PHYS 122L **Introductory Physics Laboratory** **FALL 2020**

DRAFT – SYLLABUS -- DRAFT

Place and Time:

Lecture: If used, I will post class videos online

Lab: Head synchronously on BB Collaborate, 2:00 – 4:45 pm, Tu **or** Th

Instructor: Dr. Cody Goolsby-Cole
Email: cagc@umbc.edu
Office Hours: By appointment; please feel free to email and we can set up a time

Teaching Assistant: Carson Evans
Email: cevans5@umbc.edu
Office Hours: Monday & Wednesday 12-1 PM

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.

Corequisite: You must complete PHYS 122 or PHYS 122H with a grade of C or higher or be concurrently enrolled in PHYS 122 or PHYS 122H.

I will assume that you have the Physics background provided by PHYS 121 and PHYS 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 Objectives: This is the first physics lab during your studies at UMBC. Therefore, there will be much emphasis on how to carry out and report a measurement, data evaluation, etc. Nevertheless, keep in mind that clear understanding of the principles involved is essential. Busy work without understanding is worthless.

Here is a formal list of objectives:

- 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 the proper methods of estimating and reporting errors. It is an integral part of every laboratory measurement. It is not the main purpose of the lab, but no lab report is complete without an estimation of the experimental error for every directly measured and derived quantity. Learn how to use error propagation and how to fit theoretical curves (usually straight lines) to measured data.
- 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. **Reliable computer, reliable internet, microphone, and webcam**: Since our course is online it will be vital that you have these technologies. A webcam is not required, but would greatly benefit you when working on labs so that you and your lab partner can see what each other are doing. You must also have a **computer** which runs either **Windows** (Windows 7 or higher) or a **Mac** (OSX 10.9 or higher) as the iOLab device software will only work on a computer with these operating systems.
2. **iOLab Device**: You will be using the iOlab device to carry out experiments on your own. These are pretty neat compact devices that have several different sensors build in. Associated software will enable you to see in real time your measurements and plots. You will only need to purchase the 4-month rental option which costs $54.99. You must have the device by the week of Sept 14. The link for the device is: https://store.macmillanlearning.com/us/product/iOLab-Version-2.0/p/1464101469?searchtext=iolab&ga=2.50040550.1765363233.1592228285-617191097.1583851974
3. **iOLab Manual:** The iOLab device has an associated manual which you'll need as well. You only need the 6-month rental option for the manual which is $44.99. You must have the manual by the week of Sept 14. The link for the manual is: https://store.macmillanlearning.com/us/product/iOLab-Experiments-for-Scientists-and-Engineers/p/1533919771
4. **iOLab Kits**: The labs themselves will require extra equipment in order to perform them. You will be able to pick them up on August 28 and August 31 from 10 AM - 1 PM. Find details in the course announcements.
5. **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.
6. **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.

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 Grade

2 homeworks, 100 points each	200
4 full lab reports, 100 points each	400
5 short lab reports, 80 points each	400
1 mini-lab presentation	50
Independent Investigation	100

I drop the lowest score from either a homework, full lab report, or results & analysis report which ever one gives you the best grade. With that, the achievable total is either 1050 or 1070 depending on what is dropped.

Grades will be assigned according to the following scale (with possible minor corrections):

A = 89.9% and above B = 89.9% to 79.9% C = 79.9% to 69.9%
D = 69.9% to 59.9% F = 59.9% or below

In principle, everyone can earn an A. I will not grade the class 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 C or better standing at the time of incapacitation.

Course Policies

Homework

Two homework assignments based on Ch. 0 of the LabPack and the first and second weeks of class and lab time. Find on BB under *Course Materials*. 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.

Working "in" the Lab

Lab will be held synchronously every week (Tu or Th 2:00-4:45 PM) on Blackboard Collaborate. Even though you will be working separately and everyone will be taking their own measurements, you will still be able to work with a lab partner. This way you can help one another out and bounce ideas off of each other.

Please be on time for lab; I will spend some time at the beginning of lab discussing some of the important aspects of that week's lab. Attendance is automatically recorded in Blackboard Collaborate and late penalties will be imposed if students are late.

You will need to submit all of your measurements and graphs by the end of the lab. For graphs produced on the iOLab software, you'll need to share it with the TA through the iOLab repository. You'll also want to make sure it is saved for yourself on the repository. If there are additional measurements you may need to upload those to BB.

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.

Full Lab Reports (FLR)

To receive full credit for a lab report, you must attend the lab, take data, submit measurements & graphs, and submit an electronic copy on BB of your written report within one week after you do the experiment (normally at the beginning of the next lab). DO NOT 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 report in the Lab Pack. 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.

Short Lab Reports (SLR)

Similar to the Full Lab Reports, but you don't have to include the theoretical principles and experimental procedures.

Mini-Lab Presentation

For one of the labs where you have to submit a Short Lab Report, you will also be making a short (max 5 minutes) presentation. These will take place during the first 10 minutes of lab the week following the experiment.

You and your lab partner will collaborate on the presentation which should be a summary of your results and analysis. A rubric for the presentations as well as more details will be provided later.

Late submissions for both homework and lab report will have their score reduced according to the formula:

$$\text{Final Score}(t) = \text{Original Score} * \exp(-0.1t)$$

where t equals the number of full or partial calendar days by which the assignment is late. (According to this formula, being late by one day means approximately 10% reduction and a one-week-late assignment receives approximately 50% credit. It is much less than full credit, but still much more than zero! You can hurt your grade the most by not turning in an assignment. The saying "better late then never" is valid.) The grade of the assignment is rounded up to the nearest integer.

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!

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. Also include a rationale if you propose a solo project or to work with a group of three. Will be submitted on BB. I'll discuss with you and offer written comments. (20% of independent investigation grade.)

Written report. Typewritten, a few paragraphs including (1) a summary of what you proposed, what you carried out, and key results; and (2) a reflection on the process (did you learn something about experimental physics? the nature of science?) (20% 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.(60% of independent investigation grade, evaluated by instructors and classmates)

Some general criteria: It doesn't matter how close you come to some 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?

Disabilities

If you have any condition such as a physical or learning disability, which will make it difficult for you to carry out the work as described or which will require academic accommodations, please notify me ASAP, but definitely during the first two weeks of classes.

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 could result in disciplinary action that may include, but is not limited to, suspension or dismissal." More on the requirements of academic integrity can be found at http://www.umbc.edu/gradschool/procedures/integrity.html

COURSE CHEDULE

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

Week	Dates	Activity	Assignment
1	Aug 27	No lab	
2	Sept 1 & 3	Class 1: course policies, data collection and analysis, errors, Continued in lab.	HW#1
3	Sept 8 & 10	Class 2: More on data analysis, Excel, making plots Continued in lab.	HW#2
4	Sept 15 & 17	Lab 1: iOLab Orientation | Linear Kinematics	SLR #1
5	Sept 22 & 24	Lab 2: Force and Acceleration | The Force of Friction	FLR #1
6	Sept 29 & Oct 1	Lab 3: Circular Motion Lab | Hooke's Law	SLR #2
7	Oct 6 & 8	Lab 4: Momentum and Energy | The Simple Pendulum	FLR #2
8	Oct 13 & 15	Lab 5: Breadboard | Ohm's Law	SLR #3
9	Oct 20 & 22	Lab 6: Kirchoff's Law | RC Circuits	FLR #3
10	Oct 27 & 29	Lab 7: Electric Field Plotting	SLR #4
11	Nov 3 & 5	Lab 8: Magnetic Force | Magnetic Field	FLR #4
12	Nov 10 & 12	Lab 9: Faraday's Law	SLR #5
13	Nov 17 & 19	Designing your own Lab	
14	Nov 24 & 26	No meetings	
15	Dec 1 & 3	Student Presentations	