Physics 409
Fall 2014

Instructor: Alex Small, Room 8-222, 909-869-5202, arsmall@csupomona.edu
Course web page: Blackboard
Class meetings: Monday and Wednesday, Noon-1:50pm, Building 3, Room 2029
Office Hours: Tues 10am-11am, Thurs 3pm-5pm, Fri 2pm-3pm

Required Textbook:

Computational Physics by Giordano and Nakanishi (2nd edition, 2006). We will mostly cover chapters 1-5 and 7. They actually have suggested solutions on their website:
http://www.physics.purdue.edu/~hisao/book/www/samples.html#chap1
You are welcome to consult this site, but you must design your own solutions.

Recommended references:

1. I strongly recommend this book as a reference: *A Primer on Scientific Programming With Python* by Langtangen (3rd edition, 2012, ISBN 3642302920, library catalog number QA76.76.P98 L36 2012)
2. A valuable reference book that is well worth getting is *Numerical Recipes* (any edition, library catalog number QA76.73.C15 N865 1992) by Press, Teukolsky, Vettering, and Flannery. I will copy and distribute a few pages from it, but if you are serious about computational physics you need to study this book. It is quite literally the Gospel of computational methods, as it has four authors and was originally written in an archaic language (FORTRAN, not ancient Greek).
3. An old but excellent book is *Numerical Methods That Work* by Forman Acton (library catalog number QA297 .A33 1990). It is old but timeless, and the essay in the middle is priceless.

   I have put these books on reserve at the library. You will need the library catalog numbers to request them.

4. You can also get a lot of useful programming advice from www.stackoverflow.com. Just Google for the topic you are interested in, add the words “python” and “stackoverflow” and useful links will usually come up.

Programming Language and Platform:

We will be using Python. In particular, we will be using Canopy, a Python distribution produced by Enthought. The first 2 classes will involve an introduction to Python. Python will be installed on all of the machines in the classroom. To install it on your laptop or home machine, go here:

https://www.enthought.com/products/canopy/

If you have a laptop with Python installed, I strongly recommend bringing it to class. (There are electrical outlets at every seat.) This way, you can do your classwork and homework in the same environment, with the same settings.

Project-based course:

I will only spend at most half of each class lecturing. Most of the time you will spend working on exercises on the computers, and I will come around and help you. For the second hour of class we will also have a learning assistant, Conor Rowland, a student who did quite well in this course last year, to help you as you work on problems.

Programming Assignments:

There will be 7 programming assignments, due most Fridays at 5pm, and a final project (due on December 11 at 5pm). *You must submit both code and output. Output and answers to questions should be submitted on paper, because I don't want to spend my Friday afternoon printing things.* Programming assignments will be graded on (1) the correctness of the code, (2) whether you correctly analyze your output, and (3) how well you explain your output and answer the questions posed in the assignment. Note that writing quality is part of the third criterion!

You must submit your code to me electronically. Email gets annoying for this sort of thing. We will either share code via Dropbox or Google Drive. I'll let the class vote on this on the first day.

Homework:

There will also be frequent written homeworks, that will require you to either do some physics calculations relevant to an upcoming programming assignment, do some math relevant to understanding the algorithm that you're working with, or prepare an outline of the code that you'll be developing. The purpose of these shorter assignments is to help you prepare for upcoming projects and help you get ready to use class time effectively. Homework will be due most Mondays and occasional Wednesdays.

Final project:

The final project, which will take the last few weeks, will be your own choice. A good place to look for topics would be advanced topics that we don't cover in the textbook. You can also study a topic that I suggest, or come up with your own problem involving some physical system that you want to model numerically and study.

You must submit a topic proposal to me by Wednesday, November 12! Submit a paragraph telling me the system or model that you want to study, the question that you want to answer, and the algorithm or equations that you will use. I reserve the right to reject your topic if I feel that it is too ambitious for the amount of time available (or too unambitious). The critique will count as a short written homework, and will be graded on whether it has sufficient detail for me to understand your project, and whether it is feasible to complete in the time frame of the class.

A list of possible topics (besides some of the harder projects in the book) will be posted on Blackboard.

A detailed specification of the report format is posted on Blackboard. *This report is due in my office at 5pm on December 12.* To help you write a good project report, *a draft of the first three sections is due on Monday, December 1.* A classmate working on a project unrelated to yours will critique it. *Critiques are due on Wednesday, December 3.* Your submission will count as a homework assignment (graded for completeness only) and *your critique will count as another homework (graded for usefulness)*.

Grading:

The grading formula will be:

50%	Programming assignments
25%	Homework
25%	Final project

The grading scale will be:

A: 85% or above
B: 75% to 84%
C: 65% to 74%
D: 55% to 64%
F: Below 55%

Tentative Schedule of Topics and Projects: Subject to change with notice.

Week	Day	Date	Topic	Reading	Due
2	Mon	9/29/2014	Python loops and arrays		
2	Weds	10/1/2014	Functions, more on loops and arrays		**HW 1: Interpreting code**
2	**Fri**	**10/3/2014**	**Programming Assignment 1: Loops and Functions**		
3	Mon	10/6/2014	Euler method	Chapter 1	**HW 2: Calculator exercise for differential equations**
3	Weds	10/8/2014	Air resistance	Chapter 2, sections 1-2	**HW 3: Drag forces**
3	**Fri**	**10/10/2014**	**Programming Assignment 2: Air resistance**		
4	Mon	10/13/2014	Euler-Cromer, Velocity Verlet, and oscillations	Chapter 3, sections 1-2. Euler-Cromer article (skim). Velocity Verlet article. (Articles on Blackboard under Course Documents)	**HW 4: Oscillations**
4	Weds	10/15/2014	Runge Kutta, more on the pendulum	Appendix A, and Numerical Recipes excerpt	
4	**Fri**	**10/17/2014**	**Programming Assignment 3: Oscillations**		
5	Mon	10/20/2014	Solar system	Chapter 4, sections 1-2	**HW 5: Solar system data**
5	Weds	10/22/2014	Solar system	Chapter 4, sections 3-5	
5	**Fri**	**10/24/2014**	**Programming Assignment 4: Solar system and more oscillations**		
6	Mon	10/27/2014	Electrostatics	Chapter 5, section 1	**HW 6: Relaxation method**
6	Weds	10/29/2014	Electrostatics	Chapter 5, section 2	
6	**Fri**	**10/31/2014**	**Programming Assignment 5: Electrostatics**		
7	Mon	11/3/2014	Heat flow	Handout (posted on blackboard under Course Documents)	**HW 7: Heat flow**
7	Weds	11/5/2014	Heat flow		
7	**Fri**	**11/7/2014**	**Programming Assignment 6: Heat flow**		
8	Mon	11/10/2014	Random walks	Chapter 7, sections 1-2	**HW 8: Probability**
8	Weds	11/12/2014	Random walks	Chapter 7, sections 3-5	**Final project topic proposal**
9	**Mon**	**11/17/2014**	Work on projects	**Programming Assignment 7: Random Walks**	
9	Weds	11/19/2014	Work on projects		
10	Mon	11/24/2014	Work on projects		
10	Weds	11/26/2014	Work on projects		
11	**Mon**	**12/1/2014**	Project critiques	**Draft of final project (Abstract, Background, Methods)**	
11	**Weds**	**12/3/2014**	Final critiques, questions.	**Critique of draft project**	
Finals	**Thurs**	**12/11/2014**	**FINAL PROJECT DUE AT 5PM!!!**		