

THERMODYNAMICS AND STATISTICAL PHYSICS

1. Thermodynamical systems. Phase space. Equilibrium. Quasistatic processes. Heat. Work. Internal energy. Zero thermodynamic law.
2. Infinitesimal changes. Full and not full derivatives. Quasistatic work.
3. First thermodynamic law. Its differential and integral form. Thermodynamic relations.
4. Second thermodynamic law, its different formulations. Entropy.
5. Thermodynamic potentials. Maxwell relations. Jacobians and their properties. Cycles. Efficiency. Adiabatic processes. Specific heat.
6. Thermodynamic equilibrium. Entropy growth. Irreversible processes. Thermodynamic stability. Thermodynamic fluctuations.
7. Chemical potential in thermodynamics.
8. Statistical distributions. Moments. Fluctuations. Gaussian distribution.
9. Liouville equation and its solution. Coarse-graining. Area preservation and its hydrodynamical interpretation.
10. Gibbs distribution. Canonical and microcanonical ensemble. Density matrix. Gibbs operator.
11. Temperature, free energy, internal energy. Statistical sum. Connection of the Gibbs distribution to the thermodynamics.
12. Maxwell distribution and Maxwell-Boltzmann distribution.
13. System with variable number of particles. Chemical potential and normalization condition.

14. Fermi-Dirac and Bose-Einstein statistics.
15. Combinatorial derivation of the distributions.
16. Classical limit and quantum corrections to the distributions.
17. Electron statistics in metals. Fermi energy and thermodynamics of electrons at low temperature.
18. Paramagnetic systems.
19. Statistics of oscillations and phonons.
20. Statistics of radiation. Ultrarelativistic system.
21. Theory of susceptibility. Magnetic susceptibility.
22. Statistical theory of fluctuations. Fluctuation of concentration.
23. Phase transition. Mean field approximation. Bose-Einstein condensation.
24. Kinetic equation. Boltzmann theory and entropy growth theorem.

TEXTS:

1. L.Landau and E. Lifshitz, *Statistical Physics*, 3d edition. Pergamon Press.
2. F. Reif, *Fundamentals of Statistical Physics and Thermal Physics*, McGraw-Hill.

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