Spring 2022

PHYS 450-002: Advanced Physics Lab

Hyomin Kim

Spring 2022: PHYS 450

Time: Friday 1:00 - 3:50 pm
Room: 001A Tiernan Hall
Office Hour: Fridays, 10:00 - 11:00 am

INSTRUCTOR

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DESCRIPTION

In the advanced Physics Laboratory students will learn about physical phenomena by performing quantitative measurements of fundamental physical constants, like the speed of light and gravitational constant. Students will also gain experience with experimental techniques, such as Raman spectroscopy and x-ray diffraction, which are common in physics laboratories in academia and industry. 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. *Prerequisites***:** PHYS 335 (Introductory Thermodynamics), PHYS 430 (Classical Mechanics I), PHYS 432 (Electromagnetism I), all with grade of C or better.

LEARNING GOALS

- 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

MATERIALS

- A lab notebook that can be handed in for a grade
- Various supplies found from a hobby/craft store and a local convenience store for LAB 1.

RECOMMENDED REFERENCES

• For students taking 450, it is strongly recommended that you obtain a copy of:

- 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)

OUTLINE OF THE COURSE

- OTHER THAN LAB 1, students should work in pairs or triples and divide the work between them evenly. While the data will be shared, each student will write his/her 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.
- Students should show up in the lab during the period assigned to them and expect to spend the full three hours working on the experiment. Students who complete the course requirement before the end of the semester are encouraged to work on additional experiments for extra credit, but only during their regular lab hours. Exceptions should be discussed with staff.
- Each student must attend the lab at the beginning of each period; report to the staff if you will be leaving to do library or computer work on that day. Occasionally there may be short lectures on computers, instrumentation, experimental techniques, etc. at the beginning of the lab class.
- A lab notebook is required for each student. You should record everything about your experiment in the lab notebook. When starting an experiment, you should write down a description of the experiment and appropriate references, plus any notes you take from references, etc. Include sample calculations and detailed sketches of experimental apparatus. Note relevant settings on instruments (e.g., amplifier gain, etc.).
- All data should be recorded directly into the lab book. Do not use scraps of paper for recording data. If the data are acquired using a computer, then a digital copy may be required to submit along with the lab report.
- Each team will do one initial MANDATORY Experiment and then two experiments of their choice (see list of experiments). There will be a presentation of one of the experiments at the end of the semester (see the course timetable).
- Your lab reports must be submitted on or before the deadline. The experiments will be graded by the instructor.

POSSIBLE LABS

- Cavendish Experiment
- Quantum Analog Well/Quantum Analog Atom
- Muon Lifetime
- Fourier Methods
- Magnetic Susceptibility
- Hall Effect
- Photoelectric Effect

- OTHER: discuss with the instructor

GRADING

- Your final grade will be based on the total points obtained using the following schemes. Maximum values are shown below.
- Lab report due is shown below (by 11:59 pm Eastern Time).
- Late lab reports will be penalized (5% each day).
- Careful experimental technique and Physical-Review-quality lab reports are necessary for a good grade.
    - Lab Notebook Check 10
    - Experimental Results 10 x 3 labs
    - Experimental Report 10 x 3 labs
    - Presentation 30
- 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

NJIT has an honor code (see University Code on Academic Integrity) that you are all expected to apply rigorously to your conduct in this course. All work that you submit

must be your own. All written words and ideas must be your own, unless cited (and using quotes where appropriate). All books, web materials, or other sources that you consult must be included in a bibliography at the end of your report. Any violations will be reported to the Dean of Students.

CLASS SCHEDULE FOR SPRING 2022

Week	Activity
Week 1 (Jan 21)	Introduction and Review of Syllabus, **START LAB 1**
Week 2 (Jan 28)	Lab Reports, Papers, Figures, LaTeX
Week 3 (Feb 4)	Academic Research **START LAB 2**
Week 4 (Feb 11)	**LAB 1 DUE**
Week 5 (Feb 18)	LAB 1 FEEDBACK SESSION
Week 6 (Feb 25)	
Week 7 (Mar 4)	
Week 8 (Mar 11)	**LAB 2 DUE** **START LAB 3**
Week X (Mar 18)	**Spring Recess**
Week 9 (Mar 25)	LAB 2 FEEDBACK SESSION, Scientific Presentations 101
Week 10 (Apr 1)	
Week 11 (Apr 8)	
Week X (Apr 15)	**No Class (Good Friday)**
Week 12 (Apr 22)	**LAB 3 DUE**
Week 13 (Apr 29)	**PRESENTATIONS**
Week 14 (Tuesday, May 3)	**PRESENTATIONS** **Friday classes at NJIT run on Tuesday (May 3) - Last day of class**