M.Sc. Physics Semester II Paper VII
Statistical Mechanics22PHY22C1

Theory Marks: 80
Internal Assessment Marks: 20
Time: 3 Hours

COURSE OUTCOMES

CO1 The students are able to appreciate cellular nature of phase space and interface of Statistical Mechanics with Thermodynamics

CO2 Knowledge of ensemble theory would result in greater insight into solutions of various complex problems

CO3 The students would be able to analyse the peculiar gas behavior and are in a position to extend the treatment to complex problems

CO4 The students would be equipped to explore the applications of Ising Model and to understand different approximations.

Unit I

Phase space, Ensembles, Liouville theorem, conservation of extension, Equation of motion, Equal a priori probability, Statistical equilibrium, Microcanonical ensemble, Quantization of phase space, classical limit, symmetry of wave functions effect of symmetry on counting, Various distributions using micro canonical ensemble Entropy of an ideal gas, Equilibrium Conditions, Quasi – Static Process, Entropy of an ideal gas using Microcanonical Ensemble, Gibbs paradox, Sackur-Tetrode equation,Probability distribution and entropy of a two level system.

Unit-II

Entropy of a system in contact with a reservoir, Canonical ensemble, Ideal gas in a canonical ensemble, Equipartition of energy, Third law of thermodynamics, Photons, Grand canonical ensemble, Ideal gas in Grand Canonical ensemble, Comparison of various ensembles, Quantum distribution using other ensembles.

Unit III

Transition from classical statistical mechanics to quantum statistical mechanics, Indistinguishability and quantum statistics, identical particles and symmetry requirements, Bose Einstein statistics, Fermi Dirac statistics, Maxwell Boltzmann statistics. Bose Einstein Condensation, Thermal properties of B.E. gas, liquid Helium, Energy and pressure of F-D gas, Electrons in metals, Thermionic Emission, Saha Theory of Thermal Ionization

Unit IV

Cluster expansion for a classical gas, Virial equation of state, Van der Waals gas, Phase transition of second kind, Ising Model, Bragg Williams Approximation, Ising Model in one and two dimensions, fluctuations in ensembles, Energy fluctuation in quantum statistics, Concentration fluctuation in quantum statistics, One dimensional random walk, Brownian motion.

Note: The syllabus is divided into four units. Nine questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit. A student has to attempt five questions in all.

Text and Reference Books:

[1] Statistical Mechanics by K. Huang
[2] Statistical Mechanics by B.K. Aggarwal and M.Eisner
[3] Statistical Mechanics by R.K. Patharia
[4] Statistical Mechanics by DonaladA McQuarrie
[5] Statistical Mechanics by AvijitLahiri
[6] Statistical Mechanics R Kubo