

Advanced Statistical mechanics PHY613

Instructor: Amit Dutta

Module 1: Critical Phenomena and Renormalization Group Lect. **30 hrs**

Basics of Phase transitions, mean field theory, concepts of scaling, application of real space and momentum space renormalization group techniques to magnetic and non-magnetic classical critical systems. Epsilon-expansion, large n methods and non-linear sigma models are to be used.

Books: 1. Chaikin and Lubesnky
2. S. K. Ma: Critical Phenomena
3. Nigel Goldenfeld

Module 2: Quantum Phenomena: Lect: **20 hrs**

Quantum phase transitions, Bose Einstein Condensation, An introduction to superfluidity, Bogoliubov theory, coherent states, An introduction to superconductivity: BCS theory, Bogoliubov-Degennes theory, Quantum coherence: Flux and charge qubits.

Books: 1. Annet: superconductivity superfluidity and condensates
2. Tinkham: Superconductivity

Topic may be added/dropped/rearranged/reorganized based on the progress of the course and student feedback.

Book for all the topics: Condensed Matter field theory: Altland and Simons

Required: Phy412: Statistical Mechanics, PHY543 (Preferrably)

Evaluation based on Examination and term paper presentation.