Syllabus for PHYS 3312

Welcome to Classical Mechanics! The instructor for this class is Dr. Paul MacAlevey. I have an office at Founders 2.708B and my e-mail address is paulmac@utdallas.edu. I usually assign homework by e-mail and will send to your UTD address. (If you prefer, you can go to https://www.netid.utdallas.edu and have your UTD mail forwarded to the inbox that you want to use.)

The prerequisite for this course is PHYS 3311 (Theoretical Physics).

The required textbook for the course is,

Tom Kibble and Frank Berkshire 5th edition (2004) Imperial College Press

I also recommend that you get a copy of "Theoretical Mechanics". This is an old Schaum book that I found particularly useful in moving from elementary Mechanics to other Physics courses. It should not be very expensive and will be printed on demand at the copy center. (Go to the copy center with your fee-receipt that shows that you have enrolled in PHYS 3312. Jay will copy the book for you in a few hours. **Please get this book before classes begin**.)

I do not require you to buy another textbook but will list several that you might find useful to look at.

- Keith Symon 1971 "Mechanics" 3rd edition, Addison Wesley
- Stephen Thornton and Jerry Marion 2004 "Classical Dynamics" 5th edition Brooks/Cole
- Vernon Barger and Martin Olsson 1995 "Classical Mechanics" 2nd edition McGraw-Hill
- A.P French & M. Ebison 1986 "Introduction to Classical Mechanics" 1st edition Kluwer
- Harald Iro 2002 "A Modern Approach to Classical Mechanics" World Scientific Publishing
- Daniel Kleppner and Robert Kolenkow 1973 "Classical Mechanics" 1st edition, McGraw-Hill

Topics:

Newton's Laws of Motion. Work, Energy and Momentum
A discussion of Newton's conception of space-time allows us state his laws of motion. Of great help in solving equations of motion are any conserved quantities (or first integrals of the motion). Total energy is one of them but there can be other conserved quantities.

Motion in a Uniform Field. Falling Bodies and Projectiles
Various cases of 1-D motion are examined. Several have been encountered in your freshman mechanics course. With projectiles, we move into 2-D motion.

The Simple Harmonic Oscillator and Simple Pendulum
Many models of physical phenomena involve harmonic oscillators. While they are simple physical systems, their use is much more widespread than is apparent at first. Our focus is on examining the various cases of the oscillator and pendulum.

Central Forces and Planetary Motion
These fields include the gravitational and electromagnetic and so are natural cases to examine. We'll spend most of or time looking at the gravitational case since it allows us to consider orbits of satellites and planets etc.

Moving Coordinate Systems
Newton's Laws only hold in a subset of reference frames. It becomes imperative to relate these frames (in which we have laws of motion) to frames that move. Of particular interest are rotating coordinate systems because we observe many things from such frames. An example is the observation of the flight of a projectile from a rotating Earth.

Systems of Particles
Up to now, we have dealt with the Physics of point particles. It really simplifies things if we can use most of the same concepts in our treatment of objects that are made of several particles. To make this generalization possible, we define quantities such as density, center-of-mass etc. and see what the laws of motion of point particles have to say about them.

Applications to Vibrating systems, Rockets and Collisions
Collisions are of obvious interest in the case of elementary particles, but their examination also affords another look at (unbounded) motion in a $1/r$ potential. You have seen boundary-value-problems in 3311/Theoretical Physics!

Plane Motion of Rigid Bodies
I'd like to say something about all parts of this chapter except centrodes.

Space Motion of Rigid Bodies
As for the previous chapter, I want to include several subsections except those following the ellipsoid of inertia.

Lagrange's Equations
While equivalent to Newton's equations, Lagrange's equations often give a 'practical' to find a solution to a particular physical problem. These equations also give another way of looking at the physics of particles and one that is important in the development of quantum mechanics.

Study methods:

Perhaps these suggestions are familiar to you already. At any rate, here they are.

Many people don't figure out how to study until late in their academic careers. One question to sort out is at what time you study best. Some prefer mornings before they get too busy with other things. Others prefer afternoon or evening. Find out which time suits <u>you</u> best and use that time!

Some people are under the impression that, to do much work, a long session of study is needed. While a few minutes are not enough for a study session, study in 30-minute sessions is useful. Despite the best of intentions, studying the same topic for several hours can involve lots of wasted time. The lack of an immanent deadline allows you to lose focus. People tend to be most productive at the beginning of a session (when they are still fresh) and near the end (as the deadline

approaches). It is important to realize that you can still 'spend a few hours studying'. Just change topic when you get to the end of your 30-minute study period.

Before you begin studying, assemble all the materials (books, pens etc.) that you will need. Tightly scheduled 30-minute study periods don't include time to look for books, sharpen pencils and borrow calculators etc! Few of us work well when we are tired. Do feel free to schedule breaks in your study. Just make sure that the 'breaks' don't get too long!

Make a (written) plan before you start to study. Your plan should sketch out what you want to accomplish. Unless you do, lots of time can be spent thinking about what to do next.) Make this plan as specific as possible: the more precise you are in your goals, the better you know if you reach them. Please be realistic about your aims for a study session. Rather than have a single goal of 'getting an *A* in a certain course', we often do better by establishing lots of minor goals that involve understanding certain sections of a text or doing certain problems. Modest goals are reached more often than overly ambitious ones and achieving them gives you the feeling of getting things accomplished. The plan does not have to be carefully written. You just don't want to spend a study period 'drifting' along and achieving nothing. Planning the topics to be studied in a study session is not 'studying' and is not part of your 30-minute study period! Just spend a few minutes before you begin studying in deciding what you need to get done.

In addition to the above, I would suggest a very simple strategy that worked very well for me. Review your lecture notes before a day has passed since the lecture (and certainly before the next one in that series of lectures). The aim is to review the lecture before you have time to forget what happened! There are several reasons for doing this. One is that you can't have written everything down (and I don't expect you to.) Some things may have been said but not written on the chalkboard. There might have been some connection that you noticed to another topic or another class. While there might not have been enough time to note it down, I don't want you to forget any insight that you had. It will come to you again as you review your notes soon after writing them in the lecture. Another reason for reviewing notes soon after writing them is that after hearing and following along line-by-line during the lecture, the review gives you time to ask yourself about where the topic is going and how it fits into the series of lectures being presented.

The next step is to re-write your lecture notes. Instead of writing them verbatim, include any insights or connections that you have spotted. Also, be on the lookout for anything that doesn't make sense. Maybe a line of algebra has been skipped or maybe there is simply an error…. In any event, make the addition to your notes. (If something question emerges, do ask me! I have office hours quite often and **I don't get nearly enough questions about lecture material**. Lectures do take quite a while to prepare and it is good to know that someone is noticing links to other topics that we have seen.)

Finally, summarize your reviewed notes. You will want condensed summaries for study before a test. Generate the summary that makes most sense to you. Notice that most of my comments are on the time-scale of a lecture or two. I have not referred to doing tests. However, doing tests becomes much easier if you truly stay 'on top of things' as I have suggested.

A note about missing classes

First of all, please try not to! If something arises that prevents you from attending class, please inform me as to why by e-mail. Not everything that we do in class is covered in any single textbook. If there were an ideal textbook for us then there would be little or no need for classes. An ideal textbook does not exist. By missing class, you will miss either something not covered by the book that you are reading or you will miss 'intermediate steps' in an author's argument that will help you follow along. You also pass up the opportunity to ask questions of your own and miss out on hearing the questions of others. (This latter point is significant. Other students may ask questions that

haven't occurred to you yet and hence develop your understanding of the subject.) If you **have** to miss class for some reason then it is your responsibility to get and class notes or handouts given in class. (I'm not keeping tabs on your attendance and leave some of the responsibility to you.) Please do this quickly after your absence. In order to understand the next lecture given, you will need to have obtained and worked through any notes etc. from the previous lecture. I give lectures from 'outline notes' that are probably not what you want to read. You best source of class notes is another student who wrote down exactly what we actually did. I return graded homework and tests primarily in class. Again, you'll miss this if you are absent from class. After I have tried to return the graded work to you a class from which you were absent, the responsibility for getting it from me becomes yours.

Scholastic dishonesty:

Of great importance to you as a student is that others perceive your degree as having value. That value is diminished if others suspect that a degree can be obtained through dishonest means. As your instructor, academic dishonesty gives me a false picture of the capabilities of the individual that is being dishonest. In a wider context, it gives me a false picture of what can be reasonably expected of my students.

In order to further the objective of eliminating scholastic dishonesty, the University has a policy on scholastic dishonesty for several reasons. This policy is clearly articulated in Subchapter F section 49.36 of the policy on student discipline & conduct adopted by the University and used in this course. The full chapter 49 is at http://www.utdallas.edu/student/slife/chapter49.html Students enrolling in the course are bound by this policy and are encouraged to read it. Any questions about this policy can be asked of the Dean of Students. **Any suspected cases of scholastic dishonesty will be passed along to the Dean of Students**.

Some questions have arisen in past semesters about scholastic dishonesty. Roughly speaking, these questions fall into three groups. Questions are about

- Discussions of students among themselves
- Discussions of students with either the TA or me
- Use of any material posted on the WebCT site

Discussion of problems among students is encouraged **provided each student has attempted each problem before any discussion**. It is important for every student to avoid collusion. (Collusion means the unauthorized collaboration with another person in preparing academic assignments offered for credit.) I do not authorize any student to generate homework solutions in any fixed form with the aid of any other student, group of students or any secondary source. **Anything handed in for credit must be the sole work of the student to whom credit is to be given**.

Students are welcome to ask questions of my TA or me about homework problems. However, I do not authorize these students to communicate such discussions to other students. These other students are welcome to ask me questions too.

The WebCT site contains postings exclusively for the use of the person with the privilege accessing the site. Materials on this site form another secondary source that is intended to help students in my class during the semester that the posting is made. No materials posted on the WebCT site become the property of a student. **Students acknowledge that distribution/transmission of any posting made on the WebCT site constitutes scholastic dishonesty**. (See parts (d) 1 and (d) 5 of section 49.36 of the policy on student discipline & conduct.)

The question about WebCT can be extended. I will treat in the same way any pre-existing solution to a problem assigned as homework in a previous semester, a solution to a problem asked on a test, or any problem from the book. As soon as any student in PHYS 3312 comes across any kind of pre-existing solution, that student must inform me of its existence and source. To do otherwise is to aid copying. (See part d (1) of section 49.36.) In order to maintain privacy, I can be contacted by e-mail if desired.

To complete this discussion I would like to state my policy clearly and succinctly. **I object strongly to any verbatim, unacknowledged work done by <u>anyone else</u> and presented as part of your work**. (This includes any passages from textbooks, any solutions that you come across in hard copy or on WebCT, any previously graded homework etc.

At the conclusion of the course, all students undertake to keep **all** course materials (posted solutions, graded homework etc.) for their exclusive use.