Physics 704, Spring 2011

Open notes, open Plischke & Bergersen

Study guide, version 1.02

Mean field (MF) treatment of phase transitions and critical exponents
Ginzburg-Landau extension of MF
Ising model using various schemes, 3,4-state Potts model, clock model, planar rotor, Heisenberg
Capillary-wave theory of interface fluctuations
Virial expansion, $2^{nd}$ & $3^{rd}$ virial coefficients in terms of Mayer function
Correlation functions, truncation schemes, Ornstein-Zernike
Surface energy, edge energy
Critical exponents $\alpha$, $\beta$, $\gamma$, $\nu$, $\eta$
Scaling transformations and relations
Position-space renormalization: decimation, bond-moving, majority rule
Finite-size scaling for divergent properties like specific heat, correlation length, susceptibility
Basic ideas of renormalization group flows and fixed points
Kosterlitz-Thouless transition, what is so unusual about it, where it shows up in physics
Roughening transition, duality transformation to/from 2D Coulomb gas
Transfer matrices, applications to Ising model
Markov, master equation, birth-death processes, first-passage, escape; steady state
Basics of molecular dynamics
Basics of Monte Carlo: Metropolis algorithm, detailed balance, Markov chains
Pseudorandom numbers
Fluctuation-dissipation ideas
Langevin and Fokker-Planck equations: examples, use, connection

**Homework problems (and their solutions)**

**NOT:**

Series expansions
Boltzmann eq.
Density functional theory
Jarzynski relations
Nucleation & growth vs. spinodal decomposition