Material for Week 11
Physics 4488/6562: Statistical Mechanics
https://sethna.lassp.cornell.edu/Teaching/562/
Exercises due Mon. Apr 17
Last correction at December 22, 2022, 9:28 pm

Calculus of variations is needed for Wednesday's pre-class question, analogous to the derivation of the Euler-Lagrange equations in mechanics The variational derivative is the first term in a 'function-space' Taylor series of $\mathcal{F}[\rho+\delta]-\mathcal{F}[\rho]$ with respect to $\delta(x)$.

Monday
In-class question: 10.13 *Onsager regression hypothesis*
Wednesday
Read: Chapter 10, Sec. 10.5 (Susceptibility and linear response) and 10.6 (Dissipation and the imaginary part)
Pre-class question: 10.14 *Liquid dynamics*
In-class question: 10.15 *Harmonic susceptibility, dissipation*
Friday
Read: Chapter 10, Secs. 10.7 (Static susceptibility), 10.8 (The fluctuation-dissipation theorem), and 10.9 (Causality and Kramers-Krönig)
Pre-class question: 10.18 *Harmonic Kramers–Kronig*
In-class question: 10.16 *Harmonic fluctuation-dissipation*
Monday
Read: Chapter 11, Sec. 11.1 (Stable and metastable phases) and 11.2 (Maxwell construction)
Pre-class question: 11.11 *Unstable to what?*

Exercises for everyone

10.17 *Susceptibilities and correlations.*

Select one (4488) or two (6562)

10.1 *Cosmic microwave background radiation.* (Astrophysics) Fluctuation correlations in the echo of the Big Bang have peaks that tell us about dark matter and dark energy. One feature comes from 'acoustic' oscillations discussed here.
10.4 *Spin.* (Condensed matter) Linear response for a spin in a thermal environment
10.5 *Telegraph noise in nanojunctions.* (Condensed matter) Currents through nanojunctions can detect single atoms hopping, whose correlations we study.
10.9 *Quasiparticle poles and Goldstone's theorem.* (Condensed matter) Poles in the susceptibility describe quasiparticles and their lifetimes.
10.8 *Magnet dynamics.* (Condensed matter) Linear response for a continuum system.
10.19 *Critical point response.* Linear response near a critical point (see Exercise 12.27)
N1.15 *Cell signaling and mutual information.* (Biology, Statistics) Cells maximize *mutual information* by evolving signal pathways from membrane receptors sensing food to flagella moving them forward.