Course Syllabus

PHYS 3719/3729: Undergraduate Laboratory

Section 001: Thursday 1-5, SP 306-307

Section 002: Friday 8-12, SP 306-307

Course Description

Transformative experiments in the development of the modern era in physics, including measurement of some fundamental constants of the universe. Experiments will emphasize testing models of physical behavior. The emphasis in this course will be on optimizing data-taking and data-analysis to understand the sources and significance of errors. Critical thinking skills will be honed through qualitative and quantitative justification of results.

Recommended Prerequisite: PHYS 3740

Requirement designation: Quantitative Intensive BS

Instructors

Douglas Bergman, 230 INSCC (Bldg 19), 801-585-5973, **bergman@physics.utah.edu (mailto:bergman@physics.utah.edu)** . Office hours: by appt.

Matthew "Matt" Delong, 329 JFB (Bldg 83), 801-581-7462, **delong@physics.utah.edu (mailto:%20delong@physics.utah.edu)** . Office hours: TBD

Textbook

An Introduction to Error Analysis, John R. Taylor

University Science Books, CA (1997). ISBN-10: 093570275X, ISBN-13: 9780935702750.

Available in the U Bookstore and on reserve in Marriott Library.

Course Objectives

At the end of the course the student will have:

- Demonstrated an ability to carry out appropriate experimentation and analysis of acquired data to prove or disprove a model.
- Demonstrated an understanding of the concept of a model and how it represents a physical system.
- Demonstrated an understanding of how a model is tested.
- Demonstrated an understanding of how to estimate uncertainties and apply error analysis.
- Demonstrated a mastery of equation editors and similar technology required to generate a technical scientific report.
- Demonstrated mastery of data analysis software.
- Demonstrated an understanding of the statistics of counting experiments.
- Submitted a total of four lab reports, written in the style of a scientific paper, which describe a model of a physical system, summarize a theoretical description of the system being modeled, detail measurements of physical parameters of the system, estimate the errors in those measurements, propagate those errors to the quantity being measured and establish whether the data support the model or not, including a quantitative assessment of the degree to which the model is supported.
- Presented a talk to the class on one of the lab's experiments, in the format of a 10-minute contributed talk to a meeting of the American Physical Society.

Teaching and Learning Methods

Lectures: The purpose of lectures is to present the principles of statistical analysis, error analysis, and the tools needed to work as experimental physicists. These lectures will occur in the first two weeks of class. Each lecture will occur in the first two hours of the lab period. They will be followed by two hours of work on the first experiment.

Laboratory: There will be a four hour lab period each week. Students will have theequivalent of three lab periods to develop each experiment. In case this period is not enough to develop a particular experiment, we will make every effort to have the lab facilities available to the students at any reasonable hour. The objective of this class is for students to master concepts and techniques, to understand what they are doing in each experiment.

Evaluation Methods

Lab reports: These are opportunities for the students to demonstrate to the instructor that the objectives of the lab have been met because a model has been tested, errors in the measurements have been estimated and carried through calculations and a quantitative estimate of the validity of the model established. Lab reports with a lower than excellent score may be resubmitted once after receiving instructor feedback.

Oral presentation: Each student will give one oral presentation, at the end of the semester.The presentation will be a public recount of the important activities, results and conclusions on one of the lab experiments in the format of a conference oral presentation.

Grading

Grading will be based on four lab reports and on the oral presentation given at the end of the semester, with the following weighting:

Lab report 1	20%
Lab report 2	20%
Lab report 3	20%
Lab report 4	20%
Oral presentation	20%

Grade letters will be assigned on a standard ABCD scale with grade cutoffs at 90, 80, 70, 60. There will be no + or - grades.

Academic Integrity

You must do your own original work in this course; failure to make clear the sources of any outside material you incorporate in your work constitutes plagiarism, a violation of University standards. Wherever the ideas or words of others appear in your own work, they must be properly cited. Basically there will be three kinds of sentences in your reports: (1) “common knowledge”, statements of fact familiar to those working in the field; (2) statements copied from the literature, references for which you cite and (3) your original work. Anything not in the firsttwo categories will be assumed to be in the last. The text and lecture notes posted online should be referenced when appropriate. The one exception is your data: we understand that you and your partner will turn in identical sets of data.

It is required that you be aware of the University of Utah policies as you will be held accountable to University of Utah standards. Please read the University of Utah Code of StudentRights and Responsibilities, which states in part, "In order to ensure that the highest standards of academic conduct are promoted and supported at the University, students must adhere to generally accepted standards of academic honesty, including but not limited to refraining from cheating, plagiarizing, research misconduct, misrepresenting one's work, and/or inappropriately collaborating."

ADA Statement

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations.

Student Wellness

From the Center for Student Wellness:

> "Are you concern about stress, sleep difficulties, anxiety, depression, cultural differences, relationship difficulties, balancing work and school, or finances? Would you like to perform better in class, help a friend in distress, or learn more about physical activity or nutrition? Contact the Center for Student Wellness at: **wellness@sa.utah.edu (mailto:wellness@sa.utah.edu)** ; or **www.wellness.utah.edu (http://www.wellness.utah.edu)** ; or 801-581-7776."

Experiments

Students will all do experiments 1 & 2 at the same time. Students will then pick two of the other eight experiments (availability does apply) to do for experiments 3 & 4.

- **Experiment 1: The Pendulum**
- **Experiment 2: Geiger-Müller**
- **Experiments 3/4:**
  - **Balmer Series**
  - **e/m Electron**
  - **Gravitational Constant**
  - **High Resolution Spectroscopy**
  - **Speed of Light**
  - **The Franck-Hertz Experiment**
  - **The Millikan Oil Drop Experiment**
  - **The Photo-electric Effect**

Weekly Schedule

Week 1 (1/14, 1/15): Lecture (uncertainties, means, fitting), Experiment 1: Pendulum.

Week 2 (1/21, 1/22): Lecture (Gaussian, Poisson, binomial distributions), Experiment 1: Pendulum.

Week 3 (1/28,1/29): Experiment 1: Pendulum.

Week 4 (2/4, 2/5): Experiment 1: Pendulum.

Week 5 (2/11, 2/12): Experiment 2: Geiger-Müller. **Lab report 1 due.**

Week 6 (2/18, 2/19): Experiment 2: Geiger-Müller.

Week 7 (2/25, 2/26): Experiment 2: Geiger-Müller.

Week 8 (3/3, 3/4): Experiment 3. **Lab report 2 due.**

Week 9 (3/10, 3/11): Experiment 3.

Week 10 (3/24, 3/25): Experiment 3.

Week 11 (3/31, 4/1): Experiment 4. **Lab report 3 due.**

Week 12 (4/7, 4/8): Experiment 4.

Week 13 (4/14, 4/15): Experiment 4.

Week 14 (4/21, 4/22): Oral Presentations. **Lab report 4 due.**

Course Summary:

Date	Details	
Fri Feb 12, 2016	**Experiment 1 Report: The Pendulum** (https://utah.instructure.com/courses/365367/assignments/2703267)	due by 11:59pm
Fri Mar 4, 2016	**Experiment 2 Report: Geiger-Müller** (https://utah.instructure.com/courses/365367/assignments/2703270)	due by 11:59pm
Fri Apr 1, 2016	**Experiment 3 Report** (https://utah.instructure.com/courses/365367/assignments/2703273)	due by 11:59pm
Fri Apr 22, 2016	**Experiment 4 Report** (https://utah.instructure.com/courses/365367/assignments/2703274)	due by 11:59pm
	Oral Presentation (https://utah.instructure.com/courses/365367/assignments/2703278)	due by 11:59pm