Statistical Physics

Classical Statistical Mechanics. Fundamental principles, micro-canonical ensemble, phase space, ergodic hypothesis, equilibrium, entropy, classical ideal gas, mixture entropy and Gibbs paradox.

Canonical and grand canonical ansemble. Canonical ansemble, partition function, energy fluctuations in the canonical ensemble, equipartition theorem, ideal gas. Gand canonical ensemble, Gibbs entropy, ideal gas, chemical reactions.

Quantum Statistical Mechanics. Fundamental principles, density matrix, ensembles in quantum statistical mechanics, ideal Fermi gas, Landau diamagnetism, Pauli paramagnetism, ideal Bose gas, photons, phonons, Bose-Einstein condensation, Bose- Fermi-Boltzmann gas comparisons.

Interacting systems and phase transformation. Examples of interacting systems, van der Waals liquids, gas-liquid transitions, vdW state equations, critical points, failure of vdW equation, mean field theory for phase transitions, Landau approximation and order parameter, Polymers, Ising model, mean field approximation and ferromagnetism.

Field theory techniques. Landau theory for phase transitions, failure of mean field theory.

Systems under external excitations. Linear response theory, generalized susceptibilities, non-equilibrium statistical physics, Boltzmann equation and transport properties.

Special subjects on statistical physics