PHYS-3203 Class Project Instructions

You will carry out a project involving both analytical and/or numerical calculations and write up your results in an article style. This project will address some topic in classical mechanics that we have not had time to discuss in detail in class. Your project should involve in some way a concept that we have studied this term (such as Lagrangian or Hamiltonian mechanics, coupled oscillators, special relativity, etc).

At a minimum, I expect that these projects should require time and effort equivalent to approximately two weeks worth of homework assignments, and the written report should be at least 5 pages (including title information, abstract, and bibliography). You are, of course, free to spend as much time and effort as you like, as well as to write a longer paper. Your project may have a numerical component (using software such as Maple, Mathematica, python, C++, etc); in that case, you must include your code as an appendix.

You may work in groups, as discussed below. You must have me approve the topic of your project via email by **17 March 2021**, and the reports are due at **10:59PM on 9 April 2021** by upload to `https://uwcloud.uwinnipeg.ca/s/T6ykcP988pa3kpG` (this is the usual homework upload link). **This project is worth 15% of your final course grade.**

Please send me an email if you have any questions; I am happy to meet on zoom to discuss your project.

Group Work

You are allowed and encouraged to work in groups of up to three students. In this case, the total effort (not necessarily the total length of the report) should increase accordingly; that is, the project from a group of three students should represent three times as much effort as an individual student's project. Furthermore, in addition to a single written report from the group, I will require a statement from each student in the group regarding the contributions of each group member to the project. In other words, students A, B, and C working in a group should each submit a statement indicating that student A did $X\%$ of the work on calculation Y and wrote all of the corresponding section of the paper, etc.

Report Format and Outline

One goal of this project is to give you experience in writing a physics article in the style expected for a research journal since writing technical reports is a requirement of many jobs, not just in academia.

The article must be typed. Ideally, they should be written in LaTeX; if that is not possible, then a Microsoft Word or similar document (saved as PDF) is permissible but **only** if you use an equation editor for all mathematics. I can provide a LaTeX template on request. You also **must** have a bibliography with references cited by number in the text. The bibliography should be ordered in the order references are cited.

Your report should cover all the information described here. You may use these section headingss or organize the article as seems logical to you, but it should be sectioned in some way.

- **Title Material**: The beginning of the article should give a title, a list of authors, and a short abstract giving a brief description of the project and summary of the results in a few sentences.

- **Introduction**: Describe the problem you are studying and why it is important. Review and cite any references you have read about the problem *in your own words.* Indicate what the results will be.

- **Methods**: Describe the equations that you will need to solve and the methods you will use to solve them. These should involve both your analytical approach or approximation methods (such as approximating a potential near its minimum as a harmonic oscillator) and possibly how you set up the problem for solution on a computer. It is likely that most of your typeset formulae will appear in this section.

- **Results**: Present both your analytic and any numeric/computational results. This will include formulae for analytic solutions and some representation of numerical solutions. Plots are recommended for computational results. A separate results section is most common for projects with a computational component.

- **Discussion**: Discuss the conclusions of your project in the context of the problem you wanted to solve and related questions in physics. Make sure you relate back what you discussed in the introduction.

Evaluation
Marks for the class project will be based on the following distribution:

- **Topic/Plans**: 10%
  You must have your topic approved (via email) by **17 March 2021**. This includes identifying any group working together. You will automatically receive these marks if your topic is approved on time.

- **Effort**: 20%
  Does the project show evidence of sufficient effort (ie, equivalent to 2 homework assignments per student in the group)?

- **Format**: 10%
  Are the title material and abstract laid out correctly? Is the format of the article including bibliography correct? Is it logically laid out? Is mathematics properly formatted in LaTeX or an equation editor?

- **Discussion of Problem**: 20%
  Is the problem discussed in the article described clearly in the abstract and in an introduction in the main body of the paper? Do you refer to it in some concluding section? Do you explain how the problem relates to a broader context in physics?

- **Discussion of Methods**: 20%
  Is there sufficient mathematical analysis to solve the problem? Is it explained clearly? Are the techniques you use, including computational ones, understandable?

- **Discussion of Results**: 20%
  Are results explained thoroughly? If plots are appropriate, are they labeled completely, captioned, and described in the main text? Have you considered enough angles of the problem?

Typically, if the work is divided reasonably equitably, all students in a group will receive the same marks. However, if student responses indicate that the workload was distributed in a highly uneven manner, I reserve the right to adjust grades as appropriate.

Suggested Topics

The textbooks for the course include material we likely will not cover in our lectures, and you should now have the tools you need to cover any of those. For example, you could look at rolling wheels, elastic membranes and solids, fluids, electromagnetic fields, or basic ideas in general relativity. Remember that I must approve your topic choice at an in-person meeting by **March 17**.