

Advanced Physics Lab 3119 / 3129

SS 2020

Instructors:

Dr. Daniel Fischer

email: fischerda@mst.edu

tel: (573) 308-2782

office: 120 Physics

lab: G10 Physics

office hours: by appointment

Joel Peacher (peach@mst.edu) available at lab times.

Staff:

Electrical: Andy Stubbs (126 Physics)

Mechanical: Ron Woody (G6 Physics)

Meeting Time/Room:

Tue/Thu 12:30pm-15:15pm

208 Physics

Prerequisites:

Physics 2129

Goals:

The Advanced Lab consists of two semesters of independent, team-based, research projects, typically taken in the Junior or Senior years. The overall goal of this course is to give you the experience of doing an experimental research project, which includes finding an interesting scientific question to be investigated, designing an experiment that is suited to answer the scientific question, setting up and performing the actual experiment, analyzing the experimental data and deriving quantitative results, and both presenting the results in oral and written form. These are all critical elements in the research world for either applied or basic researchers and will help you to develop and deepen the understanding of scientific methodology.

Major components of the course:

- Short written research proposal

The objective of this proposal is to convince your instructor that your experimental physics project idea is interesting and feasible with the given resources. It should include the following:

- Project title and names of investigators

- Scientific question of the research project, background, and hypothesis
- experimental realization, layout of the planned setup and detectors, measured experimental observables
- cost estimate (if applicable)
- References to other published scientific works
- Experimental work, set-up, measurement, and documentation (Individual notebooks)

All research must be documented. The object is to be able to prove that the research was actually done. This is one of the most critical skills a researcher must have. Without proper documentation it is impossible to later write a paper about the research that has been done. In this class, your **individual** notebook is the proof that you participated in the research.

- Midterm presentation

This presentation is the first of two talks which will give you practice speaking to a group of peers. The objective is to give an introduction in your research project, present the scientific question and any preliminary results you have, describe the work you hope to accomplish in the rest of semester, and try to convince a friendly yet skeptical group of people that you know what you are talking about.

- Final report

This report should be written as if you were going to submit a paper to a scientific journal. It should contain the following elements:

- Abstract: conveys full report concisely and effectively
- Introduction: includes background/hypothesis/predictions
- Methods: give enough detail to allow for replication
- Results: A careful analysis of the experimental data is extremely important. There should be a quantitative result which includes an analysis of statistical and systematic experimental errors. Include tables or graphs of measured quantities.
- Discussion: relate results to hypothesis & predictions/discuss outcome

Moreover, the report should be technically sound (grammar, spelling conciseness, etc.) and contain proper citations where required.

In writing this document you will rely on your notebooks, which will contain all the details of your work. The best is to be working on the final report throughout the semester.

- Final presentation

In this talk you will present the work you accomplished in this course. Similar to the final report, it should contain the following elements:

- Introduction: establish motivation/hypothesis/prediction
- Methods: explain in detail
- Results: present measured data and describe analysis
- Discussion: Discuss outcome/respond to Q & A

This talk should be presented with organized slides and effectively using visuals, diagrams, or tables. Being able to clearly explain your research to others is an imperative skill for all scientists.

- Teamwork

All experimental research projects rely on the effective cooperation of several individuals. The advanced lab is ideal environment to train your teamwork skills. Therefore, research projects should typically be done in groups of 3-4 students which are formed at the beginning of the semester. Even though a clear assignment of tasks in the team is effective and desirable, it is important that all the students of one group

contribute equally to developing the research idea, writing the lab report and doing the midterm and final presentations.

Grades:

Your grade will be based on the sum of the components listed above. It will **NOT** directly be based on the success of your research project. However, your grade will depend on you being able to prove that you were an active participant in the research project and showing an understanding of the scientific methodology.

Course points:

| | |
|---------------------------|--------|
| Proposal | 150 P |
| midterm presentation | 150 P |
| final presentation | 150 P |
| final report | 400 P |
| overall experimental work | 150 P |
| <hr/> | |
| SUM | 1000 P |

Grades:

| | |
|---|--------------|
| A | ≥ 900 points |
| B | ≥ 800 points |
| C | ≥ 700 points |
| D | ≥ 600 points |
| F | < 600 points |

Due dates:

| | |
|------------|----------------------|
| 02/02/2020 | Proposals |
| 03/03/2020 | Midterm presentation |
| 05/05/2020 | Final presentation |
| 05/05/2020 | Final report |

Safety:

Safety is everyone's responsibility. The instructors and staff do their utmost to ensure a safe learning environment, but in the end it is your skin. Students should always consider any potential risks involved in an experiment, e.g. those associated with the use of high voltages, chemicals, radioactive sources, lasers, ultraviolet light, cryogenic fluids, heating elements, heavy equipment, heavy metals, cutting edges, particulate dust, intense sound, high pressure gas, or vacuum. Any technical instrumentation may only be operated after approval of the instructors or staff. Lasers, chemicals, radioactive sources, liquid nitrogen, etc., may only be handled after the corresponding safety training. **Food and drinks are not allowed in the laboratory.** All safety related incidents, including close calls, must be reported to the instructors.

Disability support service:

It is the university's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please contact your lab instructor and the Student Disability Services at (573) 341-6655, sdsmst@mst.edu, visit <http://dss.mst.edu/> for information, or go to mineraccess.mst.edu to initiate the accommodation process.

Academic dishonesty:

You should behave as responsible scholars and scientists. Academic dishonesty such as plagiarism, cheating, or sabotage is unethical and unacceptable. For more detail see the Student Academic Regulations 2017 which are available at <http://registrar.mst.edu/academicregs/index.html> and the Honor Code developed and endorsed by the Missouri S&T Student Council at <http://stuco.mst.edu/honor-code/>.

Title IX:

Missouri University of Science and Technology is committed to the safety and well-being of all members of its community. US Federal Law Title IX states that no member of the university community shall, on the basis of sex, be excluded from participation in, or be denied benefits of, or be subjected to discrimination under any education program or activity. Furthermore, in accordance with Title IX guidelines from the US Office of Civil Rights, Missouri S&T requires that all faculty and staff members report, to the Missouri S&T Title IX Coordinator, any notice of sexual harassment, abuse, and/or violence (including personal relational abuse, relational/domestic violence, and stalking) disclosed through communication including but not limited to direct conversation, email, social media, classroom papers and homework exercises.

Missouri S&T's Title IX Coordinator is Chief Diversity Officer Neil Outar. Contact him (naoutar@mst.edu; (573) 341-6038; 203 Centennial Hall) to report Title IX violations. To learn more about Title IX resources and reporting options (confidential and non-confidential) available to Missouri S&T students, staff, and faculty, please visit <https://equity.mst.edu/>.

Emergency exits:

Please familiarize yourself with the classroom emergency exits shown on the egress maps posted on-line at: <http://designconstruction.mst.edu/floorplan/>

Complaints:

It is hoped that any problems can be resolved through discussions between student and instructor. If there are any complaints that cannot be resolved they can be taken to Dr. Vojta (102 Physics, vojtat@mst.edu).