**PH 406: Statistical Mechanics (3-1-0:4)**

**Review of Thermodynamics**

Laws of thermodynamics, Carnot’s engine, Legendre transformations and thermodynamic potentials, Maxwell relations. **[3L+1T]**

**Statistical Description**

Macroscopic and microscopic states, connection between statistical and thermodynamics.

**[3L+1T]**

**Ensemble**

Microcanonical ensemble: phase space, Liouville's theorem, applications of ensemble theory to classical and quantum systems; Canonical ensemble : partition function, thermodynamics in canonical ensemble, ideal gas, energy fluctuations, statistics of paramagnetism, negative temperature; Grand canonical ensemble : equilibrium between a system and a particle-energy reservoir, partition function, fluctuations, density matrices. **[9L+3T]**

**Theory of Quantum Ideal Gases**

Ideal gas in different quantum mechanical ensembles, identical particles, many-particle wave function, occupation numbers, classical limit of quantum statistics, molecules with internal motion.

**[6L+2T]**

**Bose and Fermi Gases**

Ideal Bose Gas: Bose-Einstein condensation, Helium II, blackbody radiation, phonons; Ideal Fermi Gas: Pauli paramagnetism, Landau diamagnetism, White dwarf. **[9L+3T]**

**Interacting Systems**

Ising model, solution of Ising model in one dimension by transfer matrix method, Mean field theory.

**[6L+2T]**

**Textbooks and References**

1. R. K. Pathria and P. D. Beale, “Statistical Mechanics”, Academic Press.
2. S. R. A. Salinas, “Introduction to Statistical Physics”, Springer.

3. K. Huang, “Statistical Mechanics”, John Wiley Asia.

4. D. Y. Schroeder, “An Introduction to Thermal Physics”, Pearson India Education.

5. W. Greiner, L. Neise, and H. Stocker, “Thermodynamics and Statistical Mechanics”, Springer.

6. F. Reif., “Fundamentals of Statistical and Thermal Physics”, Levant Books.