Computational Physics – PHYS 410-0001 & PHYS 510-0001

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Semester:	Spring 2025 (Jan 13th – May 9th)
Class Number	4206 (410), 4241 (510)
Lectures:	Tue & Thu, 9:30 – 10:45
Location:	La Tourette Hall 227
Office hours:	Virtual by appointment, Tue&Thu 11:00-12:00
Webpage:	http://www.aglatz.net/teaching/compphys_S2025

Required textbook

- Benjamin A. Stickler, Ewald Schachinger, *Basic Concepts in Computational Physics*, 2nd Edition, Springer 2016.

Textbook contents covered in this course

- Chapter 1: Basic Remarks
- Chapter 2: Numerical Differentiation
- Chapter 3: Numerical Integration
- Chapter 4: The Kepler Problem
- Chapter 5: ODEs & Initial value problems
- Chapter 6: The Double Pendulum
- Chapter 7: Molecular Dynamics
- Chapter 9: The One-Dimensional Stationary Heat Equation
- Chapter 11: PDEs
- Chapter 12: Pseudo-random Number Generators
- Chapter 14: A Brief introduction to Monte-Carlo Methods
- Chapter 15: The Ising Model

In addition to the textbook content, I will briefly go over programming languages, development environments, data analysis and visualization as requested.

Course information, policies, and advice

- The course will be given partially as classroom lecture and follows selected chapters of the required textbook (see above), of which some will be given as reading homework. Most chapters are taught as classroom + hands-on practice in the computer lab (or personal laptop if more convenient).
- Some problems and programming tasks will be assigned as homework.
- No late submission of homework assignments or papers will be accepted and no make-up work will be offered for missed attendance or exams, unless a valid excuse is presented in official writing by an authorized party (e.g. a doctor's note supporting absence from class due to illness or a medical procedure, or the head

of a unit requesting advance permission for a student to be absent on certain days). Such excuses should be submitted in advance of the absence, if possible, but no later than within a week after returning to class.

- Programming skills and some familiarity with *python* or the *C programming language* are expected. The knowledge of a data plotting software would be very useful.
- The main purpose of this lecture is to provide an overview of the most common methods in computational physics and get practical expertise in applying them.
- Attendance is essential and will be part of the grade, since especially the "lab"-part of this lecture is important to get hands-on experience, which is part of the learning outcome.
- There will be a midterm exam. Exams are closed book and electronic devices are not allowed.
- A single handwritten page (one sided) and be brought to the exams.
- The final exam will be replaced by a final project each student or small group have to work out.
- Students are strongly encouraged to seek one-on-one consultation with the instructor for any need related to the course. Phone or e-mail can be used if schedule conflicts prevent in-person meetings. The more time one spends on the course, the more fruitful those sessions will be.
- Efforts will be made to communicate all important announcements relating to the course either by e-mail or by posting on the course pages listed above. In addition to paying prompt attention to notifications, students should make it a habit to visit those pages frequently - at least once the day before each class. However, some announcements may also be made verbally during lectures, and not communicated in writing. If a student is absent during any part of a lecture, it is her responsibility to follow up with the instructor to be sure that she did not miss any announcement. Ignorance of any announcement - written or verbal - shall not count as an excuse.
- To get the maximum out of each lecture, come prepared by reading in advance the part of the textbook that is going to be covered in class that day.
- Last, but not the least, be respectful and courteous to others in the class. Use of "smart" devices - such as laptops, tablets, or smart phones - for reasons other than class work during class is strongly discouraged. In particular, they must not be used for entertainment or communication while the class is in session. Everyone needs to do his/her part to help make the atmosphere in the classroom as conducive to learning as possible.

Learning outcome

At the end of the course, a student is expected to have a basic understanding of

- Common deterministic and stochastic methods to solve physics problems computationally,
- How to approach and implement them,

- And understand the results and their validity.

Having completed the course, a student should be able to

- Determine the best way to solve a physics problem computationally.
- Solve a physical problem on a computer.

Prerequisites:

CSCI 240, PHYS 300, and PHYS 370, or consent of department.

Grading

The final grade is determined according to

- 35%: homework.
- 20%: midterm exam.
- 15%: lecture attendance.
- 30%: final exam/project.

This results in a total score between 0 and 1, which is then multiplied by 12, rounded to the closed integer, divided by 3, and finally graded according to*
http://www.niu.edu/regrec/grading/gradingfaqs.shtml
Note: To pass this course, you MUST score at least 50% on the homework.
* values below 2 are round to the closed integer.

Academic Integrity

Good academic work must be based on honesty. The attempt of any student to present as his or her own work that which he or she has not produced is regarded by the faculty and administration as a serious offense. Students are considered to have cheated if they copy the work of another during an examination or turn in a paper or an assignment written, in whole or in part, by someone else. Students are guilty of plagiarism, intentional or not, if they copy material from books, magazines, or other sources without identifying and acknowledging those sources or if they paraphrase ideas from such sources without acknowledging them. Students guilty of, or assisting others in, either cheating or plagiarism on an assignment, quiz, or examination may receive a grade of F for the course involved and may be suspended or dismissed from the university.

Accessibility Statement

Northern Illinois University is committed to providing an accessible educational environment in collaboration with the Disability Resource Center (DRC). Any student requiring an academic accommodation due to a disability should let his or her faculty member know as soon as possible. Students who need academic accommodations based on the impact of a disability will be encouraged to contact the DRC if they have not done so already. The DRC is located on the 4th floor of the Health Services Building, and can be reached at 815-753-1303 (V) or drc@niu.edu.