Syllabus and tentative schedule for Fall 2015
Intermediate Physics Laboratory (PHY 3802L-0011)
class held in MAP 333A, Tuesday and Thursday, 09:00-11:50 PM

Instructor: Dr. Bo Chen
Office: PSB451,
Email: Bo.chen@ ucf.edu

No textbook required, the following Reference books will be reserved in Library:

The Art of Experimental Physics, D.W. Preston, E.R. Dietz, Wiley & Sons, Inc.
Experimental Pulse NMR A Nuts and Bolts Approach, Eiichi Fukushima and Stephen B. W. Roeder, Westview Press.
Experimental Physics, Modern Methods, R.A. Dunlap, Oxford Univ. Press
Experiments in Modern Physics, A.C. Melissinos, Academic Press
Statistical Treatment of Experimental Data, H.D. Young, McGraw-Hill Book Co.
In addition, pertinent manuals will be distributed, uploaded to webcourse.

PHY 3802L COS-PHYS 3(1,5) Intermediate Physics Laboratory
Prerequisites: PHY 3101 or C.I. Laboratory work in basic measurements of physical constants; experiments in electronics, modern physics, nuclear physics, optics, and solid state physics.

Grading:

Quizzes/Interviews	20%
Homework	20%
Experiments and lab report	20%
Final oral presentation	20%
Final exam	20%

Grading Scale:

A	85% and above
B	75% to 84%
C	60% to 74%
D	50% to 59%
F	below 50%

Course Objectives:
This course will make upper-level students familiar and proficient with modern experimental methods and instrumentation. During the process, students are encouraged to work as independently as possible as a group to accomplish a task, including setting up the experiments, debug, and literature search to understand the significance and principles. Along with technical knowledge and skills, the student's ability to clearly and efficiently communicate basic principles of physics and their relations to experimental results will be developed. This ability is absolutely vital for the career of a Physicist. Therefore, lab reports will be graded for quality of writing as well as quality of results. Communication and learning skills will be tested in quizzes/interview to each experiment. Furthermore, each student is expected to give an oral presentation at the end of the semester.

Procedures:
The class will be divided in groups to perform the experiments during each class. The experiments will be weekly circulated among the groups. Each group should obtain a bound lab notebook and record all data in their notebook. For each experiment, the note book should have clear record of the apparatus, data, notes about measurements and their conditions, preliminary graphs, calculations, etc. While conducting experiments, students in each group will be interviewed by the instructor for a 20-30 minute to assess their understanding of physics principles in general. The questions are not necessarily with immediate relevancy to the experiments they are conducting, but are in general pertinent to critical physics concepts students are expect to grasp at this level. A brief survey of potential questions are listed as a guide line at the end of the syllabus, see "*Potential Questions*".

Outside the class, students within the same group will need to prepare and submit their own separated lab reports according to the notes they take in class. The format of lab report is defined clearly below, see "format specification". While certain part of the lab reports from different students in the same groups are expected to be the same/similar (such as a copy of the original lab note, description of experimental procedure and apparatus), I am expecting each present their independent Discussion). If Discussion is similar among students in the same group, loss of credits is expected for each duplicate lab report.

The lab reports are due every Tuesday subsequent to previous week.

Format specification:
The lab reports are submitted to webcourses in word format. Each lab report should always consists two parts:
1. Pages of original notes from your lab note book, handwritten. Different members in the same group can photo copy the original lab notes and attach the duplicate copy at the end of their own submission, a word document as specified in 2.
2. A word document. The name of the word document should be: ExpName_LastNameFirstLetterofFirstName. For example, if John Smith conducted the experiment for Franck-Hertz experiment, then, his word document should be: *FranckHertEXP_SmithJ.doc.* In the document, figures must be plotted by software such as excel or anything you have on your computer. The original data from your lab note book must be present in table format in the word document. All lab reports can be screen by UCF turnitin system to detect potential plagiarism(what is plagiarism in academia), if confirmed by the system, the student will be getting an F in the course, and will be reported to UCF Office of Student Conduct(http://osc.sdes.ucf.edu/).

In general, regardless of the journal format you choose, the following elements should be present in your report:

1. Title and Abstract. The abstract is part of the title page of the report, but it is a good idea to write it last. It should be a succinct summary of what the reader will find in the report. State in 3 or 4 sentences what you did and what the main findings were.
2. Introduction and Background. State briefly what the experiment is about, what is the goal of this experiment. Give historical background or place it in context of current research. Outline the basic concepts the reader should know about, or point the reader in a direction

that he/she can follow the discussion of the experiment. The theory/formula behind the experiment should be fully outlined/derived.

3. Apparatus and Procedure. Describe the apparatus. Some instrument employed may deserve some exploration of its mechanism, for example, the photomultiplier, and the diffraction grating, the magnetometer, or even the coaxial cable. You are not required to include the explanation of their function mechanism in the lab report, however, you will be expected to pertinent questions during interview. Use figures and diagrams. Explain exactly what measurements were made and how they were made.
4. Data. Give a narrative how the data was acquired. Although the original data is present in your lab note, cites data in tables, graphs, and figures. Be sure to label graphs, label axes, give all appropriate units, etc.
5. Analysis. Calculate whatever quantities are most appropriate for making comparison to theory of for extracting useful information. Be sure to include an error analysis starting with estimates and uncertainties of the measured quantities, and ending with estimates for the precision of your final results.
6. Conclusion and Discussion. State the main results of your experiment. List and discuss possible discrepancies between your experiment and theory, previous measurements, or initial expectations. In the discussion, you need to evaluate the significance of the experiments in its historical context. For example, the Franck-Hertz experiment discovered the quantization of excitation energy of Mercury, lending proof for Bohr's model. In addition, please do you research to identify certain applications/derived physics concepts/advance of physics principles from this experiment. *For this part of discussion, I am expecting each member present their independent discussion in their lab reports (each member should present a different example for the extrapolated significance).*
7. References. Acknowledge sources throughout the report. Consult the AIP style menu for format. Include an extra bibliography page if you consult other sources that you don't explicitly cite in your report. A word about the usefulness of a reference would also be appreciated, but is not required.

Criteria for lab report grading:

Lab report are always due before midnight of the following Thursday. For example, if an experiment is conducted during the week of Sept 08-10, then its report is due by email to the instructor by Sept 17, the next Thursday night 12 am. Late submission of a lab report will suffer a 1% penalty for every 24 hrs behind the supposed due date. This rule applies to the homework as well.

20%: clear presentation of the original data (hand-written).

20%: professional presentation of the word document (not sure what this means? Go to www.aps.org, find any paper to take a look.)

20%: concise, but clear and thorough explanation of relevant theory principle and experimental apparatus.

20%: clear description of experimental procedure, and data of the experiment. At the end of this, present your analysis of data. If no error/uncertanty analysis, you will only get half credit (10%) for this category.

20%: discussion of a relevant example/application/phenomena based on this experiment. I am expecting different contents from each member in the same group, which means you need to complete this part independently.

Bonus/penalty: Each group has the opportunity to ask for assistance ONCE for each experiment. If you did not ask for assistance, you will get 10% bonus. If you ask for assistance more than once, you will get 10% penalty each time you ask for assistance.

Because there is a strong emphasis on the quality of writing, I reserve the right to return the reports for rewriting. If this happens, I expect to meet the group/student during office hours to discuss improvements. I encourage you to let other people read the report before you turn it in. They don't necessarily have to be in the class or even technically literate (sometimes those people are the best reviewers).

Presentation: A 20-minute oral presentation will be given by each student during the final exam period with a few minutes for questions and answers. The presentation style will be similar to a presentation that is given at a scientific conference. The topic of the presentation should be any experiments in physics history (that is different from what we do in this course) that led to the confirmation of a theory or discovery of a new physics law.

Final exam: A short 30 minutes exam consists of only multiple choices questions. No complicated formula derivation needed, but emphasize interpretation of physics concepts and pictorial image of principles. All questions are based on physics concepts relevant to the experiments and questions from interview/quizzes.

Missed labes:
If you miss class for an excused reason (to be determined in consultation with me), arrangements for making up the lab will be made.

Schedule (Tentative):

08/25	Class begins in MAP333A, introductory meeting.
08/27	lecture on Errors, probabilities and distribution, mean value. HW1 due.
09/01	lecture on chemical lab safety course. HW3 due.
09/03	lecture on Electronics review, quantization, optical techniques. HW2 due.
09/08 – 09/10	first Experiment, and HW4 due. Suggested to start your work on HW5 now.
09/15 – 09/17	second Experiment.
09/22 – 09/24	third Experiment.
09/29-10/01	fourth Experiment.
10/06-10/08	fifth Experiment. HW 5 due.
10/13 -10/15	sixth Experiment.
10/20– 10/22	seventh Experiment.
10/27 –10/29	eighth Experiment.
11/03 -11/05	ninth Experiment.
11/10-11/12	tenth Experiment
11/17-11/19	Finish all reports, interviews, work on presentations
11/24-12/1	Final Student presentations OTC 304, and HW5 due
To be determined:	Final Exam.

Experiments: (a lab journal is required for each group, no data on pieces of paper)
1. AC electronics (RC filters, RLC resonant circuits)
2. Optical experiment: diffraction
3. Optical experiment: spectroscopy

4. Frank-Hertz experiment
5. Charge-to-Mass ratio of electrons
6. Nuclear Spectroscopy (Gamma ray spectroscopy, nuclear activation of Al, lifetime)
7. Superconducting Quantum Interference Device and Electron Spin Resonance
8. Photoelectric Effect
9. Temperature Dependence of Resistivity
10. Advanced optical experiment: measurement of Rydberg constant with optical spectroscopy and a hydrogen discharge lamp

All reports are due one week after the last lab day for the corresponding experiment.

Schedule:

Group Assignment for 3802 Fall 2015
Group A: Antia, Michael with Cain, Christopher
Group B: Carty, Alphonso with Chagoya, Katerina
Group C: Decelles, Chelsea with Rosenberg, Dylan,
Group D: Singley, Russell with Vastola, John
Group E: Weitzman, Dylan With Wood Ryan.

Group	09/08	09/15	09/22	09/29	10/06	10/13	10/20	10/27	11/3	11/10
A,	1	4	3	10	8	5	2	7	6	9
B,	2	5	4	9	6	3	10	8	7	1
C,	3	10	6	5	9	4	7	1	8	2
D,	4	7	5	1	2	6	8	9	3	10
E,	5	8	7	3	10	9	6	2	1	4
F,	6	9	8	4	1	7	3	10	2	5
G,	7	1	9	8	4	2	5	3	10	6
H,	8	2	1	6	3	10	9	5	4	7
I,	9	3	10	2	7	1	4	6	5	8

Potential questions:

1. Explain what Maxwell equations means in physics.
2. Plot the B field vs Z for a ring of radius R carrying current I.
3. What is the difference between B and H, E and D?
4. What is Helmholtz coil? How does the magnetic field generated by a pair of HC depend on the current intensity and radius of the coil?
5. In the experiment to determine e/m of electrons, show me the deflection of electrons with given direction of B and velocity. What if the tube generates position/neutron/proton?
6. In Franck-Hertz experiments, what is elastic/inelastic collision?
7. What is Bohr’s model? Why we only see the first excitation state but no other states in the Franck-Hertz experiment? If you want to see higher excitation states, what change should you make to the existing setup?
8. What is dispersion in light refraction? What is the order of magnitude for the wavelength of visible light? How do you measure its wavelength?
9. What is near field (Fresnel diffraction) approximation and what is Franhofer diffraction? What is Huygen’s principle?

10. Do you see max intensity (bright) or min(dark) at the center on the single slit diffraction pattern? Why? What is the function of intensity vs angle to describe the diffraction pattern? What condition do we have to satisfy to see diffraction pattern (size of slit with respect to the wave length, frequency of light source, etc?) If you use red light source for diffraction and see the first order maximum from a single slit at theta = 3 degree, switching to a blue light, the position for the first order maximum will be at a larger or smaller angle than 3 degrees? Why?
11. What did Young's double slits interference experiment prove? If you use red light source for diffraction and see the center maximum spanning an angle theta= 3 degree, switching to a blue light, the width of the center maximum will be broader or smaller than 3 degrees? Why?
12. If the intensity of the maximum for Young's double slits is I_0, keeping all set up the same, increase the number of slits to 4, do you expect the brightness increase or decrease, how about the width of the bright bands, why?
13. In single slit diffraction experiment, if we double the distance between the slit and the screen, what will happen?
14. What is the potential hazard/unwanted of diffraction? Please name an example.
15. In Single slit diffraction and double slit interference experiments, we all see alternating bright and dark fringes, what is the difference between diffraction and interference in physics concept?
16. RLC, RC, RL,LC circuits, which of the following are correct?$A. \oint \vec{E} \cdot \overrightarrow{ds} = 0$; B. $\oint \vec{E} \cdot \overrightarrow{ds} = -\frac{d}{dt} \iint \vec{B} \cdot \overrightarrow{ds}; C. \frac{dU}{dt} = 0; D. \frac{dU}{dt} = -I^2 R;$
17. If you want to increase the response time for an RL circuit, should you increase R or decrease R?
18. What is the Q factor in RLC circuit? If you want to increase Q what can u do for a serial connected RLC circuit?
19. What is black-body radiation? Why is it called black-body while it is radiating light? If two black bodies have different shape/size but same temperature, by observing its radiation, can we distinguish the two? How do we measure the temperature of the Sun, and the planet around it?
20. What is Rayleigh-Jeans law? How does it depend on wave length? What is Wien's law? How do they relate to Plank's law? Why the sky is blue?
21. How does a photomultiplier tube work? Why the photocathode of a PM is usually curved?
22. What are valence electrons? What are conduction electrons? What is the forbidden band? What is Fermi level/surface?
23. What is the half life of a radioactive nucleus species?
24. What is Hall effect?
25. What can we make use of charge-to-mass ratio measurements?
26. What is Josephson Junction? What is superconductivity? How to differentiate different types of superconductors? What can we do with Superconducting Quantum Interference Device(SQUID)?
27. What is equipartition theorem?
28. What is a dispersive medium for electromagnetic wave?
29. How do we know the composition of a star/planet far away in the galaxy/universe?
30. What is the difference between diamagnetism, paramagnetism, anti/ferromagnetism? What is the Curie law?
31. What is Bohr magneton?
32. What does degeneracy mean for a quantum number(or what does it mean when we say a quantum number is good)?
33. What does quenching of orbital angular momentum mean in crystals?

34. How does coaxial cable conduct electromagnetic waves with little attenuation and shield from external interference?
35. What is Johnson noise? What is its characteristics?
36. What is Nyquist theorem?
37. If you repeat an experimental measurements N times, average the N set of obtained data, will it increase your signal noise ratio or not? How much will it increase /decrease your signal noise? Why?
38. What is equipartition theorem? What is the root mean square velocity of a gas molecule at a specific temperature? How to tell if a specific kind of molecule at its gaseous state at room temperature exists in the atmosphere?