

Physics 307: Science and Computers I

Fall 2009

General Information

Course Time and Place: Tues./Thurs. 11:00AM-12:20PM in PB115

Instructor: Dr./Prof. Schwarz

Office: PB215

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Course Webpage: <http://physics.syr.edu/courses/PHY307.09Fall/index.html>

Office Hours: Tuesday 12:30PM-1:30PM or by appt.

Course Objectives

Have you ever wondered how Earth's trajectory around the Sun would be modified if Jupiter, the most massive planet in the solar system, were twice, or even 10 times, as massive? Well, such a question can be addressed in this class! It can be addressed because we are going to use computers to simulate the trajectories of the planets in our solar system. In the simulation, Jupiter's mass is a parameter—a parameter that can be changed.

Simulating physical systems is yet another means by which to learn how the natural world works and is to be complemented with analytical calculations and experiments. Not only will your knowledge of Newtonian gravity and other aspects of classical mechanics be reinforced in this course through the use of computers, problems in electricity and magnetism will also be studied computationally. Both classical mechanics and electricity and magnetism are introduced in PHY211/212, which is why these two courses are prerequisites for this course. You will also learn about perhaps one or two other areas of physics while taking this course, but the physics instruction in these areas will be self-contained, so not to worry.

While this course contains the word "Computers" in the title, no prior experience with computers is required. At the outset, you will be introduced to a very user-friendly numerical computing environment called MATLAB that allows you to simulate planet trajectories and plot and manipulate data, for example.

By the end of this course, your knowledge of physics will be strengthened via simulating physical systems. Also, your simulation skills should include

- (1) plotting and manipulating preconstructed data files, taking finite differences of the data, fitting data, comparing data with analytical curves,
- (2) understanding some of the computing issues related to solving problems numerically such as round-off error,
- (3) being able to write small programs containing do loops and if/then statements,
- (4) generating your own data files and analyze them,
- (5) solving ordinary linear and nonlinear differential equations numerically using various methods including the Euler method,
- (6) solving transcendental equations numerically using the bisection method,

- (7) generating random walks using random number generators and analyzing the statistics of the random walk,
- (8) gaining experience writing scientific computer lab reports.

All of the above skills will come in handy for understanding material in future physics courses and in the world of research!

Textbook

There is one **required** textbook for the course. It is a general computational physics book cleverly titled:

Computational Physics by N. Giordano and H. Nakanishi.

Course Work

We will be meeting in the PB 115 Computer Lab each class. On Tuesdays, we will discuss a particular physics problem, say, the effects of air resistance on the trajectory of a cannon ball. The simulation of this problem will involve a new computational skill, such as the “do loop”. We will then “work through” the new computational skill using the computers in front of us and discuss it. On Thursdays, you will be introduced to a lab on a related problem, which you will begin to go through. I will be there to assist you as you begin to go through it. The lab report will be due on Tuesday of the following week and will involve some outside class time.

In addition to weekly lab reports, there will be one mid-term and one final exam. There will also be a final project that I will discuss with each of you individually the last four weeks of the course. It will essentially be an extended lab report of a physics problem that we agree upon and involves several of the skills listed above.

Assessment

Weekly lab reports: 60 percent

Midterm Exam: 10 percent

Final Exam: 10 percent

Final Project: 20 percent

Computing assistance

If your program does not work, spend up to about 30 minutes trying to fix the problem. If the problem persists after 30 minutes, then walk away and come back to the problem later to try to fix it a second time. After several iterations of this and the problem still persists, please contact me via email detailing the problem, i.e. what line does your code crash, with your program attached. Please do not wait until the last minute to do this since I read my email a few times a day and may not be able to get to it immediately. In other words, expect around a maximum of 24 hours response.

A Note About Working with Friends and Academic Integrity

Students are encouraged to discuss the course content with each other. However, when it comes time to complete your weekly lab report, **the final work you turn in must be your own**. You should never copy anybody else's work, or even paraphrase it. Copying is against school policy and can ultimately result in expulsion. If you have not read over SU's academic integrity policy, it can be found online at http://supolicies.syr.edu/ethics/acad_integrity.htm. Enough said about that!

Academic Accommodations for Students with Disabilities

Students who are in need of disability-related academic accommodations must register with the Office of Disability Services (ODS), 804 University Avenue, Room 309, 315-443-4498. Students with authorized disability-related accommodations should provide a current Accommodation Authorization Letter from ODS to me (Dr. Schwarz) and we will review those accommodations together. Accommodations, such as exam administration, *are not provided retroactively*; therefore, planning for accommodations as early as possible is necessary. Please go to <http://disabilityservices.syr.edu> for further information.