INFORMATION FOR PHYSICS 3302
Spring 2009

INSTRUCTORS:

Professor:	Matthew B. Johnson,	Nielsen Hall 129,	325-3961 x36129	johnson@physics.ou.edu
TA:	Mark Curtis	Nielsen Hall 404,	325-3961 x36404	mark.e.curtis-1@ou.edu

CLASS HOURS: Wed. 4:00-5:30, Nielsen Hall

ROOM: Advanced Lab, Nielsen Hall B25 (Basement), Door Code 3141 (π).

GROUPS: Set up groups of two in first lecture.

OFFICE HOURS: Prof. Johnson, Nielsen Hall 129, Mon., Wed., Fri., 1:00-2:30 PM.

WEB PAGE: http://www.nhn.ou.edu/~johnson/Education/Juniorlab/
and directories (folders) therein.

TEXTBOOK: **Statistical Treatment of Experimental Data, H.D. Young**
Original Edition: ISBN-10: 0070726469; ISBN-13: 978-0070726468
Publisher: McGraw-Hill (June 1962).
Reprint: Waveland Press (1996).

LAB NOTEBOOK: **1302 style, *Computational Notebook*, from the Bookstore. Good for your Capstone next year.**

SUPPLEMENTAL: *Experiments in Modern Physics,* Melissinos, (Academic),
Experimental Physics, Dunlap, (Oxford), and
Building Scientific Apparatus, Moore/Davis/Coplan, (Addison-Wesley).
Copies of these supplemental texts will be available in the junior lab.

COURSE DESCRIPTION AND OBJECTIVES:

The Junior and Senior Laboratory are being restructured. Basically, in addition to the "classic" fundamental constant experiments that are currently being improved, several more technologically oriented labs are being perfected both in this room and down in the Thin Films Lab (AKA *h* and GRILL). Hopefully more experiments (of both varieties) will be developed in the future by capstone students (design credit for Eng.-Phys. students). These labs are intended to teach you many skills required to do modern scientific experiments ranging from correct handling of instrumentation and hardware (optics, electronics, vacuum, cryogenic, and nuclear), how to set up an experiment -both the equipment and the procedure, understanding errors in a measurement and their propagation to the final result, interfacing computers to instrumentation and automating experiments, data analysis and modeling with various software packages, writing up lab reports into a clear concise paper or report, and how to make a short presentation.

Junior Lab I will consist of seven experiments starting with one on statistics, to introduce probability distributions, error propagation and EXCEL (the data analysis program we will be using), followed by three classical "classics" that measure constants that are associated with classical physics; and finally three quantum and applied "classics" and that measure quantum effects and constants or more applied effects. A tentative schedule is included in this handout.

Junior Lab II will be done on a less formal basis fewer but more involved labs, including at least one from the Thin Film Lab will be performed. See me to discuss scheduling for this lab.

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SPECIFICS

Assignments: There will be some assignments, especially at the start. These are typically due the next week **before** class starts.

Experiments: Students will work in pairs on an experiment. We will attempt to run three experiments in parallel to allow students sufficient time at the bench to work on the experiment. How we actually set up, run and report experiments will be quite different from what you (and I) are used to. They will not be done in the usual cookbook fashion in which students simply follow a set procedure. I have found that the cookbook paradigm of lab courses does not get the student thinking independently. Moreover, at the end of the course students often do not remember key features of the experiments. Instead, we will explore improved ways of approaching the usual experiments (explore in the sense that I have not done this before and that we have to adapt this approach). We will start with the following approach.

I The week before we meet the first time for the lab, you will receive a packet containing the following: the purpose of the experimental measurement we intend to do, e.g. measure the speed of sound; papers and other reference materials describing early measurements, these will give some of the historical background and describe how the first measurements were made; a list of the equipment that we have at our disposal for our experiment; and finally, some helpful hints and associated questions from me.

II Based on the information in the packet, you will devise your own procedure for to making the wanted measurement with the tools we have at hand. Lab partners can work together but should not simply copy each other's work. This procedure will be in your lab notebook and a copy of it will be handed in at the start of the weekly class. During this class you will present your procedure to the other lab partners who are doing the same experiment. After constructive criticism we should all arrive at an improved procedure. At the end of this meeting any peculiarities of the instruments to be used will be demonstrated and any obvious failure modes will be discussed. Then each pair will schedule two times to work on the experiment. Each student should write up the revised procedure as well as any other important information in his or her lab notebook.

III At the first meeting time I suggest the pair become familiar with the equipment. Make sure that there is a signal or what ever. Even make sure that the experiment works and the measured value is in the ball park.

IV At the next meeting time the pair should take careful measurements according to the procedure developed above (I through III). Any tricks to increase reliability, accuracy and precision learned while playing with the equipment (see III) should be put to use. All data should be neatly recorded in each person's lab notebook.

V Next the data should be analyzed and compared to expected or accepted values. Note that error analysis should be included here. To do a full error analysis first determine the error inherent in the measurment as determined by propagation of errors. Then determine the error between your measured value and the accepted value. Finally compare this inherent error to the latter error. In a good measurement this error from the accepted value should be less than the inherent error. If this is not the case there are problems and these must be addressed. Partners may work together but this work should be recorded in each lab notebook.

VI Finally, partners will prepare their lab report. This may be in the form of a talk to the class, a talk to the Prof. and TA, an oral quiz with the lab books open or a written report. The intent is to make sure you understood the lab not to make it more time consuming to you. The lab report is due at the end of the second week of the lab. (The next packet will be handed out then.)

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Talks: Each lab pair will give a presentation to the class during one of the regular class meetings. Topics may include the historical relevance of the experiments. You may choose other topics but I must agree to it. The presentations will be 20 minutes long (with 5 minutes for questions) and made by lab partners using viewgraphs. Copies of the viewgraphs are to be handed in and a small poster based on the viewgraphs (see the posters around the classroom). Sign up for which presentation you want to do as soon as possible.

Expect to work 6-8 hour/week outside of the class meeting time. For each lab figure on something like 2-3 hours of preparation time to come up with a reasonable procedure, 8-10 hours with the equipment including both familiarization and taking data, and 2-3 hours preparing the data for presentation or a lab write-up. Note there is one lab every *two* weeks.

In this course it is IMPERATIVE that you keep up.

GRADING POLICY:
Each lab will be out of 10 (10-9 is an A, 8 is a B, 7 is a C and 6-0 is unacceptable and the report must be resubmitted). Each assignment will be out of 5. At present I do not plan to have any quizzes, but that is not final. The talk/poster is out of 15, with 10 for the talk and 5 for the poster. Your final grade will be determined by totaling your six best labs marks with your talk and assignment marks.

WITHDRAWAL:
The University withdrawal policy as published in the class schedule will be followed. This means that a withdrawal with an automatic W will be possible up to 5 PM on Sept. 30. After this date an F will be given upon withdrawal if that is the earned grade at the time. After Nov. 1 a withdrawal with a recorded grade is possible only by petition to the Dean of the College of Arts and Sciences. Please note that the policy for switching to audit is exactly the same as for withdrawal, so this is not an alternative way of escaping the course when you have a failing grade.

CHEATING:
The University's policies on cheating will be followed. See the student handbook under academic misconduct for descriptions of infractions and the resulting penalties. Casual cheating on a lab report is not acceptable. *i.e.* no copying of other peoples data or even your own lab partners write up. I will report any form of cheating to the Dean's office for further penalties.

STUDENTS WITH DISABILITIES:
All students with disabilities that require special consideration should be registered with special student services. Any student in this course who has a disability that may prevent her or him from fully demonstrating her or his abilities should contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation in the course.

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SCHEDULE: (tentative)

Date	Lecture Title	Experiment	
21 Jan.	Introduction		
28 Jan.	Statistics 1	Statistics I	
4 Feb.	Statistics 2	Statistics II	
11 Feb.		Classical	*c*
18 Feb.		Classical	*c*
25 Feb.		Classical	*k*
4 Mar.		Classical	*k*
11 Mar.		Classical	*e/m*
18 Mar.	**SPRING BREAK**	Classical	*e/m*
25 Mar.		Quantum	*h/e*
1 Apr.		Quantum	*h/e*
8 Apr.		Quantum	*Balmer*
15 Apr.		Quantum	*Balmer*
22 Apr.		Quantum	*Balmer*
29 Apr.		Quantum	*Balmer*
6 May		Projects	*Demos*
13 May	Talks Completed		