Phys. 670 (Xerxes Tata, Fall 2017)

This class builds on a year long undergraduate course (such as PHYS 480 and PHYS 481 at UH) that you should have already had. Among other things, I will assume that you have already solved the Schroedinger equation for simple problems and know how to find the eigenvalues and eigenfunctions for the simple harmonic oscillator and the hydrogen atom, and that you have also obtained the spherical harmonics as eigenfunctions of orbital angular momentum.

Although some of the topics that we discuss will be a repeat of what you may have seen, the treatment will be at a deeper level. PHYS 670 will be treated as the first part of a two-semester course (with PHYS 671). In Phys. 670, we will use Principles of Quantum Mechanics by R. Shankar as the main text, but you are encouraged to supplement this with any of the other excellent texts of your choosing. These include: Sakurai, Merzbacher, Schiff, Landau and Lifschitz, Davydov, Messiah, Baym, Dirac, Gottfried and Yan and the relatively new book by Weinberg, to name a few. Remember that different texts present different perspectives, something very useful at this stage in your education. You will be required to have some knowledge of Hamiltonian mechanics and of electromagnetic theory at the undergraduate level. It will be helpful to know something about the Poisson Bracket formulation of classical mechanics (Sec. 2.7 of our text, or Chap. 9 of Goldstein).

Topics to be covered:

- Brief review of problems with classical physics
- Linear vector spaces, operators, eigenvalue problems; special issues with infinite dimensional spaces.
- Postulates of Quantum mechanics
- One dimensional quantum mechanics
- The simple harmonic oscillator – creation and annihilation operators
- The path integral formulation
- The generalized uncertainty relations
- Quantum mechanics in 3-dimensions
- Multiparticle systems
- Identical particles
- Symmetries in quantum mechanics
- Rotational invariance and orbital angular momentum

- Spherically symmetric potentials; free particle in spherical polar coordinates
- Intrinsic angular momentum

I would like to cover through Chapter 14 this term, but if we do not get there, Phys. 671 will continue where we stop.

HW will be assigned regularly (roughly weekly), and will count for 1/3 of your grade. Also we will have one mid-term and a final exam (format TBD), each counting for a third of your grade.

The class will prepare you for PHYS 671 and will provide a treatment of topics in non-relativistic quantum mechanics at an advanced level.