Physics 827 (Autumn 2010)

Quantum Mechanics I

Lectures: Mon. & Wed. 2:30 - 3:18 and Fri. 1:30 - 3:18 in Smith 1048

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This is the first of a three-quarter sequence designed primarily for graduate students in Physics. Grad students from Math, Chem. and Engg. are welcome. The second and third courses, Phys 828 and 829, will be offered in Winter 2011 and Spring 2011.

Prerequisites: Some exposure to simple ideas of quantum and atomic physics at the undergraduate level would be most helpful, though it is not a strict prerequisite. I will assume that the students have previous knowledge of mathematical methods (like matrices, simple differential equations, etc.) used in undergraduate physics/math/engg. classes. Students will need to know special functions (e.g., Legendre polynomials, spherical harmonics, Bessel functions) and solution of partial differential equations for Phys 828 and 829. These topics will be covered by Prof. Heinz in Phys 834 (Au 2010).

Syllabus: Here is an outline of topics to be covered in the first quarter.

- Inadequacy of classical mechanics: stability of the atom; two-slit experiments.
- Mathematical preliminaries: review of linear algebra and introduction to Hilbert spaces. (I will stress applications to physics, *not* mathematical rigor.)
- Postulates of QM. States, superposition principle, operators, time-evolution, measurement, uncertainty relations.
- One-dimensional problems: free particle, bound states, scattering, and tunneling.
- Harmonic Oscillator.
- Two-level systems.

The **Text Book** for Physics 827, 828 and 829 will be:
"*Principles of Quantum Mechanics*" (2nd Edition)
by R. Shankar, (Springer, 1994) [ISBN 0-306-44790-8]
Although I will follow Shankar's development of the subject in general, I may also deviate from the book on several points, most particularly in the discussion of two-level systems and some elementary ideas about quantum computation.
Other useful **references** are:
"*Quantum Mechanics*" Vols. I & II by C. Cohen-Tannoudji, B. Diu and F. Laloe, (John Wiley & Sons, NY, 1977).
"*Lectures on Quantum Mechanics*" by G. Baym, (Benjamin, NY, 1969).
"*Feynman Lectures on Physics*" Vol. III by R.P. Feynman, R.B. Leighton and M. Sands, (Addison Wesley, Reading, Mass., 1965).

Grading:

- Home work: 30%
- Mid-term exam: 30%;
- Final Exam: 40%

Exam Schedule:

- Mid-Term Exam: Friday, Oct. 29, 1:30 PM - 3:18 PM in Smith 1048
- Final exam: Wednesday, Dec. 8, 1:30 PM - 3:18 PM in Smith 1048

All Examinations will be closed-book and no notes will be permitted.

Home Work Assignments:
Home work will be assigned on a regular basis throughout the quarter. You will be able to download the problem sets from the **Course Website:**

www.physics.ohio-state.edu/∼randeria/courses/QM-I-827/physics_827.htm

Students should check the course website for further information.

If you have any questions about this Class, please do not hesitate to contact me by email (randeria@mps.ohio-state.edu) or phone (292 2457), or come to my office (Physics Research Building, Room 2024).