SF State PHYS 440/740: Computational Physics

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Course Format

Component	Units	Day & time	Delivery format	In-class time	Out-of-class time
Lecture	2 units	TTh 5:00-5:50	Synchronous online via Zoom	100 minutes	200 minutes
Lab	1 unit	TTh 3:30-4:45	Synchronous online via Zoom	150 minutes	50 minutes
			Total	**250 minutes**	**250 minutes**

Out-of-class times are minimums and not a guarantee of any particular grade, especially a grade of A which will require as much time as necessary to acquire competency in the course material. Students enrolled in the graduate section should expect to spend 50% to 100% more out-of-class time.

Quick note on e-mail contact

So that I can identify and respond to e-mails from you expeditiously, please put [PHYS440] or [PHYS740] at the beginning of the subject line. I will respond to emails within 48 hours.

Course Overview

Analysis and development of numerical algorithms with a focus on computer simulations of physical systems. Topics may include: finite difference methods for nonlinear ordinary differential equations and chaos theory, N-body gravitational systems, and molecular dynamics; numerical linear algebra; Fast Fourier Transforms, finite difference and spectral methods for partial differential equations; Monte Carlo methods for integration, Markov chains, statistical mechanics and spin systems; introduction to parallel programming. Lecture, 2 units; laboratory, 1 unit. (PHYS 740/PHYS 440 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

Course Objectives & Student Learning Outcomes

(1) To be able to analyze real-world systems in physics, and to make valid approximations and develop simplified models of such systems;
(2) To be able to translate models of physics phenomena into the language of mathematics;
(3) To be able to identify and implement the appropriate computational algorithms to solve the mathematical representations of models of physics phenomena;
(4) To be able to understand the limitations of any physics model, its mathematical representation, or its computational solution;
(5) To be able to communicate the results of computational investigations with both written expositions and appropriate visualizations.

Learning Resources

Required:
(1) "Computational Physics" by Mark Newman, CreateSpace Independent Publishing, 2013, ISBN-13: 978-1480145511, $48 (new). Chapters 2-5 can be downloaded for free at: `http://www-personal.umich.edu/~mejn/cp/index.html`.

Optional:
(2) "Numerical Recipes: The Art of Scientific Computing" by W. Press, S. Teukolsky, W. Vetterling, and B. Flannery, Cambridge University Press. Older editions are available for free at: `http://numerical.recipes`.
(3) "Computational Physics" by Richard Fitzpatrick, self-published. Available for free at: `http://farside.ph.utexas.edu/teaching/329/329.html`.

Prerequisites & Corequisites

(1) Math: introductory courses in differential equations and linear algebra
(2) Computer Science: introductory course in Python programming
(3) Physics: a complete introductory sequence in classical physics, some modern physics

Please see me if you have any concerns about your preparation.

Intellectual Property

Assignments & Grades

During the computer lab sessions, students will work on short, guided exercises to acquaint them with the computational algorithms discussed in lecture. These guided exercises will lead into more complex computational investigations that will be finished outside of class lab time. Students will be expected to produce visual representations (graphs, animations) summarizing their computational investigations of various physics phenomena. Graduate students enrolled in Physics 740 will be expected to have more detailed, sophisticated investigations.

This course will have no in-class or final exams.

Grades will be based on the following assessments:

6 Computational Assignments	75% (First assignment is 10%, subsequent assignments are 13%)
5 Peer Reviews	15%
2 Computational Show & Tell	10%

There will be a"grace period" of one week after the due date for each assignment, after which peer reviews will be assigned. If you are more than one week late on an assignment, you will not get to participate in peer review for that assignment, and you will lose the peer review points. Peer reviews will be due one week later. You will then be allowed to revise your initial submission for the assignment, which will be due one week later.

Letter grades will assigned according to the following scheme:

	A: 90.00% – 100.0%	A-: 85.00% – 89.99%	
B+: 80.00% – 84.99%	B: 75.00% – 79.99%	B-: 70.00% – 74.99%	
C+: 65.00% – 69.99%	C: 60.00% – 64.99%	C-: 55.00% – 59.99%	
D+: 50.00% – 54.99%	D: 45.00% – 49.99%	D-: 40.00% – 44.99%	F: 00.0% – 39.99%

Late Policy: Turning in assignments after the one week grace period will result in you not participating in peer review and losing all of the the peer review points for that assignment. If you are late turning in your peer review, you will forfeit half your peer review points for that assignment. Apart from that, I will evaluate all work turned in before **the hard final deadline Thursday, May 23, 2024.**

Policy on Collaboration & Academic Integrity

You are strongly encouraged to discuss course material with your fellow classmates. When working on assignmemts, first try to solve the problems on your own. Struggle. Struggle some more. If you get stuck, feel free to discuss overall methods and approaches with your classmates, but not the details! Your written solutions should be solely your own, and should be written-up in isolation from your fellow classmates. Copying is strictly prohibited. Using the internet to download solutions manuals is also considered cheating. Cheating via any method on exams will result in a grade of zero on that exam and being reported to the department chair and/or college dean for possible discipline.

Add, Drop, Withdrawal & Repeat Policy, Grade Option Deadline

Friday, February 16, 2024: Add/drop deadline. You can drop yourself from the class online without any penalty and without any record, for any reason. After September 11, students must petition for an official withdrawal.

Friday, May 10, 2024: Change grade option deadline (letter grade to CR/NC and vice versa). For CR, undergraduates need an equivalent grade of at least C-minus, whereas graduate students need an equivalent grade of B-minus.

Monday, April 22, 2024: Withdrawal for "serious & compelling reasons" deadline. If the petition is approved, the designation "W" will appear on the transcript. Students are only allowed to repeat a class once at SF State. Note that designations of W, WU, NC count toward this limit.

Friday, May 17, 2024: Withdrawal "by exception for documented serious & compelling reasons" deadline. Documents must be provided to support the petition to withdraw. If the petition is approved, the designation "W" will appear on the transcript. Students are only allowed to repeat a class once at SF State. Note that designations of W, WU, NC count toward this limit.

Expected Code of Conduct

Students may not capture audio, photos, or video from class sessions on their own devices without the explicit permission of the instructor and everyone present, unless part of a DPRC-authorized accommodation.

Students may not post any course materials to any third-party sites or post any recordings, screenshots, audio or chat transcripts in any setting outside the class; violations of this are subject to student disciplinary action.

In the mission statement of the department, we state: *"The pursuit of science is a human endeavor, and our department welcomes the full spectrum of humanity to contribute their perspectives, passions, and skills to scientific exploration.* **The Department of Physics & Astronomy will not tolerate any behaviors or actions from faculty, staff, and students that has negative impact on the educational & professional opportunities of any member of the department. Discrimination on the basis of race, ethnicity, nationality, religion, sex, sexual orientation, gender, gender identity, gender expression, marital status, medical condition, genetic information, veteran or military status, is strictly prohibited.**

Please pay close attention to the official SF State "Nondiscrimination Policy and Complain Procedures":
`https://bulletin.sfsu.edu/policies-procedures/nondiscrimination-policy/`

Violations of expected code of conduct will be reported to the Office of Student Conduct.

Disability Access

Students with disabilities who need reasonable accommodations are encouraged to contact me early in the semester. The Disability Programs and Resource Center is available to facilitate the reasonable accommodations process. The DPRC, located in Student Services Building 110, can be reached by phone at 415-338-2472 (voice/TTY) or by e-mail at `dprc@sfsu.edu`.

Religious Holidays

The faculty of San Francisco State University shall accommodate students wishing to observe religious and cultural holidays when such observances require students to be absent from class activities. It is the responsibility of the student to inform the instructor, in writing, about such holidays during the first two weeks of the class each semester. If such holidays occur during the first two weeks of the semester, the student must notify the instructor, in writing, at least three days before the date that they will be absent. It is the responsibility of the instructor to make every reasonable effort to honor the student request without penalty, and of the student to make up the work missed.

Student Disclosures of Sexual Violence

SF State fosters a campus free of sexual violence including sexual harassment, domestic violence, dating violence, stalking, and/or any form of sex or gender discrimination. If you disclose a personal experience as an SF State student, the course instructor is required to notify the Dean of Students. To disclose any such violence confidentially, contact:

The SAFE Place - (415) 338-2208; `http://www.sfsu.edu/~safe_plc/`

Counseling and Psychological Services Center - (415) 338-2208; `http://psyservs.sfsu.edu/`

For more information on your rights and available resources - `http://titleix.sfsu.edu`

Recording of Lectures & Privacy

As the instructor of this course, I will be using Zoom to record our class sessions/lectures for the sole purpose of supporting student learning. To maintain privacy, I will post links to the recordings in our campus's learning management system Canvas to limit access to the members of this course only. It is expected that students also refrain from sharing these recordings outside the context of this course. Students who have privacy concerns may turn off their video and/or change their user name for the duration of the session.

At the beginning of each recorded Zoom session, you will be prompted to acknowledge that the session is being recorded and that you would like to continue in the session. These recordings will be retained for one semester beyond the end of this course, to support students who may have received an incomplete grade, and will then be deleted. As always, any student who has concerns about these recordings may speak with me at any time during the semester to discuss your concerns.