List of subjects for oral exam: Statistical Physics 2

1. Ferromagnetic phase transition: The Ginzburg-Landau theory. Conditional free energy, Ginzburg-Landau functional.
2. Correlation functions and their scaling properties. Universal scaling collapse, and connection between various critical exponents. Classical liner response.
3. Basic ideas of renormalization group.
4. Superfluidity: basic phenomena, the two-fluid model, the Gross-Pitaevskii functional and the time independent Gross-Pitaevskii equations, vortices and healing length.
5. Basic properties of density matrix and density operators, mixed states and pure states.
6. Neumann equation. Spin in an external magnetic field, spin relaxation.
7. The equilibrium structure of the density operator. Neumann entropy and the principle of maximal entropy.
8. Linear response theory. Energy dissipation and generalized susceptibilities, the Kubo formula.
9. Kubo formula, classical and quantum noise, and the fluctuation-dissipation theorem.
10. Classical limit of the fluctuation-dissipation theorem, Onsager's regression hypothesis, and Nyquist-Jhonson noise.
11. Markov processes. H-theorem for closed and open systems.
12. Detailed baance, Monte-Carlo simulations, simulated annealing.
13. Langevin equation and Brownian motion. Drift, diffusion, and Eistein relation.
14. Focker-Planck equations, velocity relaxation of a particle, and diffusion equation.