PH424 Spring 2023 Manuscript Preparation Guidelines

No formal template is provided because there is no one set way to write a formal lab report (i.e. a scientific paper/manuscript). You've had good exposure in PH411; those guidelines generally hold well in 424,
(http://physics.oregonstate.edu/ mcintyre/COURSES/ph411/ph411labwriteup.pdf).
But please also read this guide and ask questions early!

The story: We are aiming for an intelligent scientific story. You can choose your favorite way to organize, but the guidelines below are tried and true. A good report is like an essay with sub-headings with insightful figures & equations added in. Declare victory (the experiment taught you something!) and discuss the significance of what you have done. You need to write good prose, valid (numbered) equations, and to pay attention to clarity. Be succinct, but make sure you explain clearly and demonstrate steps in important derivations.

The audience: Your audience is incoming juniors majoring in physics who do not know the experiment or the model, but are trained in introductory physics. Your audience is NOT the instructors! Imagine you had to hand this report to your boss (and believe me, your boss often does not know the specifics of the science as well as you do, so is in many ways like the incoming students!). Would the boss appreciate and understand the discoveries and conclusions of your experiments? Would the boss be excited about your work and your your ability to do science, and hence recommend that your work be continued?

Guidelines:

1. **Thoughtful title!** What did you find out? What's interesting?
2. **Abstract:** A short description of what you learned and the significance. It should be accessible to a broader audience than the report itself.
3. **Introduction:** State the goal of your experiments. What are you are trying to establish with your measurements? Why is this experiment important? What are applications? Who will care?
4. **Theoretical model:** discuss and present your theoretical model. Do not rederive, but select the critical steps. More details can be presented in an appendix, if you like.
5. **Methods:** Briefly describe the experiment you did, including an informative circuit diagram. Include separate sketches of the oscilloscope trace(s) at interesting frequencies. [Points are assigned for correct results and for your ability to put your discussion in a sensible, clear and logical fashion.] Mention critical steps, but remember to define variables and constants. Methods should never read like a lab manual.
6. **Presentation of results:** You'll want at least 3 data figures (graphs); possibly more. The quality of your captioned figures is absolutely critical. Describe your results so that your audience understands what is in the figures. Tell them what to look for and what they should be noting. You'll need a table of your raw measurements to determine amplitude and phase and the conversions you made. You can plot the results for amplitude and phase of the resulting response in a graph, too.

7. **Discussion & Assessment:** Is your model a reasonable one for the physical system? Are the main features present? Do the details agree? How might you modify the model to more accurately reproduce the data? What physics was learned? Why are your results important in a grander scheme?

8. **Conclusions/Summary** (be positive, what was the main message, declare victory!) Write a short summary (<200 words) that summarizes the results of the experiment, the modeling that you did, and the validity of the model. Be positive, summarize the main message, declare victory!

9. **References & Acknowledgements** (textbooks, science literature papers) at least 2+, avoid Wikipedia, go to the source.

FAQ:

QUESTION: How do I get started writing a scientific manuscript?
ANSWER: You always start a scientific manuscript by making carefully-prepared, insightful and information-dense figures with captions. Modern manuscripts of experimental science revolve around the figures; the purpose of your text is to support the scientific story that should be self-evident from the figure and captions alone. I read or review scientific manuscripts daily and I cannot remember the last time I have read a paper from start to finish (like a book). Scientists will read (i) figures, (ii) abstract and concluding paragraphs, (iii). introduction and scientific model. If you can't get a a believable scientific message from those three areas, the paper will be rejected. For the LRC Resonance manuscript you'll need 3-5 figures (more if you think they are necessary). Long tables have no place in any scientific manuscript, but can be put in an optional appendix).

QUESTION: How long is a scientific manuscript?
ANSWER: Don't let the word manuscript scare you! Brevity tends to make the better paper. We routinely give out the same high (or low) grades to the 8-page and 35-page paper. Making a short manuscript is difficult. Especially on your first attempt, it is better include rather than exclude. When in doubt, ask for help, because irrelevant inclusions do negatively impact the paper. Fundamentally, a scientific manuscript and a 'lab report' are the same thing. We use the word 'manuscript' because your experiment is complex and involves theory/data simulation; you can now tell a deep and compelling story. Imagine you were the first person to discover a that a LRC circuit resonates - how would you communicate and prove your ground-breaking discovery?

QUESTION: How should I format a scientific manuscript?
ANSWER: 1.5 or double spaced with 11 or 12-point font is best. We will not give you extra points for using TeX or making it look publication ready (but you won't penalized either). All real journals have editorial production staff, who do ALL the formatting once the paper passes the scientific review process. Your job is to make the figures good and make the layout reasonable. All manuscripts have labeled sections for Abstract and References. Section headings for Introduction, Methods, Discussions and Conclusions (2-3 paragraphs max) are encouraged to help you organize your thought, but they are not required. Use as many or as few section headings as you need to tell a convincing scientific story. I recommend more section-headings if you find yourself struggling (just be sure to look at the paper holistically afterwards).

QUESTION: Can't you just give me a template and tell me what you want?
ANSWER: In short, no! Organizing your text and figures well is the greatest challenge. Now that you've written 'lab reports' in other classes, we are now asking you to do this organizational thinking! Scientific writing is a complex, creative and abstract process; the best template is the one that sells your scientific message clearly and succinctly. In the real world, there exist no such templates; you will expected to choose how to communicate your science best. That being said, I did provide a basic template on the course web-page for those who need it. You can also use the template from previous courses such as PH411 too. Also examine some physics journals (Phys Rev B, American Journal of Physics, Nature Physics), how do they organize it? Any of these templates can be successful; it is the content and 'scientifiic story' that matters.

QUESTION: How can you possibly expect us to write a scientific-paper quality manuscript?
ANSWER: I don't!!! I have been working at writing scientific manuscripts for many years, and I still have to work at it! Real manuscripts (even 4-page ones) can take months to write and involve lots of outside help. Still, as physicists, preparing a 1st draft manuscript on your science will likely be expected of you in the workplace or by your advisor in graduate school. The goal here is to get your feet wet, and begin to move beyond the cookie-cutter 'lab report' models and templates you may have encountered in lower-division courses or in high-school.

If you really want a template, here's one possibility. But you can organize in other ways.

Title (make it informative)
Ima Student *
Department of Physics
Oregon State University, Corvallis OR.
Date:

ABSTRACT

Write an abstract of about 100 words that states succinctly what you investigated and THE RESULTS of your experiment. (You are not writing a novel, but if you were, the abstract would tell you who the thief was.) You should include words that colleagues might use in a search.

* When you put your name on a piece of scientific work, you are implicitly making the following affirmation:

I promise that what is reported here is a true account of the results obtained in my experiment. I have upheld the highest standards of scientific integrity in recording and reporting the truth. I further promise that this is my own work, except as explicitly stated in the acknowledgment section. I have not included the work of any others without proper attribution. Any sources such as texts or internet articles are explicitly quoted in the reference/bibliography section. Any information I have gained from these acknowledged sources has been studied carefully and internalized and reported in my own words so that it reflects my own understanding and interpretation.

This is just as important an issue as it ever has been, and the scientific community suffers greatly when fraud, plagiarism, piracy, theft of intellectual property is tolerated. As scientists and future leaders of science, you must think such issues in your own work.

INTRODUCTION
*Always start out with **what** was done ("this report describes ...") and why. The motivation might be an explicit hypothesis that is to be tested, or to test a model, or an exploratory study.*

THEORETICAL MODEL
Present the theoretical model that you think describes the system. You should describe clearly and succinctly, remembering your audience. Use equations (numbered and properly punctuated to be part of the text), showing important steps, but not rederiving all the work from class. (You can put derivations in the appendix, if you like, and those can be scanned copies of handwritten work - supplementary information is not held to the same standards as the main text). Graphs are very important in this section - equations don't "speak" to people in the same way.

EXPERIMENTAL METHODS
(a) Description of the apparatus
(b) Data acquisition procedure
A brief description of the apparatus and how you acquired data is important. You have to convince people that understand your equipment and know how to use it. You must convince readers that your

method is valid and give them enough information to repeat the experiment, but not long lists of detail. You measured voltages and phase shifts, so show some graphs of the data in different frequency ranges. Illustrate how you made your voltage measurements (peak-to-peak? Zero to peak? How did you measure the phase shift? No report is complete without a detailed, clear illustrations. Every figure must have a label and a caption. Every figure must be referred to in the text.
Figure 1. Diagram of the circuit. *(Make caption informative)* Figure 2, 3, 4 ... Oscilloscope traces *(make the caption informative so that the figure stands alone).*

RESULTS
Present and describe your results. A table is likely to be helpful. It should have good headings, units. Be careful to display the appropriate number of significant figures. It you quote a voltage of 2.325 V, you imply that that you believe the voltage is accurate to 1 or digits in the last figure. Check significant figures on recorded and calculated quantities. Table 1. Frequency, voltages, times, phases etc. (make the caption informative so that the table stands alone). *Every table must have a label and a caption. Every table must be referred to in the text.*

DISCUSSION AND ASSESSMENT
Compare the measurements to the predictions of the model. In this particular lab, it is particularly powerful to present your assessment graphically as well as verbally. What features of the model are observed? Are there features or details that do not agree? Can you suggest refinements to the model that might predict the data better?

SUMMARY AND CONCLUSIONS
Many statements in the summary will have been made in previous parts of the report, particularly in the assessment. In the summary is to provide an overview and a strong conclusion. Look for consequences of the successes, and note loose ends that may need further work. This is a good time to reassess your abstract and see whether the results of the experiment are reported in the abstract.

ACKNOWLEDGEMENTS
The measurements were taken in a group including Jane Smith, José Sanchez, and Dr. Wei-Min Wu. Note how full names are given. Professional courtesy demands that you identify your colleagues appropriately. Helpful comments were provided in conversations with Jane Smith, who suggested the particular style of presenting the data. The photograph on page x was taken by José Sanchez. Prof. Bohr's help improved my understanding of numerical integration. Note that all you present in this report is assumed to be entirely your own work unless you state otherwise here. Be sure to honestly credit others. Your raw data are certain to be identical to that of others in your group, but all analysis MUST be independent, especially including spreadsheet and computer analysis. Discuss your analysis with others, and exchange ideas, but do not work together to produce the same graphs.

REFERENCES
References may contain general sources, including lecture notes and texts. Be specific about the pages you consulted. If very specific information is referenced, make sure that is indicated at the relevant place in the report.

Word, R.C; Bodegom, E.; Honohan, I., "Using the Vernier LabPro as an Ohmmeter and Multimeter", The Physics Teacher 42, 436 (2004).

APPENDICES (Supplementary material)
Supplementary material is not held to the same standards of formatting as the text, so even scanned handwritten notes would be OK. Make sure that different topics are in different appendices.

Appendix A: Table of complete data if your table is too long for the text (though 10 or so representative frequencies with the associated data would be great in your report proper).

Appendix B: Maybe a more detailed derivations if you've worked hard on those?