Syllabus **Applied Quantum Mechanics (PHYS 709)** Fall 2009

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Office hours: by appointment.
Classes: Tuesdays and Thursdays 2:30-3:45 in Cardwell Hall, room 144.

Prerequisite Introduction to Quantum Mechanics (PHYS 662), Mechanics (PHYS 522), or equivalent.
Textbook (required): Introduction to Quantum Mechanics, D.J. Griffiths, 2nd edition (Pearson Prentice Hall, 2005)

Supplementary books (not required):

- Quantum Physics – Atoms, Molecules, Solids, Nuclei, and Particles, R. Eisberg and R. Resnick
- Feynman Lectures in Physics – Vol. III, R. Feynman
- Quantum Mechanics, C. Cohen-Tannoudji, B. Diu, and F. Laloe
- Quantum Mechanics – Nonrelativistic Theory, L. D. Landau and E. M. Lifshitz
- Quantum Mechanics, A. Messiah
- Quantum Mechanics, A. S. Davydov
- Quantum Mechanics, L. I. Schiff
- Quantum Mechanics, K. Gottfried
- Principles of Quantum Mechanics, R. Shankar

Guidelines for homework:

1. In order to successfully complete this course you need to practice what we discuss in class by carefully working through all assigned problems.
2. I encourage you to discuss homework assignments in small groups. However, I require that you write down all homework solutions on your own and return them to me in class at the assigned due dates. Only hand in what you understand and are able to reproduce and defend in case I contact you. You will receive no credit for solutions that you have copied and partial credit for incomplete solutions.
3. In order to obtain full credit, I request that you present correct answers in a professional, well-organized, and readable manner.
4. Clearly state which references, such as scientific papers, integral tables, books, online resources, etc., you have used to complete the assignments.
5. Once you have completed a problem, sit back, relax, and think about your result in every possible way. Does it make sense? Is this a purely quantum mechanical effect or can it be explained within classical mechanics (and how)? Are there related phenomena? Are the techniques used really new to you or have you already applied them to solve other problems (which ones)?
6. In addition to the “for credit” homework assignments, I will frequently ask you in class to complete simple calculations that we cannot discuss in class in all detail. These assignments will not be graded, but it is important that you carefully “fill in” these gaps when reviewing your lecture notes. This is done most efficiently **before** the subsequent lecture.

Exams:

There will be two in class and one final exam. You have to attend the final exam to pass this course. All exams will be held in CW 144 unless announced otherwise. I will attempt to relate some exam and homework problems to recent physics colloquia.

Grading:

	Points	Grade:	Points
Exam 1	200	A	> 849
Exam 2	200	B	700-849
Final exam	300	C	550-699
Homework	300	D	450-549
Total	1000	F	< 450

Tentative course outline:

1. Short review of linear algebra

2. Properties and interpretation of the wave function. Operators. Expectation values.

3. The time-independent Schrödinger equation. Stationary states. Simple 1D problems. Wave packets. Bound and continous states. Tunneling. Some scattering.

4. Quantum mechanics in Hilbert space. Efficient mathematical formalism. Dirac notation. Properties and meaning of observables, their eigenfunctions and eigenvalues. Abstract, position, and momentum representation. Matrix representation of linear operators.

5. The time-dependent Schrödinger equation. 3D problems and solution techniques. Angular momentum addition. Spin. The hydrogen atom.

6. Identical particles. Symmetrization postulate. Bosons and Fermions. Spin and statistics. Applications to nuclei, atoms, and solids.

7. Time independent approximation schemes. Time-independent perturbation theory with applications to atomic (hyper-) fine structure, Zeeman and Stark effect. Mean field approximation.

8. Variational principle with application to the He atom.

9. WKB approximation with applications to tunneling decay.

10. Time-dependent perturbation theory with applications to atoms in external electromagnetic fields. Transition rates, Fermi's golden rule.

11. Central-potential scattering. Born series. Cross sections.

12. Elements of relativistic quantum mechanics. Klein-Gordon and Dirac equation.

Disabilities: If you have any condition such as a physical or learning disability, which will make it difficult for you to carry out the work as I have outlined it or which will require academic accommodations, please notify me and contact the Disabled Students Office (Holton 202), in the first two weeks of the course.

Cheating and plagiarism are serious offenses and may be punished by failure on the exam, paper or project; failure in the course; and/or expulsion from the University. Any form of electronic communication during exams, including text messaging, violates our Honor System. For more information refer to the "Academic Dishonesty" policy in K-State Undergraduate Catalog and the Undergraduate Honor System Policy on the Provost's web page at http://www.ksu.edu/honor/.