Conservation Laws and Newtonian Mechanics — Preliminary Syllabus

Short Course Title: Classical Mechanics

Fall 2025, Deep Springs College, ***Prof. Brian Hill***

Overview

Our essential goal in one semester will be to understand Newtonian physics, but with a modern perspective. The course will use calculus (mostly derivative calculus but also some integral calculus for mass distributions), but I will provide reminders for the calculus results as we use them, so don't be disuaded if your calculus is rusty.

For Part I of this course to be a transferrable, and to be a thorough preparation for what might be your second semester of college-level introductory physics elsewhere, we cannot completely depart from what is standard. On the other hand, we certainly don't have to mimic any particular methodology for covering the standard material, and we will be taking a modern approach.

We will begin the semester with a study of the major conservation laws. These can be viewed as a consequence of Newtonian mechanics, but as physics progressed into the 20th century, and relativity and quantum mechanics theories were developed, the conservation laws survived fully intact even as the limits of Newtonian mechanics were discovered. It therefore makes sense to begin with the conservation laws and then in the second half of the semester, we will see Newtonian mechanics as the first example of a theory that obeys the conservation laws.

Text and Unit Outline

There is an endless supply of textbooks with roots going so far back (e.g., Sears, *Principles of Physics,* 1944) that it is hard to think of even their most recent incarnations as modern. The traditional sequence is thoroughly-tested and internationally-recognized, but we will be going a slightly different direction. To have the modern approach that I advertised above and in the course proposal, we will use two volumes from a new and ambitious textbook series created by Thomas Moore at Pomona College:

- ***Six Ideas that Shaped Physics*, 4th Edition, Volumes C and N** for Terms 2 and 3, respectively

By the end of the fall semester, we will have covered the same material as is usually covered in the first semester of a many-semester physics sequence, but with a different organization and emphasis.

Grading and Homework

- 30% homework
- 20% for each of three exams (totaling 60%)
- 10% thorough preparation for class and leadership of course

There will be a new homework and a homework solution for almost every class, and accumulating and reviewing them will be valuable. To be organized, I recommend locating a three-ring binder and having access to a working three-ring hole punch.

Assignments must be on standard 8 1/2 x 11 paper, without tears. Multi-page assignments should be stapled. Corrections should be erased (if done in pencil) or recopied (if done in pen). To make quality diagrams and graphs, you will very often need a ruler. The nicest technical work is facilitated by engineering pads: **Roaring Spring Engineering Pad at Amazon**. Engineering pads have gotten silly expensive if you buy them one at a time, so perhaps you will organize a group order. Engineering paper is only meant to be used on one side. The dark graph markings on the reverse are designed to subtly show through to the front side.

Absences and Late Work

The College's policies on absences and late work are applicable except that I don't require as much advance notice as is specified in the Deep Springs Handbook: specifically, one day's advance notice of an absence (or a need to turn in late work) is acceptable for our class. See the Deep Springs Handbook for additional details.

To say the same thing more colloquially, don't wait until after dinner the day before something is due to get started and realize that you are in over your head. Instead, start on work two evenings in advance. This is because the mind needs time to adapt to each new idea that is introduced. If it did not need time, we'd just cover the whole subject of classical mechanics in a week or so. It really does not take very long to write down all the foundational formulas, including all the results that we will derive from them.