Physics III - Modern Physics

PHYS 2402

Spring 2008, Tue-Thu 9:30 AM - 10:50 AM, SC010

Instructor: Professor Nural Akchurin, Nural.Akchurin@ttu.edu, Tel:742-3767

Office Hours: Tue-Thu 1:30-2:30 PM or by appointment, SC101.

Course Textbook: Randy Harris, *Modern Physics*, 2nd edition, Pearson - Addison Wesley, 2008. We will use this book as our main text. I will assign reading and problem assignments from this book.

Supplementary Reference Textbooks: There are several good introductory textbooks in special relativity, quantum mechanics, materials, nuclear and particle physics. I list some of my personal preferences and I encourage you to study from any textbook that you feel is helpful. The last two books are useful for the lab part of the course.

1. Paul A. Tipler and Ralph A. Llewellyn, *Modern Physics*, W.H. Freeman, 2000.
2. John Taylor and Chris Zafaritos, *Modern Physics for Scientists and Engineers.*
3. E. Taylor and J. Wheeler, *Spacetime Physics*, 2nd Ed. W. H. Freeman, 1992.
4. Jeremy Bernstein, Paul M. Fishbane, and Stephen G. Gasiorowicz, *Modern Physics.*
5. Mary L. Boas, *Mathematical Methods in the Physical Sciences*, John Wiley and Sons, 3rd ed., 2006.
6. J. R. Taylor, *An Introduction to Error Analysis*, 2nd edition, University Science Books, 1997.
7. A. C. Melissinos and J. Napolitano, *Experiments in Modern Physics*, Academic Press, 2003.

The objective of this course is to develop a solid understanding of special theory of relativity, simple quantum mechanical systems, hydrogen atom, spin, atomic physics, nuclear physics and fundamental particle interactions. We will start with a discussion of special theory of relativity, move to simple quantum mechanical systems and explore the Schrödinger equation. We will later concentrate on the hydrogen atom and spectroscopy. Remember, it is not what we cover, but uncover that matters.

Requirements:

1. **Homework:** Homework sets will be assigned regularly (see Class Schedule) and will be based on the material presented in class. Homework assignments will NOT be collected but there will be 20-minute-long quizzes on the dates indicated based on homework assignments ($Q_i, i = 1, ..., 5$). There will be 5 sets. Working on the homework problems by yourself is a good idea. You will know if you understand the topic or not. Of course, you are welcome to discuss the questions with me, the lab TA and your classmates.

2. **Laboratory:** You will be working on several different experiments in the lab (Science 301). There are two lab sections on Monday and Wednesday afternoons 2 to 5 PM. Laboratory experiments are an integral part of this course. Nine experiments will complement the topics discussed in class. You will setup experiments, collect data and analyze the information. You will also keep a "logbook" with all the information about your lab work. The "lab manual" gives sufficient information to get you started on each these experiments. At the end of each experiment, there are questions which you are asked to answer in your report. The term paper will be based on one of the experiments in the lab or topics discussed in class. The final lab reports will be graded. Consult with your TA about your particular schedule – which experiment when–.

3. **Paper:** A term paper will be written (5-10 pages) and orally presented (15 minutes). Topic for the term paper will be decided in consultation with the instructor based on the topics covered in the lab and the course. The term paper will have to conform to the Physical Review *RevTeX4*, see URL http://authors.aps.org/revtex4/ guidelines. Term paper grade is 10% of your grade (out of 25%). I also give you the Physics Colloquium schedule and encourage you to attend these talks. You might find a topic interesting and decide to write your paper on that.

4. **Attendance:** I expect all will attend class and participate in discussions. If you have an excuse for not coming to class, you can call or email me.

5. **Exams and Final Grade:** There will be one in-class closed-book and a final in-class exam. The final grade consists of 25% quizzes, 25% lab work, 25% mid-term exam, and 25% final exam grades. Final exam is scheduled. The final grading metric is 100-85:A, 85-70:B, 70-55:C, 55-40:D and 40-0:F.

Outcome: Understanding of special theory of relativity, historical "modern" physics experiments and their influence on physics, quantum mechanical phenomena (*e.g.* the Schrödinger equation), and proficiency in mathematical techniques used in basic quantum mechanics.

Assessment: Assessed by class discussions of the course material, review of the lab logbook and the term paper, interactions in problem solving sessions, quizzes and the two exams.

Disability: Any student who, because of a disabling condition, may require some special arrangements in order to meet the course requirements, should contact the instructor as soon as possible, so that the necessary accommodations can be made. Proper documentation must be presented from the Dean of Students' Office.

PHYS 2402 Class Schedule

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Week	Topic	Chapter	T	W	Th	F
1	Special Relativity	2	1/6		1/8	
2	Special Relativity	2	1/13		1/15	
3	Waves and Part. I	3	1/20		1/22 Q1	
4	Waves and Part. I	3	1/27		1/29	
5	Waves and Part. II	4	2/3		2/5	
6	Uncertainty, Bohr Atom	4	2/10		2/12 Q2	
7	Bound States	5	2/17		2/19	
8	SHO	5	2/24		2/26 **E**	
9	Unbound States	6	3/3		3/5	
10	Particle-Wave	6	3/10		3/12 Q3	
11	Spring Break		3/17		3/19	
12	Hydrogen Atom	7	3/24		3/26	
13	Spin and Atomic Physics	8	3/31		4/2 Q4	
14	Spin and Atomic Physics	8	4/7		4/9	
15	Statistical Mechanics	9	4/14		4/16	
16	Molecules and Solids	10	4/21		4/23 Q5	
17	Molecules and Solids	10	4/28 Last Day		4/30 Final Exam	

Q_n means quiz based on HW assignment where $n = 1, .., 5$. **E** means mid-term.