

Department of Physics

Indian Institute of Technology Kanpur

PHY604 : Review of Statistical Mechanics

Course content:

S. No.	Topics	No. of Lecture and Tutorial Hours
1	Problem oriented review of Statistical Mechanics. Review of thermodynamics: Laws of thermodynamics; thermodynamics of phase transitions and phase diagram.	3
2	Review of Ensembles and rules of calculation : Micro-canonical, canonical, grand-canonical and other ensembles; applications to models of ideal classical and quantum gases.	12
3	Models of classical interacting systems : Ising model in 1-dimension: exact solution by transfer matrix ; Peierls-Griffiths argument for Ising model in 2-dimensions; Mean-field approximation for magnets and fluids, Landau Theory, critical exponents, upper and lower critical dimensions.	12
4	Models of quantum interacting systems : Density matrix, Transverse Ising model, exact solution by Jordan-Wigner transformation, Heisenberg model- magnons; Mermin-Wagner theorem; general theory of quantum phase transitions..	9
5	Brief overview of Non-equilibrium statistical mechanics : Random walk and diffusion, Markov processes and master equation; Systems near equilibrium- Linear Response Theory, Fluctuation-Dissipation Theorem; Escape over a barrier- relaxation phenomena; critical dynamics.	6
6	Supplementary reading materials for term papers: Momentum-space Renormalization Group, Real-space Renormalization Group, Duality in Statistical mechanics, Various types of series expansions, Boltzmann equation, Molecular hydrodynamics, BBGKY hierarchy; Random and glassy systems, Linear and branched Polymers, Percolation; XY model and vortices-superfluidity.	N.A

Reference books:

1. M. Kardar, "Statistical Physics of Particles" (CUP, 2007).
2. R.K. Pathria, "Statistical Mechanics" (Academic Press, 2007).
3. D. Chowdhury and D. Stauffer, "Principles of Equilibrium Statistical Mechanics" (Wiley, 2000).
4. B.K. Chakrabarti et al. "Quantum Phase Transitions in Transverse Ising Models" (Springer, 1996).
5. S.K. Ma, "Statistical Mechanics" (World Scientific, 1985).
6. L.D. Landau and E.M. Lifshitz, "Statistical Mechanics" (Academic Press, 1975)
7. K. Huang, "Statistical Mechanics" (Wiley, 1987)