Phys 462/662 – Thermal and Statistical Physics - 3 credits

Bulletin Description:

Classical postulates and laws of thermodynamics; cyclic processes and entropy; thermodynamic potentials, equilibrium, stability, and phase transitions; Maxwell-Boltzmann distribution, applications to classical gases and magnets; quantum statistics, Bose-Einstein and Fermi-Dirac distributions, applications to quantum gases. Prerequisite: PHYS 350

Course Objectives:

The objectives of the course are to master the foundations of thermodynamics and statistical mechanics and to apply theoretical and computational methods to solving practical problems in a variety of physical systems.

Contents Listing:

Part 1: Thermodynamics

- Thermodynamic systems and postulates
- Heat, work, energy, and the First Law of Thermodynamics
- States, entropy, and the Second Law of Thermodynamics
- Cyclic processes and thermal engines
- Equilibrium and stability
- Ideal and nonideal gases, equations of state (e.g., van der Waals)
- Phase transitions (1^{st}- and 2^{nd}-order), Clausius-Clapeyron equation, critical phenomena
- Legendre transformations and thermodynamic potentials

Part 2: Statistical Mechanics

- Basics of probability and statistics
- Microstates, macrostates, statistical ensembles, and the Second Law (revisited)
- Phase space and ensembles
- Classical Statistics: Maxwell-Boltzmann distribution
- Applications: ideal gases, paramagnets, and ferromagnets
- Quantum Statistics: Bose-Einstein and Fermi-Dirac distributions
- Applications: quantum gases, blackbody radiation, properties of solids
- Computer simulation methods and applications to materials

References: Stowe, *Thermodynamics and Statistical Mechanics*; Schroeder, *An Introduction to Thermal Physics*; Reif, *Fundamentals of Statistical and Thermal Physics*; Callen, *Thermodynamics*; Fermi, *Thermodynamics*