

Physics 517-8-9
Graduate Physics Level Quantum Mechanics

References on reserve:

1. Quantum Mechanics, Albert Messiah
2. Modern Quantum Mechanics, JJ Sakurai
3. Principles of Quantum Mechanics, R Shankar
4. Quantum Mechanics (2 volume set), Claude Cohen-Tannoudji et al
5. Quantum Mechanics: Fundamentals (Graduate Texts in Contemporary Physics) ed 2, Kurt Gottfried and Tung-Mow Yan
6. Lectures on Quantum Mechanics (Lecture Notes and Supplements in Physics), Gordon Baym
7. Quantum Mechanics, Eugene Merzbacher
8. Principles of Quantum Mechanics (International Series of Monographs on Physics), Paul A. Dirac
9. Quantum Mechanics: Non-Relativistic Theory, Volume 3, Third Edition (Quantum Mechanics), E M Lifshitz and L D Landau

Syllabus 517-518-519

- 517:**
- Matter Waves and Light Corpuscles
wave particle duality, wave packets, Heisenberg uncertainty relation, probability distributions, correspondence principle, Copenhagen interpretation
 - States and Operators
Hilbert space, observables and hermitian operators, commutators, matrix mechanics, diagonalization of matrices, Dirac notation, orthogonality and completeness, compatible observables, complete sets of compatible observables, unitary operators, changes of basis, time evolution in Schrodinger and Heisenberg pictures,
 - 1D Schrodinger Equation
free particles, stationary solutions, bound states, eigenvalue problems, discrete and continuous energy spectra, tunnelling, reflection and transmission, 1D harmonic oscillator
 - Intro to Path Integrals
Feynman's formulation of Quantum Mechanics, propagators, transition amplitudes
 - Electromagnetism
Landau levels, electromagnetic gauge transformations, Aharonov-Bohm effect
 - Classical Limit
Motion and spreading of wave-packets, Ehrenfest's theorem, WKB method, stationary phase approximation to path integral, coherent states.
- 518:**
- Symmetries
Equivalent descriptions, continuous and discrete symmetries, unitary and antiunitary transformations, Noether's theorem, conservation laws, representation theory, rotation, translation, parity and time reversal, nonabelian symmetries and degeneracies
 - 2 and 3 D problems
spherical potentials, spin and orbital angular momentum, Wigner-Eckart theorem, hydrogenic atoms, spherical harmonics
 - More than one particle
addition of angular momenta, Clebsch-Gordon coefficients, constants of the motion, entangled states, EPR, Bell's inequalities
 - Identical Particles
Permutation symmetry, Fermi-Dirac statistics, Pauli exclusion, Bose-Einstein statistics, Spin and Statistics
 - Perturbation Theory and Approximations
Stationary perturbations, degenerate and nondegenerate perturbation theory, Variational Techniques, time dependent perturbation theory, interaction picture, adiabatic and sudden changes, selection rules
- 519:**
- Scattering
Born series, phase shifts, partial waves, bound states, resonances, cross sections, S matrix, unitarity
 - Second Quantization
Fock space, creation and annihilation operators, field equations of motion, electromagnetic field quantization, radiation
 - Quantum statistics
pure and mixed states, entanglement, measurement, entropy, density matrix
 - Interpretations of Quantum Mechanics
Copenhagen, "many worlds", nonlocal hidden variables, consistent histories, decoherence, locality and no communication theorem