Statistical Physics IV: Non-equilibrium statistical physics

ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE (EPFL)

Thematical topics for the written exam (the questions will be pertinent to the topics listed below)

1. Fluctuation-dissipation theorem and its applications
2. Electrical Johnson noise and Brownian motion
3. Ito formula and calculus
4. Stochastic processes; absolute and conditional probabilities, correlation functions and Markov processes
5. Gaussian processes and their properties and the Law of large numbers
6. Kramers-Moyal expansion and the Fokker-Planck equation – derivation and application
7. Fokker-Planck Eqs: Wiener and Ornstein Uhlenbeck processes
8. Kramers Equation and Kramer's Escape Problem – mathematical form and its solution
9. The mathematics of anomalous diffusion and Levy flights – critical exponents and continuous time random walks
10. Jarzinski equality and fluctuation theorem
11. Mesoscopic (classical) Master equation - derivation and applications
12. Quantum Langevin equations of a Harmonic oscillator
13. Definition of spectral densities in classical and Quantum Physics
14. Open quantum systems: The Quantum Langevin Equation. Harmonic oscillator/two level system interacting with a heat bath of harmonic oscillators
15. The Quantum Optical Master Equation – Lindblad form and outline of steps of the derivation
16. Quantum regression theorem and applications
17. Decoherence of quantum states: energy relaxation and dephasing of a two level system and harmonic oscillator
18. Quantum noise limits in optical interferometers (e.g. used in gravity wave detection)