

5575 226
DEPARTMENT OF PHYSICS
ANDHRA UNIVERSITY

Common for M.Sc. Physics and M.Sc. Space Physics
II Semester
(w.e.f 2009-10 batch)
P202, SP202: STATISTICAL MECHANICS

UNIT-I : Basic Methods and Results of Statistical Mechanics:

13 Hrs

Specification of the state of a system, phase space and quantum states, Liouville's theorem, Basic postulates, Probability calculations, concept of ensembles, thermal interaction, Mechanical interaction, quasi static process, distribution of energy between systems in equilibrium, statistical calculations of thermo dynamic quantities, Isolated systems (Microcanonical ensemble). Entropy of a perfect gas in microcanonical ensemble. Canonical ensemble - system in contact with heat reservoir, system with specified mean energy, connection with thermodynamics, Energy fluctuations in the canonical ensemble. Grand canonical ensemble, Thermodynamic function for the grand canonical ensemble. Density and energy fluctuations in the grand canonical ensemble. Thermodynamic equivalence of ensembles. Reif Ch:2, 3.3, 3.12 Ch:6

UNIT-II : Simple Applications of Statistical Mechanics:

12 Hrs

Partition functions and their properties. Calculation of thermo dynamic quantities to an ideal mono atomic gas. Gibbs paradox, validity of the classical approximation. Proof of the equipartition theorem. Simple applications – mean K.E. of a molecule in a gas. Brownian motion. Harmonic Oscillator, Specific heats of solids (Einstein and Debye model of solids), Paramagnetism, Partition function for polyatomic molecules, Electronic energy, vibrational energy and rotational energy of a diatomic molecule. Effect of Nuclear spin-ortho and para Hydrogen. Reif Ch:7, Ch:9.12

UNIT-III: Quantum Statistics:

15 Hrs

Formulation of the statistical problem. Maxwell-Boltzmann statistics. Photon statistics, Bose-Einstein statistics, Fermi-Dirac statistics, Quantum statistics in the classical limit, calculation of dispersion for MB, BE & FD statistics Equation of state of an Ideal Bose Gas, Black body radiation, Bose-Einstein condensation, Equation of state for a weakly degenerate and strongly degenerate ideal Fermi gas. Thermionic emission. The theory of white dwarf stars. Reif Ch:9

UNIT-IV: Non Ideal Classical Gas:

10 Hrs

Calculation of the partition function for low densities. Equation of state and virial coefficients (Van Der Waals equation) Reif Ch:10.3, 10.4

Phase Transitions and Critical Phenomena:

Phase transitions, conditions for Phase equilibrium, First order Phase transition – the Clausius-Clapeyron equation, Second order phase transition, The critical indices, Van der Waals theory of liquid gas transition. Order parameter, Landau theory.. Sinha Ch:10

Text Books

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| 1. Fundamentals of Statistical and Thermal Physics | F. Reif |
| 2. Statistical Mechanics, Theory and Applications | S.K. Sinha |
| 3. Statistical Mechanics | R.K. Pathria |