

Physics 486 Syllabus
Spring 2008
Prof. Viano

Course Description/Goal: Senior seminar is designed to integrate the various topics of your undergraduate physics education into an experience that completes your transition from student of physics to professional physicist. One very important part of this is learning how to give a good research presentation. This skill is absolutely essential to the success of a 21st century scientist. It doesn't matter how great your work is if you can't communicate it to others. Other topics include essential skills for future researchers, ethical issues in science, and the role of the true citizen scientist.

Course meeting times: We will meet for the equivalent of two hours a week, at a time to be specified by acclamation. Some of those meetings will be the normal departmental seminars, which are from 3:30-5:00pm on designated Thursdays.

Expectations: You are expected to attend all required meetings and presentations, be prepared for each meeting by having completed outside reading or other preliminary work.

Assignments:

The Seminar Presentation: you will give a 45 minute long seminar on a physics-related topic of your choice on the date specified. Usually this seminar covers a research project in which you were involved at some point during your college career, but it could also be on a topic you find interesting and would like to present to a general public audience.

Other assignments: two of the five possible activities listed below will be selected by the class at the first meeting:

1. *a journal club on current topic in physics*

How do you read a scientific article effectively? In a *good* journal club, everyone reads the same article on some interesting topic prior to a group discussion *and* prepares careful thoughts on a few pre-designated topics. One person leads a *discussion* (not a report) of the article and the pre-designated topics (which could be a novel experimental method, an emerging subfield of physics, etc).

2. *the effective literature search*

You're given a new research topic and told to "search the literature" to see what's been done in that area and what problems or questions remain to be answered so you can design your project. How do you get this information from the peer-reviewed literature? How do you use a periodicals database? How do you access the articles once you know what you want to read? Do you actually have to go into a library and get the journal off a shelf? (and the answer is "yes" more than you think). We could each take a topic and find out the current state of things from the peer-reviewed literature. This activity could be tied to #1.

3. *learn how to perform statistical tests on real data with Analyze-It*

When you submit a scientific paper, the reviewers expect proper statistical analysis on the data, and significant results indicated only when there is true statistical significance. There are about fifty different ways to test data for significance, and the type of test depends on the number of variables, the number of data points, and the independence (or dependence) of the variables. The Excel add-on program *Analyze-It* is an excellent tool for analyzing typical data sets found in physics research. By learning to effectively use this package, you will also receive a crash course in "useful" statistics.

4. *plan and implement a science outreach event at a public school or other venue*

In 1987, the Harvard-Smithsonian Center for Astrophysics performed a survey highlighting a serious dilemma facing US education; even the best and brightest fail to fully grasp the most basic scientific concepts.¹ A 2002 survey by the National Science Foundation found that half the public didn't know that electrons are smaller than atoms or that dinosaurs and humans never walked the earth together. In 4th grade, U.S. kids are at the head of the pack in science achievement. By 8th grade, they start to fall behind the leaders. By 12th grade, U.S. students are far behind almost all those other industrialized nations.

An outreach project of your own design will give you the opportunity to use your knowledge of physics to excite young people about science and show them that learning science is stimulating, surprising, rewarding, and fun. At the same time, it will help you gauge your level of scientific growth and confidence.

5. *discuss scientific ethics by reviewing test cases in science/math*

This statement on Engaging Students in Issues of Professional Conduct was adopted by the Society of Physics Students (SPS) and Sigma Pi Sigma Council on September 29, 2006:

The professional behavior of researchers is integral to the success of individual scientific investigation as well as to the ongoing success of science itself. Incidents of dishonest research or authorship practices, while rare, undermine the efforts of those working towards the advancement of science for the benefit of humanity. These dishonest actions, committed in the interest of career advancement, name recognition, financial gain, or simply through ignorance, are deplorable and should be seriously addressed by the physics community.

The Society of Physics Students (SPS) recommends that physics departments include a "professional ethics" education component in their programs at both the undergraduate and graduate levels. This component should focus on promoting honest and professional conduct in students' careers by involving them in discussions of responsible scientific behavior.

We could read and discuss case studies provided by the Society of Physics Students National Council as a way to consider our own opinions and development as ethical scientists.

Grading: Your grade for seminar is weighted as follows.

Main presentation: 50%

Other assignments: 50%

"If you cannot - in the long run - tell everyone what you have been doing, your doing has been worthless."
- Erwin Schrodinger, Science and Humanism

¹ "A Private Universe", Harvard-Smithsonian Center for Astrophysics, Science Education Department, Science Media Group. ISBN 1-57680-404-6