San José State University
Department of Physics and Astronomy
PHYS 240, Computational Physics, Spring 2015

Course and Contact Information

Instructor: Aaron Romanowsky

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Office Hours: Tuesdays, 10:30−11:30am; Thursdays, 2:45−3:45pm

Class Days/Time: Tuesdays, Thursdays, 1:30−2:45pm

Classroom: Clark 111 (Incubator Classroom)

Prerequisites: **PHYS 105B, 110B, 163, and a programming language**

Web Page and Messaging

The Canvas online course management system is an integral part of this course – providing announcements, distribution of handouts, submission and grading of assignments, online quizzes, coordination of class projects, etc. Your enrollment in the course gives you access to the site – please check there for further information and updates, including to the syllabus. Canvas is accessed via http://sjsu.instructure.com (using a web browser, or App for iOS or Android), and more information and help can be found at: http://www.sjsu.edu/at/ec/canvas/student_resources/index.html.

You are responsible for regularly checking your email for course news, and Canvas for feedback on your assignments. You may also want to make use of the Canvas Notifications system to receive updates about upcoming deadlines, etc. Canvas also provides "Modules" and "Assignments" pages that are useful for keeping track of course progress and deadlines. Feedback on assignments will be posted on Canvas, but please do not use the Canvas messaging system for any urgent matters: **use direct email instead**.

Course Description

This course provides a foundation in numerical techniques and computational methods as applied to solving problems from various branches of physics, along with experience in numerical Python programming.

This semester the course meets in the Incubator Classroom, which provides a state-of-the-art technology-assisted, flexible learning environment, with facilities such as screen-sharing, multiple projectors, smart boards, and lecture capture. For further information, see http://www.sjsu.edu/at/asc/classroom_resources/. The bottom line is that this special classroom should help in the course being very interactive.

Prerequisites include full upper division sequences in classical and quantum mechanics as well as electromagnetism, and significant programming experience. The course will make substantial use of differential equations and linear algebra.

Learning Outcomes and Course Goals

Course Learning Outcomes (CLO)

The goals of this course are (1) to understand how continuous equations can be broken down and solved approximately with finite computational steps; (2) to gain experience with basic, specific methods and algorithms used in computational physics; and (3) to learn how to apply computational methods to novel physics problems.

Upon successful completion of this course, students will be able to:

1. carry out numerical calculations and create plots using Python
2. use numerical programming to solve a variety of standard physics problems
3. design and conduct an original, computationally-oriented project

Required Texts/Readings

Textbook

The main, required text that we will follow is:
Numerical Methods for Physics. Alejandro L. Garcia. Prentice Hall: 2nd edition (2000). ISBN 0-13-906744-2.
It is on order at the campus bookstore, can be found online for around $70−$140 (hardcover version recommended), and there is also a copy on reserve at the SJSU library.
Additional material including errata can be found on the author's webpage at http://www.algarcia.org/nummeth/nummeth.html.

Other Readings

Additional textbooks and other readings will be listed on Canvas.

Other equipment / material requirements

Intensive computer usage outside of class hours will be required for the assignments. Students should identify immediately a lab or personal computer that will be suitable for programming, internet access, and word processing. The SCI 242 computer lab will also be available during certain hours (schedule TBD).
Close the door when you leave. If you find the room locked, go to the department office (SCI 148) for help.

Library Liaison

Physics & Astronomy library liaison: Jennifer Dinalo, jennifer.dinalo@sjsu.edu
See also Physics & Astronomy LibGuide at http://libguides.sjsu.edu/physics_astronomy.

Course Requirements and Assignments

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in University Policy S12-3 at http://www.sjsu.edu/senate/docs/S12-3.pdf.

The homework provides opportunities to practice and extend the concepts learned in class, and comprises the dominant component of the course grade (see below). It is generally assigned and due *twice a week*. Peer review may be part of the evaluation process. Homework grades are evaluated partially on producing the correct results, and partially on the coherence of the code and the analysis.

The course will culminate with student projects, in order to promote the ability to carry out independent and creative computational work. The project work will be carried out gradually, as part of the weekly assignments.

NOTE that University policy F69-24 at http://www.sjsu.edu/senate/docs/F69-24.pdf states that "Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading."

Grading Policy

The overall grading scheme is as follows:

Assignments:	75%
Final project and presentation:	25%

The letter-grade assignment is:

A+	97–100	A	93–96	A–	90–92
B+	87–89	B	83–86	B–	80–82
C+	77–79	C	73–76	C–	70–72
D+	67–69	D	63–66	D–	60–62
F	0–59				

No late homework is accepted, but you can miss up to 5 assignments over the semester.

Note that "All students have the right, within a reasonable time, to know their academic scores, to review their grade-dependent work, and to be provided with explanations for the determination of their course grades." See University Policy F13-1 at http://www.sjsu.edu/senate/docs/F13-1.pdf for more details.

Classroom Protocol

Attendance, on-time arrival, and participation are crucial for success in this course. Cell phones on 'silent', please. Additional guidelines for using the classroom computers will be provided.

University Policies

General Expectations, Rights and Responsibilities of the Student

As members of the academic community, students accept both the rights and responsibilities incumbent upon all members of the institution. Students are encouraged to familiarize themselves with SJSU's policies and practices pertaining to the procedures to follow if and when questions or concerns about a class arises. See University Policy S90–5 at http://www.sjsu.edu/senate/docs/S90-5.pdf. More detailed information on a variety of related topics is available in the SJSU catalog, at http://info.sjsu.edu/web-dbgen/narr/catalog/rec-12234.12506.html. In general, it is recommended that students begin by seeking clarification or discussing concerns with their instructor. If such conversation is not possible, or if it does not serve to address the issue, it is recommended that the student contact the Department Chair as a next step.

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's Catalog Policies section at http://info.sjsu.edu/static/catalog/policies.html. Add/drop deadlines can be found on the current academic year calendars document on the Academic Calendars webpage at http://www.sjsu.edu/provost/services/academic_calendars/. The Late Drop Policy is available at

http://www.sjsu.edu/aars/policies/latedrops/policy/**.** Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the Advising Hub at http://www.sjsu.edu/advising/.

Consent for Recording of Class and Public Sharing of Instructor Material

University Policy S12-7, http://www.sjsu.edu/senate/docs/S12-7.pdf, requires students to obtain instructor's permission to record the course and the following items to be included in the syllabus:

- "Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material."
    - It is suggested that the greensheet include the instructor's process for granting permission, whether in writing or orally and whether for the whole semester or on a class by class basis.
    - In classes where active participation of students or guests may be on the recording, permission of those students or guests should be obtained as well.
- "Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent."

Academic integrity

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The University Academic Integrity Policy S07-2 at http://www.sjsu.edu/senate/docs/S07-2.pdf requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The Student Conduct and Ethical Development website is available at http://www.sjsu.edu/studentconduct/.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 at http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf requires that students with disabilities requesting accommodations must register with the Accessible Education Center (AEC) at http://www.sjsu.edu/aec to establish a record of their disability.

Accommodation to Students' Religious Holidays

For information, see Canvas:
https://sjsu.instructure.com/courses/1136449/assignments/syllabus#religious

Student Technology Resources

See "other equipment" above. Although computers for general student use are available in various locations around Campus, it may be challenging to use them for the programming assignments in this class. Options include the Academic Success Center at http://www.sjsu.edu/at/asc/ located on the 1st floor of Clark Hall and in the Associated Students Lab on the 2nd floor of the Student Union; the SCI 242 computers, and computers in the Martin Luther King Library.

SJSU Peer Connections

For brief information about Peer Connections, see Canvas page here:
https://sjsu.instructure.com/courses/1136449/assignments/syllabus#peer
or the Peer Connections website at http://peerconnections.sjsu.edu.

SJSU Writing Center

For brief information about the Writing Center, see Canvas page here:
https://sjsu.instructure.com/courses/1136449/assignments/syllabus#writing,
or the Writing Center website at http://www.sjsu.edu/writingcenter.

SJSU Counseling Services

The SJSU Counseling Services is located on the corner of 7th Street and San Fernando Street, in Room 201, Administration Building. Professional psychologists, social workers, and counselors are available to provide consultations on issues of student mental health, campus climate or psychological and academic issues on an individual, couple, or group basis. To schedule an appointment or learn more information, visit Counseling Services website at http://www.sjsu.edu/counseling**.**

PHYS 240 / Computational Physics, Spring 2015, Course Schedule

Topics, readings, and schedule are provisional and subject to change with fair notice (via class or email).

Course Schedule

Week	Date	Topics, Readings, Assignments, Deadlines
1	January 22	introduction to course and Python
2	January 27	numerical programming and plotting with Python
2	January 29	NumPy arrays and vectorizing; numerical errors (Garcia Ch. 1.5)
3	February 3	numerical precision; ODEs: Euler method, projectile motion (Garcia Ch. 1.5, 2.1)
3	February 5	ODEs: error analysis, pendulum (Garcia Ch. 2.1, 2.2)
4	February 10	ODEs: Verlet's method and fancy pendula (Garcia Ch. 2.2)
4	February 12	ODEs: interactive widgets; celestial orbits (Garcia Ch. 3.1)
5	February 17	ODEs: Runge−Kutta methods (Garcia Ch. 3.3)
5	February 19	ODEs: adaptive time steps and other methods; chaos (Garcia Ch. 3.3, 3.4)
6	February 24	systems of linear equations (Garcia Ch. 4.1, 4.2)
6	February 26	nonlinear equations and Newton's method (Garcia Ch. 4.3)
7	March 3	linear regression (Garcia Ch. 5.1)
7	March 5	error propagation and polynomial fits (Garcia Ch. 5.1, Press Ch. 15.4)
8	March 10	confidence limits; general and non-linear least squares (Press Ch. 2.6, 15.4−15.6)
8	March 12	Monte Carlo methods; embarrassingly parallel programming (Press Ch. 15.6)
9	March 17	Fourier transforms (Garcia Ch. 5.2)
9	March 19	Fourier transforms, FFTs, aliasing (Garcia Ch. 5.2, 5.3)
10	March 31	NO CLASS: Cesar Chavez day
10	April 2	PDE types, FTCS, diffusion equation (Garcia Ch. 6.1, 6.2)
11	April 7	PDEs: neutron diffusion, advection equation (Garcia Ch. 6.3, 7.1)
11	April 9	PDEs: advection equation, fluid mechanics of traffic flow (Garcia Ch. 7.1, 7.2)
12	April 14	guest lecture: PDEs: Laplace equation and relaxation methods (Garcia Ch. 8.1)
12	April 16	guest lecture: PDEs: Poisson equation and spectral methods (Garcia Ch. 8.2)
13	April 21	PDEs: stability analysis (Garcia Ch. 9.1)
13	April 23	PDEs: implicit schemes & Schrödinger equation (Garcia Ch. 9.2)
14	April 28	special functions (Garcia Ch. 10.1)
14	April 30	guest lecture: Monte Carlo methods for lattice models – condensed matter physics
15	May 5	basic numerical integration (Garcia Ch. 10.2)
15	May 7	Gaussian quadrature, quantum perturbation methods (Garcia Ch. 10.3)

Week	Date	Topics, Readings, Assignments, Deadlines
16	May 12	improper integrals, random numbers, Monte Carlo methods (Garcia Ch. 11.2)
Final Exam	May 21	Clark 111, 12:15−2:30pm