm and the above late penalties will be applied for late submissions. However, please let me know as soon as you can of any documented extended illness or family responsibilities that may impact your ability to keep up in the class, and we'll try to make a plan to keep you on track to succeed! There is a make up week for labs near the end of the semester.

Independent Investigation: Most of the semester, you'll be performing measurements and analysis which we prescribe for you, and for which the expected outcome is known. In contrast, you'll spend the last few weeks of the semester in uncharted waters, designing and carrying out an investigation on a topic of your own choosing. Elements of your independent investigation include:

Proposal. A few paragraphs addressing (1) what you want to do and why, and (2) how you plan to carry it out (both collection and analysis of data), and (3) equipment requirements (there will be an inventory of available equipment that you can use). You must work with a lab partner for your investigation though only one proposal needs to be submitted. The proposal itself will be submitted on BB. I'll discuss with you and your lab partner and offer written comments. (10% of independent investigation grade.)

Written report. Same as a regular lab report that you'd submit throughout the semester. (45% of independent investigation grade)

Presentation: 12 min presentation (10 min, 2 min for questions). Motivate the question you asked, describe how you designed your experiment, and summarize your results and analysis. Include any lessons learned that you might apply next time. (45% of independent investigation grade, evaluated by instructors and classmates)

Some general criteria: It doesn't matter how close you come to resolving the question you ask of nature – much more important is the process. Do you make a convincing case that your question is interesting and worthwhile? Do you make some use of the elements of planning measurements or data analysis that you've learned? Did you take advantage of feedback you received during planning? Do you show evidence that you've shared the work – taken the lead on some aspects, while checking on those aspects your partner has led?

Academic Integrity

All instances of academic misconduct will be addressed according to the UMBC Policy on [Academic Integrity](#). Examples include attempting to make use of disallowed materials on assignments, soliciting help by posting material on the internet for any assignment, looking at posted material from others online, altering graded work and submitting it for regrading, asking someone else to take an assignment in your place, copying another's work on an assignment, asking someone else to do an assignment and representing it as your own, permitting or assisting another student to carry out any of the above, or any other instance of academic misconduct. Penalties range from a grade of 0 on the assignment to an F in the course (at my discretion), and from denotation of academic misconduct on the transcript to expulsion (as determined by official hearing of the Academic Conduct Committee).

Accessibility and Disability Accommodations, Guidance and Resources

Accommodations for students with disabilities are provided for all students with a qualified disability under the Americans with Disabilities Act (ADA & ADAAA) 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 create equal access for students when barriers to participation exist in University courses, programs, or activities.

If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at sds.umbc.edu for registration information and office procedures.

SDS email: disAbility@umbc.edu

SDS phone: (410) 455-2459

If you will be using SDS approved accommodations in this class, please contact me (instructor) to discuss implementation of the accommodations. During remote instruction requirements due to COVID, communication and flexibility will be essential for success.

Sexual Assault, Sexual Harassment, and Gender Based Violence and Discrimination

UMBC's Policy on Sexual Misconduct, Sexual Harassment and Gender Discrimination and Federal Title IX law prohibit discrimination and harassment on the basis of sex in University programs and activities. Any student who is impacted by sexual harassment, sexual assault, domestic violence, dating violence, stalking, sexual exploitation, gender discrimination, pregnancy discrimination, gender-based harassment or retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources:

Mikhel A. Kushner, Title IX Coordinator (she/her/hers)

410-455-1250 (direct line), kushner@umbc.edu

You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community.

If you are interested in or thinking about making a report, please see the Online Reporting Form. Please note that, while University options to respond may be limited, there is an anonymous reporting option via the online form and every effort will be made to address concerns reported anonymously.

Spring 2022 Safety Protocols and Compliance Statement

UMBC has set clear expectations for masking while on campus that include the requirement that you must wear a KN95 face mask or equivalent that covers your nose and mouth in all classrooms regardless of your vaccination status. For information on masks equivalent to KN95s please click the following link: <https://covid19.umbc.edu/masks/>

This is to protect your health and safety as well as the health and safety of your classmates, instructor, and the university community. Anyone attending class without a KN95 mask or wearing one improperly will be asked by the instructor to put on a KN95 mask or fix their mask in the appropriate position. Any student that refuses to comply with this directive will be asked to leave the classroom immediately and failure to do so may result in the instructor requesting the assistance of the University Police. Students who refuse to wear KN95 masks may be referred to Student Conduct and Community Standards and may face disciplinary action for violations of the Code of Student Conduct, specifically, Rule 2: Behavior Which Jeopardizes the Health or Safety of Self or Others and Rule 16: Failure to Comply with the Request of a University Official. UMBC's on-campus safety protocols, including masking requirements, are subject to change in response to the evolving situation with Covid-19.

COURSE SCHEDULE

The schedule below is tentative and may be adjusted throughout the semester.

Week	Dates	Activity	Assignment
1	Feb 1 & 3	Course policies, uncertainties, error propagation, and data analysis	HW #1
2	Feb 8 & 10	Plotting, least squares fitting, data linearization	HW #2
3	Feb 15 & 17	Group A: 1. Atwood's machine Group B: 2. The Ballistic Pendulum	LR #1
4	Feb 22 & 24	Group A: 2. The Ballistic Pendulum Group B: 1. Atwood's machine	LR #2
5	March 1 & 3	Group A: 3. Simple Harmonic Motion Group B: 4. Angular Momentum	LR #3
6	March 8 & 10	Group A: 4. Angular Momentum Group B: 3. Simple Harmonic Motion	LR #4
7	March 15 & 17	Group A: 5. Velocity of Sound Group B: 6. Heat Capacity and Latent Heat	LR #5
8	March 29 & 31	Group A: 6. Heat Capacity and Latent Heat Group B: 5. Velocity of Sound	LR #6
9	April 5 & 7	Group A: 7. DC Circuits and Ohm's law Group B: 8. The Current Balance	LR #7
10	April 12 & 14	Group A: 8. The Current Balance Group B: 7. DC Circuits and Ohm's law	LR #8
11	April 19 & 21	Both Groups: 9. The Ratio of e/m for the Electron	LR #9 Independent Investigation Proposal
12	April 26 & 28	Independent Investigations Part I	
13	May 3 & 5	Independent Investigations Part II/ Makeup Lab	
14	May 10 & 12	Student Presentations	Independent Investigation Lab Report