# PHYS 122L: DRAFT SYLLABUS — Spring 2023

**Place and Time:**
Class — Tu 1:00-1:50 PM in Physics 226
Lab — Tu or Th 2-4:45 PM in Physics 110 (First two weeks in Physics 226)

**Instructor:** Dr. Cody Goolsby-Cole (cagc@umbc.edu)
**Office Hours**: M 12:10-1 PM; W 2-3 PM; Th 1-1:50 PM. Held in Physics Tutorial Center (Physics 226A). Also, feel free to stop by my office (Physics 323) anytime too.

**Teaching Assistant**: John Caporaletti (johnc3@umbc.edu)
**Office Hours**: MW 12-1 PM in Physics 110 and on BB Collaborate

**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:** Completion of PHYS 122(H) with C or higher or concurrent enrollment. You should also have a good working knowledge of equations and concepts from PHYS 121 & 122 as well as knowledge of calculus (derivatives & integrals), trigonometry, geometry, and algebra.

**Course Management**
I will use Blackboard to manage the course. Assignments, class slides, lab notes, and announcements will be posted on Blackboard as well as your grades. It is your responsibility to keep up to date with the course materials and announcements posted on Blackboard.

**Course Objectives:** The first two weeks 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:**

**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.

**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.

**Discord**: Discord allows for a continuous chat between students, TAs/LAs, and the instructor. Course announcements will also be posted on discord. Here is the link. Enter your full name (as listed on the official class roster) and student ID in the approval chat to gain access to the rest of the course. Your nickname must also be the same as that listed on the official class roster.

**Technology**: 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 & 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 |

Lowest pre-class quiz/class work is dropped. Combined there will be a total of 11 major assignments: 2 homeworks; 4 lab reports; and 5 analysis reports (this excludes the lab report for your independent investigation. All 11 assignments count equally and the best 10 of 11 will count toward your grade.

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 rare and exceptional cases and you must have a C or better in the course.

## 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 the reminder of the course*. Not completing the homeworks or doing poorly on them will leave you ill-prepared to achieve passing grades for the rest of the course.

Homework assignments are to be turned in by hand and are due at the beginning of lab 2 PM Tuesday or Thursday (depending on your registration) and <u>late submissions will not be accepted</u>. Your work must be either clearly and neatly handwritten or typed using a word processor. For a solution that requires calculations in Excel, include a printout of your spreadsheet with the main answer circled or highlighted. Everything on your spreadsheet should be clearly labeled so the grader can easily tell what each cell/column/row represents. For any calculations you perform in Excel, you must explicitly show the formula you are using.

You are encouraged to collaborate with your classmates, but eventually each student must have their own unique solutions and be able to explain their solutions to the instructor. You are forbidden from using any external sources except the instructor, TA, fellow classmates, and class notes.

### Pre-Class Quiz/Class Work

Each week you will have a Blackboard 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 questions yourself.

Class will take place in Physics 226 on Tuesdays from 1-1:50 PM and will help prepare you for that week's lab. 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 at 2 PM Tu or Th. (Note: for the first two weeks there will be no actual labs you'll perform, but we will still use the lab time and be in Physics 226). 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.)

LabArchives is where you will access the lab manual and your own lab notebook. You must record all your data, observations, calculations, and any variations from the standard procedure in your lab notebook. Before leaving lab you must have either the TA or instructor check your notebook and you must also pick up your lab station. 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 important data needed in your analysis.

**Lab Reports**

There will be a total of 5 lab reports due throughout the semester. 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 the instructor or the TA lab reports, they will be deleted.

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 Materials 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.

## Analysis Reports

For five labs instead of writing a full lab report, you will be submitting an analysis report which will include all the important elements of lab reports such as reporting data, discussion of results, and error analysis. The format is not as strict as the lab report and will be more like a series of questions you'll need to answer for each lab. More details on analysis reports will be provided.

## Late Submissions for Assignments

No late submissions will be accepted for homework assignments, in-class work/quizzes, or quizzes on Blackboard. One lab or analysis report (excluding the independent investigation lab report) can be submitted up to one week late with a 5% penalty for each full day late. In order to submit your report late, you must email Dr. G <u>before</u> it is due letting him know you'll be submitting it late. Failure to notify Dr. G means you can not submit your report late and you'll earn a zero. No other late submissions for lab reports or analysis reports will be accepted and a grade of zero will be earned if the report is not turned in on time.

**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. (5% of independent investigation grade.)

*Written report*. Same as a regular lab report that you'd submit throughout the semester. (50% 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](mailto: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.

# COURSE SCHEDULE

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

| Dates | Course Material/Lab | Assignment — Due Date |
|---|---|---|
| Week 1<br>Jan 31/Feb 2 | Course policies, uncertainties, error propagation, and data analysis | BB Syllabus Assessment — Tu 1 PM |
| Week 2<br>Feb 7/9 | Plotting, least squares fitting, data linearization | BB Pre-Class Quiz — Tu 1 PM<br>Homework 1 — Tu/Th 2 PM |
| Week 3<br>Feb 14/16 | Group A: Atwood's Machine (Lab Report)<br>Group B: Ballistic Pendulum (Analysis Report) | BB Pre-Class Quiz — Tu 1 PM<br>Homework 2 — Tu/Th 2 PM |
| Week 4<br>Feb 21/23 | Group A: Ballistic Pendulum (AR)<br>Group B: Atwood's Machine (LR) | BB Pre-Class Quiz — Tu 1 PM<br>Lab/Analysis Report — Tu/Th 2 PM |
| Week 5<br>Feb 28/Mar 2 | Group A: Angular Momentum (LR)<br>Group B: Simple Harmonic Motion (AR) | BB Pre-Class Quiz — Tu 1 PM<br>Lab/Analysis Report — Tu/Th 2 PM |
| Week 6<br>March 7/9 | Group A: Simple Harmonic Motion (AR)<br>Group B: Angular Momentum (LR) | BB Pre-Class Quiz — Tu 1 PM<br>Lab/Analysis Report — Tu/Th 2 PM |
| Week 7<br>March 14/16 | Group A: Heat Capacity and Latent Heat (LR)<br>Group B: Velocity of Sound (AR) | BB Pre-Class Quiz — Tu 1 PM<br>Lab/Analysis Report — Tu/Th 2 PM |
| Week 8<br>March 28/30 | Group A: Velocity of Sound (AR)<br>Group B: Heat Capacity and Latent Heat (LR) | BB Pre-Class Quiz — Tu 1 PM<br>Lab/Analysis Report — Tu/Th 2 PM |
| Week 9<br>April 4/6 | Group A: The Current Balance (LR)<br>Group B: DC Circuits and Ohm's Law (AR) | BB Pre-Class Quiz — Tu 1 PM<br>Lab/Analysis Report — Tu/Th 2 PM |
| Week 10<br>April 11/13 | Group A: DC Circuits and Ohm's Law (AR)<br>Group B: The Current Balance (LR) | BB Pre-Class Quiz — Tu 1 PM<br>Lab/Analysis Report — Tu/Th 2 PM |
| Week 11<br>April 18/20 | The Ratio of e/m for the Electron (AR) | Ind. Inv. Proposal — Monday<br>BB Pre-Class Quiz — Tu 1 PM<br>Lab/Analysis Report — Tu/Th 2 PM |
| Week 12<br>April 25/27 | Independent Investigations (Ind. Inv.) | Analysis Report — Tu/Th 2 PM |
| Week 13<br>May 2/4 | Make Up Lab/Independent Investigations | |
| Week 14<br>May 9/11 | Student Presentations | Ind. Inv. Presentation — Tu/Th 2 PM<br>Ind. Inv. Lab Report — May 16th |