Physics 321 - Spring 2017
Course Outline

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Office hours: MWF 11:00-11:50 a.m. Feel free to drop in any time. I’ll be happy to help you if my schedule permits.

Overview
If you haven’t discovered it yet, you will soon find that upper division physics is mostly a revisiting of Physics 121/123/220/222. But since you have more mathematical tools now at your disposal, you will learn how to do some really impressive problems. Physics 321 is the advanced version of Physics 121.

Prerequisites
Mostly, you need to know Physics 121. We will review some basic ideas from Physics 121 as we go, but this will only be a quick review. If you find that some of these concepts are hazy, you might want to look over an introductory text. Mathematically, you need to have completed or be concurrently enrolled in Math 303 or Math 334. You should also have completed Physics 230 or have a basic understanding of Mathematica, as we will use it extensively in class. If you don’t feel too competent in Mathematica, don’t worry about it; you’ll learn what you need to know as we go.

We also recommend that you concurrently enroll in Physics 330. Our content will be somewhat correlated with Physics 330, as 330 uses examples from nonlinear dynamics to teach computational physics.

Learning Outcomes
- Use Newtonian mechanics with forces and torques to solve problems in Cartesian and curvilinear coordinates.
- Solve mechanics problems using work-energy, and conservation of energy, momentum and angular momentum.
- Solve and analyze rigid-body problems and problems in non-inertial frames.
- Use Lagrangian and Hamiltonian mechanics to obtain the equations of motion for a variety of problems, including the use of generalized coordinates and cyclic coordinates.
- Use perturbation and similar techniques to linearize equations of motion to analyze stability and study coupled systems using normal modes.

Course Philosophy
1) **You are responsible for your own learning. Don’t expect me to force you to learn.** For many of you, this is your first upper division course. You may find that this is a new experience. You are in a smaller class primarily composed of physics majors who really want to learn. The “get a good grade with as little work as possible” mentality that is so prevalent in lower division classes has no place here. I will give you the tools you need to learn, but it is your responsibility to use them wisely; I’m not going to force you to do that. You could get through the homework, for example, by checking answers before you put much work into the problems, but you’re not going to learn much and you’ll just be frustrated.
2) **Real physicists don’t do homework with paper and pencils.**

In the past half century, computers have revolutionized physics. When I took mechanics, the focus was on finding the classes of problems we could solve, often learning special tricks for each class of problems. Now you can solve very complicated problems easily; you can change parameters and see how that affects the solution in just seconds; you can analyze systems in detail with no special tricks. This is the kind of physics you will be doing in real life. But it does require tools, and the tool we will principally use is Mathematica. The downside to this is that there are often students in our class that for various reasons don’t have a lot of Mathematica background. Because this is not a course in Mathematica, I provide Mathematica worksheets as templates for you to do the numerical analyses. For some of you the scripts may seem too confining. For others, they may seem too daunting. While I can sympathize with each of these viewpoints, I have found that the middle ground I have taken works fairly well for everyone.

3) **Fundamentals are fundamental.**

Albert Einstein once said, “I want to know how God created this world. I’m not interested in this or that phenomenon, in the spectrum of this or that element. I want to know His thoughts, the rest are details.” You’re probably a physics major because you share to some degree this same sentiment. (If you like physics because physicists have fun toys or have big paychecks, you probably should rethink your major.) What’s most important in physics, even classical mechanics, is to have a solid understanding of the philosophical underpinnings and the fundamental principles. There’s certainly a place for working problems in physics, but physics is not fundamentally problem solving. Physicists need to have a passion for getting to the real core of a problem, whether it’s understanding quantum theory or building a better spectrometer.

**Text**

The textbook is *Classical Mechanics* by John R. Taylor. If you do not read the material in advance, you will find that class will be difficult. To provide extra incentive, you will receive points for doing the reading on time. You will need to submit an online form once you have completed the reading for each lecture. Late reading will receive a 30% penalty. Reading is considered late if it is completed after the beginning bell, so it doesn’t help to come to class late. You will know that you have successfully submitted the online form if you see a confirmation page.

**Homework**

Almost all homework will be turned in using Mathematica. Each assignment will include hints, helps, and solutions. You are given credit for understanding the problem, rather than for getting the right answer. While the homework is essentially self-grading, to get credit for the homework, you will need to send an email to the course TA (p321hw@byu.edu) with the Mathematica file attached. Most homework assignments will also have a short hand-worked section to reinforce basic concepts.

Homework for Hour 12 is called Homework 12, and so forth. Homework 12 is due at midnight on the day of the following day’s lecture, unless I give you an extension. Homework will be accepted up to one week late, but with a late penalty of 30%.

You can find the homework assignments on the course website. Not all lectures have homework assignments.
**Take-home Tests**
A take-home Test will be due most Thursdays at midnight. The tests consist of Mathematica questions much like the homework problems. Each test will cover the material from the lectures indicated on the course web page. You may use the textbook, your own class notes, your own homework solutions, and any other materials from the course website to aid you in doing the problems. You may not use any other sources of information and you may not discuss the test with anyone except the instructor. These tests should be submitted by sending an email with the Mathematica file attached to p321test@byu.edu.

If you turn in a weekly test late, it is penalized 10% per day late.

**Midterm Tests**
The course material is divided into three units. We will have midterm tests for the first two units during the semester. These tests will be closed book and administered in the Testing Center. They will consist primarily of essay questions that will require you to explain concepts, problem-solving strategies, etc. There will be relatively few problems on the tests; these will be given when it is easier to ask you to solve a problem than to explain how you would solve the problem.

**Final Exam**
The final exam will have two parts. The first part will consist of selected questions from the first two exams and sample tests. The second part will be similar to the midterm exams, but cover only Unit 3 material. The Final Exam will be held in the classroom on Wednesday, June 21 beginning at 9:00 a.m. The University policy is that exams are to be given at the scheduled time. If there is an important reason you need to take the exam at a different time, please talk to me as soon as possible.

**Can’t Keep Up?**
It is very important to stay on top of things. If you feel that you are getting left behind, please come see me quickly. I am happy to help, but please recognize that it will probably take extra time and effort on your part to catch up.

**Grading**
I will do my best to give you a fair grade based on your performance. Your scores will be available online and will be updated from time to time throughout the semester. I will try to give you an indication of your approximate letter grade as well.

The components of your total score are as follows:
- Reading: 5%
- Homework: 20%
- Take-home Tests: 45%
- Midterms: 20%
- Final: 10%
LEGAL NOTICES:

The University suggests that the following statements be included in all course outlines. Please note that I fully endorse these policies.

**Honor Code Standards**
In keeping with the principles of the BYU Honor Code, students are expected to be honest in all of their academic work. Academic honesty means, most fundamentally, that any work you present as your own must in fact be your own work and not that of another. Violations of this principle may result in a failing grade in the course and additional disciplinary action by the university. Students are also expected to adhere to the Dress and Grooming Standards. Adherence demonstrates respect for yourself and others and ensures an effective learning and working environment. It is the university’s expectation, and my own expectation in class, that each student will abide by all Honor Code standards. Please call the Honor Code Office at 422-2847 if you have questions about those standards.

**Preventing Sexual Discrimination or Harassment**
Sexual discrimination or harassment (including student-to-student harassment) is prohibited both by the law and by Brigham Young University policy. If you feel you are being subjected to sexual discrimination or harassment, please bring your concerns to the professor. Alternatively, you may lodge a complaint with the Equal Employment Office (D-240C ASB) or with the Honor Code Office (4440).

**Students with Disabilities**
If you have a disability that may affect your performance in this course, you should get in touch with the office of Services for Students with Disabilities (1520 WSC). This office can evaluate your disability and assist the professor in arranging for reasonable accommodations.