

**Physics- PH-401**

**Paper VII: Statistical Physics**

**Max.Marks:40**

**Internal assessment:10**

**Time:3 Hours**

**Note:**

1. The syllabus is divided into 4 units. 9 questions will be set.
2. Question no 1 will be compulsory, it contains 6 parts (form all the four units) and answer should be brief but not in yes / no.
3. Four more questions are to be attempted, selecting one question from each unit. Questions 2-9 may contain two or more parts. All questions carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

**Unit –I: Statistical Physics I**

Microscopic and Macroscopic systems, events-mutually exclusive, dependent and independent. Probability, statistical probability, A- priori Probability and relation between them, probability theorems, some probability considerations, combinations possessing maximum probability, combination possessing minimum probability, Tossing of 2,3 and any number of Coins, Permutations and combinations, distributions of N (for N= 2,3,4) distinguishable and indistinguishable particles in two boxes of equal size, Micro and Macro states, Thermodynamical probability, Constraints and Accessible states, Statistical fluctuations, general distribution of distinguishable particles in compartments of different sizes, Condition of equilibrium between two systems in thermal contact--  $\beta$  parameter, Entropy and Probability (Boltzman's relation).

**Unit –II: Statistical Physics II**

Postulates of statistical physics, Phase space, Division of Phase space into cells, three kinds of statistics, basic approach in three statistics. M. B. statistics applied to an ideal gas in equilibrium- energy distribution law (including evaluation of  $\sigma$  and  $\beta$  ), speed distribution law & velocity distribution law. Expression for average speed, r.m.s. speed, average velocity, r. m. s. velocity, most probable energy & mean energy for Maxwellian distribution.

### **Unit-III: Quantum Statistics**

Need for Quantum Statistics: Bose-Einstein energy distribution law, Application of B.E. statistics to Planck's radiation law B.E. gas, Degeneracy and B.E. Condensation, Fermi-Dirac energy distribution law, F.D. gas and Degeneracy, Fermi energy and Fermi temperature, Fermi Dirac energy distribution law, Fermi Dirac gas and degeneracy, Fermi energy and Fermi temperature, Fermi Dirac energy distribution law for electron gas in metals, Zero point energy, Zero point pressure and average speed (at 0 K) of electron gas, Specific heat anomaly of metals and its solution. M.B. distribution as a limiting case of B.E. and F.D. distributions, Comparison of three statistics.

### **Unit-IV: Theory of Specific Heat of Solids**

Dulong and Petit law. Derivation of Dulong and Petit law from classical physics. Specific heat at low temperature, Einstein theory of specific heat, Criticism of Einstein theory, Debye model of specific heat of solids, success and shortcomings of Debye theory, comparison of Einstein and Debye theories.

### **References:**

1. Prakash S and Agarwal J P, Statistical Mechanics, Kedar Nath Ram Nath & co, Meerur
2. Reiff. statistical Physics, Berleley Physics Course Volume 5, Mc Graw Hill Book Co Ltd, New Delhi
3. Mc Quarrie D A. Statistical Mechanics, Viva Books Pvt Ltd, New Delhi.
4. Ashley Cmter (August 1999), Classical and Statistical Thermodynamics .
5. Richard Fitzpatrick, Thermodynamics and Statistical Mechanics: An intermediate level course Lulu.com,2007