Physics 105B Syllabus

Winter Quarter 2012

1 Welcome to Physics 105B

This course will continue the discussion of Analytical Mechanics from 105A. In this part, we will continue to develop and consolidate the Lagrange approach to mechanics. We will review the central force problem and discuss angular momentum in the rotational motion of point particles and then extend the treatment to rigid bodies. We will follow this with problems in accelerated frames where interesting accelerations (centrifugal, Coriolis, etc.) appear when considering rotating frames (time permitting). Finally, we will devote our attention to the modifications of kinematic and dynamical quantities in the relativistic regime.

2 Course Information and Contact

- Instructor: Prof. Manuel Calderón de la Barca Sánchez
- E-mail: `calderon at physics.ucdavis.edu`
- [redacted]

When using e-mail to contact me, please include "PHY 105" in the subject line. If you are browsing from a public computer terminal, make sure to include your return email address (and your full name) in the body of your message, as it often does not show up in the email header. We would prefer replying to your official `ucdavis.edu` email (to make sure it goes through the campus spam filters).

2.1 Website

Go to
`http://smartsite.ucdavis.edu/`
and Login using your kerberos username and password, you should see a tab for the course, PHY 105B 001 WQ 2012, or you can get it from the dropdown menu on the right. Please make sure you check the website frequently as course announcements and reminders will be posted there. Grades and homework assignments will be posted there as usual. The course schedule including all homework due dates, midterm, and final exam dates will be posted on the smartsite schedule for this course. You can find the pdf of the syllabus (this document) on the site.

In case you need help with Smartsite, the quickest way is to call IT Express at 754-HELP (Monday through Friday from 7 AM to 9 PM). You can also send email at `smarstite-help@ucdavis.edu` or directly in person at Shields Library 182.

2.2 Text

Textbook: **David Morin, "Introduction to Classical Mechanics", Cambridge, 2008.**

Additional resources:

- Landau & Lifshitz, Mechanics, Butterworth-Heinemann, 3d Edition, 1982.
- Goldstein, Classical Mechanics, 3d Ed. Addison Wesley, 2002. (Graduate Level Text)

2.3 Lecture Hours

Lectures are **Tuesday and Thursday, 9:00-10:20 am** in room **130 Physics**.

3 105B Topics

We will follow the text throughout the two quarters of this course. The second quarter of the course will cover:

- Central Forces
  We will attack problems where the potential depends only on the distance from the source. These includes motion of a planet under the gravitational attraction of the sun, first studied by Kepler.
- Angular Momentum, constant direction
  We will treat the mechanics of rotating bodies. First, we will tackle the case where the angular momentum only changes in magnitude under the action of a torque while the direction is kept constant. We will discuss rigid bodies and moments of inertia.
- Angular Momentum, general changes
  In this section, we will treat the case where the angular momentum can change both its direction and magnitude under the action of a torque. We will introduce the inertia tensor and Euler's equations for generalized rotational motion of a rigid body. We will discuss the case of the heavy symmetric top, to discuss many of the motions that are possible aside from rotations, including precessions and nutations.
- Accelerating frames of reference (time permitting)
  We will obtain a procedure for applying Newton's laws on accelerating frames, and discuss how this applies in several important cases, including Focault's pendulum and tidal forces.
- Relativistic Kinematics
  We will introduce and work with Einstein's theory of Special Relativity, which is essential when treating objects moving at near the speed of light. We will first discuss the Michelson-Morley experiment and the postulates of relativity, then review the basic quantities needed for simple kinematics: lengths, time, and velocities, with an eye on the new insight brought about by the postulates. We will analyze the key relativistic effects of time dilation, length contraction and general Lorentz transformations.
- Relativistic Dynamics
  In the final sections (time permitting), we will discuss what happens to the masses, forces, energies, and momenta as particles move through space and time in the context of general relativity. We will discuss how these behave under Lorentz boosts and discuss the case of relativistic collisions and decays.

4 Grading

All grading will be on a 100 point scale, The components of the grade are as follows.

4.1 Homework

We will have homework problem sets every week from the end-of-chapter problems. Collaboration and discussion with your classmates on homework sets is greatly encouraged, but each one must submit their own homework. Try to write the solutions as an explanation to one of your colleagues. It is when we try to explain what we are doing that we best are able to understand the problems ourselves. All the homeworks will be averaged and will count for 40% of the final grade. The homework is an integral part of the course, it is where you will really learn mechanics. I hope that by now many of you realize that without working every week on the problems, it will be difficult to arrive at the midterm and the final well prepared by simply studying the night before. Learning happens throughout this course. We will discuss the general ideas in lecture and do examples, but only by working through many problems on your own can you truly master the subject matter.

4.2 Midterm

There will be one mid-term held on Feb 14. This will be closed-book and closed-notes, but you can bring one formula sheet. The Midterm will count 30% of the final grade.

4.3 Final Exam

The **final exam** is **Tuesday, March 20, 2010 from 10:30 am - 12:30 pm**. You **must** take the final exam at this time and day. **If you cannot take the final at the appointed time, please bring this up immediately**. If you qualify for extra time you must make this known well in advance of any exam for which you want this to apply. Again, the final will be closed-book and closed-notes, but a formula sheet is allowed. The final exam will count for 30% of the final grade.

4.4 Calculation of Final Grade

Your course grade is based on your performance on the homework, midterm and on the final exam. Your Final Grade grade is determined by the following grading scheme:
40% Homework + 30% Midterm + 30% Final exam
The default course grade limits are:

A's	$\geq 97 \rightarrow$ A+	$\geq 93 \rightarrow$ A	$\geq 90 \rightarrow$ A-
B's	$\geq 87 \rightarrow$ B+	$\geq 83 \rightarrow$ B	$\geq 80 \rightarrow$ B-
C's	$\geq 77 \rightarrow$ C+	$\geq 73 \rightarrow$ C	$\geq 70 \rightarrow$ C-
D's	$\geq 67 \rightarrow$ D+	$\geq 63 \rightarrow$ D	$\geq 60 \rightarrow$ D-
F's		$< 60 \rightarrow$ F	

5 Additional Notes

In lecture, it will be assumed that you have done and understood the homework. On some occasions, a topic will be discussed only after you have done a homework problem on it. This is intentional, and there are at least two good reasons for it. The first is that this is an upper division college class, and we are training you to solve problems on your own. The aim is to help you develop and sharpen your problem solving skills, which is not the same as giving away answers. The homeworks will mainly include problems that do not have worked out solutions. Part of the goal is for you to develop enough confidence in your skills that you don't need to know an answer beforehand, but you can get to an answer by yourself. This is, after all, what you will be hired to do when you graduate. No one will pay for you to solve problems that already have answers. The second reason is that learning is best achieved when you have already thought hard about a problem, struggled with it, come up with your own questions about it, and tried your best to tackle it before coming to lecture. At that point, you will be ready to absorb the material covered with much more ease, and furthermore appreciate the subtleties that would have escaped you had you not asked yourself all the questions when you tried to solve a problem on your own. If you come to lecture after thinking hard about a topic, the discussion in lecture will seem straightforward and simple. If you are working on your own and you get stuck, a good strategy that you can use is to try first one of the worked out problems. The text we are using has a lot of worked out examples, sometimes with more than one solution. By mastering these, you will be in a better position to tackle the homework problems.

If you get stuck on a point, please come to office hours, and if you can't make it during the scheduled times, you can set up appointments with the course instructor or the TA. If you get stuck and you think you are not alone, though, let us know – it may mean that this topic should be covered in more detail in lecture.