Syllabus for Physics 310: Classical Mechanics, Spring '08

Basic information:

•**Course prerequisites:** passing grades in PHYS 212 and in MATH 234 or its equivalent. If you do not meet these prerequisites and haven't talked to me yet, please see me soon!

•**Instructor:** Ms. Yumi Ijiri
Wright 216 office/017 lab
Phone: 775-6484
Email: yumi.ijiri@oberlin.edu

•**Class hours and location:** 11:00-11.50 am, MWF in Wright 209.

•**Extra session:** Tentatively scheduled for Wednesday evening beginning some time around 7 or 8 pm. This is an extended time to discuss strategies for the problem sets, work on issues with Mathematica and the like.

•**Office hours:** Tentatively one scheduled for Thursday at 11 am and a second hour to be determined based on schedules.

•**Course website:** Information about assignments and the like will be available on the course website on Blackboard.

•**Textbook:** The required textbook for this class is *Classical Mechanics,* by John Taylor (author of the PHYS 212 lab book on error analysis). See also a list of books placed on reserve for PHYS 310 for additional help with this material.

•**Software:** Because of Oberlin's site license, you are entitled to have a free copy of Mathematica on your own computer. To get the installation disk, contact Melinda Keller in Room W206. Mathematica is also installed on campus computer labs, particularly those within the department. Note: declared physics majors are allowed to have a dept. key which allows you off-hour access to dept. computers. The course website on Blackboard has additional information about Mathematica.

•**Evaluation:** Grading will be based on the following:

Problem sets	30%
In-class presentation and class participation	10%
1st take home exam (Mar. 7th -10th)	20%
2nd take home exam (Apr. 11th- 14th)	20%
Final Exam (due Thurs. May 15th at 7 pm)	20%

I will drop your lowest homework score.

Detailed description:

•**Objectives:** In this course, we will explore classical mechanics in further detail, specifically how to treat fundamental concepts such as force, energy, and momentum in the context of more complex systems. To do so, we will make use of mathematical techniques you have learned elsewhere as well as those introduced in the course itself. You will also gain some exposure to computational methods using a very powerful program called Mathematica. Some of the topics for this class, such as chaos and nonlinear dynamics, are areas of active physics research. Others, such as Hamiltonian and Lagrangian approaches, have wide applicability throughout advanced physics. In short, this course serves as a gateway to a variety of different topics.

In summary, then, the specific objectives of the course are as follows:

1) increase your knowledge and understanding of concepts such as force, energy, momentum, and angular momentum as applied to more realistic problems
2) increase your mathematical and computational sophistication
3) increase your knowledge of the techniques and methods of use to “modern” physicists

•**Course design:** This course emphasizes problem solving in the belief that "you learn by doing" and that you can't really understand some concept unless you can apply it and discuss it. With this in mind, the course has several important features:

1. Problem sets: Each Friday, a problem set will be due **at the start of class**. **Late homework will not be accepted unless prearranged and then only for rather good reasons (i.e. sick, illness in the family…)** As you’ve probably figured out by now, it is very important to keep on top of the material. You are encouraged to talk and work with others about the problems, especially after you've made a first attempt at them by yourself. The final writeup, however, should be yours completely--and in it, you should name your collaborators or sources you've used, as well as write and sign the honor code “I affirm that I have adhered to the honor code in this assignment.”

2. In-class presentation and class participation: Throughout the course, I encourage you to ask questions about the material. At the end of the semester, with another student, you will be asked to give a ~15-20 minute oral presentation concerning a specific issue in classical mechanics, with up to 5 minutes for questions. You and your partner should prepare a worksheet which summarizes the calculations/derivations involved in your presentation. The topic is of your choosing, but it must relate to classical mechanics and have at least one appropriate published reference. Further details and topic ideas will be given later in the semester. The presentation should give you an opportunity to investigate classical mechanics as applied to something more modern (and even publishable!) as well as to improve on your speaking skills.

3. Exams: There will be three exams for this class--two during the semester and one final exam. Each will be two hours in length. The two during the semester will be take home exams (Mar. 7th -10th and Apr. 11th- 14th for the second), while the third is due at the start of the scheduled exam period, Thurs. May 15th 7 pm. The exams may be longer in length than you may be used to, but this is to ensure enough time for you to do your best effort. For each exam, you will work alone, using your textbook, your notes, and homework solutions (yours and mine). You must write and sign the honor code: "I affirm that I have adhered to the honor code in this assignment."

•**Course topics**: A tentative list of topics and the schedule is given below:

Dates	**Topics**	**Comments**
Feb. 4,6,8	**CH 1, 2.** Newton's laws, math review/Projectile motion	
Feb. 11,13,15	**CH 2, 3.** More motion, charged particles/Momentum (linear and angular)	
Feb. 18,20,22	**CH 4.** Work-energy	
Feb. 25,27,29	**CH 5.** Oscillations	
Mar. 3,5,7	**CH 5, 6.** Fourier series/Calc. of variations	EXAM 1
Mar. 10,12,14	**CH 7.** Lagrangian methods	
Mar. 17,19,21	**CH 8.** Two body problems and Kepler orbits	
	Spring break	
Mar.31, Apr. 2,4	**CH 9.** Noninertial reference frames	
Apr. 7,9,11	**CH 10.** Inertia tensor and rotational motion of rigid bodies	EXAM 2
Apr. 14,16,18	**CH 11.** Coupled oscillators	
Apr. 21,23,25	**CH 12.** Chaos	
Apr. 28,30,May 2	**CH 14.** Collision theory	
May 5,7,9	**In class presentations**	
May 15	**FINAL due by 7 pm outside my office**	

•**Other information:** If you are a student with a learning disability or other special needs, I encourage you to talk with me early in the semester about the course. We may need some advance notice to work with Jane Boomer in Student Academic Services to assure that the proper paperwork is in place so that necessary accommodations can be made.

•**Additional resources:** I encourage you to look for other references that will explain the material in a better fashion for you. Below are other texts, the majority will be placed on reserve in the science library.

At the course level:
-Baierlein, Newtonian Dynamics (Used in 1990. Not loved, but some students liked its style.)
-Barger and Olsson, Classical Mechanics (Considers lots of real world problems: superball, archery. May give you some project ideas.)
-Marion and Thornton (or just Thornton), Classical dynamics of particles and systems (the old text, used before Taylor's book came out--not so popular either!)

More introductory:
-Feynman, Lectures on Physics, Vol I. (Lots of gems throughout. Chaps 1-25 are directly relevant.)
-Halliday, Resnick, Walker, Fundamentals of Physics (You might want to refer to your old standby!)
-Kleppner and Kolnikov, Introduction to Mechanics (An introductory text, but a good one. Lots of good examples and problems.)

More advanced: (so you know…)
-Goldstein, Classical Mechanics (Excellent graduate text.)
-Landau and Lifshitz, Mechanics (Another classic graduate text, like Goldstein. The first volume of a series covering all of physics at a very high level. Difficult, penetrating, and rewarding. Be warned that the authors make intentional small errors.)
-Symon, Mechanics (A solid but stuffy book, written in 1953 and still going strong. Above the level of this course.)

Other topics:
-Jammer, Concepts of Force (Philosophically oriented history of classical mechanics. Interesting despite many errors.)
-Lindsay and Margenau, Foundations of Physics (Philosophically oriented treatment of classical mechanics.)
-Mach, The Science of Mechanics (A discussion of the underlying foundations of mechanics and an intriguing history of the subject.)

Mathematica books:
-Don, Mathematica (available online--see the BB link)
-Wolfram, The Mathematica book
-Zimmerman, Mathematica for physics