Methods of Experimental Physics I (Phys 537), Fall 2014

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Class Meeting Times and Location: 11:00AM - 11:50AM MWF, Room 103 Brockman Hall

Assignments: Weekly problem sets and self-scheduled bi-weekly laboratory exercises, including the machine shop practical course. Other than the machine shop course, labs take place in Brockman Hall 120. The door code is 6100#.

This is the first semester of a two-semester course, but each semester is independent.

Course Learning Goal: The course goal is to familiarize students with basic experimental techniques that are common to all physics research laboratories. It will provide hands-on knowledge, which is lacking in most undergraduate educations. The course is designed to prepare students to be contributing group members from the first day in the lab.

Topic Learning Goals: By the end of the course, students will be able to
(1) make proper mechanical design drawings and build simple components using machine tools,
(2) design, construct, debug, and be able to explain the function of electronic circuits involving passive components, transistors, operational amplifiers, and digital integrated circuits,
(3) apply the basic concepts of control theory to determine the stability and bandwidth of a feedback control system,
(4) read, write, and operate basic Labview™ programs,
(5) calculate the parameters of and choose appropriate components and materials for a vacuum system operating at low, high, and ultrahigh vacuum,
(6) apply statistics to describe the outcome of experimental measurements, and
(7) identify the appropriate detector technologies to use for various experiments involving light and particle counting, describe how they work, and know their capabilities and limitations.

Regular laboratory exercises will complement classroom sessions and problem sets. Laboratories will occur approximately every two weeks. Problem sets will be due weekly. Final grades will be weighted 50% homework, 45% labwork, and 5% class participation and course engagement.

The main textbook for Phys 537 will be “Building Scientific Apparatus,” by Moore, Davis, and Coplan, 4th edition. We will also extensively use “The Art of Electronics,” by P. Horowitz and W. Hill, 2nd edition, and its “Student Manual.” You should have a statistics book. A good one is “Data reduction and Error Analysis for the Physical Sciences”, by P. Bevington. “Feedback Loop Stability Analysis” by W. S. Friauf may also be useful. These are all on 2-hour reserve at Fondren, but I recommend buying them if you intend to pursue experimental science. If you need Ares access (https://rice.ares.atlas-sys.com/ares/), use password phys537.

The topics covered and approximate schedule will be:
Phys 537 (fall semester)

1. (6) Mechanical Design – materials and properties, tools and shop practices, mechanical drawing, Autocad.
2. (18) Laboratory Electronics – circuit theory, passive and active components, operational amplifier circuits, digital electronics, control theory.
3. (3) Labview Programming.
4. (5) Vacuum Technology – gas theory, outgassing, pumping speed, pressure measurement, pumps, vacuum hardware and design.
5. (6) Statistics and Signal recovery– recording and analysis of data, data uncertainty, Noise.
6. (4) Light and Particle Detector Technology

Honor Code and Grading Policy

Problems sets and laboratory exercise in this class are covered by the honor code. You are encouraged to work together and discuss subjects in the course, but you must write up your own problem sets and your own lab reports. You should never copy the work of another student. You may not look at solution sets from previous years or solution sets found on the internet.

Assignments that are turned in late will be penalized. The grade will be multiplied by a decaying exponential with a time constant of τ=1 day (final grade=original grade x exp[-time_late/τ]).

Redemption Points: Students may earn back up to 20% of all points lost on a given problem set or laboratory assignment by submitting a corrected version. Students should look at the solution set but are encouraged to rework the problem, rather than copy the solution. To receive credit, a student must submit corrected versions of all the problems on a given assignment on which he or she lost points. Corrected versions should be on a separate piece of paper attached to the original assignment. All corrected assignments must be submitted by the first Friday after the last day of class.

If you have a documented disability that will impact your work in this class, please contact one of the instructors to discuss your needs. Additionally, you will need to register with the Disability Support Services Office in the Ley Student Center.