PHYS 4840
Mathematical and Computational Physics II, 4 credits
University of Wyoming, Spring 2026

Class Times and Locations

TR 2:45–4:00 PM, from 20 Jan 2024 to 15 May 2024
Physical Science Building room 227

Instructor

Richard Barrans, Ph.D., M.Ed., Assistant Lecturer, Physics and Astronomy
PS 116, no phone in office, rbarrans@uwyo.edu.
Office Hours: M 3:10–4:10 PM, T 1–2 PM; W 7–8 PM; F 10–11 AM. The Wednesday evening office hours are held in PS 234. All other hours are in my office, PS 116.

TA: Sam Barber

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.

Required Materials

Textbook: Newman, Mark. *Computational Physics*. 2013.

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.

Grading

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

Item	Percent
In-class exercises	25%
Homework exercises	25%
Projects	50%

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. Your grade is not a prediction of your future success or an evaluation of your potential as a scientist or engineer.

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.

You are encouraged to steal code from anywhere you can, but comments in your 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 problem-solving ability, creativity, and content knowledge.

Attendance and Absence Policy

Attendance is expected in class sections, but there is no grade for attendance. Classwork should be started in class. You can get credit for two classwork assignments submitted without attending the class.

Course Components

Internet

Course information and assignments will be accessible through WyoCourses. Other resources will be posted at the course website at www.barransclass.com.

Classroom behavior policy

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 or video equipment, ensure that it does not become a distraction

during class. To protect the privacy of your fellow students, no unauthorized video or audio recording during class is allowed. If you require recording for accommodation of disabilities, work with Disability Support Services and me to accommodate your needs.

Pursuant to Wyoming state law, individuals who possess a valid concealed carry permit issued by the State of Wyoming may carry a concealed handgun on the University of Wyoming campus, except in designated restricted areas as defined by law and institutional policy. Permit holders are solely responsible for understanding and complying with all applicable federal, state, and local laws, as well as University of Wyoming regulations. Firearms must remain fully concealed and secured in a holster on the permit holder's body, or within a personal carrier (e.g., backpack, purse) that remains under the permit holder's immediate and continuous control at all times. If participation in course-related activities prevents the permit holder from maintaining exclusive control of their concealed firearm, it is their responsibility to make appropriate arrangements prior to attending class.

Academic Freedom and Institutional Discrimination

UW Regulation 2-15 on Academic Freedom states, "Academic freedom in teaching protects the rights of Academic Personnel to teach according to their expertise. Academic Personnel are entitled to freedom in discussing their subject. Academic Personnel have a responsibility to ensure that their teaching is effective and consistent with the standards of the discipline, understanding that disciplines may have diverse points of view on any given subject. Teaching may involve controversial material; however, with academic freedom in the classroom, Academic Personnel also have the responsibility to respect others' freedom to express disagreement and alternate opinions." Additionally, "Academic freedom does not negate the rights of students and the public to disagree with Academic Personnel's work, although students are expected to learn material with which they may disagree." Also adopted by UW in its Academic Freedom policy, "Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled."

Classroom statement on diversity

The University of Wyoming values an educational environment that supports students of all backgrounds and viewpoints. Diversity of viewpoints is considered a resource for learning. Topics may be difficult, not only intellectually but emotionally; however, discussions are essential to meeting the course's student learning outcomes and assisting students in developing problem-solving and critical-thinking skills. During all conversations, respect and civility are of utmost importance.

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.

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.

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

AI technology

Students are permitted to use advanced automated artificial intelligence or machine learning tools on assignments in this course if that use is properly documented and credited. For example, text generated by ChatGPT-5 should include a citation such as "GPT-5 Thinking." (YYYY, Month DD of query). "Text of your query." https://chat.openai.com/" Material generated using other tools should follow a similar citation convention.

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.

Green Dot program at UW

Here at The University of Wyoming, we are committed to reducing and preventing power-based personal violence such as sexual assault, relationship violence, and stalking. Green Dot is a bystander intervention program to reduce these forms of violence with one thought; If everyone does one thing, no one will have to do everything. A Green Dot is your choice at any moment to make campus safer by promoting safety for everyone and letting others know that you will not tolerate violence. A Green Dot is any behavior, choice, word or attitude that sends a clear message that:

1. Violence is not okay with you, and
2. Everyone is expected to do their part.

Additional information on Green Dot training and resources are available at http://www.uwyo.edu/greendot/.

Substantive changes to syllabus

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, by email, and on WyoCourses. Please check your university email daily.

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 19	Course mechanics IDLE, Python exercises	2.2–2.3 Math coding exercises
Jan 26	2.3–2.7 Functions	2.4–2.7 Serial structures, looping
Feb 2	3.1–3.4 Static visualizations	3.5 Animations 4.1–4.3 Numerical considerations
Feb 9	5.1–5.3 Even-step integrating	5.4–5.6 Higher-order integrating
Feb 16	5.6–5.9 Practical concerns in integrating	5.10–5.11 Differentiation, interpolation
Feb 23	6.1 Systems of linear equations	6.2–6.3 Systems of nonlinear equations
Mar 2	6.4 Optimization	7.1–7.4 Fourier transforms
Mar 9	8.1 First order ordinary differential equations	8.2–8.5 More ordinary differential equations
Mar 16	**Spring Break**	
Mar 23	Project discussion	Project planning conferences
Mar 30	8.6 Boundary value problems	9.1–9.2 Partial differential equations
Apr 6	9.3 Initial value problems	10.1 Generating “random” numbers
Apr 13	10.2 Monte Carlo integration	10.4–10.4 Monte Carlo simulation
Apr 20		
Apr 27		
May 4		
May 14	**Finals Week**	**Project presentations** 1:15–3:15