Quantum Mechanics - I

PHYS 4307
V0 Syllabus

Fall 2009, Tue-Thu 9:30 - 10:50 AM, SC010

Instructor: Professor Nural Akchurin, `Nural.Akchurin@ttu.edu`, Tel:742-3427

Office Hours: Tue-Thu 11:00-12:00 PM or by appointment, SC039.

Course Textbook: David J. Griffiths, *Introduction to Quantum Mechanics*, 2nd edition, Pearson - Prentice Hall, 2005. We will use this book as our main text. I will assign reading and problem assignments from this book. It is a good idea to own this book.

Supplementary Reference Textbooks: There are several good textbooks available in quantum mechanics. I list some of my personal preferences and I encourage you to study from any textbook that you feel is helpful.

1. These are considered undergraduate text books.
   (a) John S. Townsend, *A Modern Approach to Quantum Mechanics*, University Science Books, 2000.
   (b) Eugene Merzbacher, *Quantum Mechanics*.
   (c) Hendrik Hameka, *Quantum Mechanics, A Conceptual Approach*
   (d) Stephen Gasiorowicz *Quantum Physics*
   (e) A. C. Phillips, *Introduction to Quantum Mechanics*
2. You will find the following useful for mathematical techniques that are widely used in physics.
   (a) Arfken, G. *Mathematical Methods for Physicists*, 3rd edition, Academic Press, 1985.
   (b) Boyce, E. B. and DiPrima, R. C., *Elementary Differential Equations and Boundary Value Problems*, John Wiley and Sons, Inc., 1969.
   (c) Morse, P. M. and Feshbach, H., *Methods of Theoretical Physics*, McGraw-Hill Book Company, Inc., 1953.
   (d) Gradshteyn, I. S. and Ryzhik, I. M. *Table of Integrals, Series, and Products*, 5th edition, Academic Press, 1994.
   (e) Abramowitz, M. and Stegun, I. A. *Handbook of Mathematical Functions*, Dover Publications, Inc., 1972.

The objective of this course is to develop the foundations of quantum mechanics in the context of a field theory. We will start with the discussion of amplitudes (wave functions), the Schrödinger Equation and develop a modern formalism used in quantum mechanics today. We will concentrate on hydrogen atom and solve it completely and make connections with spectroscopy and chemistry. Then, we will discuss two-particle systems, atoms and solids. Remember it is not what we cover, but uncover that matters.

A few other things we need to discuss in the beginning of class. 1) Based on the past experience, the problem solving sessions have been always useful. I would like to insert them into the class schedule as appropriate but everybody should look at their calendars before we set some dates. 2) I would like to use MATLAB in class to solve some numerical problems. MATLAB is now a common tool in science and engineering. The down side is that it costs money ($\sim$100$ for student version) and the university does not have a campus-wide license. We should discuss this in class too. 3) Class projects are also useful and extends the class material to topics that are not normally discussed in class. I have a growing set of problems/projects that are suitable for this class and I would like each person to pick a topic and work on it. Again, we should discuss this in class before we formalize it (*i.e.* change the grading scheme). I would like to hear your thoughts on these at any time (email is fine).

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 $\sim$20 minutes quiz on the dates indicated based on homework assignments ($\mathrm{Q}_i, i = 1, ..., 5$). There will be 5 sets. Of course, you are welcome to discuss the questions with me or your classmates.

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

3. **Exams and Final Grade:** There will be one in-class closed-book and a final in-class exam. The final grade consists of 50% quizzes, 20% mid-term exam, and 30% final exam grades. The final grading metric is 100-85:A, 85-70:B, 70-55:C, 55-40:D and 40-0:F.

Outcome: Understanding of quantum mechanical phenomena at a deeper level (*e.g.* the Schrödinger equation), and proficiency in mathematical techniques used in quantum mechanics.

Assessment: Assessed by class discussions of the course material, application of mathematical tools by each student 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 4307 Class Schedule

Week	Topic	M	T	W	Th	F
1			-		8/27*	
2	Ch1		9/1*		9/3	
3	Ch1-2	(Labor Day)	9/8		9/10	
4	Ch2		9/15		9/17 Q1	
5	Ch3		9/22		9/24	
6	Ch3		9/29		10/1 Q2	
7	Ch4		10/6		10/8	
8	Ch4	(Holiday)	10/13 (Holiday)		10/15 Q3	
9	Ch4		10/20		10/22	
10	Ch5		10/27		10/29 **E**	
11	Ch5-6		11/3		11/5	
12	Ch6		11/10		11/12	
13	Ch7		11/17		11/19 Q4	
14	Ch7		11/24	(Thanksgiving)	11/26 (Thanksgiving)	
15	Ch8		12/1		12/3 Q5	
16	Ch8		12/8*	Last Day of Classes		12/11 **F**

Ch_n signifies the chapter from Griffiths's where n is the chapter number. Q_n means quiz based on HW assignment where $n = 1, .., 5$. **E** means mid-term and **F** is final exam. * means I am at CERN and we will make up for these days.