Course: Methods of Experimental Physics I, PHYS 537
Term: Fall 2018
Room: Herman Brown Hall 22
Class: MWF, 11:00-11:50

INSTRUCTOR CONTACT INFORMATION

Instructor: Karl Ecklund
Office: Herman Brown Hall 232C
Email: Karl.Ecklund@rice.edu
Office Hours: by appointment

COURSE OBJECTIVES AND LEARNING OUTCOMES

Course Learning Objective: The course objective 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.

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. (15) Laboratory Electronics – circuit theory, passive and active components, operational amplifier circuits, digital electronics, control theory.
3. (4) 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. (6) Light and Particle Detector Technology

Topic Learning Outcomes: 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.

REQUIRED TEXTS AND MATERIALS

The main textbook for Phys 537 will be "Building Scientific Apparatus," by Moore, Davis, and Coplan, 4th edition. (ISBN 978-0-521-87858-6) We will also extensively use "The Art of Electronics," by P. Horowitz and W. Hill, 2nd edition (ISBN 0-521-37095-7), and its "Student Manual" (ISBN 0-521-37709-9). (Note: a 3rd Edition also exists.) 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. "Techniques for Nuclear and Particle Physics Experiments," by W. R. Leo, good sections on basic statistics, detectors, and fast electronics. These are on 2-hour reserve at Fondren, but I recommend buying them if you intend to pursue experimental science.

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 9320#.

GRADE POLICIES

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

RICE HONOR CODE

In this course, all students will be held to the standards of the Rice Honor Code, a code that you pledged to honor when you matriculated at this institution. If you are unfamiliar with the details of this code and how it is administered, you should consult the Honor System Handbook at http://honor.rice.edu/honor-system-handbook/. This handbook outlines the University's expectations for the integrity of your academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process.

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.

DISABILITY SUPPORT SERVICES

If you have a documented disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with Disability Support Services (Allen Center, Room 111 / adarice@rice.edu / x5841) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

SYLLABUS CHANGE POLICY

This syllabus is only a guide for the course and is subject to change with advanced notice.