Approved: 2nd adhoc meeting

PH 302: Introduction to Statistical Mechanics (2.5-0.5-0-3)

1. Statistical concepts and examples - random walk problem in one dimension – mean values – probability distribution for large N. Probability distribution many variables. [6 Lectures]

2. Statistical description of a system of particles – Statistical ensemble- Microstate and macrostate – Density of states. Connection between statistics and thermodynamics - Relation between number of macrostates and entropy – classical ideal gas. Gibb's paradox. [6 Lectures]

3. Liouvellie's theorem- Phase space and connection between mechanics and statistical mechanics Microcanonical ensemble – Computational methods to calculate phase space trajectory- Molecular dynamics and Monte Carlo methods. [6 Lectures]

4. Canonical ensemble – partition function. Thermodynamics from the partition function – Helmholtz free energy. Classical ideal gas- equipartition and virial theorem. System of harmonic oscillators and spin systems. Grand canonical ensemble- density and energy fluctuations- Gibbs free energy. [6 Lectures]

5. Formulation of quantum statistical mechanics – density matrix- micro-canonical, canonical and grand canonical ensembles- Systems composed of indistinguishable particles, Slater determinant. [6 Lectures]

6. Maxwell-Boltzmann , Fermi-Dirac, and Bose-Einstein statistics – Ideal gas in classical and quantum ensembles – Ideal Bose systems – Black body radiation- lattice vibrations in solids- Ideal Fermi systems – magnetic systems- Pauli paramagnetism-Landau diamagnetism – electron gas in metals. [6 Lectures]

7. Brownian motion – Langevin equation – Fluctuation-dissipation theorem-correlation functions and friction coefficient. [4 Lectures]

References

1) Fundamentals of statistical and thermal physics, F. Reif
2) Introduction to statistical physics, K. Huang
3) Statistical physics by F Mandl
4) Statistical Mechanics, R K Pathria
5) Statistical Physics by K Huang