

Quantum mechanics, atomic and molecular physics:

Hydrogen atom: radial and angular components of the wavefunction

Periodic table, Hund's rule

Hydrogen molecule

Static perturbations (degenerated and non-degenerated cases)

Variational method

Kinetic orbital momentum

Mathematics:

Fourier transforms and delta function

Basics of functionals and functional derivatives

Statistical Physics:

Concept of thermodynamic potential. Legendre transformations.

Partition function. Entropy

Quantum statistics: Fermi-Dirac and Bose-Einstein

Electrodynamics:

Electrodynamics of continuous media.

Complex refractive index. Absorption and reflection.

Basic Solid State Physics:

Crystal symmetries. Bravais lattices.

X-ray diffraction.

Electronic and ionic degrees of freedom: Born-Oppenheimer approximation.

Phonons in 1D periodic systems: Brillouin zone.

Dynamical matrix.

Acoustic and optical branches.

Electronic band structure.

Bloch functions

Programming Language:

Fortran 95 or C

Recommended bibliography

C. Kittel, Introduction to Solid State Physics 8th Edition (Wiley, 2004)

N.W. Ashcroft and N.D. Mermin, Solid State Physics (Saunders, 1976)

W.A. Harrison, Solid State Theory (Dover, 1980)

L.D. Landau and E.M. Lifshitz, Statistical Physics - Part 1 3rd edition (Butterworth-Heinemann, 1980).

E.M. Lifshitz and L.P. Pitaevskii Statistical Physics, Part 2: Theory of the Condensed State? (Butterworth-Heinemann, 1980).