Mangalore University

Department of Physics
MSc Physics

502: THERMODYNAMICS AND STATISTICAL PHYSICS (52 Hrs.)

Course Outcome

CO1 On completion of this course, student will have an idea of basics of Thermodynamics, Liouvillis theorem, probability - thermal equilibrium.
CO2 Student will have knowledge of Bose-Einstein and Fermi-Dirac distributions and degenerate Fermi and Bose gases - Bose-Einstein condensation.
CO3 The candidate will have basic understanding of Boltzmann distribution, calculation of velocities - average and r.m.s velocities Gibbs‟ paradox, Sackur - Tetrode equation.
CO4 The student will come to know the basics of Brownian motion: Langevin equation for random motion, Random walk problem. Diffusion and Einstein relation for mobility.

Unit I Thermodynamics: Concept of entropy - principle of entropy increase - entropy and disorder. Enthalpy - Helmoltz and Gibb's functions. Maxwell's relations - TdS equations - energy equations - Heat capacity equations - heat capacity at constant pressure and volume. Phase space and ensembles - Lioullis theorem, probability - thermal equilibrium. **[13 hrs]**

Unit II Classical statistics: Boltzmann distribution, calculation of velocities - average and

r.m.sveleocities Gibbs' paradox, Sackur - Tetrode equation, partition functions - translational partition funciotn, vibrational, rotational and electronic partition functions. Boltzmann equipartition theorems. Application to specific heats. **[13 hrs]**

Unit III Quantum statistics: Bosons and Fermions - Bose-Einstein and Fermi-Dirac distributions - degenerate Fermi and Bose gases - Bose-Einstein condensation - Planck's law of black-body radiation. Liquid helium - Lambda transition.

Fluctuations - Fluctuations in canonical, grand canonical and microcanonical ensembles. Number fluctuations in quantum gases. **[13 hrs]**

Unit IV Brownian motion: Langevin equation for random motion, Random walk problem. Diffusion and Einstein relation for mobility.

Time dependence of fluctuations: power spectrum of fluctuations, persistence and correlation of fluctuations. Wiener - Khinchin theorem, Johnson noise and Nyquist theorem. Shot noise, Fokker-Planck equation. **[13 hrs**

Text Books:

1.Zeemansky M W and Dittman R H, 'Heat and Thermodynamics', VII Edn. (McGraw Hill International Edn., 1999)
2.Gopal E S R, 'Statistical Mechanics and Properties of Matter' (Macmillan, 1976)
3.Agarwal B K and Melvine Eisner, 'Statistical mechanics' (Wiley Eastern Ltd., 1991)

Reference Books:

1. Kittel C and Kroemer H, 'Thermal Physics', II Edn. (CBS Publ., 1980)
2. Chandler D, 'Introduction to Modern Statistical Mechanics' (Oxford university Press, 1987)
3. Reichl L E, 'A Modern Course in Statistical Physics' (University of Texas Press, 1980)
4. Landau and Lifshitz, 'Statistical Physics', III Edn. (Oxford, Pergamon, 1980)
5. Gupta M C, 'Statistical Thermodynamics' (New Age, 1995)
6. Reif F, 'Fundamentals of Statistical and Thermal Physics' (McGraw Hill, 1965)