Department of Physics

College of Arts & Sciences, Florida International University

Advanced Quantum Mechanics, 6645(6)

Misak Sargsian

M,W 5:00-6:15pm, CP 204

Office Hours M,W - 3:30-4:30pm, CP224, sargsian@fiu.edu, 305-348-3954

Lecture 1- Classical Physics:
(1)Mechanics and Newton's Laws
(2) Principles vs Laws (3) Basic Quantities of the nature
(4) Lagrangian, Action, Least Action Principle (5)Hamiltonian

Lecture 2 - Classical Physics:
(1) Symmetries, (2)Transformations & Operators
(3) Elements of group theory, (4) Generators and Algebra
(5)Example of Space Translation and Rotation

Lecture 3 - Foundation of Quantum Mechanics
Planck Paper
(1)Complex Vector States in the Hilbert Space
(2)Linear Operators
(3)Relating above to physical observables
(4)Correspondence Principle

Lecture 4 - Schroedinger Equation
1)Time-Translation of the state vectors and Hamiltonian
2) Shcroedinger Equation and canonical commutators
3)Planck constant and natural units
4)Uncertainty principle
5) Space translation of state vectors and momentum operator
6) Wave functions and Shroedinger wave equation
7) Continuity equation - no probability is lost in QM

Lecture 5 - Stationary States
1)Seven Pillars of Wisdom of Schroedinger Equation
2) Virial Theorem

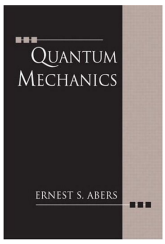
Lecture 6 - One Dimensional Examples:
(1) Using symmetry properties of Hamiltonian to solve Schroedinger equations
(2) Two state systems
(3) Infinite square well
(4) Finite size one-dimensional square well
(5) Delta function type potentials
(6) Canonical Quantization
(7) Harmonic Oscillators

Lecture 7- Three Dimensions with Spherical Symmetry
(1)Orbital Angular momentum;
(2) What it means to be spherically symmetric in QM
(3) Properties of Angular momentum operator
(4) Schredinger Equation for Spherical Symmetry case
(5) Runge-Lenz vector in quantum mechanics
(6) Hydrogenlike Atoms
(7) Radial Wave functions of Hydrogen Atom

Lecture 8- Symmetry and Spin
(1)Spin and Rotations
(2)Generators of rotation in the spinor space
(3) Spin wave functions
(4) Total angular momentum
(5)Addition of Angular Momenta
(6) Clebsch-Gordan Coefficients
(7) Example of Deuteron Wave function

Lecture 9 - Approximation Methods of Bound State
(I)Bound State Perturbation Theory

? **Information.**



Textbook: **"Quantum Mechanics"**
Ernest S. Abers

Two pieces of the Final Grade:

Homeworks (100%)

Homework Assignments:

HW1.pdf (due Jan. 21)

HW2.pdf (due Jan. 28)

HW3.pdf (due Feb . 4)

HW4.pdf (due Feb 11)

HW5.pdf (due Feb 18)

HW6.pdf (due Feb 25)

HW7.pdf (due March 4)

HW8.pdf (due March 11)

HW9.pdf (due March 22)

HW10.pdf (due March 27)

HW11.pdf (due April 5)

HW12.pdf (due Apr 12)

HW13.pdf (due Apr 19)

Take Home Exam (due Apr 26)

(1)The Perturbation Expansion
(2)Example:Harmonic Oscillator
(3)Fine Structure of Hydrogen Atom
(3.1) The Spin-Orbit Coupling Correction
(3.2) The Relativistic Kinetic Energy Correction
(4) The Hyperfine Structure of the Hydrogen Atom
(5) Other Atoms
(6) Atomic Clocks
(II) The Variational Method
(1) The General method
(2) Application to the Helium Atom
(III)Molecules
(1)The Born-Oppenheimer Approximation
(2)Application to Hydrogen Molecular Ion
(IV) WKB Approximation

Lecture 10- Potential Scattering

(1)Kinematics, Setting up the scattering problem
(2)The Scattering Amplitude
(3) Born Approximation, Yukawa and Coulomb interactions
(4)The Optical Theorem
(5) Partial Waves
(5.1) Expansion of a Plane Wave in a Legandre Series
(5.2) Parial wave expansion of the scattering amplitude
(5.3) Calculation of the Phase Shift
(6) The Radial Wave function
(6.1) The integral Equation
(6.2) Partial Wave Green's Functions
(6.3) Scattering by an Impenetrable Sphere

Lecture 11- Quantum Mechanics of Many-Body Systems

(1)Nonrelativistic Identical-Particle Systems
(2) Creation and Annihilation of Bosons
(3) Creation and Annihilation of Fermions
(4) Bosonic Gas
(5) Fermionic Gas
(6) From White Dwarfs to Neutron Stars

Grades

Some policies: **<3unjistifed absences, >50% attendances**
No carbon copied homeworks

A• B • C • D • E