Physics 253 - Modern Physics Dr. Frosso Seitaridou
Syllabus - Fall 2012

Welcome to Modern Physics! This course covers the physical concepts developed in the 20th century. The concepts we will learn this semester are concepts that almost everybody has heard of (e.g., relativity, x-rays, quantum physics, etc.). Needless to say that these concepts have inspired many works of science fiction and, of course, they have many applications in modern technology.

A good understanding of modern physics will help you a) understand modern technology (e.g., GPS, x-rays, etc.), b) hone your thinking skills, d) recognize the philosophical implications these concepts have! Since you have already taken Introductory Physics, by the end of Physics 253 you will have seen and understood almost all physics concepts! I hope you are excited! In addition, you will conduct on your own some of the original experiments that led to the development of these concepts, and you will also work on your scientific writing skills by writing laboratory reports on these experiments (see below for more details on those.)

Goals of the Course

At the end of this course, we will be able to:

1. Have a fundamental understanding of the physical concepts developed in the 20th century.
2. Apply these concepts in order to solve simple problems in modern physics.
3. Recognize the reasons why some of the concepts are subject to different interpretation by physicists.
4. Appreciate the philosophical implications of these concepts.
5. Recognize the physics concepts behind modern technological advances.
6. Develop your skills in scientific writing.

To achieve these goals, we will solve problems, use laboratory exercises, write lab reports, and, depending on interest, I will be giving you some reading assignments that are outside our textbook.

Student work submitted as part of this course may be reviewed by Oxford and Emory faculty/staff for the purposes of improving instruction and enhancing Emory education.

Writing Intensive

This course satisfies the Continuing Writing Requirement for eligible students. The basis for this is a) the writing of the solutions to the homework problems, b) the writing of the short lab reports, and c) the writing and revision of the full lab reports. For more details on that, please see the "Homework" and "Lab Reports" sections below.

Important Information

Instructor and Contact Information: Dr. Frosso Seitaridou. You can reach me by emailing at eseitar@emory.edu or by calling my office at 4-8344.

Office Hours: My office is at Pierce 209. I have an open door policy: if I am in the office and the door is open, feel free to come in. We can talk about physics and homework assignments, your student life, and anything else you would like to chat about. You can also email me to make individual appointments.

Prerequisite: Math 112 and either Physics 142 or Physics 152

Textbook: Tipler and Llewellyn, *Modern Physics*, Fifth Edition

Homework: All homework assignments (reading and problems) together with their due dates are shown below. It is expected (and you will find it very helpful) that you have done the reading before we talk about it in class.

With regards to the assigned problems, you will be asked to present the solutions in the form of paragraphs. That is, your solutions should contain both text and equations and should be organized in the same way you organize your thoughts and arguments in a paragraph. You can see such a solution every time you read an example in your introductory physics and modern physics textbooks. We will talk about examples of such solutions during class, but there is also an example below, in the section titled "How to solve a physics problem."

Reading Schedule and Assignments

Week	Dates	Section	Assigned Problems and comments (for lab assignments, see below)
1	29-Aug	1.1	
	31-Aug	1.1	
2	3-Sep	No class	Labor Day
	5-Sep	1.2	
	7-Sep	1.2	
3	10-Sep	1.3	Skim spacetime diagrams. Read pages 1-5 from Einstein's 1905 paper
	12-Sep	1.3	
	14-Sep	1.4	Due: Ch1: 4*,6,10
4	17-Sep	1.4	Skim muon decay and the spacetime interval
	19-Sep	1.5	
	21-Sep	1.6	Skim the headlight effect from book.
5	24-Sep	2.1	
	26-Sep	2.2	
	27-Sep		Please, attend the Lyceum talk on the Higgs particle
	28-Sep	2.2	Due: Ch1: 8, 16,18,20,26,28
6	1-Oct	2.3	
	3-Oct	2.4	Skim creation and annihilation
	5-Oct	2.4	Due: Ch2: 3,6,8,10,12, and the reading on the Fabric of the Cosmos, ch. 1-3
7	8-Oct	3.1	
	10-Oct	3.2	
	12-Oct	3.3	Due: Ch 2: 16,17,20,22
8	17-Oct	3.4	
	19-Oct	4.1	
9	22-Oct	4.2	Due: Ch 3: 2,4,6,13,16
	24-Oct	4.2	
	26-Oct	4.3	
10	29-Oct	4.3	Due: Ch 3: 18,21,28,30,34,38
	31-Oct	4.4	

	2-Nov	4.5	
11	5-Nov	5.1	Due: Ch 4: 2,4,6,8,10,14,16
	7-Nov	5.2	
	9-Nov	5.2	
12	12-Nov	5.3	Due: Ch 4: 18,19,22,26,28,34,36
	14-Nov	5.4	
	16-Nov	5.5	
13	19-Nov	6.1	Due: Ch 5: 2,6,14,17,18
14	26-Nov	6.2	
	28-Nov	6.2	
	30-Nov	6.3	Due: Ch 5: 24,30,32,38,41
15	3-Dec	6.4-6.5	
	5-Dec	6.6	
	7-Dec	7.1	Due: Ch 6: 2,4,6,10,16
16	10-Dec	7.2	

* Don't be tricked by the book "organizing" the problems by sections. You will find that in order to solve a problem you might have to look at other sections, sometimes even sections from a different chapter. So keep that in mind for all the problems that are assigned from the book.

Tests and Exams: There will be three tests and one final exam (for dates, see below). The tests will be on the material covered up until that point (the second test will cover the material after the first test and, similarly, the third test will be on the material after the second test). The final exam will be cumulative. There is no such thing as a make-up exam!

Re-grading Assignments: I am very careful when I grade assignments. However, I might make mistakes when I grade. If you would like me to re-grade a test or assignment, your request should be submitted to me **in writing within 24 hours** from the time I give back the graded assignment. Note that such a request will result in me re-grading the whole assignment/test (not just the specific problem you requested).

Attendance: I find attendance and class participation to be vital for this course. You are allowed **3 absences regardless of whether you have a valid reason for them or not.** Therefore, I recommend that you save those for when you really need them (e.g., you get sick) instead of skipping class. If you are absent from class on a day when there is an Organic Chemistry or a Math test, 10 points will be taken off of your next Physics test. If you exceed the 3 absences, there will be a 5% deduction off of your final grade for every additional absence. **ATTENDANCE IS MANDATORY FOR LAB SESSIONS**.

Tardiness and Cell Phones: Being late for a class, or having your cell phone ring in the middle of one, is distracting not only for you but also for me and for your classmates. Students who are late for class for more than 5 min will generally not be allowed to attend that day's lecture and will be considered absent. Students whose cell phone rings during class will be asked to leave the classroom and will be considered absent. For the same reason, **I will not allow food or drink during class**, with the exception of a bottle of water.

Grading: **Grades to assignments will be given based on correctness, not completion.** So, especially for the homework make sure that you solve the problems correctly! Grades for the course are assigned on the plus-minus scale. The final grade will be determined based on the following weighting:

Homework: 30%
Exams: 10% each test (30% total), 20% for the final
Lab Reports: 20%

Course Content: Relativity, Atoms, wave-particle duality, quantum physics

Important dates: Make sure you include these important dates in your planner/calendar. The actual times for the tests will be determined during class.

Date	Description
Sep. 21, 2012	Test 1
Sep. 27, 2012, 7:30pm-9pm	Please, attend the Lyceum talk on the Higgs particle
Oct. 19, 2012	Test 2
Nov. 16, 2012	Test 3
Friday, Dec. 14, 2012, 9am-12pm	Final exam: Cumulative

Working with the Honor Code: The Oxford College Honor Code applies to this course as follows:

Tests and final exam: The work presented in these assignments should be your own. No collaboration permitted. You are expected to follow the instructions given by me and abide by the Honor Code. Sharing calculators, pencils, etc., is not allowed

Lab reports: Each student will be submitting his/her own lab report. However, since the experiments will be done in groups of 2-3 students, you are allowed and encouraged to discuss your data and the implications of your data with your lab partner(s).

Homework assignments: You are encouraged to work on the assignments **by yourselves first, before consulting other classmates for help.**

Study groups: Even though you cannot work together on tests and exams, you are definitely encouraged to form study groups and study concepts together and explain to each other things that you were not clear about from class or from your reading assignments. However, as mentioned above, you are strongly encouraged to work on the homework assignments by yourself first, before consulting your classmates for help.

Religious Holidays: You need to tell me immediately if any religious holidays will interfere with the course, especially the final exam and tests

How to Solve a Physics Problem

Your homework assignments will consist of pre-lecture reading assignments, and problems. In your solutions to all problems I expect to see that you solve the problems following several important steps.

1. Read the problem carefully so that you know what is given and what is asked.
2. Draw a picture when applicable.
3. Label all the quantities in the diagram, those that are given and those that you need to find. Also, **show your coordinate system if applicable and show which direction you have defined as positive!**
4. State the Physics Laws that apply to that problem. For example: ``Particle in 1D box"
5. Write the law in equation(s) form.

6. Solve the equations and substitute the values. **Always include the units!** Also, show your work! You cannot just write the initial equation and then the result. You have to show me the intermediate steps. This way, I can identify the wrong step and help you understand why what you did is not right.
7. Check your answer. Do the units match? Does the sign in front of your result make sense? Is the answer too big or too small compared to what you expected?

Since this course satisfies the writing requirement, steps 4-6 above are critical to me for evaluating your work in terms of the quality of writing. You need to explain your thinking process not just via equations, but also with words. For example, your work should look like this:

"Based on the given information for the potential, its form is that of the infinite square well. For this potential, the solution to the Schrodinger equation is given by eq. 6-32 on page 233 from the textbook:

If we plug in the appropriate values for n, L, and x as given by the problem, we find that…"

In this example you see that I have identified the concept (Infinite square well), the equation that describes the concept and what I am about to do with this equation, and I have explained the process of my thinking in words. **You are expected to use proper syntax, grammar, punctuation, etc. when you write up your solutions and, of course, in your lab reports,** which are discussed in detail below.

Requirements for the Lab portion of this course

As noted above, the lab portion of the course constitutes 20% of your grade. Even though this 20% will be based on your lab reports, you will not be able to write a lab report that shows your understanding of the experiment unless you follow these steps:

1. Bring your lab handout: You will be given the lab handout in advance. You are expected to have read the lab handout BEFORE coming to the lab. If you do not read the handout carefully before coming to lab, you will have a hard time understanding what you are doing, which will ultimately show in your report in the form of incomplete and incorrect explanations.
2. Answer all the questions in the lab handout: Some of these questions will require that you spend time at home analyzing the data and drawing graphs. I will definitely be looking for the answers in your lab report (more details on the lab reports later). Failure to present these answers in your lab reports will affect your lab grade.
3. Understand the lab: Experiments require repetition in order to ensure that your data is reproducible. Sometimes students regard this repetition as "busy work." However, remember that at all times you need to be thinking about what your data means, if this is what you expected and why (or why not) and, also, what the reproducibility (or lack of) means. Essentially you are expected to be thinking about what conclusions you can draw from your data. These conclusions should be included in your lab report.

Lab Reports

Throughout the semester you will write 4 full lab reports and several short lab reports.

a) Full lab reports: Each full lab report will be, approximately, 5-7 pages long (including data and figures). For each report, you will be submitting a first draft and then a final draft. After you submit the first draft, I will read it and make comments on it, and return it to you. You will then, if you wish, have a week to revise your first draft and submit your final draft. The evaluation will be done based on the "Physics Lab Report Evaluation Sheet" attached at the end of the syllabus. Full lab reports should contain all the parts listed in the Evaluation Sheet (i.e., title, abstract, introduction, materials and methods, results, discussion, conclusion, and references) and will be written for the following experiments:

   1) Measuring the speed of light
   2) The Millikan Oil Drop experiment
   3) The Black-Body Radiation
   4) The Frank-Hertz experiment

   Each full lab report will be due a week after the corresponding experiment is conducted.

b) Short lab reports: For the remaining labs, you will be writing short lab reports, each of which will be approximately 2-3 pages (including data and figures). Short lab reports will contain only the following sections: title, brief introduction that includes a thesis statement, results, discussion (in the short lab reports, the discussion will essentially consist of the answers to the questions in the lab handout that are supported by your results,) and conclusion. Short lab reports will not be submitted in drafts. In other words, for these reports you will not be given the option of revision. Similarly, the short lab reports will be due a week after the corresponding experiment is conducted.

Schedule of Labs

The table below shows the schedule of our labs for this semester. This schedule is tentative and the order of the labs might change depending on the status of the equipment, the pace of the class, etc. Any changes will be announced in advance.

Week	Lab
1	Matlab tutorial
2	Matlab project #1. Short report is due on week 3.
3	Measuring the speed of light: a) Michelson interferometer and b) Speed of Light apparatus. Your full lab report can be on either (a) or (b) – you choose! That's due on week 4.
4	Brownian motion and Microfluidics part 1: Fabricating microfluidic devices (no lab report needed)
5	Brownian motion and Microfluidics part 2: Observing Brownian motion inside Microfluidics. Short report is due on week 6
6	a) Matlab project #2. b) Also due this week: Research 2 journal papers (one on Microfluidics and one on Brownian motion). Be ready to describe the papers to your classmates. 1-page summary for each paper due on week 7
7	a) Millikan oil drop experiment (Full lab report due on week 8) b) Submit a 1-page summary for each of the 2 papers you found in week 6b.
8	a) Properties of the electron b) Also due this week: Based on the papers you researched and their summaries, is there a

	new question you would like to have answered? Be ready to justify during lab
9	a) Matlab project #3. Short report is due on week 10 b) Also due this week: a 3-page paper on how you would go about designing an experiment that would address the hypothesis you developed on week 8b.
10	Blackbody radiation (Full lab report is due on week 11)
11	a) Planck's constant apparatus/photoelectric effect (class demo) b) Light emitting diodes. Short report is due on week 12.
12	Atomic spectra. Short report is due on week 14.
13	No lab – Thanksgiving break
14	Franck-Hertz experiment (Full lab report is due on week 15)
15	a) Bragg diffraction (Short report is due on reading day) b) Particle in a box (in class)
16	No lab – Reading day

Physics Lab Report Evaluation Sheet

1. Scientific validity and style (16 points)

a. Is it clear that the author has understood the purpose of the experiment, the data acquisition and analysis process, and what the results mean? (2 points)
b. Does the author tell a story in the report as a whole and in each section of the report? Is there a beginning, middle and an end to the story? Is there too much repetition? (a good story should not be repetitive. Also, since you are writing a story, you should avoid lists!) (1 point)
c. Does the author avoid generalizations and vague statements, such as: "There are many applications of relativity in everyday life"? (1 point)
d. Is the author consistent with the style (does not alternate between "we" and "I" and sticks with one tense, etc.)? (1 point)
e. Does the tone indicate what the author did instead of telling the reader what to do? (1 point)
f. Are scientific terms used in their proper meanings? For example, are they referring to "g" as the "gravitational acceleration" instead of just "gravity" or "gravitational force", etc.?(1 point)
g. Are abbreviations used only for scientific notation and after these abbreviations have been defined? (1 point)
h. Does the author use short but concise sentences that only try to make one point? (1 point)
i. Does the author avoid awkward sentences (i.e., is the syntax proper)? (1 point)
j. Does the author avoid spelling mistakes? (1 point)
k. Are all figures/tables/graphs labeled, titled, with the proper units, and axes labels, etc.? (1 point)
l. Are all figures/tables/graphs easy to see and understand (not too small, not too big, easy to read, etc.) (1 point)
m. Do all figures/tables/graphs have a proper caption? Are the captions descriptive? (1 point)
n. Are all figures/tables/graphs explained and discussed in the main text? (1 point)
o. Is it obvious to the reader what point the author is trying to make by including each figure/table/graph? (1 point)

2. Title (2 points)

a. Are you interested in reading the report after looking at the title? (1 point)
b. Does it provide a one-sentence description of the whole report? (1 point)

3. Abstract (5 points)

a. Does the abstract provide a one-sentence summary from each of the subsequent sections (except for the references)? Is the abstract well balanced? (for example, does it have too much information for one of the sections of the report at the expense of the other sections?) (1 point)
b. Are these sentences connected logically to each other in a smooth way? (avoid lists!) (1 point)
c. Does the author avoid mentioning unnecessary details that the reader can only understand after reading the report? (the author cannot assume that the reader knows the experiment) (1 point)
d. Does the author avoid referring to equations and figures via the use of their numbering (e.g., equation 2, figure 3, etc.)? (1 point)
e. Are the important results/highlights of the experiment mentioned, with specific numbers, when appropriate? (1 point)

4. Introduction (8 points)

a. Is there a story? Does the author start with the concept under investigation, the equations that describe it, the derivations from one equation to the next, the point of the experiment? (1 point)
b. Have all the necessary concepts and equations been introduced and derived? (1 point)
c. Are the derivations explained step by step (instead of just listing each step)? (1 point)
d. Are all equations given their own line and number? (1 point)
e. Are all the new variables defined (including SI units) after each equation where they first appear? (1 point)
f. Are all the important variables explicitly stated? (important variables are those that you measure, calculate, etc. If a variable appears in a figure/table, then it is definitely an important variable) (1 point)
g. Does the author avoid referring to details that the reader can only know after reading the whole report (i.e., the author cannot assume that the reader knows the experiment)? (1 point)
h. Is there a thesis statement (i.e., what will the author try to accomplish by doing this experiment, what is the hypothesis)? (1 point)

5. Materials and Methods (4 points)

a. Is a figure provided that explains the setup? Is the figure referenced in the main text? (1 point)
b. Are the important components of the setup indicated on the figure? (1 point)
c. Are important details of the setup and procedure stated and explained? (1 point)
d. Will a person unfamiliar with the experiment be able to reproduce it after reading this section? (Is it easy to understand the setup based on the author's description?) (1 point)

6. Results (7 points)

a. Are all results presented in a way that conveys the point the author is trying to make (i.e., use a table instead of a graph, etc.)? (1 point)
b. Are the results/tables/figures explained in the main text? (1 point)
c. Is the order in which the results are presented logical? (1 point)
d. Are important intermediate results included (even if they are not directly asked in the lab handout)? (1 point)

e. Does the author specifically state which results are raw, calculated, intermediate, etc.? (1 point)
f. For the calculated results, does the author explain how the calculation was made by referring to equations from the Introduction? (1 point)
g. Has the data analysis been done correctly? (1 point)

7. Discussion (4 points)

a. Does the author discuss the results by referring to equations from the Introduction and connecting them to figures/tables/graphs or important calculations from the Results section? Are the answers to the questions in the handout smoothly incorporated in this section? (1 point)
b. Are the sources of error listed and explained in a way that is consistent with the results? (1 point)
c. Has the author discussed if the hypothesis was verified based on the results/data? Has the author explained the reasons why the hypothesis has been verified or not? (1 point)
d. Are improvements to the experiment listed and discussed? Is it clear how these suggestions will improve the experiment? (1 point)

8. Conclusion (2 points)

a. Does the author provide a summary of the experiment with all the highlights reviewed? (1 point)
b. Is the author specific when listing the applications of the concepts and equations described in the report? (1 point)

9. References (2 points)

a. Does the author use the appropriate format for the references? (1 point)
b. Are all references included? (1 point)

Total number of points: 50 points