Syllabus: Physics 223; Section 001
Spring, 2018

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241 Jorgensen, Thursday, Section 001: 2:00 pm - 5:00 pm

Official Course Description
Physics 223 • General Physics Laboratory III
(1 cr) Prereq: Physics 213 or parallel.
Laboratory experiments in electromagnetic waves, subatomic and atomic particles, and radiation
Lab fee required.

Required Materials
1. Pen

Recommended Materials
1. Spare notebook for individual notes

Laboratory Objectives
1. Strengthen your understanding of and intuition for basic physics concepts in Measurements, Electromagnetism, Physical optics, Atomic, Nuclear, and High-energy physics.
2. Develop your skills at collecting and analyzing data and formulating meaningful conclusions based on this data.
3. Utilize computational tools for data analysis and for comparing experimental data to theoretical predictions.
4. Enhance your ability to communicate results and ideas through scientific writing and graphical representations. Gain experience at writing formal reports describing technical scientific work.
5. Further develop your skills at using various computer-based tools for studying sciences.
6. Practice your skills at working cooperatively within a group to achieve solutions to given problems.
7. Give you experience at relating physics concepts to real-world applications.
8. Obtain one hour of x-ray radiation safety training and three hours of use with an analytical x-ray machine.

Laboratory Requirements and Procedures
1. Lesson reports are due to your instructor before you leave the lab each week unless your instructor informs you otherwise. Be sure to gauge your time in order to finish all necessary parts. You will not receive a grade for a lesson unless you submit your work to the instructor.
2. Your laboratory instructor will grade each lab report according to the Grading Guidelines.
3. In the workplace, supervisors don't generally use letter grades or percents to rate your performance. Typically, they use verbal scores and comments. To help prepare you for this, we rate the labs in a similar fashion; then use a formula to turn the verbal scores into percents. See the grading guidelines section of this syllabus for more information.

4. If you have a question about a score given for a lesson or report, you must discuss this with your lab instructor. Please do not discuss personal grading issues during lab time. You should discuss concerns privately with your lab instructor at the end of lab or at a time outside of lab. If you feel a score is inappropriate, you should explain why, in writing/email, and give this written explanation to your lab instructor within one week of when you received it. Scores will not be reconsidered or changed after the one-week deadline has passed.
5. Attendance at all laboratory meetings is mandatory. If you must be absent, discuss your situation (in person or through email) with your lab instructor immediately. If you think your absence may be excusable, then write an explanation of the situation and give it to your lab instructor within one week of missing lab. This explanation should be in writing/email. Your lab instructor may take this situation into account when assigning final grades at the end of the term.
6. You are expected to complete two formal reports during this semester, one written and one verbal. More details on the expectations for the formal lab reports appear later in this syllabus and will be given in class by your instructor.
7. There will be no final exam given for this course.
8. Having experience working successfully in teams is highly useful for scientific and technical career goals. Therefore, part of the intention of the laboratory experience is to give you practice working with different people. You will be assigned different lab partners at least twice during the term.
9. Be sure to write neatly in your lab book and organize your work so that it is presented clearly. If the instructor can't read your work, then he/she doesn't have to grade it!
10. Each group will submit one Group Lab Report. It is important that EACH group member participate in the experiment, but only ONE "scribe" should record data and answer questions in such a way that each group member is in agreement. At the end of lab, each group member must peruse the report and agree to its contents. No group member is allowed to leave until the lab report is agreeable to all group members.
11. You will choose a different "scribe" for the experimental report at least on a weekly basis. You may change scribes more often as directed by the lab instructor.
12. 223 lab students are encouraged to bring their own lab notebook to take notes while conducting the experiment. Only ONE group report will be graded, but students may take individual notes for their formal reports.
13. The group report grade will be the grade each group member receives for that experiment. As such, each group member must agree to the group report contents before the group report is submitted.
14. The lab instructor reserves the right lower an individual group member's grade if that group member is not fully participating.
15. Any student caught copying another student's work verbatim in a group report or using lab reports from previous terms will automatically receive a zero for that experiment. In addition, the Department Chair may be notified for further possible action.
16. Students are expected to maintain a positive educational environment for all students in this class as outlined in the Students' Rights and Responsibilities section of the Undergraduate Bulletin.

Grading Guidelines for Physics 223

At the end of each laboratory period, you are to submit your group lab work to your instructor for grading. Your instructor will read through your work and make comments as to areas that need improvement and areas that are especially good. Along with this feedback, each lab report you complete will be graded on a "Quality" grading scale. This scale is defined below.

Quality of Lab Techniques, Application of Physics Concepts, and Conclusions:

- Excellent - The quality of the lab work is practically perfect.
- Impressive [+ -] - The quality of the lab work is impressive. The physics concepts have clearly been thought through and were carefully applied. The experimental techniques and data collection were completed carefully. The data analysis was done precisely with all graphs and values labeled. Questions were answered in detail with all reasoning justified and explained. The wrap-up discussion shows a great overall understanding of the big idea of the lab activities and all results are based on the work done in lab.
- Good [+ / / -] - The quality of the lab work is good. Report may include some small misunderstandings or have some missing units or labels. Some physics concepts have been identified. Measurements may be a little sloppy, but overall the experiment was completed correctly. Graphs were completed and represented the data collected. Wrap-up discussion represents a summary of the results obtained.
- Weak - The quality of the lab work is weak. The report may contain some significant mistakes or misunderstandings. Experimental techniques may have been careless and results suffered. Important information or aspects of the analyses may be missing. Relevant graphs may have some formatting errors or omissions. Wrap-up discussion is simply a statement of the final result or missing.

Calculation of Final Lab Grades:

The following scale will determine the final lab grades for this course:

Quality Score	=220 (11 labs * 20)
Formal Report Score	= 80 (2 formal reports * 40)
Final Lab Score	= 300

In Physics 223, the Quality Score will be assigned based on the following scale.

$$(\#Exc)(20), (\#Imp+)(19), (\#Imp-)(18), (\#Gd+)(17), (\#Gd)(16), (\#Gd-)(14), (\#Wk)(12)$$

Estimate of Final Lab Grade = $\{[(all\ Quality) + (all\ Report)]/300\} * 100\%$

Range	Grade
$96\% \leq x < 100\%$	A+
$93\% \leq x < 96\%$	A
$90\% \leq x < 93\%$	A-
$86\% \leq x < 90\%$	B+
$83\% \leq x < 86\%$	B
$80\% \leq x < 83\%$	B-

It is possible that grades will be "scaled up" at the end of the semester so your final grade could be higher than estimated by this equation. No grades will be "scaled down."

Changes to Syllabus
This syllabus is subject to change. Any changes will be approved by the Laboratory Manager and announced and posted in the laboratory room.

Guidelines for Writing an Experiment Report

Experimental logbooks are a crucial component of all technical work. Whether you are an engineer hoping to obtain a patent, a scientist hoping to publish your research, or a health professional documenting a patient's condition, accurate and detailed lab notes are essential. One goal for the physics 223 course is for you to develop your skills at communicating scientific information through writing. Therefore, each laboratory period you will be required to complete and turn in a write-up in a bound logbook and you will be expected to write two formal reports during the semester. This weekly write-up should include all information necessary so that anyone (you, the lab instructor, or someone not even in the class) can read it and follow what happened. You should include all relevant information along with your experimental techniques, measured data, calculations, conclusions, etc. It is this form of 'reporting' that you will work to master during this term in your lab write-ups.
Your lab instructor will highlight some of the important details that should be included in all write-ups. The following can serve as a helpful guide.

Basics:

Since this is a technical record of your experimental studies in this course, all work should be recorded *in pen* in your logbook. If you should make a mistake, simply draw one or two lines through it. This will make sure that your logbook represents an accurate record of all scientific work you complete in this course. Be sure to write neatly if you expect your work to be graded!

Example of a mistake: ~~42 cm~~ 24 cm

Information:

The following information should be included for each lesson:

- Experiment title
- Date
- Your name
- Name of your partner(s)
- Name of the computer and of all saved data files (if applicable).

Techniques:

If the procedures are not specified in this manual, then you should *briefly* describe the techniques you use to complete an experiment. This information will allow someone to understand what you did even if they were not watching. For example, you might

describe which variables are to be held constant, which ones are to be manipulated, and which ones will be measured. In addition, if there are many different kinds of equipment that can be used in an activity, do not list all of them. Instead, you should only record the items you actually use.

Experimental Data:

Carry out your procedures carefully to get the best results. Sloppy work will give you sloppy results. All measured quantities should be written down. Place the numbers in tables where helpful and label all quantities. Every recorded number must include the appropriate units.

Data Analysis:

Calculations - Include a sample of any mathematical calculations you perform on your data including each formula entered into a spreadsheet. You do not need to show the same steps over and over if you are using a calculator or spreadsheet for your calculations.

Graphs - You will often analyze your results in the form of a graph. All graphs should be properly labeled, titled, and drawn neatly with the aid of a ruler or graphing software.

Inserts - You will often have information to insert into your logbook (graphs on graph paper, computer print outs, etc.). These should be trimmed when possible and then taped into the book to continue the flow of your experimental work.

Questions:

Answer all numbered questions as completely and clearly as possible.

Wrap-Up Discussion at End of Each Lab:

Accuracy: Your report should include a brief discussion of how your results or techniques could have been improved. Try to list sources of experimental uncertainty. Do NOT simply say "Experimental error" and do not make excuses for sloppy work. Answer the question, "If I were to repeat this experiment, what could I do differently to reduce experimental uncertainty and improve my results?"

Implications: At the end of your report, write a conclusion about the "big idea" of your work. Do not just restate a final number, but *summarize the general physics concepts that were used and the implications of these concepts.* This is often the most important part of your lab report so be sure to put time and thought into writing a useful statement. Try to answer the question, "What did all of this mean?"

Participation:

Each lab student is expected to participate in all aspects of the lesson, to contribute to the group's work, and to allow and encourage the active participation of the other members of the group. Effective group work is one of the skills most sought after by engineering firms and industry and this laboratory course should provide you with experience in working as a group member. You can expect to change your partners at least two times during the semester.

Spring 2018 --- Laboratory Schedule --- Physics 223

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Dates	***Group A***	***Group B***	***Group C***
Jan. 11	Modeling Data	Modeling Data	Modeling Data
Jan. 18	Radiation Safety Lecture	Radiation Safety Lecture	Radiation Safety Lecture
Jan. 25	Interference	Interference	Interference
Feb. 1	Blackbody Radiation	Measuring C	Spectral Analysis
Feb. 8	Spectral Analysis	Blackbody Radiation	Measuring C
Feb. 15	Measuring C	Spectral Analysis	Blackbody Radiation
Feb. 22	Nuclear Scattering	Nuclear Scattering	Nuclear Scattering
March 1	Prepare Formal Report	Prepare Formal Report	Prepare Formal Report
March 8	Photoelectric Effect + **Formal Report due!**	Photoelectric Effect + **Formal Report due!**	Photoelectric Effect + **Formal Report due!**
March 15	Pi, Muon, Positron Decay	Pi, Muon, Positron Decay	Pi, Muon, Positron Decay
March 22	**No Labs- Student Holiday**	**No Labs- Student Holiday**	**No Labs- Student Holiday**
March 29	Why is the Sky Blue?	Particle in a Box	X-Ray Diffraction
April 5	X-Ray Diffraction	Why is the Sky Blue?	Particle in a Box
April 12	Particle in a Box	X-Ray Diffraction	Nuclear Scattering
April 19	Prepare Final Pres.	Prepare Final Pres.	Prepare Final Pres.
April 26 (*Dead week*)	Final Presentations	Final Presentations	Final Presentations
May 3 (*Finals)*	*No lab final*	*No lab final*	*No lab final*

The experiment schedule may change during the semester.
Due to the possibility of new experiments mid-semester, this schedule is in a state of fluctuation. Each lab will be posted at least one day before lab, so students can read through the experiment before class. The lab write-ups will be posted on Canvas. Students can print the labs before class, in class, or simply read them from Canvas during the lab time.

Laboratory Manager:
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