Physics 4604 Wave Mechanics I Fall 2016 **Syllabus**

Lectures: MWF 11:30-12:20 MSB 306
Instructor: Richard Klemm richard.klemm@ucf.edu office: 407-882-1160 PSB 402
Office hours: Mon 7:00-9:00 and Tues 8:00-9:00 PSB 402, plus by appointment (send email).
Recitations Mon 1:00-3:00 and Thurs 4:30-5:30, all in PSB 158
LA: Dylan Rosenberg drosenberg@knights.ucf.edu
Office hours: see above (recitations). Other times in PSB 467
Grader: Gregory Shinaberry shinabeg@gmail.com cell: (443)-220-6913
Web page: www.physics.ucf.edu/~klemm/
Required text: David J. Griffiths, *Introduction to Quantum Mechanics* (2nd edition) (Pearson, Prentice Hall 2005) *Note*: 2nd edition textbook errata URL:
http://academic.reed.edu/physics/faculty/QMIIErrata2.pdf
Also required: a **working I-clicker.** Register your I-clicker before class, if possible, and bring it to every class except for exam dates.
Other recommended texts: Steven Gasiorowicz, *Quantum Physics* (3rd Ed.) (Wiley, Hoboken, NJ, 2003). Richard P. Feynman, *The Feynman Lectures on Physics, Volume III: Quantum Mechanics* (the New Millennium edition by Feynman, Leighton, and Sands)(Basic Books, New York, paperback 2011). This book is downloadable for free from the Cal Tech website. Versions of these texts will be placed on reserve in the UCF library.
Prerequisites: (1) Mathematics: PHZ 3113: Introduction to Theoretical Methods in Physics, which includes vector calculus, linear algebra, complex numbers, differential equations, partial differential equations, and complex variables
(2) Physics: PHY 3220: Mechanics I.
The lecturer and the LA will do their best to fill in the holes, if any, in your backgrounds.

All faculty members are required to document students' academic activity at the beginning of each course. In order to document that you began this course, please complete the following academic activity (attendance sheet) by the end of the first week of classes, or as soon as possible after adding the course, but no later than **August 26**. Failure to do so will result in a delay in the disbursement of your financial aid.

Reading is an essential part of PHY 4604! Reading the material from Griffiths before class is *very important*! The lectures are supposed to clarify your understanding, and to help you make sense of the material. The lectures will also contain some material from Gasiorowicz and Feynman, but primarily so that the material will enrich your understanding.

Homework is due every Wednesday (except exam weeks) at the start of class. If you need an extension, please ask, as it could be that others also could use some more time on difficult problems. Late homework can't be accepted once the solutions are distributed by email. The lecturer will provide advance notices of these distributions. This is an essential part of learning physics, and its importance cannot be overstated. For each problem, state the reasoning used to obtain the answer, and show all of the essential steps in the derivation. Just writing down the correct answer is entirely insufficient, and will not be credited. **The main point is to show that you know how to construct the solution**.
Collaborations with other students in the class are encouraged, as that is how most physicists actually work, and employers prefer to hire those who work well in groups. However, the collaborations should primarily be of a conceptual nature, as each of you should develop the ability to work out the details of the homework problems individually. Each of you should turn in your handwritten homework in your own words, reasoning, and equations, and the content should in principle be at least slightly different from everybody else's. If you prefer to type it using LaTeX or some other common software, that is also

acceptable, but be sure to use your own notation. You may also scan your homework, create a pdf of it, and send that to me by email.

Questions during lecture are **strongly encouraged**! There are two main ways to ask questions: (1) verbally, by raising your hand, and (2) by texting the question to the LA. I will try to answer as many questions in class as I can, but there may be many other questions that occur to you, either during or after class, that can be expressed in a short text message to the LA. Longer questions can be sent to the LA by email. The LA will compile a daily list of all questions, send it to the instructor, and will answer the shorter questions himself. The longer and more subtle questions will be answered by the instructor.

There will be **recitation periods** to go over the conceptual points necessary to solve the problems. Please think about the homework problems **before** you go to the recitations. We will not work out the problems in complete detail for you, but will discuss how to set up the problems. You will learn much more if you have already thought about each of the problems before the recitation periods.

Permission has been granted by the COS for each of you to have access to the cloud version of Mathematica©. This will be useful in making two- and three-dimensional plots of mathematical functions that you will be deriving in this class. The physics undergraduate major room (PSB 467) contains 3 new computers, each of which has working hard-disk copies of Mathematica© and other software programs. You can access these computers with your UCF login info.

Grading: Two **midterm exams**, each 20% of the course grade. **Homework**: 30%, and **final exam**: 30%. **The Final Exam will be Wednesday, December 7, from 10:00 AM to 12:50 PM in MSB 306** (the lecture room). It will be a comprehensive exam, covering the entire course, with some emphasis on the topics covered since the second midterm exam.

There will not be any makeup exams. The only allowable excuse for missing a midterm exam is a medical absence confirmed in writing by your physician. If you miss a midterm exam, your score will be determined by the weighted average of your scores on the other two exams. All exams are closed book exams. Formula sheets will be provided on the exam. ***All cell phones, iPads, computers, etc., that can access the internet are strictly prohibited during exams.***

I-clickers and online participation: these are essential tools in the learning process. They help you to learn the concepts that are essential to understand quantum mechanics, and they help me to find out if you are getting it. Your in-class answers are not graded, so do not be shy about answering the questions. However, I-clicker questions, possibly with slight modifications, will comprise major portions of the exams.

Students with **disabilities** should inform the lecturer and the LA within the first two weeks of class, in order that their academic needs can be properly met. Please supply the appropriate documentation, particularly if special assistance from another person would be needed.

Tentative schedule for PHY 4604 Fall 2016

Week #	dates	topics	reading
1	8/22-8/26	Introduction, QM postulates, probability & statistics	Griffiths 1.1-1.3
2	8/29-9/2	Review of complex numbers, classical waves, linear	Griffiths 1.4-1.5

		Operators, history of QM, Schrödinger wave eqn.	
3	9/5-9/**9**	**Holiday 9/5.** Operators & eigenvalues, expectation	Griffiths 1.6, 2.1, 2.2
		Values, separation of variables, infinite square well	
4	9/12-9/16	Infinite square well, completeness, Fourier series,	Griffiths 2.2-2.3
		amplitudes, simple harmonic oscillator **Midterm exam 9/16**	
5	9/19-9/23	SHO with operators, free particles, Fourier transforms	Griffiths 2.3-2.4
6	9/26-9/30	Heisenberg uncertainty, delta function potential,	Griffiths 2.4-2.5
		Plane-wave ``orthonormality'', coherent state	
7	10/3-10/7	Scattering, reflection & transmission,	
		currents, step& bump potentials, tunneling	Griffiths 2.6
8	10/10-10/14	(Alfons Schulte, guest lecturer 10/10 & 10/12) **Midterm exam 10/14**	
		Finite square well potential, vector wave functions,	Griffiths 3.1-3.3
9	10/17-10/21	Hilbert spaces, operators, observables, expectation	
		Values, proof of Heisenberg uncertainty principle,	Griffiths 3.4-3.5
		Energy-time uncertainty, Dirac notation, matrix Hamiltonian forms	
10	10/24-10/28	generalized HUP, compatible observables,	Griffiths 3.6, 4.1
		time dependence of expectation values, 3D	
11	10/31-11/4	Central potentials, , separation of variables in 3D,	`
		Griffiths 4.1-4.2 Spherical harmonics, angular momentum operators	
12	11/7-11/11	Angular momentum uncertainty,	
		angular momentum operators **Holiday 11/11**	Griffiths 4.2-4.3
13	11/14-11/18	Hydrogen wave functions, spin	Griffiths 4.3-4.4
14	11/21-11/25	addition of angular momenta, spin eigenvectors &	Griffiths 4.4
		eigenvalues, expectation values **Holiday 11/25**	
15	11/28-12/2	reviewing spin and angular momenta. Schwinger bosons	
			Griffiths 4.4
16	12/5	Semester review	

Final Exam Wednesday 12/7 10:00AM-12:50PM in MSB 306 (same room)