CHM 421/621: Statistical Mechanics (4)

Prerequisites: *CHM 222/PHY 309, CHM 322/PHY 303*

Review of classical thermodynamics: Laws of thermodynamics and thermodynamic potentials, Legendre transforms and derivative relations, conditions of thermodynamic equilibrium and stability.

Elementary probability theory: Definition of probability, distribution functions and moments, average, variance and binomial distribution for large numbers and central limit theorem, statistical concept of uncertainty.

Fundamental principles of statistical mechanics: Macroscopic and microscopic states, fundamental postulates of statistical mechanics, statistical mechanical ensembles and their distribution functions, partition functions, entropy and Boltzmann distribution law, relation between partition functions and thermodynamic quantities in different ensembles, and fluctuations.

Ideal systems: Monatomic, diatomic and polyatomic gases and calculation of partition functions, heat capacities of gases, equipartition theorem and the Maxwell velocity distribution, Gibbs paradox, ortho- and para-hydrogen, blackbody radiation, heat capacities of solids (Einstein and Debye models), chemical equilibrium in ideal gas mixtures, photon and phonon gas systems of quantum particles and concept of different populations (Bose-Einstein and Fermi-Dirac statistics), distribution function of ideal Bose and Fermi gases, classical limits of quantum systems.

Suggested Readings **:**

- Callen, H. B., *Thermodynamics and an Introduction to Thermostatistics*, Ed. 2nd, Wiley, **1985**.
- Hill, T. L., *An Introduction to Statistical Thermodynamics*, Dover, **1987**.
- McQuarrie, D. A., *Statistical Mechanics*, University Science Books, **2000**.
- Widom, B., *Statistical Mechanics: A Concise Introduction for Chemists*, Cambridge University Press, **2002**.
- Chandler, D., *Introduction to Modern Statistical Mechanics*, Oxford University Press, **1987.**
- Pathria, R. K., *Statistical Mechanics*, Ed. 2nd, Butterworth-Heinemann, **1996.**