PHYSICS 405 COURSE DESCRIPTION
SPRING 2012
Lecture Room 3112 Physics, Lab 3210

Physics 405 is an advanced undergraduate laboratory course with experiments from many fields of modern physics for physics majors. Students have full access to the experimental equipment and establish their own work schedules and procedures with the guidance of faculty and staff. Emphasis is on independent experiment organization, data acquisition, data analysis, and scientific report preparation.

PREREQUISITE: Physics 375

LECTURES: Wednesday 12:00-1:00 PM

COURSE WEB SITE: http://elms.umd.edu then select link for Physics 405.

INSTRUCTORS: Prof. Robert Anderson and Dr. Simone Kulin

Prof. Anderson
Office: 2346 Physics
Phone: 301-405-6142
Email: banders@umd.edu

Office hours Mon 2pm -5pm and by appointment – phone or email --- Phone preferred

Dr. Simone Kulin
Office: 3333 Physics
Phone: 301-405-6068
Email: skulin@umd.edu

Office hours: Tue & Wed 10:30am -1:30pm

TEACHING ASSISTANT:

Name: Solomon Granor
Office: 3103B Physics
Phone: 301-405-6192
Office hours: To be determined
Email: sgranor@umd.edu

Wrick Sengupta
301 405 -5969
wricksg@umd.edu

LABORATORY STAFF:

Allen Monroe
Phone: x56002
Email: amonroe@umd.edu

Office: 3311 Physics
Office Hours: 8AM – 4PM M-F

Tom Baldwin
Phone: x56004
Email: tbald@umd.edu

Office: 3202 Physics
Office Hours: 9:00AM – 5:30PM M-F

SCHEDULE:

Instructor and TA lab hours will be announced in class and posted in the lab and on our web site.
The lab is open Monday through Thursday from 9:00 AM - 5:00 PM and on Friday from 9:00 AM to 4:00 PM. If you arrive before the door is open, ask Tom or Allen to open the lab for you. If you are the last person to leave one of the lab rooms, please close the door. If you are coming back, have Tom or Allen open the door again when you return. You must be done for the day at the time the lab closes. If you are not done taking data at 5:00 PM and you are signed up for the following day, leave a note on your experiment so that a staff member does not disassemble your experiment.

TEXT and MATERIALS:

Physics 405 Laboratory Manual – Department of Physics, Spring 2010 edition
THIS WILL BE AVAILABLE ELECTRONICALLY THROUGH OUR WEB SITE -- THIS VERSION IS NOT AVAILABLE IN PRINT

And one of the following:

*Data Reduction and Error Analysis for the Physical Science*s - Phillip R. Bevington and D. Keith Robinson (McGraw Hill, Inc., 2003, ISBN 0-07-247227-8);

An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurement – John R. Taylor (University Science Books, 1997, ISBN 0-935702-75-X).

You will need **TWO (2)** lab notebooks. Two are required so that you can work in one notebook while the other is being graded. Acceptable lab notebooks should be 8.5" x 11" or larger, should be bound (with spiral or book binding), and have numbered, quad-ruled pages. Pages should be permanent, not perforated for tear-out.

LECTURES:

For approximately the first half to the semester there will be a 1-hour lecture from **12:00 – 1:00 PM in Rm. 3112 on Wednesdays**. We will cover error analysis, laboratory measurement techniques, and any other material germane to the course. You will be responsible for understanding the material presented in lecture and, when appropriate, expected to include some of this material in your notebook reports and in your final formal report. If you miss a lecture you are responsible for finding out from a classmate what was covered. During the second half of the course, the lecture slot will be used for 12-minute presentations by students. **Attendance at the Wednesday lectures and presentations is mandatory! The lecture and presentation schedule will be posted on the course website.**

EXPERIMENTS:

Experiments consist of one or two work units. In order to pass the course, 6 units of work must be completed, which will typically consist of four to six experiments, of which at least one must be a 2 unit experiment. **Completion is defined as performing the laboratory work, data analysis, and submitting a laboratory notebook for grading**. **Failure to complete all 6 units will result in failing the class;** Each student is required to work on the experiments entirely by her/himself. At the completion of each experiment, you will need to hand in the laboratory notebook for grading. Every attempt will be made to grade your experiments promptly so that you will be able to improve your next report before handing it in. The notebook reports are meant to be your notes and documentation of your work in the lab, and *are not meant to be a formal write-up*. (Please refer to the laboratory manual for more information on the notebooks.)Your first experiment will usually be a one-unit experiment. (This is so that you can begin to get feedback on your labs as soon as possible.)

LIST OF EXPERIMENTS

1. Measurement of the Velocity of Light ..... (1 unit)
2. Experimental Atomic Spectroscopy ..... (1-2 units)
3. The Franck-Hertz Experiment..... (1 unit)
4. Measurement of Planck's Constant..... (1 unit)
5. Hyperfine Structure of Rubidium ..... (1 unit)
6. The Charge-to-Mass (e/m) Ratio of Electrons..... (1 unit)
7. Gamma-Ray Spectroscopy ..... (1 unit)
8. Radioactive Decay – NOT AVAILABLE
9. Gamma-Gamma Angular Correlation ..... (2 units)
10. The Hall-Effect in Metals ..... (2 units)
11. Cosmic Rays ..... (2 units)
12. Nuclear Magnetic Resonance in the Earth's Field(NOT-AVAILABLE) (2 units)
13. Acousto-optic Diffraction – BY PERMISSION ONLY..... (2 units)

SCHEDULING EXPERIMENTS:

There is an online sign-up sheet that can be accessed from any computer with an internet connection or from the computer in Rm. 3210. The URL is http://www.physics.umd.edu/cgi-script/courses/p405.pl

Prior to carrying out an experiment, you are required to complete the preparatory questions at the start of the experiment. The answers to the prep questions must be written on paper and submitted at the latest at the beginning of the class period in which they are due. **You must have the preparatory questions examined and initialed by either the instructor or the TA before you begin the experiment.**

Work on the experiments must be formally scheduled. Time slots are available in ½-day periods. In order to save your experimental setup, you must sign up for two consecutive periods. When an experiment has been completed your data acquisition finished the experiment must be dismantled. Work on the experiment must be completed **within a week** after the preparatory questions have been signed.

DUE DATES FOR THE NOTEBOOK REPORTS:

Notebook reports are due according to the schedule shown in the syllabus. Students performing more then four experiments may turn in their notebooks earlier than indicated on the schedule but not later. Notebooks must be turned in personally before the beginning of class on Wednesdays, or, if submitted ahead of schedule, dropped in the box outside of Mr. Baldwin's office in the slot marked "Phys 405". **There is a 2-point penalty per day for late reports, which can be submitted up to one week after the due date. Reports more than a week late are not accepted and will result in an F for the course.**

All 6 units must be completed by May 02, 2012. Failure to do so will result in a failing grade for the class.

FORMAL REPORT:

One of the experiments carried out during the semester is to be rewritten as a formal report and is to be turned in by **Monday, May 7, 2012**. Please refer to the laboratory manual and the information on the course website for the format of the formal report.

ORAL PRESENTATIONS:

Each student will be expected to give one 12-minute presentation on an experiment of his or her choice. The talks will be followed by questions from other students, the TA and the instructors.

GRADING:

Notebooks (20 per unit)	70%
Formal report	15%
12-minute presentation	15%
TOTAL	100%

VALID EXCUSES:

If you have a valid excuse for missing a due date for a notebook report or a 12 minute talk (e.g., a medical emergency) see your instructor to make alternate arrangements, beforehand if at all possible. Ex post facto (after the fact) excuses will require validation and may not be acceptable. You must speak to one of the instructors. The TA does not have the authority to make alternate arrangements

ACADEMIC DISHONESTY (CHEATING): Academic dishonesty is a serious offense that may result in suspension or expulsion from the university. In addition to any other action taken, the normal sanction is a grade of "XF", denoting "failure due to academic dishonesty," and will normally be recorded on the transcript of the offending student. Students are required to perform all experiments, analysis, and write-ups independently. The experiments may be discussed with other students, but **each student must work independently**.

TIPS FOR DOING WELL:

Good time management is the key to success in this class. Don't fall behind! Don't wait until the last day to do an experiment!

Read the lab manual carefully before attempting an experiment.

Answer the preparatory questions in your notebook and have them checked by your instructor or TA before you begin the experiment.

Keep a complete log for each experiment including experimental diagrams of measurement configurations actually used to obtain data, results, estimates of various errors and limitations to the measurements, analysis used to obtain final results, and a proper estimate of all errors including systematic errors as well as statistical errors.

Show clearly the reasoning that you used to arrive at your conclusions. If your experimental results do not agree with the known or accepted values, your reasoning may be the only means for determining what went wrong.

Additional information, a list of experiments, and more detailed help can be found at the course website.

IMPORTANT DATES:

First Class	Wednesday, 25 Jan
Last Day for Schedule Adjustment	Friday, 3 February
Last Day to Drop with a "W"	Friday, 6 April
Spring Break	19-23 March
Final Report Due	Monday, 7 May by 5:00 PM

TENTATIVE SCHEDULE (subject to change as needed)

Dates	Lecture	relevant reading	Due Dates 0101 & 0102
Wed. 1/25	Introduction to Experiments	Skim the lab manual	
Wed. ..2/1	Lecture #1 RADIATION SAFETY		**Expt #1 Prelabs**
Wed. ..2/8	Lecture #2 Statistics Random/Systematic Errors	Bevington Ch 1-2 Taylor Ch 3,4,5,10,11	
Wed. 2/15	Lecture #3 Electronics	Building Scientific Apparatus, Ch.6	**Expt #1 Notebook**
Wed. 2/22	Lecture #4 Vacuum Technology	Building Scientific Apparatus, Ch 3	**Expt #2 Prelab**
Wed. 2/29	Lecture #5 Detectors	Building Scientific Apparatus Ch 7,	
Wed. 3/7	Tour of Campus Reactor	To be confirmed	**Expt #2 Notebook**
Wed. 3/14	Instructions: Formal Report & Presentations		**Expt #3 Prelab**
Wed. 3/21		NO CLASS: SPRINGBREAK	
Wed. 3/28	12 Min. Presentations		
Wed. 4/4	12 Min. Presentations		**Expt #3 Notebook**
Wed. 4/11	12 Min. Presentations		**Expt #4 Prelab**
Wed. 4/18	12 Min. Presentations		
Wed. 4/25	12 Min Presentations		**Expt #4 Notebook**
Wed. 5/2	General Discussion		**Expt #5 Notebook**
Mon.5/7			**Formal Report**

All prelab questions for an experiment must be completed and checked (initialed) by the TA or the instructor before you start your lab. The laboratory notebook due dates correspond to a schedule of four experiments, typically two 1-unit and two 2-unit ones. It is recommended that students who choose to do more experiments turn in their work earlier, but no later than the dates indicated. Prelabs will be signed anytime when an instructor or TA is available, but must be submitted at the latest on the dates indicated in the schedule.

GRADING OF NOTEBOOKS:

Your lab notebook should give a complete description of how you did your experiment and how you analyzed your data. Another person should be able to take your notebook and duplicate your experiment.

For the notebook reports you must do the following:

1. Write in a real lab notebook: Notebooks should be quad ruled, with numbered pages.
2. Write in ink. If you make a mistake, draw one line through it - don't erase it, scratch over it, or use white-out.
3. Staple/past/tape all graphs and analysis in notebook. Label axes. Include any formulas, derivations, etc. needed to understand your graph.
4. Give a brief description of theory behind experiment.
5. Provide the actual circuit diagram you used to do the experiment.
6. Provide a clear description of the procedure used to take data.
7. Provide the units of all numbers.
8. Provide and explain your estimate of the random and systematic errors in all important quantities affecting your final result. Must use proper error analysis techniques.
9. Pay attention to significant figures.
10. Analyze your data. Write down the methods you used. If you use ***Mathematica***, do not simply paste your ***Mathematica*** notebook into your lab notebook - write down in your lab notebook your analysis steps. Compare statistical error with random error (reduced χ^2). Discuss.
11. Quote your results with final total error (including systematic errors).
12. When appropriate, compare your answer to the expected value and discuss discrepancies.
13. Be sure you have answered all the questions asked for in the lab manual, including discussion questions at the end of a unit.
14. Be sure you have done all the parts of the experiments that you were asked to do.

GENERAL GRADING SCHEME FOR LABORATORY NOTEBOOKS:

Description of procedure (including prep questions) **3 pts**
Raw data (including tables, plots, etc.) **5 pts**
Analysis (including errors and final results) **8 pts**
Everything else on above list **4 pts**

Two points will be subtracted from any report grade for each day late. Reports more than a week late are not accepted. Failure to submit all report results in an F for the course!