THE OHIO STATE UNIVERSITY

COLLEGE OF ENGINEERING

Statistical Thermodynamics

MECHENG 8503

Credit Hours:
3.00 - 3.00

Course Levels:
Graduate (5000-8000 level)

Course Components:
Lecture
Independent Study

Course Description:
Microscopic aspects of thermodynamics for engineering graduate students. Starts with kinetic gas theory and classical statistics of independent particles. Derives statistical distribution functions and thermostatic properties of real substances.

Prerequisites and Co-requisites:
Prereq: Grad standing in MechEng or AeroEng, and permission of instructor.

Course Goals / Objectives:
- Understand the microscopic basis for the thermodynamic properties of real systems and matter
- Understand the Boltzmann equation, the equilibrium between collisions between particles and the forces driving the flux of particles, electrical current and heat
- Understand statistical distribution functions
- Gain experience in the application of those concepts to some practical systems: electrons in solids, heat capacity and conduction, light, and plasmas

Course Topics:
- Introduction to statistical thermodynamics and thermal physics
- Kinetic Gas Theory
- The Boltzmann equation, collisions, use in transport of mass, heat and electrical charge.
- Statistical distributions functions: probabilistic arguments, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac
- Microstates, macrostates, thermodynamic probability, partition function, Heisenberg uncertainty principle
- Relation to macroscopic phenomenological thermodynamics, relation between entropy and probability.
- Bose-Einstein statistics in light (photons) and sound waves (phonons) and conduction of heat
- Introduction to quantum mechanics
- The harmonic oscillator (quantum), molecular vibrational and rotational levels
- Solids: crystal structures, electrons in crystals
- Fermi-Dirac statistics for electron distribution in solids
- Conduction of electrical current

Designation:
Elective