Intermediate Experimental Physics II: UA 74 (Spring 2018)

Instructor: Prof. Andrew Kent
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Pre or Co-requisite: Intermediate Experimental Physics I (PHYS-UA 73).
Lecture: Monday, 3:30-4:45 PM, Meyer Hall, Room 122

Lab Instructor: Alvin Modin, E-mail: asm579@nyu.edu
Office room: 726 Broadway, room 1035
Office hours: TBD and by appointment

Lab Sections: 2. Tuesday 3:30 PM – 6:30 PM
3. Thursday 9:15 AM – 12:15 PM

Labs begin the week of February 12, 2018.

Website: http://classes.nyu.edu/

Course Description

This is the second of two intermediate-level laboratory courses that covers topics in modern physics and experimental techniques. Classic experiments that illustrate fundamental physics principles are conducted and analyzed. In addition, a goal is to further knowledge of data analysis methods introduced in Introductory Experimental Physics I (PHYS-UA 71), II (PHYS-UA 72) and Intermediate Experimental Physics I (PHYS-UA 73).

Texts

- Descriptions of the labs: http://physics.nyu.edu/~physlab/Lab_Main.
- Laboratory Notebook.
- Introduction to Python for Science, D. Pine, can be found at http://physics.nyu.edu/~physlab/Lab_Main/PythonMan.pdf

Additional texts (optional)

- "University Physics," 13th edition, by Young & Freedman, Pearson Addison Wesley (2012).
- "Feynmann Lectures on Physics," Feynman, Leighton & Sands, Addison-Wesley, http://www.feynmanlectures.info/

Grading

The relative weights of components of the course grade are:

Laboratory Reports*	60%
Lab activities (quizzes and participation):	10%
Midterm	10%
Final Exam	20%
Total:	100%

*Grading of lab reports: 10 pts for each lab report will be as follows:

- 2 points for handing in the lab on time, competing all portions of the lab report.
- 3 points for an explanation of the experiment and the physics underlying it. The 3 point maximum will only be given for reports that go beyond paraphrasing what is in the lab manual.
- 5 points for the analysis of the data, including uncertainties, sources of error and propagation of both. If your data is far from what is expected you should try to understand why. At the very least, you should perform multiple runs of the experiment to determine the experimental uncertainties and to try to understand whether there is something systematically incorrect in the experiment (i.e. uncontrolled experimental parameters, poor alignment of a detector or a laser, etc.) Experimental results that are far from expectations and without any possible explanation or justification will be heavily marked down.
- Up to a 2 point bonus will be awarded for conducting and analyzing an original experiment.
- Lab reports are **due 1 week** after you complete the experiment.
- Students may redo up to 2 labs to improve their results and lab grade. However, points lost because a laboratory report was handed in late *will not be awarded* in the re-graded lab report.

Course Schedule

- The first lecture will be on **Monday, January 22th**
- The first laboratory meeting will be the week of **February 12th**
- Midterm Exam **Monday, March 5th** in class
- Final Exam, **Monday, May 7th** in class

Lab Schedule

There is just one experimental setup of each lab. So students rotate through the laboratories and the lecture is not (necessarily) in the order of the labs.

Experiments:

- **Electron Spin Resonance**
- **Frank-Hertz**
- **Michelson Interferometer**
- **Two slit interference with single photons**
- **X-ray lab: Bragg diffraction**
- Compton scattering (note this lab uses the X-ray lab apparatus)
- Half-life
- Nuclear spectroscopy
- Magnetic torque
- Photoelectric effect
- Seismometer
- Speed of light

Students will do 8 labs. The required labs are in bold: Frank-Hertz, Michelson Interferometer, Electron Spin Resonance, X-ray lab Bragg diffraction and Speed of light. Students conduct 3 additional labs chosen from the above list.

Notes:

- The lab experiments are all set up during the semester
- **Two** students do the experiments together and share data
- Everyone turns in their own lab report indicating their lab partners
- There is no textbook for the course. Information will be provided in the lab manuals, in lecture, on the Classes website and in handouts.

Lecture Topics:

1. Introduction to the course and labs
2. Crystal lattices and x-ray diffraction
3. Speed of light and the Michelson-Morley experiment
4. Spin resonance and magnetic resonance imaging
5. Photoelectric effect
6. Blackbody radiation, Rayleigh-Jeans law, the ultraviolet catastrophe
7. Photons, Planck's law, the Cosmic Microwave Background (CMB) radiation
8. Radioactivity, doses and physiological effect
9. Bolometers, resistance, Wheatstone bridge, voltage/current measurements and digital electronics
10. Electronic states in metals, semiconductors and insulators
11. Semiconductors: doping, p-n junctions, detecting light (photons) light emitting diodes, transistors
12. Review