Statistical Mechanics

1. **Thermodynamics**

   Basic notions of thermodynamics: intensive and extensive quantities, heat, work, temperature, equation of state, ideal gas, zeroth principle of thermodynamics, thermodynamic processes, exact differential, state function. The first and second laws of thermodynamics, temperature as an integrating factor. Thermodynamic proof of independence of energy of an ideal gas on the system's volume, entropy change of isothermal decompression of an ideal gas. The heat capacity and Mayer equation. Adiabatic processes of an ideal gas. The third law of thermodynamics and its consequences. Free energy, free enthalpy and their properties.

2. **Gibbs statistical mechanics - classical**

   Fundamentals of classical Gibbs mechanics: ergodic hypothesis, microcanonical ensemble. Classical ideal gas in microcanonical ensemble. Gibbs paradox. Canonical ensemble, energy fluctuations. Real classical gases. Classical model of a crystal. Grand canonical ensemble, example of ideal gas, energy and particle number fluctuations.

3. **Gibbs statistical mechanics - quantum**

   Fundamentals of quantum Gibbs mechanics, quantum ensembles. Quantum model of a crystal. Thermodynamic functions of quantum ideal gases. Quantum ideal gases in classical limit. Degenerated gas of fermions. Bose-Einstein condensation. Photon gas.

4. **Kinetic theory**

   Basic notions of kinetic theory of gases: distribution function and macroscopic quantities, equilibrium distribution function, interpretation of a pressure. Collisionless transport equation and Boltzmann collision term. H theorem. Collisional invariants and definition of thermodynamic equilibrium. Molecular chaos, Ehrenfests' model of dogs and fleas. Hydrodynamics of ideal fluid. Collision term in relaxation time approximation. Quasiequilibrium solutions of transport equation. Matching conditions and macroscopic quantities in quasiequilibrium. Dissipative energy flow and heat conductivity. Dissipative momentum flow and viscosity. Hydrodynamics of viscous fluid.

5. **Stochastic processes**

   Einstein approach to Brownian motion. Langevin formalism.

Literature:

1. *Statistical mechanics*, K. Huang
2. *Introduction to statistical physics*, K. Huang
3. *Statistical physics*, L.D. Landau, E.M. Lifshitz

Steps (requirements) to get a passing grade:
- pass the test-out at the end of October

  OR
- problem-solving classes - collect up to 50 points, AND
- written exam - collect up to 50 points, AND
- oral exam - upgrade or degrade the final scores

Grades:
- 3 (60-74 points)
- 4 (75-90 points)
- 5 (91-100 points)