Lahore University of Management Sciences

PHY 300 / PHY 500 – Experimental Physics Lab II / Graduate Physics Lab
Fall 2016

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Secretary/TA	Umar Hasan, Lab Instructor
TA Office Hours	
Course URL (if any)	http://physlab.org/lab-ii-phy-300/

Course Basics				
Credit Hours				
Lecture(s)	Nbr of Lec(s) Per Week	N/A	Duration	N/A
Recitation (per week)	Nbr of Rec (s) Per Week	N/A	Duration	N/A
Lab (if any) per week	Nbr of Session(s) Per Week	2	Duration	See timetable issued by Registrar's office.
Tutorial (per week)	Nbr of Tut(s) Per Week	N/A	Duration	N/A

Course Distribution	
Core	For Physics Majors and Physics Graduate (MS) Students
Elective	SSE
Open for Student Category	SSE
Closed for Student Category	N/A

COURSE DESCRIPTION
The course introduces the students to advanced and more rigorous experiments in physics, in which they cover a variety of important fields of physics through hands on experiments of varying complexity and duration. The course is offered mainly for students majoring in physics, as the most of it deals with the advanced concepts of physics and needs knowledge of fields varying from quantum mechanics optical physics

and solid state devices. Students are required to independently carry out the experiments and record their observations in properly maintained journals, demonstrating the essence of experimental science. Marking and evaluation greatly depends on students' capability to properly accumulate and critically interpret the experimental observations, which they have to prove in the form of reports.

COURSE PREREQUISITE(S)	
•	Experimental Physics I (PHY 100) for undergraduates

COURSE OBJECTIVES	
•	Advanced physics experimentation
•	Scientific report-writing
•	Stimulating research activity and building new hardware for research in experimental physics

Learning Outcomes	
	After successful completion of this course, students should be able to: 1. operate advanced scientific instruments with a keen sense of safety, ratings, ability to interpret various modes of operation; 2. obtain an appreciation of vacuum and low temperature systems, building hardware, thermal control of equipment, using measurement sensors and transducers, condition signals, acquire data into the computer; 3. analyze and interpret physical data acquired from experiments and correlate them with rigorous theory; 4. comment on corroboration of experimental results with theoretical predictions, explore the limitations of experimental work and devise ways of improvement and adapting experimental schemes for enhancing precision, accuracy, robustness; and finally, 5. write technically advanced scientific reports.

Grading Breakup and Policy

See the grading scheme that will be uploaded on http://physlab.org/lab-ii-phy-300/ .

Grading will be on a relative scale. However, I will decide the cutoffs based on my judgment.

Quiz and assignment on uncertainties	25
Quiz and work on data acquisition	25
Technical Report 1	25
Technical Report 2	25
Experiments (10 weeks of experimental work)	300
Total Marks	400

Expectations from Technical Report:

- Is the abstract really an abstract? Are the conclusions really conclusions?
- Are the sections titled properly? For example in an experiment that looks at the Franck-Hertz experiment using an oscilloscope, it is quite inappropriate to title a section "*The Oscilloscope*". The measuring apparatus is simply a tool that reveals the ionization curve of mercury in the Franck-Hertz tube. Yes, if you are performing on an experiment aimed at understanding the lock-in amplifier, sections titled "*Working Principle of a Lockin amplifier*" is quite apt.
- Avoid shopping lists of apparatus and equipment. The apparatus you use must be seamlessly integrated into the main text.
- Avoid reproducing text and figures from the laboratory manuals.
- Be consistent in capitalization. Avoid excessive capitalization: "*the cathode*" instead of "*the Cathode*" should be preferred.
- Don't copy-paste the figures churned out by Matlab. They have to be pruned, the fonts adjusted, the sizing has to make the axes and the labels readable, unwanted legent boxes showing "*data 6*", "*data 7*" don't mean anything. Gain familiarity with a nice graphics software. Our choice is Adobe Illustrator. You are free to choose your own.

- All symbols and figures should be in LaTeX's math mode. Units are preferred outside the math mode.
- Appropriate paragraphing is important. Each paragraph should start, in many cases, with a topic sentence. At the end of every paragraph, I should expect what to find next. This interwoven theme should be made clear at the very beginning. In short, don't make the report feel like a hop-on, hop-off route in a labyrinth, rather it should come out as one, logically consistent, unified thematic journey through the experiment.
- Only relevant theory must be discussed.
- Of course, grammar and style also matters. No need to be overly verbose, simple, succinct, short sentences are effective.
- Avoid using imperative tense and the second pronoun ("*you will lift a beaker*"), rather passive voice and past tense ("*the beaker was placed*").
- Use proper sentences. Each sentence ends with a full stop. An equation is a part of a sentence. All sentences must end.
- Avoid starting sentences with "and", "now", "also", "then", with symbols and numerals (1,2,565,-3, E, Vi) etc.

What am I specially looking for:

- Does the report intelligently choose the kinds of graphs that reveal underlying physical patterns. Are the variables correctly chosen? Are the scales appropriate? Do we have close-ups of regions that show some salient features, such as kinks, transitions, or other forms that are not visible in zoomed out views.
- Are similar graphs strung together as sub-figures or are they spattered as distinct graphs with their individual numberings.
- Is there sufficient level of cross-referencing and linking of graphs and tables.

- I am not interested in an uninteresting account of the procedure regurgitated from the manual, rather a concise description of the procedure interwoven with insight, discussions, suggestions and interpretations. This is by far the most important thing that I am looking for.
- Is the bibliography uniform? Are the citation schemes the same or different across the various references.
- Are the experimental parameters clearly stated?
- Are there sufficiently neat schematic illustrations that aid the readability of the text?

Marks will be deducted for:

- Not complying to rules of the lab: one must bring a lab notebook which is defined as a hard bound diary; one must leave the lab with all the apparatus in neat and orderly fashion so that it is ready for the next group; leaving cluttered pages and your personal belongings in the lab
- Missing a lab session: there will be no make-up labs
- Arriving late.
- Arriving in the lab without reading the experiment manual of the assigned experiment.

Examination Detail	
Midterm Exam	None
Final Exam	None

COURSE OVERVIEW

Week/ Lecture/ Module	Topics	Recommended Readings	Objectives/ Application

Here is a list of experiments:

http://physlab.lums.edu.pk/index.php/Experiment_in_Lab-II

	Code	
Studying Phase Transition With a Strain Gage	2.7	statistical mechanics
Measuring Muon Lifetime	2.20	nuclear
Gamma-ray spectroscopy	2.19	nuclear
Synthesis of High Temperature Superconductor Using Citrate Pyrolysis and Observing the Meissner Effect	2.18	condensed matter, materials
Low temperature conductivity	2.17	condensed matter, materials
Ellipsometry	2.16	condensed matter, optics
Surface Plasmon Resonance	2.15	optics
Energy dispersive X-ray fluorescence	2.14	nuclear
Synthesis and Ferroelectric Properties of KNO3 Films	2.13	condensed matter
The Magnetic Pendulum	2.12	non-linear
Tracking Brownian motion through video microscopy	2.11	statistical mechanics
Band Structure and Electrical Conductivity in Semiconductors	2.10	condensed

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	Code	
		matter, semiconductors
Michelson Interferometry	2.9	optics
Noise and Autocorrelation	2.8	signal processing
Faraday's Effect	2.6	magnetism, optics
Chaos and Non-Linear Physics	2.5	non-linear
Superconducting Quantum Interference Devices (SQUIDs)	2.4	quantum
Temperature oscillations in a metal: Probing aspects of Fourier analysis	2.3	thermal
Introduction to the Lock-in Amplifier	2.2	measurements, signal processing

Tuning a Laser Diode	3.6	optics
Investigating Longitudinal Laser Modes using a Scanning Fabry-Perot Interferometer	3.5	optics
Analyzing the Polarization State of Light through the Fourier Series	3.4	optics
Investigating Polarization of Light through Jones Calculus	3.3	optics
Diffraction from Single and Double Slits	3.2	optics

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Reflection, Transmission and Fresnel Coefficients	3.1	optics

	Experiment Code	
Projectile Motion	5.1	mechanics
Sliding Friction	5.2	mechanics
Colliding Pucks on a Carom Board	5.3	mechanics
Spring Pendulum	5.4	mechanics

In addition there will be sessions on:

1. Mechanical Workshop Practice
2. Data acquisition and Labview
3. Data processing, statistical analysis and scientific modeling
4. An optional studio track for design and implementation of new experiments

Textbook(s)/Supplementary Readings
Listed on course website: http://physlab.lums.edu.pk/index.php/Experiment_in_Lab-II