

DEPARTMENT OF PHYSICS, UCSD
Modern Physics Laboratory
Physics 2DL, Spring 2009

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Office Hours: 3:00-4:00 PM on Mon or by appointment

web: <http://physics.ucsd.edu/students/courses/spring2009/managed/physics2dl/>

TA: Marko Lubarda malubard@ucsd.edu, Randall Kelley rkelley@physics.ucsd.edu

Lectures: Mondays 1:00-1:50, WLH 2207
The lectures will discuss the experiments, related physics, and error analysis.

Lab Periods: Tue 12:30-3:20, Wed 1:00-3:50, Thu 12:30-3:20, MYR-A 2574

Experiments:

1. Optical Spectra and Diffraction Grating
2. Coherence of Light and Interferometer
3. The Photoelectric Effect
4. e/m of the Electron
5. The Frank-Hertz experiment
6. Electron Diffraction

Weeks 1, 2, 3 will be discussion of the experiments.

Each student will then do 6 experiments, with a lab partner, in Weeks 4-9.

Week 10 may be used for make-up.

Lab reports will be due at the lab session 1 week after the experiment is performed.

Final will be on week 10.

Homework from Taylor, 2nd Edition

| | | |
|--|-------------------|------------|
| Probs 3.10 & 3.28 (optional: 3.36 & 3.41) | due at W4 lecture | (20 April) |
| Probs 4.18 & 4.26 (optional: 4.6 & 4.14) | due at W5 lecture | (27 April) |
| Probs 5.20 & 5.36 (optional: 5.2 & 5.6) | due at W6 lecture | (4 May) |
| Probs 7.2 & 8.10 (optional: 6.4, 8.6 & 8.24) | due at W7 lecture | (11 May) |
| Probs 9.14 & 12.3 (optional: 12.14) | due at W8 lecture | (18 May) |

Final Exam (June 1): The exam will cover the material in the lectures and the labs. Some of the questions will be taken from the homework problems and lecture examples. Lab questions will include derivation of background theory, sketching of apparatus and circuits, and description of results.

Grading Policy:

| | |
|----------|----------|
| Lab Work | 6x12=72% |
| Homework | 10x1=10% |
| Exam | 18% |

Required:

John R. Taylor, *An Introduction to Error Analysis*, 2nd Ed., 1997.

Laboratory Manual, Physics 2DL.

Notebooks (lab): Two 7 7/8 x 10 1/8 quadrille ruled notebooks

(You will work with one notebook while the other one is being reviewed by the TA).

Calculator: A scientific calculator with a statistical analysis package (mean, standard deviation, and linear regression).

Recommended: R.A. Serway, C.J. Moses, C.A. Moyer, *Modern Physics*

Guide to the Lab Report

| | Credit (12 points total) |
|---|--------------------------|
| Diagram(s) showing the overall experimental set-up and relevant electrical circuits | 3 |
| Key Equations | 1 |
| Data recording, analysis, and presentation in graphs | 4 |
| Error analysis, dominant sources of error | 2 |
| Discrepancies with published results | 1 |
| Experimental conclusions | 1 |

How to ACE Your Lab Reports

1. All reports must include physical and electronic diagrams.
 - a. Make a clear diagram showing the overall experimental set-up.
 - b. Make clear diagrams of all relevant electrical circuits.
2. Record your data carefully.
 - a. Don't just write numbers. Say what the numbers represent, and include units (e.g. ohms) and the associated uncertainty (e.g. 5%).
3. Make your graphs understandable.
 - a. Justify the choice of plot. A sentence like "We expect the voltage V to decay exponentially with time so we plot $\log(V)$ vs. time to obtain a straight line" is all you need.
 - b. Give the graph a title.
 - c. Label your axes with the variable and units [e.g. t (msec) or d (10^{-8} cm)].
 - d. Put error bars on the experimental points.
 - e. If you are fitting (comparing) experimental points to some mathematical expression (the fitting function), then include the fitting function on the graph. Include also any fitting parameters with their uncertainties (errors).
4. When you use measured values to calculate a result, e.g. $q = x/y$, use the errors (uncertainties) associated with x and y to find the uncertainty in the calculated value q .