Welcome to Physics 123/253 Signals&Noise!

Tue/Th 2:10 – 3:30 Physics 185, plus lab.

Prerequisite(s): Physics 9ABCD [or 9HA-9HD] and 104A, or equivalent. Techniques of measurement and analysis designed to avoid systematic error and maximize signal/noise ratio. Illustrative examples of optimal filters ranging from condensed matter to cosmology.

This course has a website described below.

This course combines studies in techniques of measurement of low-level signals in physics with a lab component. There is also a scientific writing component. In this course you will learn how things work (electronics and some optics), the nature of fundamental noise, how to make measurements, solve problems encountered in experiments that detect low level signals, how to analyze data, identify sources and nature of error and estimate their numerical significance on key findings of your experiments, and write up scientific reports on your experimental results. Like in real life experiments, you will need to find your way through unknowns and failures. (Not cook-book type experiments. You will "own" your experiment, from design to analysis to publication.) There are some required lab experiments designed to familiarize you with electronics and test and measurement equipment, and then you will chose one of several elective experiments to focus on. Students will be assigned to their main experiment in roughly equal numbers based on a survey.

For the lab component, you will work in small teams. However you will record/analyze experimental set-ups and data, and write lab reports by yourself. The first day of the class (Sep 26) will be on organization matters and on statistics and error analysis. It is very important that you read the assigned and suggested reading BEFORE class. You will not have time to come up to speed during lab class. Homework will be assigned in-class or on the web *Calendar* page for that week. Your first lab begins the following week. Your first week is critical. You should gain working knowledge of data analysis, error estimation, and least-

square fitting methods before week1, so that you can undertake the experiments and homework. You will find Bevington and Robinson "Data Reduction and Error Analysis for the Physical Sciences" a useful reference. *Individual work is stressed. Thorough write-ups of your experiments in the style of a scientific publication are required.*

A spiral bound lab book with large gridded and numbered pages: the Ampad #22-157, 9-1/4 x 11-3/4 inch (available in the Bookstore) is required.

We have created a web site which contains most of the material you will need. It also describes the mandatory and elective labs for 123/253. You are encouraged to explore the various web pages on the individual experiments: read the overview, experiment guides, related material, etc, but do not expect the guides to be like cookbook manuals. The 123 / 253 website:

http://123.physics.ucdavis.edu

To access weekly assignments and resources, go to the *Calendar* tab. In advance of the first meeting of the class on Sep 26, read the web page material on Week0: "Guide & Homework" and "Study Guide" and corresponding resources, particularly chapter 10 in Melissinos on "Elements from the Theory of Statistics". Be prepared to discuss this material in class.

Homework is assigned for Sep 26 (see *Calendar*) and is due at the following class.

The lecture/discussion class will meet in physics 185, and will be interactive. On some Tue/Th classes the last 20 minutes will be in the lab, and on a few days the entire class period is in the lab. See the *Calendar* for updated schedule. The various experiments are spread between 154 and 156 Roessler and you will start those in Week1. You will need to spend a few hours per week on your experiments. The lab is open 5 days per week 9-4:30. Enter through Roessler 156. Your TA is Andrew Bradshaw, with lab equipment support from Brian Barnett. See the *Calendar* page for each week and also the *Projects* tab. More details can be found there.

Grading is based on midterm and final exams, your formal project report, homework, lab book, and in-class participation. The midterm consists of two parts, one of which is a “practical” 15 minute in-lab demonstration of your electronics and test equipment knowledge.

Finally, in advance of the first class on Sep 26 please send me a brief email describing your scientific interests plus details on the pre-requisite courses for Signals&Noise that you have taken:

tyson@physics.ucdavis.edu