PHYS 450: Advanced Physics Lab (Spring 2025)

DATE/TIME
Fridays 1:00 pm - 3:50 pm

LOCATION
Room: 001A Tiernan Hall (lab) and 107 Tiernan Hall (for occasional lectures)

OFFICE HOUR
Wednesdays 10:00 am-12:00 pm (other times by appointment)

INSTRUCTOR
Professor Hyomin Kim
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DESCRIPTION
Students will gain experience with experimental techniques, instrumentation, theoretical and applied electronics, solid state electronic devices, experiments in modern physics by performing quantitative measurements of fundamental physical parameters. This course focuses on solving problems, which occur in experimental measurements and offers basics of data acquisition, data analysis, data storage, and professional data presentation. Students perform lab experiments in a mostly unstructured setting, in which students are given the equipment and related manuals and perform experiments with very minimal instructor's supervision. Students are highly encouraged to plan experiments and perform necessary analyses independently.
*Prerequisites***:** PHYS 335 (Introductory Thermodynamics), PHYS 430 (Classical Mechanics I), PHYS 432 (Electromagnetism I), all with grade of C or better.

LEARNING OUTCOMES
- Learn about physical phenomena by performing quantitative measurements.
- Gain experience with techniques and instrumentation used in modern physics laboratories in academia and industry.
- Gain experience in solving problems, which occur in experimental measurements.
- Learn basics of data acquisition, data analysis, data storage, and data presentation.

ORGANIZATION
- This is a largely hands-on course, in which students learn about lab experiments in a mostly unstructured setting.
- There are no exams. Only lab reports, oral presentations and attendance will be graded. Lab reports must be prepared as a separate document, well-illustrated and explained. Neatness and thoroughness counts! The lab reports and presentations will be graded by the instructor.
- There will be presentation sessions at the end of the semester, during which each student will give an oral presentation about one of their experiments (see the course timetable for more details).
- Although your attendance may not be checked in every class, make sure to attend, as you will need to work with your group members. If you must miss a class, please send me an official notification in advance via email.
- Lab report due dates: The due dates for the assignments are shown in the schedule below (by 11:59pm on Mondays in the following week after each lab assignment is complete). If you have a legitimate excuse for not getting the lab done on time (i.e. equipment or due to sickness), seek permission to turn it in late from the instructor. Otherwise, you will receive 5% reduction in credit per week for a late lab report.
- Use of Canvas: Lab assignments and reading materials will be shared on Canvas. Some contents (e.g., schedule, lab topics) are subject to change due to uncertainties related to the class size, etc.

- Mode of delivery: It is expected that the students attend the class IN PERSON. There will be NO virtual mode of delivery (unless otherwise announced).
- Food and drink are NOT allowed in the lab (001A TIER).
- Students should work in pairs or triples and divide the work between them evenly. While the data will be shared, each student will write their own lab report. The goal of this course is to help students enhance their ability to solve experimental problems. You should try to work out problems for yourself, but the lab instructor and teaching assistant (if assigned) will be glad to make suggestions when necessary.
- While students are expected to show up in the lab during the period assigned to them, it may be acceptable to use the class hour flexibly (the instructor will give more details during the first class).
- Each student must attend the lab at the beginning of each period as there may be occasional, short lectures on lab report writing, presentation skills, computers, instrumentation, experimental techniques, etc.
- A lab notebook is highly recommended for each student to record everything about the experiment in the lab notebook: for example, a description of the experiment and appropriate references, sample calculations, detailed sketches of experimental apparatus, and relevant settings on instruments.
- All data should be recorded directly into the lab notebook or computer. Do not use scraps of paper for recording data.

RECOMMENDED REFERENCES

- Strunk and White, "The Elements of Style", (MacMillan, New York, 1979)
- Bevington and Robinson, “Data Reduction and Error Analysis for the Physical Sciences”, 3rd Edition,(McGraw-Hill Education, 2002)

REQUIRED SUPPLIES

- Lab Notebooks: It is highly recommended to have a lab notebook containing your notes while you take and analyze your data.
- Computer and Software: A personal computer is necessary for data analysis. It is recommended to install necessary software. A programming language to read data should be installed on your computer. Python is highly recommended.

POSSIBLE LABS

- Cavendish Experiment
- Quantum Analog Well/Quantum Analog Atom
- Fourier Methods
- Magnetic Susceptibility
- Photoelectric Effect
- DC plasma discharge
- Millikan oil-drop experiment
- Software defined radio receiver (or GNSS receiver) and magnetometer
- OTHER: Discuss with the instructor

GRADING

- The course grade will be based on lab reports (60%), oral presentation (30%), and attendance and participation (10%).
- Lab report due is shown in the schedule below (by 11:59 pm Eastern Time).
- Late lab reports without prior permission will be penalized (5% each week).
- Careful experimental technique and good quality lab reports are necessary for a good grade.
- The grading breakdown is as follows:
    - 85-100% A
    - 80-84% B+
    - 70-79% B
    - 65-69% C+
    - 55-64% C
    - 50-54% D

- 0-49% F

GENERAL LAB RULES

- There will be NO food, chewing gum, or beverages allowed in the Lab.
- If equipment seems to be malfunctioning, work with the lab instructor to address the issue.
- Lab manuals and equipment manuals may be signed-out for copying but must be returned immediately.
- Damaged or lost manuals should be reported for replacement.
- If you break something, report it immediately.
- Clean up after your lab session; leave the apparatus and work area in good condition for the next group.
- Return tools, support stands, rods, brackets, etc. to the proper place. If you don't know the proper place, ask.
- When you need a tool from a set (e.g. a set of wrenches), take the whole set, then return it whole. It is easier to locate a whole set than one missing piece.

ACADEMIC INTEGRITY

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: NJIT Academic Integrity Code. Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

OFFICE OF ACCESSIBILITY AND RESOURCES

Students who need academic accommodations in connection with a disability must initiate the request with NJIT Office of Accessibility and Resources (OARS). Students need to register with the Office of Accessibility in order to officially disclose their disability status to the College and to determine eligibility for appropriate reasonable accommodations (including any prior IEPs or 504s). Please contact OARS at the start of the semester (or as soon as possible) to coordinate any accommodation request/s: https://www.njit.edu/accessibility/, Room 201 (Kupfrian Hall) or email us at OARS@NJIT.EDU

GENERATIVE AI

In general, students are allowed to use generative AI tools (e.g., ChatGPT) to assist report writing and coding. However, it is not acceptable to copy and paste the entire contents generated by AI tools as it may be considered as plagiarism. The final product (lab reports) must be your own work.

VIDEO RECORDING

Video recording is allowed only to help students understand lab settings/procedures. Recording the entire lecture/class is prohibited.

CLASS SCHEDULE FOR SPRING 2025*

Note: Occasionally, there will be short lectures (see the schedule below) in FMH 403B.

Week	Activity
Week 1 (01/24)	Introduction and Review of Syllabus, START LAB 1
Week 2 (01/31)	
Week 3 (02/07)	Lab reports, papers, figures, LaTeX, Academic Research 101
Week 4 (02/14)	
02/17 Monday	LAB 1 DUE
Week 5 (02/21)	LAB 1 FEEDBACK SESSION
Week 6 (02/28)	
Week 7 (03/07)	
Week 8 (03/14)	HamSCI Workshop (@NJIT)
03/17 Monday	LAB 2 DUE
Week X (03/21)	Spring Recess
Week 9 (03/28)	LAB 2 FEEDBACK SESSION, Scientific Presentations 101
Week 10 (04/04)	
Week 11 (04/11)	
Week X (04/18)	No Class (Good Friday)
Week 12 (04/25)	
Week 13 (05/02)	PRESENTATIONS
Week 14 (05/07) Wednesday)	PRESENTATIONS Friday classes at NJIT run on Wednesday (May 7) - Last day of class
05/12	LAB 3 DUE

*May be subject to change.