

Quantum mechanics

- Dirac's formalism: Hilbert space, state vectors, operators, representations
- Schrodinger's formalism: wavefunctions, position and momentum representations
- Dynamics: Schrodinger equation, Heisenberg picture
- Quantum measurements: canonical observables, Heisenberg uncertainty principle, Ehrenfest's theorem (classical equations of motion)
- Bound states: infinite and finite quantum wells (1D-3D), spherical wells, hydrogen atom
- Harmonic oscillator: operator formalism, spectrum, wavefunctions, time evolution
- Angular momentum & spin: operator formalism, spectrum, spherical harmonics, finite matrix representations, time evolution, angular momentum addition
- Extended states: plane waves, scattering in one dimension (potential steps), quantum tunneling
- Particles in electromagnetic fields: gauge field, gauge invariance, Aharonov-Bohm effect
- Symmetries: unitary transformation operators, symmetry and conserved quantities, time-evolution, continuum translation, discrete translation (on a lattice), rotation, spatial inversion (mirror), time reversal
- Identical particles: exchange statistics, many-body states of fermions and bosons
- Quantum statistical mechanics: density matrix, pure and mixed ensembles

Suggested literature: *Modern Quantum Mechanics - 2nd edition*, J. J. Sakurai and Jim J. Napolitano, Pearson (2010).