PHYS 4840
Mathematical and Computational Physics II, 4 credits
University of Wyoming, Spring 2024

Class Times and Locations

TR 9:10–10:50 AM, from 17 Jan 2024 to 10 May 2024
Classroom Building Room 207

Instructor

Richard Barrans, Ph.D., M.Ed., Assistant Lecturer, Physics and Astronomy
PS 116, no phone in office, rbarrans@uwyo.edu.
Office Hours: M 2:10–3:10 PM, W 9:00–10:00 AM, TR 11:00 AM–noon

Teaching Assistant (Grading)

Harrison Leiendecker, (remote), hleiende@uwyo.edu.

Enrollment Restrictions

Prerequisites are MATH 2210, PHYS 2320, and PHYS 3000.

Course Description

Provides a comprehensive overview of computational physics and provides numerous numerical techniques applied to physics problems. Topics include numerical computations and visualizations, numerical solutions of ordinary differential equations, linear systems, curve fitting, discrete Fourier transforms, partial differential equations, integration, and Monte Carlo simulations of stochastic systems.

Student Learning Outcomes

- Code working programs in Python.
- Apply numerical computation to realistic physics problems.
- Communicate the operation and output of your programs using appropriate commenting, documentation, and presentation.

Textbook

Newman, Mark. *Computational Physics*. 2013. Bring your book to class.

Required Examinations, Assignments, and Activities

Exercises will be assigned in class. Students are expected to read the appropriate textbook sections on their own. The course will culminate with independent capstone projects.

Required Participation Outside of Class Meetings

The course description says there will be a weekly lab session; however, the class meets in a computer lab four hours a week, so that's it. Of course, read the textbook and practice coding outside of class.

Grading

The final grade will be determined from consensus between you and the instructor.

Item	Percent
In-class exercises	50%
Projects	50%

Exercises

These are short, or perhaps long, programming assignments to give you practice. Some exercises will be posted on-line via WyoCourses, and others may be assigned directly in class. Students are encouraged to work together on exercises, but are expected to submit their own work. Assignments that are not completed during class time should be finished outside of class.

Students are encouraged to steal code from anywhere they can, but comments in the code should acknowledge the source and explain how the code works.

Projects

The last several weeks of class will be devoted to independent projects of the students' choosing. These projects apply techniques of scientific computing to a problem of physical interest, and demonstrate the student's mastery of physics, problem-solving ability, and attention to detail.

When students choose projects, they will confer with the instructor to decide the scope of the project and criteria for success. When the project is submitted, they will again confer with the instructor to reflect on the project and grade it.

A note about grades: Your grade in this course reflects only your performance over a 15-week period on a limited set of evaluations. It does not reflect your worth as a person or what I think of you. Because of the limited scope of this course, your grade is not a prediction of your future success or an evaluation of your potential as a scientist. In short, do not cause yourself (or your instructor) anxiety by making more of your grade than it really is.

Attendance and Absence Policy

Attendance is expected in class sections, but there is no grade for attendance.

Course Components

Internet

Course information and assignments will be accessible through WyoCourses.

Student Conduct

Students are expected to respect others' opinions and abilities, and to help each other during group work activities. Those who repeatedly disrupt the class or interfere with other students' opportunity to learn will be asked to leave the class. If you have a cell phone or

any other personal audio equipment, ensure that it does not make noise during class. No unauthorized video or audio recording during class is allowed to protect the privacy of your fellow students. If you require recording for accommodation of disabilities, work with Disability Support Services and me to accommodate your needs.

Diversity

The University of Wyoming values an educational environment that is diverse, equitable, and inclusive. The diversity that students and faculty bring to class, including age, country of origin, culture, disability, economic class, ethnicity, gender identity, immigration status, linguistic, political affiliation, race, religion, sexual orientation, veteran status, worldview, and other social and cultural diversity is valued, respected, and considered a resource for learning.

Disability Support

The University of Wyoming is committed to providing equitable access to learning opportunities for all students. If you have a disability, including but not limited to physical, learning, sensory or psychological disabilities, and would like to request accommodations in this course due to your disability, please register with and provide documentation of your disability as soon as possible to Disability Support Services (DSS), Room 128 Knight Hall. You may also contact DSS at (307) 766-3073 or udss@uwyo.edu. It is in the student's best interest to request accommodations within the first week of classes, understanding that accommodations are not retroactive. Visit the DSS website for more information at: www.uwyo.edu/udss. Once UDSS informs me of the accommodations appropriate for you, I will implement them.

Academic Dishonesty Policy

Academic honesty develops respect between faculty and students, ensures fair and effective grading, and creates an environment that fosters learning. Although I encourage you to study with other students, any assignments, exams, and lab submissions must represent your OWN work.

Academic dishonesty will not be tolerated in this class. Cases of academic dishonesty will be treated in accordance with UW Regulation 2-114. The penalties for academic dishonesty can include, at my discretion, an "F" on an exam, an "F" on the class component exercise, and/or an "F" in the entire course. Academic dishonesty means anything that represents someone else's ideas as your own without attribution. It is intellectual theft – stealing - and includes (but is not limited to) unapproved assistance on examinations, plagiarism (use of any amount of another person's writings, blog posts, publications, and other materials without attributing that material to that person with citations), or fabrication of referenced information. Facilitation of another person's academic dishonesty is also considered academic dishonesty and will be treated identically.

Students are permitted to use advanced automated artificial intelligence or machine learning tools on assignments in this course only if instructor permission is declared in advance. Unless given permission to use those tools, students are expected to complete each assignment without substantive assistance from others, including automated tools.

Physics is fun. Involvement in a case of academic dishonesty is not fun.

Duty to Report

UW faculty are committed to supporting students and upholding the University's non-discrimination policy. Under Title IX, discrimination based upon sex and gender is prohibited. If you experience an incident of sex- or gender-based discrimination, we encourage you to report it. While you may talk to a faculty member, understand that as a "Responsible Employee" of the University, the faculty member MUST report information you share about the incident to the university's Title IX Coordinator (you may choose whether you or anyone involved is identified by name). If you would like to speak with someone who may be able to afford you privacy or confidentiality, there are people who can meet with you. Faculty can help direct you or you may find info about UW policy and resources at http://www.uwyo.edu/reportit.

You do not have to go through the experience alone. Assistance and resources are available, and you are not required to make a formal complaint or participate in an investigation to access them.

Disclaimer

Information in the syllabus was, to the best knowledge of the instructor, correct when distributed at the beginning of the term. The instructor, however, reserves the right, acting within the policies and procedures of the University of Wyoming, to make changes in the course content, schedule, or instructional techniques during the term. If any changes to the syllabus become necessary, students will be notified in class and on WyoCourses.

Student Resources:

- DISABILITY SUPPORT SERVICES: udss@uwyo.edu, 766-3073, 128 Knight Hall, www.uwyo.edu/udss
- COUNSELING CENTER: uccstaff@uwyo.edu, 766-2187, 766-8989 (After hours), 341 Knight Hall, www.uwyo.edu/ucc
- ACADEMIC AFFAIRS: 766-4286, 312 Old Main, www.uwyo.edu/acadaffairs
- DEAN OF STUDENTS OFFICE: dos@uwyo.edu, 766-3296, 128 Knight Hall, www.uwyo.edu/dos
- UW POLICE DEPARTMENT: uwpd@uwyo.edu, 766-5179, 1426 E Flint St, www.uwyo.edu/uwpd
- STUDENT CODE OF CONDUCT WEBSITE: www.uwyo.edu/dos/conduct

Tentative Schedule

Week of	Tuesday	Thursday
Jan 15	Course mechanics IDLE, Python exercises	2.2–2.3 Math coding exercises
Jan 22	2.3–2.7 Functions	2.4–2.7 Serial structures, looping
Jan 29	3.1–3.4 Static visualizations	3.5 Animations 4.1–4.3 Numerical considerations
Feb 5	5.1–5.3 Even-step integrating	5.4–5.6 Higher-order integrating
Feb 12	5.6–5.9 Practical concerns in integrating	5.10–5.11 Differentiation, interpolation
Feb 19	6.1 Systems of linear equations	6.2–6.3 Systems of nonlinear equations
Feb 26	6.4 Optimization	7.1–7.4 Fourier transforms
Mar 4	8.1 First order ordinary differential equations	8.2–8.5 More ordinary differential equations
Mar 11	**Spring Break**	
Mar 18	8.6 Boundary value problems	9.1–9.2 Partial differential equations
Mar 25	9.3 Initial value problems	10.1 Generating “random” numbers
Apr 1	10.2 Monte Carlo integration	10.4–10.4 Monte Carlo simulation
Apr 8	Project discussion	Project planning conferences
Apr 15		
Apr 22		
Apr 29		
May 6	**Finals Week**	**Project presentations** 10:15–12:15