Course Information

Course: PHYS 331 Fall 2014
Advanced Classical Mechanics

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Classes: MWF 9 – 10 am Olin 264

Office Hours: TR 2 – 3 pm, and by appointment

Text: John R. Taylor, *Classical Mechanics*, University Science Books, Sausalito 2005.

Webpage: http://www.eg.bucknell.edu/~kvollmay/phys331_f2014/

Objectives: Mechanics describes the motion of systems ranging from elementary particles up to for example planets in the cosmos. Classical mechanics provides the basis for all areas in theoretical physics including quantum mechanics, statistical mechanics and fluid mechanics.

Starting with Galileo and Newton in the seventeenth century classical mechanics is one of the oldest branches of physics. In the eighteenth and nineteenth century Lagrange and Hamilton reformulated elegantly Newton's equations making the solution to more complicated problems feasible. A few decades ago classical mechanics was revitalized with the still evolving field of nonlinear dynamics. The recent rapid development of computers enable the solution of a vast variety of applications of classical mechanics resulting in active fields such as nonlinear dynamics, soft and condensed matter and astronomy.

In this course we start with a short review of classical mechanics as you have seen it in PHYS 211 and PHYS 221. We then go beyond Newton's mechanics developing so called variational approaches and their applications. As basis for the understanding of current research we cover topics such as nonlinear mechanics and the prefound Liouville's theorem for Hamiltonian mechanics.

For more general learning objectives see
http://www.bucknell.edu/x50075.xml

Course Structure: Since this course will be interactive, it will be *essential that you come prepared to class*. For each reading assignment you will have to submit a **journal entry**. The purpose of these journal entries is to encourage you to do the reading and to spend class time most effectively. Your journal entry should reflect that you have done the reading and can contain any or all of the following: a summary, comments on what part of the reading was most difficult, easy, and interesting, or general comments about the course. I encourage your feedback. These journal entries will be **due 8 am** on the day of the class. However, it would be extremely helpful if you could get them to me earlier, to give me time to incorporate your feedback.

There will be **homework assignments** for each class both for you to be continuously involved with the class material and for me to get feedback on your understanding of the class material. Homework assignments will be due at the beginning of class. I will randomly decide (based on a tossed die!) whether to collect the homework (1/2 of the time) or have you self-grade it. I will provide guidelines for the self-grading, and solution sets for each homework set. Usually I will start the class with a brief summary of the last class. Then the course material will be discussed in lecture form, and will be practiced in the form of in-class problems for which sometimes **you** will be working on the blackboard.

Grading: Since the course structure relies on you coming to class prepared, it is important that you work steadily on the reading with journal entries and homework assignments. For this reason, journal entries are due 8 am before class and will *not* be accepted late. Scoring of the journal entries will be on a 2-point scale. You will be able to drop two of your lowest journal entry scores. Your participation is essential for the class discussions, and therefore counts together with the journal entries 10% towards your grade.
Homework will take a considerable amount of your time and is intended to give you plenty of practice. **No late homework will be accepted!** This is because the solution sets will already have been distributed, and because the goal is for you to be working on the problems while we are discussing the material. You will get to drop your lowest two homework grades. You are encouraged to work together on the homework, but you must write up your solutions individually. There will be three in class exams and a cumulative final. Attendance is required.

Journals & Participation	10 %
Homework Assignments	30 %
Exam 1	15 %
Exam 2	15 %
Exam 3	15 %
Final	15 %

Course Syllabus

dates	topic	text
Aug. 27/29 Sept. 1/3	Review: Newton's Laws	Ch 1 – 4
Sept. 5/8	Oscillations	Ch 5
Sept. 10/12/15/17/19	Nonlinear Dynamics	Ch 12
Sept. 22	Exam 1	
Sept. 24/26	Variational Principle	Ch 6
Sept. 29 Oct. 1/3/6	Lagrange's Equations	Ch 7
Oct. 8/10/15/17	Central Force Motion	Ch 8
Oct. 20	Exam 2	
Oct. 22/24/27/29	Noninertial Frames	Ch 9
Oct. 31 Nov. 3/5	Rigid Bodies	Ch 10
Nov. 7/10/12/14	Coupled Oscillators	Ch 11
Nov. 17	Exam 3	
Nov. 19/21/24 Dec. 1/3/5	Hamiltonian Mechanics	Ch 13
Dec. 8	Review & Outlook	
TBA	FINAL	