Physics 380: Applied Laboratory Techniques
Class Meeting Time, Room
Semester

Instructor Information

Dr. Stephen Tsui
stsui@csusm.edu
760-750-4144
SCI2 Room 217
Office hours:

Text

Materials will be made available on the course website. You may be interested in also referring to texts such as *Practical Physics* by Squires or *The Art of Experimental Physics* by Preston.

Course Description

Physics 380 is an advanced laboratory course for Applied Physics majors that emphasizes experimental design, data analysis, troubleshooting, and technical writing. In many ways, 380 serves as a primer that will introduce you to the culture of research in physics and prepare you for your future careers in industry or academia. You will conduct experiments, investigate scholarly literature, perform data analysis, and exercise professional writing.

Student Learning Outcomes

- Develop good experimental work habits and record keeping.
- Gain experience with data analysis.
- Develop insight into experimental design.
- Gain experience with literature review and technical writing.
- Hone your professional judgment.
- Become prepared to work in a research environment.

Grading

Project Reports	60%
Term Project	20%
Laboratory Notebook	10%
Additional Assignments	10%

As with all things involving experiment, all items in this document are subject to change at the wanton discretion of the instructor. Due notice will be given.

Drop In Times

Although the course officially meets Tuesday and Thursday from 2:30-5:15, drop-in times to work on experiments will be allowed so long as there is on-duty staff available in the building to support the equipment. This does not necessarily mean these people can answer all your questions, but they will be around to provide safety consultation and track down supplies if necessary.

Support Technicians

Janine x8011, Rm 241	Monday-Friday 8:30 am-3:30 pm
Kim x8224, Stockroom	Monday-Friday 1:30 pm-6:30 pm
Raechel	TBD

Emergencies, call CSUSM PD at x4567 or 911

Any experiments taking place in Dr. Tsui's laboratory or involving the plasma cart must occur while Dr. Tsui is available in the building, especially on Mondays, Tuesdays, and Thursdays. He must be notified before any work can be conducted. First use of the hydraulic press, furnace, or VersaLab requires Dr. Tsui to be in the laboratory.

The Advanced Laboratory Suite

You will be working in groups to perform experiments. Some of our set-ups are intended to reinforce what you have already learned in your other courses. Some of the experiments will expose you to techniques and ideas that you perhaps have not seen elsewhere. Depending on the difficulty, you will be given between one to three weeks to work on an experiment. Lab reports are expected the week after obtaining your data, and lab notebooks can be checked at any time. Available experimental suites include:

Surface Probe Microscopy: STM and AFM
Plasma Physics: the Paschen curve and Langmuir probe
Charge: Millikan's oil drop
Optics: Michelson Interferometry
LabVIEW: create your own data acquisition system
Electronic Noise: voltage measurement using a lock-in amplifier
NMR: Earth's field NMR apparatus
Particle Physics: determine the muon lifetime
Superconductivity: YBCO synthesis and characterization using VersaLab

You will also be responsible for any additional homework assignments, and your term project will be a mock grant proposal which will be described at the end of this document.

Course Schedule and Deadlines

Term Project Abstract	date
Rocket Car Races	date
Term Project	date
Peer Review of Term Projects	date
Peer Review Response	date

Academic Honesty

You will be working in groups throughout this course, but it is important that you contribute meaningfully to the work. First, you know by now that the best way to learn is by doing. Second, one day, I might have to serve as a reference for you, and every questionnaire asks how well you work in a group.

Official CSUSM Statement: "Students will be expected to adhere to standards of academic honesty and integrity, as outlined in the Student Academic Honesty Policy. All written work and oral presentation assignments must be original work. All ideas/material that are borrowed from other sources must have appropriate references to the original sources. Any quoted material should give credit to the source and be punctuated with quotation marks. Students are responsible for honest completion of their work including examinations. There will be no tolerance for infractions. If you believe there has been an infraction by someone in the class, please bring it to the instructor's attention. The instructor reserves the right to discipline any student for academic dishonesty, in accordance with the general rules and regulations of the university. Disciplinary action may include the lowering of grades and/or the assignment of a failing grade for an exam, assignment, or the class as a whole."

Lab Report Format (assuming single 1.15 spacing and single column)

Each laboratory team will upload one report per project, preferably in PDF format on Cougar Courses. Both content and quality of writing will be evaluated. Organize the reports as:

Abstract (500 words maximum) – 3% of grade

Summarize the significance of the experiment and your results.

Background (approximately 1 page) – 10% of grade

Present the relevant background information that allows the reader to understand the significance and purpose of the experiment. General textbook knowledge does not require referencing, but you must cite any specialized information you find. *Wikipedia is a fine place to start your research, but it is not something that you can cite!*

Experimental Methods (approximately 1-2 pages) – 15% of grade

Describe the experiment and any quirks that might have been associated with the experimental setup.

Data and Discussion (approximately 1-2 pages per figure) – 55% of grade
Your data is the starring role, and what you write is the supporting cast. For each figure, insert a descriptive caption in 10 point font underneath it. Make sure that your figures are well labeled and contain the results of error analysis. For each figure, write a detailed description and explanation of the figure, including physical meaning and experimental setup parameters where relevant. Calculations do not have to be explicitly shown (that is for your laboratory notebook), but you must summarize any type of analysis that was necessary for each figure, such as a basic equation or mathematical method. Also identify any sources of error. This is where you prove that you understand your results.

Conclusion (approximately 1 page) – 10% of grade
Present the outcomes of your work and the significance of the experiment. Also offer comments on future improvement.

Group Contributions – 5% of individual grades
List the names of your group members and briefly list their contributions. This is a way to help ensure everybody is pulling their fair share of the work.

References – 2% of grade
Use standard American Physical Society citation format, which can be found at:
https://journals.aps.org/authors/references-physical-review-physical-review-letters

Laboratory Notebooks
You may either keep a paper or digital notebook while you work on the experiments. Your notebooks will be spot-checked for completion and quizzed. For instance, I can ask you for written details of a project or simply ask you to show me something pertinent.

What I expect to find in your notebooks are:

- Dates and Title Headings of activities
- Description of the experimental setup, which should include test parameters and *drawings*
- Raw data and figure sketches
- Notes regarding experimental difficulties or procedures you tried
- Equations pertinent to any analysis, and rough calculations
- Written locations of pertinent computer files
- Printed copies of your plots or tables taped onto or inserted in the pages
- Scientific notes and ideas
- No erasing. Crossed out errors by single or double lines, only.

The analytical work that you do not put in your lab reports must either be written in your lab notebook or clearly shown in a computer data file.

Term Project (assuming single 1.15 spacing and single column)

Your term project will be to search the literature for an experiment that you find interesting, redesign or improve upon the experimental method, and write a relatively short proposal for your idea. The redesign can either improve on the quality of the obtained data or yield additional data that might complement the original results. Whether you go into industry or academia, if you are put in charge of a research team, you will eventually have to write a proposal.

Term Project Abstract *(approximately 1 page) – 10% of project grade*

After you find an article about the experiment that you are interested in, write a one page summary of the experiment, its results and significance, and what you propose to modify. You do not have to go into any great detail, and you are free to change your ideas as you continue to work on your project.

Term Project *– 70% of project grade*

Abstract (500 words maximum) – 3% of grade

Summarize the significance of the experiment.

Background (approximately 1-3 pages) – 15% of grade

Present the relevant background information that allows the reader to understand the significance and purpose of the experiment. General textbook knowledge does not require referencing, but you must cite any specialized information you find. *Wikipedia is a fine place to start your research, but it is not something that you can cite!*

Experimental Methods (approximately 2-5 pages) – 35% of grade

Describe the original experiment and your redesign. Include figures.

Expected Outcomes and Impact (approximately 2-5 pages) – 35% of grade

Why are you suggesting your changes? What will improve, or what new information will be obtained? Include original data figures and discuss your impact on those figures.

Budget Table – 10% of grade

Create a table that lists out what you need, what its purpose is, and how much the item costs (with the name of a company that you can buy it from).

References – 2% of grade
Use standard American Physical Society citation format, which can be found at:
https://journals.aps.org/authors/references-physical-review-physical-review-letters

***Peer Review** – 5% of grade*
You will be tasked with anonymously reviewing and rating another classmate's proposal and presentation. In your one page review, you will:

- Summarize the experiment and its significance
- Mention one thing that you like about the proposal
- Mention one thing that you do not like about the proposal
- Ask one qualitative technical question about the proposal
- Rate the proposal and presentation (will not affect the classmate's grade)
    - Poor, Fair, Good, Excellent

***Peer Response** – 5% of grade*
You will write a one page letter responding to your reviewer. You will address the one thing your reviewer did not like and answer their one technical question about your proposal. Do be cordial as you write your response.