PHYC 521: Graduate Quantum Mechanics I

Time and Location:

11:00-11:50 M W F, Physics & Astronomy Room 184.

Instructor:

Rouzbeh Allahverdi, Physics & Astronomy Room 172.

E-mail: rouzbeh@unm.edu.

Office Hours: M W 14:00-15:00.

Problem Session:

9:00-9:50 M, Physics & Astronomy Room 5.

Teaching Assistant:

David Vrba, E-mail: dvrba01@unm.edu.

Course Webpage:

Course notes and homeworks will be posted on:

http://panda.unm.edu/Courses/Allahverdi/Phys521Fa09/

Recommended Textbooks:

"Principles of Quantum Mechanics", 2nd edition, by R. Shankar, 2nd Edition. This is the text that we will use.

"Quantum Mechanics", vol. I and II, by C. Cohen-Tannoudji, B. Diu, and F. Lalo. This is a great reference book to have around.

"Modern Quantum Mechanics", by J. J. Sakurai. Good advanced text with a modern perspective, but very dense and with few examples.

Grading Policy:

Homework Assignments (approximately 10 problem sets) 35%, Two Midterms (one in late September, one around mid November) 40%, Final Exam 25%.

Tentative Syllabus:

I. Foundations (4 weeks)

Mathematical foundation- Hilbert space, Linear operators, The eigenvalue problem.

Review of classical mechanics- Lagrangian and Hamiltonian formulation, Poisson brackets, Canonical transformations.

Quantum mechanics- Postulates, Schrodinger equation, Propagator.

II. Systems in one dimension (3 weeks)

One-dimensional potentials- Free particle, Particle in a box, Bound states, Tunneling.

Simple harmonic oscillator- Quantum oscillator, Different representations.

Heisenberg uncertainty principle- Derivation, Minimum uncertainty wavepacket, Classical limit.

III. Path integral formulation of quantum mechanics (1 week)

Feynman path integral- Recipe, Path integral evaluation of the free particle propagator, Equivalence to the Schrodinger equation.

IV. Systems with multiple degrees of freedom (6 weeks)

N particles in one dimension- Identical particles, Bosons and Fermions.

Symmetries and their consequences- Continuous symmetries and conserved quantities, Degeneracy of states, Translational invariance, Time-translational invariance.

Rotational invariance and angular momentum- Rotations in two and three dimensions, The eigenvalue problem of angular momentum.

Central potentials- Particle in a spherical box, The Hydrogen atom, Harmonic oscillator in three dimensions.

V. Approximate methods (1 week)

Variational method- Rayleigh-Ritz method, WKB method.