# Physics 321 Syllabus

Classical Physics I
Spring 2019

**Instructor**

Paul Nakroshis
Room 252 Science Building
Department of Physics
Portland Campus

pauln@maine.edu
www.portlandphysics.me
twitter: @PaulNakroshis

**Office Hours:** By arrangement. However, in general, I am in my office/lab Monday through Friday, and you are encouraged to stop by an ask questions. If you want to arrange a time in particular, please contact me and suggest a time to meet.

**Course Description:** This course is the first of a two semester Classical Mechanics sequence. We will spend the first semester entirely devoted to the mechanics of Newton and Lagrange. Our main focus will be to extend and develop the concepts of mechanics more thoroughly and carefully than in Physics 121. We will study particle motion, momentum, energy, oscillations, and Lagrangian Mechanics. I assume you have taken a calculus-based introductory physics sequence, and have successfully completed at least two semesters of calculus, and are at minimum, enrolled in MAT 252 (Calc C). This course will prepare you well for the mechanics section of the physics GRE, and together with PHY 323, forms the solid background needed to study graduate level mechanics. I hope that you will find this course challenging and very interesting!

**Textbooks:**

Classical Mechanics, by John R. Taylor. An extremely well-written textbook. Read it and work through the examples.

**Recommended Reading:**

The Feynman Lectures in Physics, by Richard Feynman.
When I was an undergraduate summer student at the Fermi National Accelerator Laboratory, the Head of the Theory section, Drasko Jovanovic, said to me: "...if you want to be a real physicist, read and understand *cold* all three volumes of the Feynman Lectures." An excellent and inspiring series of lectures.

Mechanics, by Thorton and Marion. This is a classic text, any edition is a fine reference.
An Introduction to Mechanics, by Daniel Kleppner and Robert Kolenkow. Cambridge University Press, 2012; ISBN 978-0-521-19811-0

**Atendance Policy:**

I expect that everyone will be at every class except in extenuating circumstances. If I find that you are missing class too often (i.e. more than three times), you can expect that I will talk with you and that you will likely receive a lower grade for the course, or asked to leave if this repeated absence is coupled with poor quality work written work. If you miss a class in which a test is given, you will not be given a makeup except in truly *exceptional* cases or if you have prearranged due to a conflict.

**Outside Help/Office Hours**

In general, if my office door is open, I am happy to help you, so feel free to stop in and ask questions.

**Learning Objectives**

By the end of this course, you should be able to:

1. understand how to apply Newton's laws of motion in three dimensions,
2. solve mechanics problems in cartesian, polar, cylindrical, and spherical coordinates systems,
3. understand the conditions needed for linear momentum, angular momentum, and energy conservation and use these principles to solve problems,
4. set up and solve (analytically) differential equations that describe the motion of particles experiencing drag forces,
5. understand how to characterize a conservative force, and derive potential energy functions from a given force law,
6. how to compute a force from a potential energy,
7. characterize simple harmonic motion with and without damping, and with and without driving forces,
8. understand how to represent harmonic motion in a Fourier series,
9. derive the Euler-Lagrange equation, and solve problems using Lagrangians bot with an without constraint forces, and
10. understand the physics of a two body central force problem, and apply them to gravitational systems, for both bound and unbound orbits.

**Assessment**

I am unfortunately obligated to assign a letter grade for each person enrolled in this course. This grade is my *subjective* sense of your level of understanding of the physics we discuss in this class. In addition, I will base this on your performance on 2 exams, roughly weekly problem sets, and a comprehensive final exam as follows:

| | | |
|---|---|---|
| Exam # 1 | Friday 1 March | 100 pts |
| Exam # 2 | Friday, April 12 | 100 pts |
| Problem Sets | roughly 8-10 throughout term | 600 pts |
| Final | Wednsday 8 May 10:45-12:45 | 200 pts |
| | **Total Points** | **1000** |

**Notes on problem sets:**

(1) Late problem sets will lose 50% per day late. Problem sets are due at the start of class, one week after they are assigned.

(2) Problems sets should be written as if the audience is a student at another university looking for help in understanding the solution to the problem. As such, you should lead the reader through the solution by appealing to relevant physical principles and you should write in grammatically correct english. The well written problem set will read like an excellent solution manual, with textual descriptions interspersed with important mathematical equations (as well

as pictorial and graphical descriptions when needed) placed on a separate line, centered on the page.

Please do things to make my reading of your problem set as pleasant as possible—for instance, neat writing, clearly discussed assumptions you've made, and boxed final answers will help me follow along without difficulty. If I am struggling to read your writing, or have to try to figure out your reasoning, or find your answer, you will not receive higher than 70% credit. Neatness and completeness count.

(3) Some problems I assign will be from the text. Of course, many of these have online solutions in the wildness that is the internet—if, at your first attempt of a problem you get stuck and you then look at those solutions you will be doing yourself a **massive** disservice—there is nothing wrong with putting a problem down and returning to it later. In order to solve a problem you sometimes have to go down the wrong path (sometimes several wrong paths), this is an essential part of learning. I encourage you to struggle mightily by yourself and then struggle together with your classmates, and if you absolutely get stuck, see me and I'll try to push you in the right direction (or maybe a wrong one just so you can see what the right path is).

**Grading Scale**

| A | A- | B+ | B | B- | C+ | C | C- | D | F |
|---|---|---|---|---|---|---|---|---|---|
| 930-1000 | 890-929 | 870-889 | 830-869 | 790-829 | 770-789 | 730-769 | 690-720 | 600-689 | 0-599 |

**Rough Schedule**

The schedule below is tentative, and I reserve the ability to adjust it as needed.

| **Date** | **Reading** | **Events** |
|---|---|---|
| 23 & 25 Jan | Ch 1 | |
| 28 Jan to 1 Feb | Ch 1 & 2 | |
| 4 Feb - 8 Feb | Ch 2 | |
| 11 Feb - 15 Feb | Ch 3 | |
| 20 Feb & 22 Feb | Ch 4 | |
| 25 Feb - 1 Mar | Ch 4 | **EXAM 1** Friday 1 March |
| 4 Mar - 6 Mar | Ch 5 | Video lecture on Mon, Fri, Live on Wed. |
| 11 Mar - 15 Mar | Ch 5 | |
| 18 Mar - 22 Mar | | Spring Break |
| 25 Mar - 29 Mar | Ch 6 | |
| 1 Apr - 5 Apr | Ch 6 | |
| 8 Apr - 12 Apr | Ch 7 | |
| 15 Apr - 19 Apr | Ch 7 | **EXAM 2** Fri 12 April |
| 22 Apr - 26 Apr | Ch 8 | |
| 29 Apr - 3 May | Ch 8 | |
| Wednesday 8 May | | **Final Exam** 10:45 - 12:45 Room 262 Science |