Physics 316
Intermediate Mechanics

Spring Term, 2016
Lecture MWF 09:20AM - 10:30AM, Kroehler Science Center, Room 214
Laboratory, Wednesday 01:30PM - 03:20PM, Carnegie Hall, Room 210

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Course Description: This term, we will tackle a variety of topics that we collectively call *intermediate mechanics*. For much of the term, the topics will be familiar to you or you have been introduced to the topics previously: forces and potentials, kinematics and dynamics, momentum, rotational physics, oscillations and orbits. However, we will be expanding on these topics, introducing further rigor, as well as developing a strong computational foundation for treating these and other topics, and, finally, introducing a few (likely) new topics including the variational principle and Langrangian mechanics. In short, we return to the study of classical Newtonian mechanics that we began in PHY 141 (and a bit of PHY 142) to examine the classical description of how things move and interact under the influence of forces. We do so now equipped with a more sophisticated array of mathematical tools. In addition to additional mathematical depth, we will also add conceptual depth and develop computational tools and methods.

Course Goals: This course represents the completion of your introduction to physics. We have three main goals 1.) Develop concepts in classical mechanics with mathematical and analytical rigor to solve real work problems. 2.) Develop elements of computational techniques that help to facilitate goal (1). 3.) Continue our quest to be better scholars by developing our problem solving, project management and communication skills.

If you are pursuing a course of study in engineering, this class will serve as your vector mechanics course and (along with Vector Statics – PHY 315) will prepare you for further study in all areas of engineering. If you are pursuing a course of study in physics, this class serves as the prerequisite for PHY 416 (Advanced Mechanics), in which you will learn about more sophisticated treatments of classical mechanics such as the formalisms of LaGrange and Hamilton.

On the use of mathematics: I need only quote the great man:

"To those who do not know mathematics it is difficult to get across a real feeling as to the beauty, the deepest beauty, of nature... If you want to learn about nature, to appreciate nature, it is necessary to understand the language that she speaks in."
—*Richard Feynman (The Character of Physical Law (1965) Ch. 2)*

Required Text: *Classical Mechanics, 1st ed.* John R. Taylor (University Science Books, 2005).
ISBN-13: 978-1891389221; ISBN-10: 189138922X

Other Texts:

- **Classical Mechanics: A Modern Perspective**, Barger and Olsen
- **The Feynman Lectures on Physics, Volume I**, R. Feynman, R. Leighton, and M. Sands
- **Classical Dynamics of Particles and Systems**, Thornton and Marion
- **Vector Mechanics**, Beer, Johnson, and Clausen

Course Elements

- **Problems** are assigned regularly throughout the term and due dates will be provided. Problems should be neatly written with complete solutions and explanations of your work. Generally, you should outline your approach at the beginning of the solution and offer interpretation and or observations concerning the result of the calculation. Students are encouraged to collaborate, however, each student's solution must be his or her own. The problems will facilitate your learning in this course and need to be done in a timely fashion. In order to incentivize prompt completion of problem sets I reserve the right to penalize for late assignments.

- There will be **one midterm exam** and **a comprehensive final exam** during the course. You will be expected to complete the exams on your own. Details of the format and coverage will be provided during the course.

- There is a dedicated **computational laboratory** in this course. You will be expected not only to show up to the laboratory but you will be asked to utilize things you learn in the laboratory "experiments" in other aspects of the course. We'll be working mostly in the language *Octave* which is available all over campus and can be downloaded for free. The computational experiments are designed to be completed in the 2-hr period but may require outside that time to complete.

- Your will be required to **present at least one problem solution** in class. These will be short presentations but effective ones of your solution to an assigned problem. Presentations should be rehearsed and solutions should be checked with the instructor prior to class. Grades will be based on the effectiveness of the presentation style as well as the quality, completeness and correctness of the solution. Presentation media can (and often should!) be used but must be effective.

- **Participation and attendance** during class and laboratory is mandatory. While class won't provide everything you need for the course, it's a time for discussion and development of key ideas. Please show up on time. We're a small course and it's a distraction when students don't show up or show up late. Because I feel so strongly that attendance facilitates learning I've given you the opportunity to enhance your grade by simply being in class and asking good questions. Of course, the reverse of that last statement logically follows.

Grading Policy:
You will earn a grade in this class based on the following weightings:

- Problem Sets 30%
- Midterm 20%
- Problem Presentation(s) 5%
- Prompt Attendance/Participation 5%
- Laboratory 20%
- Final 20%

Office Hours (Tentative):
My schedule for the term is posted outside my office door and is subject to change. I'll make a point to be in my office during the following periods with the expressed purpose of discussing physics related questions:

- Monday, 1pm-2pm
- Tuesday, 8am-10am
- Wednesday, 10:30am-12pm
- Thursday, 2pm-4pm
- Friday, 10:30am-12pm

Look at my schedule- I have additional flexible time that I'm happy to meet with you to talk physics. Office hours are first come first serve, but other times can be arranged by appointment.

Honor Code

Each student is expected to present his or her own work; however, you are encouraged to work together on the assignments. You should write up your own assignments, but working with classmates to solve problems can be a valuable learning aid. Two ground rules. First, working together is most effective if all individuals contribute more or less equally to the group effort. You should be very wary if you are always on the giving or the receiving end in such effort. Second, when you receive significant assistance through conversation with a colleague, I ask you to follow common scientific courtesy and acknowledge that help briefly in your submitted work.