

PHYS 3143 Quantum Mechanics I

Description and Objectives

This course will teach you the basic principles of Quantum Mechanics. You will learn theoretical principles and problem solving skills applied to the quantum world of atoms, molecules and photons. The knowledge obtained in this class will serve as a foundation for further advanced classes such as Quantum Mechanics II (PHYS 4143), Statistical Mechanics (PHYS 4142), and various electives.

Textbook

"A modern approach to Quantum Mechanics". 2nd Edition. John. S. Townsend ISBN 978-1-891389-78-8.

Pre-requisites

PHYS 2213, MATH 2552 or 2562 (Differential Equations). You will also need Linear Algebra.

Tests and Grading

- Homework: 25% of the final grade
- 2 Tests 40 % of the final grade (20% each)
- Final Exam: 35% of the final grade

The tests will last 2 hours 10 minutes and will cover the material presented since the previous test. Students are allowed to bring their own materials to the tests (class notes, books etc.) Use of internet-enabled devices during the tests is prohibited. The final exam will cover all the material studied in the course. It will last 2 hours 50 minutes and will be scheduled according to institute policy.

Grading Scale

90 – 100% = A; 80 – 89% = B; 70 – 79% = C; 60 – 69% = D; 0 – 59% = F.

List of topics covered.

Stern-Gerlach Experiments.
Stern-Gerlach Experiments, The Quantum State Vector
Matrix Mechanics, Rotation Operators. The Identity and Projection Operators, Matrix Representation of Operators.
Changing Representations, Expectation Values.
Rotations, Generators, Commuting Operators.
The Eigenvalues and Eigenstates of Angular Momentum. Uncertainty Relations and Angular Momentum.
The Spin- $\frac{1}{2}$ Eigenvalue Problem. A Stern-Gerlach Experiment with Spin-1 Particles.
The Hamiltonian and the Schrodinger Equation, Time Dependence of Expectation Values.
Precession of a Spin- $\frac{1}{2}$ Particle in a Magnetic Field. Magnetic Resonance.
Position Eigenstates and the Wave Function, The Translation Operator.
The Generator of Translations, The Momentum Operator in Position and Momentum Basis.
A Gaussian Wave Packet. Properties of Solutions to the Schrodinger Equation in Position Space.
The Particle in the Box and in the δ -function potential, Inversion Symmetry and the Parity Operator.
The One-Dimensional Harmonic Oscillator, Operator Methods. Position-Space Wave Functions, The Zero-Point Energy.
Scattering in One Dimension.