Wollo university

College of Natural science

Department of physics

Course title: Quantum mechanics I

Course code: phys 2072

Course Description

Origin and developments of quantum mechanics, Limitations of classical mechanics, Mathematical foundations of quantum mechanics, observables and operators, properties of operators, wave function and probability density, Eigen values and eigen states, expectation values, uncertainty principle, Schrodinger equation, Heisenberg equation, time evolution of expectation values, Free particle, Infinite potential well, Finite potential well, Finite potential barrier, reflection and transmission coefficients, Harmonic oscillator

1) Origin and Development of Quantum Mechanics

1.1) Review of Modern Physics
1.2) Limitations of Classical Mechanics
1.3) Development of Quantum Mechanics

2) Mathematical Foundation of Quantum Mechanics

2.1) Measurements and Observables
2.2) Operators and Observables
2.3) Expectation Values of Dynamical Variables
2.4) Uncertainty Principle

2.5) Wave Function and its Physical Interpretation
2.6) Probability Density
2.7) Current Density

3) Operator Algebra

3.1) Linear Operators
3.2) Dirac Notation (Bra and Ket)
3.3) Normalization and Orthogonalisation
3.4) Commutation Relation
3.5) Kroncker Delta Function
3.6) Adjoint and Hermitian Operators
3.7) Eigen Values and Eigen Functions
3.8) Dirac Delta Function
3.9) Fundamental Postulates

3.10) Expectation Values
3.11) Fundamental Commutation Rules
3.12) Correspondence with Poisson's Brackets
3.13) Schwartz Inequality

4) The Schrödinger and Heisenberg Equations

4.1) Time In/Dependent Schrödinger Equation
4.2) Solution of the Schrödinger Equation
4.3) Boundary Conditions
4.4) One-Dimensional Potentials
4.5) Zero Potential (Free Particle)
4.6) Square Well Potential
4.7) Infinite Well Potential
4.8) Step Potential
4.9) Barrier Potential.
4.10) Reflection and Transmission Coefficients
4.11) Quantum Tunneling
4.12) Time Evaluation of Operators
4.13) Hamiltonian Operator
45) The Harmonic Oscillator
5.1) Simple Harmonic Oscillator
5.3) Energy Eigen Values and the Zero Point Energy
5.4) Correspondence Principle
5.5) Gaussian Wave Function 5.2) 1D Schrödinger Equation and its Solution for the Harmonic Oscillator.14) Schrödinger and Heisenberg Pictures

5.6) Hermite Polynomials and 1D Solutions of the Harmonic Oscillator

5.7) 3D Harmonic Oscillator

5.8) Description of the HO in terms of Creation and Annihilation Operators

References

1. John S. Townsend, A modern approach to quantum mechanics, 2nd university Science Books, (2000).

2. W. Greiner, Quantum mechanics (an introduction), 4th ed., Springer (2008).

3. David Griffith, Introduction to Quantum mechanics: Benjamin Cummings, (2004).

4. J.J Sakurai, Modern quantum mechanics Revised edition, (1993).