

Spring 2024

## PHYS 450 - 002: Advanced Physics Lab

Hyomin Kim

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# PHYS 450: Advanced Physics Lab (Spring 2024)

## DATE/TIME

Fridays 1:00 pm - 3:50 pm

## LOCATION

Room: 001A Tiernan Hall (lab), 403B Faculty Memorial Hall (for occasional lectures)

## OFFICE HOUR

Fridays 10:00 am-11:00 am (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.

## OUTLINE OF THE COURSE

- 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 (e.g., amplifier gain, etc.).
- All data should be recorded directly into the lab notebook or computer. Do not use scraps of paper for recording data.

- Each team will do a total of THREE (3) experiments of their choice (see list of experiments) – There will be some alterations for Spring 2024 due to the total solar eclipse (April 8, 2024). The instructor will explain this during the first day of class.
- 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).
- Lab reports: Lab reports, written in Word or some similar word processor, are the final product of each lab assignment, and must be prepared as a separate document, well-illustrated and explained. Neatness and thoroughness counts! See the sample report and “Tips for Writing Lab Reports” (shared via “Files” on Canvas). The lab reports will be graded by the instructor.
- 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 not cooperating or due to sickness), seek permission to turn it in late from the instructor. Otherwise, you will receive 5% reduction in credit per day for a late lab report.
- There are no exams. Only lab reports, oral presentations and attendance will be graded.
- Use of Canvas: Lab assignments and reading materials will be shared on Canvas (“Files”). Some contents (e.g., schedule, in particular) are subject to change.
- 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).

### 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 (free). 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
- OTHER: Discuss with the instructor
- Special experiment for this year: High Frequency (HF) radio signal propagation experiment during the total solar eclipse (April 8, 2024).

### 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 day).
- 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](mailto:dos@njit.edu).

### CLASS SCHEDULE FOR SPRING 2024\*

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

Week	Activity
Week 1 (01/19)	Introduction and Review of Syllabus, START LAB 1
Week 2 (01/26)	Lecture (lab reports, papers, figures, LaTeX)
Week 3 (02/02)	Academic Research 101
Week 4 (02/09)	LAB 1 DUE
Week 5 (02/16)	LAB 1 FEEDBACK SESSION
Week 6 (02/23)	
Week 7 (03/01)	
Week 8 (03/08)	LAB 2 DUE
Week X (03/15)	Spring Recess
Week 9 (03/22)	LAB 2 FEEDBACK SESSION, Scientific Presentations 101
Week X (03/29)	No Class (Good Friday)
Week 10 (04/05)	
Week X (04/08)	Solar Eclipse
Week 11 (04/12)	
Week 12 (04/19)	
Week 13 (04/26)	PRESENTATIONS
Week 14 (Tuesday, 04/30)	PRESENTATIONS, Friday classes at NJIT run on Tuesday (May 2) - Last day of class
05/03	LAB 3 DUE

\*May be subject to change.