

Elements of quantum mechanics
topics of the complex exam

1. The double slit experiment, wave function in space as probability amplitude
2. De Broglie waves, their physical meaning, plane waves as generalized basis
3. The notion of linear operators, operators of coordinate and momentum
4. Linear operators in Hilbert space, Dirac's notation, the spectral theorem for self-adjoint operators
5. Representations, commuting and noncommuting operators, CSCO
6. Postulates of quantum mechanics
7. Expectation value and variance of the physical quantities in quantum theory
8. Heisenberg inequalities
9. The Schrödinger equation and its consequences, unitarity, and the continuity equation.
10. Ehrenfest theorems, constants of motion, Bohr frequencies, and the origin of the selection rules
11. Time evolution of conservative systems
12. The spectrum of the 1D harmonic oscillator, algebraic treatment
13. Algebraic theory of angular momentum.
14. Spherical harmonics and parity
15. Radial equation, the eigenvalue problem of the attractive Coulomb potential
16. Approximation methods, stationary perturbation theory
17. Elements of scattering theory, scattering amplitude and cross section.
18. Many body problems, identical particles, bosons and fermions.

Literature:

- D. Griffiths: Introduction to quantum mechanics, Second ed. Pearsons 2005
- C. Cohen Tannoudji, B. Diu, F. Laloe: Quantum Mechanics Vols 1, 2, Wiley, 1977
- A. S. Davydov: Quantum Mechanics, Pergamon, 1965