PH4211 Statistical Mechanics
Revision class 2025

Foundations/basics

Entropy — Fundamental Postulate
Equilibrium — T, p, μ
Boltzmann factor — extend Fundamental Postulate
Partition function
(Briefly) Liouville's theorem / Second law - coarse graining
Third Law: historical / practical — importance of quantum mechanics

Weak interactons

Non-ideal gas
Virial expansion
Cluster expansion — different models for B_2
Van der Waals approach
Comparison, through B_2

Strong interactions & phase transitions

Phenomenology / "Botany"
1st and 2nd order transitions / cons and non-cons order parameter
Critical exponents
Liquid-gas / van der Waals
Weiss ferromagnet - Heisenberg exchange / Weiss model
Landau theory
Ferroelectricity
Universality

Irreversibility / non-equilibrium

Fluctuations, $1/\sqrt{N}$ rule, energy fluctuations/ heat capacity
Brownian motion
Langevin equation -- friction!
Onsager hypothesis

Not required

Quantum phase transitions
Superfluidity
Bose-Einstein condensation