

Syllabus: Physics 5810 Computational Physics

Course Information

- **Course times:**
Lecture: Wednesdays & Fridays 12:40-2:45pm
- **Credit hours:** 4
- **Mode of delivery:** In person

Course Prerequisites

Prerequisites: CSE 1222, CSE 1223, CSE 1224, Astronomy 1221, Engineering 1221, or Engineering 1281H; and Physics 5500

It will be expected that you have some experience with one or more of: Mathematica, MATLAB, Python, C, fortran, or C++. The teaching strategy is to give you computer programs and have you run and then modify (or debug) them as you follow along through worksheets. Let me know if you are concerned about your preparation (e.g., if you have very limited experience).

Course Description

Experimental and theoretical aspects of areas of current interest in Computational Physics.

The goal of the course is to make every student comfortable in addressing physics problems using computational methods. Given that in contrast to the physics textbook's end-of-chapter problems, hardly any real life problems can be solved using pencil and paper, being comfortable using computational methods is a very important skill for every physicist. Being comfortable addressing physics problems with computers means knowing how to write good code, but also understanding the shortfalls of computational algorithms, and how to evaluate a computation's results for plausibility rather than just believing that everything that comes out of a computer must be correct. The course will address all these issues. In addition, we will hopefully also learn a bit of interesting physics that can only be addressed computationally; it is a physics course after all! Since the only way to learn computation is by doing, lecturing will be minimal and most of the class time will be spent hands on working through worksheets on the computers in the classroom (or your own).

The course will cover the following topics:

- Unix environment and how to write a computer program
- Rounding errors in floating point arithmetic

- Using scientific computing libraries
- Numerical differentiation and integration
- Solving Linear algebra, differential equations, and quantum mechanics problems with programming
- Parallel processing
- Oscillations, pendulums, and chaos
- Debugging, optimizing, and profiling
- Random numbers and Monte Carlo methods
- Ising model

Learning Outcomes

1. Write correct, clear, and well-documented computer code.
2. Know some of the tools (algorithms) of computational Physics.
3. Understand the limitations of computational solutions to Physics problems.
4. Understand where computational solutions to Physics problems are better than analytical solutions.
5. Have a better understanding of Physics through having to put Physics concepts into code.
6. Have a better understanding of Physics through playing with numerical solutions to Physics problems.

How This Course Works

Mode of delivery: This course expected to be delivered in person.

Credit hours and work expectations: This is a 4 credit-hour course. According to [Ohio State bylaws on instruction](http://go.osu.edu/credit%20hours) (go.osu.edu/credit hours), students should expect around 4 hours per week of time spent on direct instruction in addition to 8 hours outside of class to receive a grade of [C] average.

Attendance, grading, and participation requirements:

Pre-class readings (10%)

For most class periods, you will be expected to complete a reading assignment before class. These will be announced in class and on Carmen. On days with reading assignments you have to answer some questions about the reading using the "Quizzes" feature of Carmen by 3:59am the day of class. Your answers will not be graded; the only requirement is that you submit the questionnaires on time. Your credit for this section of the course is the fraction of the reading assignment feedbacks that you have submitted on time.

In-class worksheets (30%)

We will be spending most of the class time working in pairs on computational problems. As you are doing so, you will be filling out worksheets, which are handed in at the end of every section of the course. These worksheets will be graded using categories of outstanding (12 points), adequate (11 points), or needs improvement (10 points). The in-class worksheets can be submitted for unlimited re-grading until four weeks after they were first handed out or April 24 whichever comes first. The four week due date will be announced on the worksheet and in Carmen. It is firm in order to avoid procrastination.

Problem Sets (30%)

Problem sets will be due roughly every other week. They serve to ensure a thorough understanding of the material worked on in class. Since we all have many other commitments, they will be rather limited in length. The problem sets will also be graded using the categories of outstanding (12 points), adequate (11 points), or needs improvement (10 points). As long as you hand something showing credible effort in by the due date, you are allowed to make improvements based on grading comments until four weeks after the due date or April 24, whichever comes first.

Final project (30%)

In the latter half of the semester you will be asked to come up with a project of your own choice. There will be examples but you are also welcome to choose something from your own research as long as it involves computation. These projects are due on the last day of class, in Carmen. They will be graded using the same categories as the in-class worksheets and the homework. You are encouraged to discuss your projects with me as you are working on them.

Attendance (0%)

While I will not specifically take attendance, this being a hands-on class means that it just does not make any sense without you attending. Also note, that the in-class worksheets make up 30% of the grade. Of course, if you are sick or need to travel for a session or two let me know and I will do my best to accommodate this.

Academic integrity and collaboration: Your submitted assignments should be your own original work. We do encourage students to help each other understand the material. However, the bulk of each assignment should be - unambiguously - each student's own work. Science is a collaborative field and so working together is important, but one must be careful to distinguish one's own contributions from those of others.



Course Materials, Fees and Technologies

Required Materials and/or Technologies

There is no required text to buy but there will be readings for each class session from handouts passed out in class and background notes posted online. We will supplement these with readings from the [2015 lecture notes](#) by Morten Hjorth-Jensen from the University of Oslo. Prof. Hjorth-Jensen's course in computational physics covers similar topics. (His course web pages: [FYS3150 \(Links to an external site.\)](#) and [FYS4411 \(Links to an external site.\)](#).) These will be posted on Carmen. For a long list of other interesting books look at the "Textbooks" page in the "Useful information" Module on Carmen.

CarmenCanvas Access

You will need to use [BuckeyePass](#) (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you do each of the following:

- Register multiple devices in case something happens to your primary device. Visit the [BuckeyePass - Adding a Device](#) (go.osu.edu/add-device) help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- [Install the Duo Mobile application](#) (go.osu.edu/install-duo) on all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at [614-688-4357 \(HELP\)](tel:614-688-4357) and IT support staff will work out a solution with you.



Technology Skills Needed for This Course

- Basic computer and web-browsing skills
- [Navigating CarmenCanvas](https://go.osu.edu/canvasstudent) (go.osu.edu/canvasstudent)
- [CarmenZoom virtual meetings](https://go.osu.edu/zoom-meetings) (go.osu.edu/zoom-meetings)

Technology Support

For help with your password, university email, CarmenCanvas, or any other technology issues, questions or requests, contact the IT Service Desk, which offers 24-hour support, seven days a week.

- **Self Service and Chat:** go.osu.edu/it
- **Phone:** [614-688-4357 \(HELP\)](tel:614-688-4357)
- **Email:** servicedesk@osu.edu

Digital Flagship

Digital Flagship is a student success initiative aimed at helping you build digital skills for both college and career. This includes offering an engaging collection of digital tools and supportive learning experiences, university-wide opportunities to learn to code, and a Design Lab to explore digital design and app development. Digital Flagship resources available to help Ohio State students include on-demand tutorials, The Digital Flagship Handbook (your guide for all things tech-related), workshops and events, one-on-one tech consultations with a peer or Digital Flagship staff member, and more. To learn more about how Digital Flagship can help you use technology in your courses and grow your digital skills, visit go.osu.edu/dfresources.

What to do if you feel like you are falling behind

Reach out! Contact an instructor or TA, and we can help you develop strategies to help. We also strongly recommend that you form study groups--interacting with other humans helps solidify concepts. Everyone in the group brings a different perspective and skillset to the table.

Grading Scale

The grade for this class is determined by a weighted average of pre-class readings, in-class worksheets, homework assignments, and a final project. There will be no curve grading and I hope that everybody will get an A. The final grades will be determined according to the standard OSU scheme:

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70–72.9: C-
67–69.9: D+
60–66.9: D
Below 60: E

Other Course Policies

Discussion and Communication Guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Writing style:** While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using good grammar, spelling, and punctuation. A more conversational tone is fine for non-academic topics.
- **Tone and civility:** Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across to others.

Academic Integrity Policy

See [Descriptions of Major Course Assignments](#) for specific guidelines about collaboration and academic integrity in the context of this online class.

Ohio State's Academic Integrity Policy

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's [Code of Student Conduct](#) (studentconduct.osu.edu), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the university's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- [Committee on Academic Misconduct](http://go.osu.edu/coam) (go.osu.edu/coam)
- [Ten Suggestions for Preserving Academic Integrity](http://go.osu.edu/ten-suggestions) (go.osu.edu/ten-suggestions)
- [Eight Cardinal Rules of Academic Integrity](http://go.osu.edu/cardinal-rules) (go.osu.edu/cardinal-rules)

Copyright for Instructional Materials

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Statement on Title IX

All students and employees at Ohio State have the right to work and learn in an environment free from harassment and discrimination based on sex or gender, and the university can arrange interim measures, provide support resources, and explain investigation options, including referral to confidential resources.

If you or someone you know has been harassed or discriminated against based on your sex or gender, including sexual harassment, sexual assault, relationship violence, stalking, or sexual exploitation, you may find information about your rights and options on [Ohio State's Title IX website](http://titleix.osu.edu) (titleix.osu.edu) or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu. Title IX is part of the Office of Institutional Equity (OIE) at Ohio State, which responds to all bias-motivated incidents of harassment and discrimination, such as race, religion, national origin and disability. For more information, visit the [OIE website](http://equity.osu.edu) (equity.osu.edu) or email equity@osu.edu.

Commitment to a Diverse and Inclusive Learning Environment

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

Your Mental Health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. No matter where you are engaged in distance learning, The Ohio State University's Student Life Counseling and Consultation Service (CCS) is here to support you. If you find yourself feeling isolated, anxious or overwhelmed, [on-](#)

[demand mental health resources](http://go.osu.edu/ccsondemand) (go.osu.edu/ccsondemand) are available. You can reach an on-call counselor when CCS is closed at [614- 292-5766](tel:614-292-5766). **24-hour emergency help** is available through the [National Suicide Prevention Lifeline website](http://suicidepreventionlifeline.org) (suicidepreventionlifeline.org) or by calling [1-800-273-8255\(TALK\)](tel:1-800-273-8255). [The Ohio State Wellness app](http://go.osu.edu/wellnessapp) (go.osu.edu/wellnessapp) is also a great resource.

