Physics PH 4723/6723
Applications of Quantum Mechanics

Instructor:
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Time and Location:
12:30 am-1:45 pm
Tuesday and Thursday
HILBUN Hall 152

Office hours: Walk in at any time.

Pre-requisite:

PH 4713/6713: Introduction to Quantum Mechanics

Text Book:

Introduction to Quantum Mechanics by David J Griffiths, 2nd Edition (2005), Pearson publishing.

Reference Books put on reserve in the library:

J.J. Sakurai , Modern Quantum Mechanics, (Revised edition)

Cohen-Tannoudji, et.al , Quantum Mechanics, Vol. I and II (1977)

Grading information:

There will be a mid-tern and a final exam and 6 homework sets:

(1) Mid-term exam, 20 %

(2) Final exam, 20 %

(3) Homework: 10 % $\times$ 6= 60 %.

A letter grade will be given as your final grade

Tentative Syllabus: Adjustments can be made depending on students' feedbacks.

Chapter 5, Operator Methods in Quantum Mechanics (continuation from Phys4713)

Dirac notations, bras, kets, x-representation, p-representation, Fourier transform. (2 lectures)

Chapter 6: Central force problems in 3 dimensions

a. Spherical Coordinates, Orbital Angular momentum, (Associated) Legendre Polynomials, Spherical harmonic functions

b. Infinite Square potential, Finite square potential, δ-shell potential, bound states, radial quantum numbers, spherical Bessel and Neumann functions, Spherical Hankel functions.

c. Three dimensional harmonic potentials, Confluent Hyper-geometric function

d. Hydrogen atom, Confluent Hyper-geometric function, (Associated) Laguerre Polynomials.

e^*. Hellmann-Feynman theorem and its applications to central force problems.

Chapter 7, Theory of angular momentum and quantum spins

a. Theory of angular momentum,

b. Algebraic method to solve harmonic oscillators, raising and lowering operators.

c^*. Schwinger oscillator representations of a angular momentum

d. Additions of two angular momenta, Clebsch-Gordan (CG) Coefficients,

e. Stern-Gerlach experiment, Quantum Spins,

f. Additions of two spins,

g. Spin-orbital coupling, addition of orbital angular momentum and spin.

Chap.8. Time-independent Perturbation theory

a. Non-degenerate perturbation theory,

b. degenerate perturbation theory,

c. Spin-orbit coupling, Total angular momentum, fine and hyperfine structure of an Hydrogen atom,

d. Zeeman effects, anomalous Zeeman effects.

Chap.9. Time-dependent Perturbation theory

a. Schrodinger picture, Heisengber picture, Interaction picture

b. Transition probabilities, Fermi's golden rule,

c. Constant perturbation, Harmonic perturbation,

d^*. Stimulated Emission and absorption of radiation, Spontaneous radiations, Einstein's A and B coefficients.