QUANTUM MECHANICS I–Physics 3803

I Lagrangian and Hamiltonian Dynamics

1. Introduction
2. The Lagrangian, the Action, and Hamilton's Principle
3. Calculus of Variations
4. Functional Derivatives
5. Back to Hamilton's Principle
6. More Degrees of Freedom
7. The Euler-Lagrange equation
8. The Advantages of the Lagrangian Formalism
9. Quantum Mechanics and the Sum Over Paths
10. The Hamiltonian Dynamics
11. The Hamiltonian and Energy
12. Advantages of the Hamiltonian Formalism
13. The Hamiltonian and Quantum Mechanics
14. Postulates of Quantum Mechanics
15. Quantum Correspondence Principle
16. The Wave Equations

II Mathematical Tools [Griffiths 3]

1. Linear Vector Spaces
2. Inner Product and Inner Product Spaces
3. Dirac Notation
4. Linear Operators
5. Eigenvectors and Eigenvalues
6. Expectation Value
7. The Uncertainty Principle
8. Dirac Delta Functions
9. Operators in Infinite Dimensions

10. Hilbert Space and Fourier Transform
11. The Momentum Space or the $p-$basis

III One-dimensional Schrödinger Equation [Griffiths 1 and 2]

1. The Postulates of Quantum Mechanics
2. Implications of the Postulates
3. Expectation Value
4. The Uncertainty Principle
5. Ehrenfest's Theorem
6. Stationary State Solutions
7. Equation of continuity
8. The Schrödinger Equation: (a) Free Particle, (b) Infinite Square Well, (c) The Delta-Function Potential, (d) Finite Square Well.

IV Harmonic Oscillator [Griffiths 2.3]

1. Introduction
2. Energy Eigenstates of the Harmonic Oscillator
3. The Harmonic Oscillator in the Coordinate Basis

V Angular Momentum [Griffiths 4.1 and 4.3]

1. Two Dimensions
2. Three Dimensions
3. Schrödinger equation for spherically symmetric potentials

VI Hydrogen Atom [Griffiths 4.2]

1. Relative Motion of Two Particles
2. Introduction to the Hydrogen Atom
3. Fundamental Quantities Associated with Hydrogen Atom
4. Numerical Estimates
5. Comparison with Experiments