NIU Course Syllabus for Physics 463/563

Thermodynamics, Kinematic Theory, and Statistical Mechanics

Spring 2016, Tuesdays and Thursdays, 3:30-4:45 pm

Course Description:

Review of such topics as the laws of thermodynamics, the entropy concept, and thermodynamic potentials. Probability, distribution functions and transport phenomena. Introductory treatment of classical and quantum-mechanical statistical mechanics. Emphasis on applications to areas of modern physics.

Prerequisites : PHYS 320 or consent of department.

Credits: 3. **Contact hours**: 3.0. **Lecture hours**: 3.0. **Method of delivery**: Traditional

Course Goals:

1. Develop logical, objective, and critical thinking with scientific method using classical thermodynamics, kinematic theory and classical and quantum-mechanical statistical mechanics.
2. Develop the relationship between classical thermodynamics, kinematic theory, and statistical mechanics based on the classical and quantum mechanics.
3. Develop advanced quantitative analytical skills and methods with statistics, advanced calculus and partial differential equations.

Student Learning Outcomes: Upon successful completion of the course, with statistics, advanced calculus, and partial differential equations, students will be able to explain, analyze and/or apply:

- The Kinematic theory of gases. This is a bridge to statistical mechanics.
- Concepts of distinguishable and indistinguishable particles.
- Relationship between thermodynamic probability and Entropy.
- Concepts of quantum states, energy levels, and density of states.
- Classical and quantum statistics such as Boltzman, Fermi-Dirac, Bose-Einstein, and Maxwell-Boltzman statistics.
- Relationship between classical and statistical thermodynamics such as
    - paradox in classical thermodynamics,
    - fundamental understanding of thermodynamics of ideal gas,
    - the heat capacity of gases and solids,
    - magnetism,
    - Bose-Einstein gases, and
    - Fermi-Dirac Gases
- Information Theory (if time allows).

(Tentative schedule)

0: Review of Thermodynamics (Ch. 1- 10) Dr. L. Lurio: January 19, 2016

1: Introduction to the course & Review of Thermodynamics (Ch. 1- 10) *HW. Summarize Thermodynamics definitions, laws and their applications. 10 – 15 pages.*

2: The Kinetic Theory of Gases (Ch. 11)

3: Statistical Thermodynamics (Ch. 12)

4: Classical and Quantum Statistics ((Ch. 13)

Mid-Term I: February 25th, Thursday

5: The Classical Statistical Treatment of an Ideal Gas (Ch. 14)

6: The Heat Capacity of a Diatomic Gas (Ch. 15)

7: The Heat Capacity of Solid (Ch. 16)

Mid-Term II: March 31st, Thursday

8: The Thermodynamics of Magnetism (Ch. 17)

9: Bose-Einstein Gases (Ch. 18)

10: Fermi-Dirac Gases (Ch. 19)

(11: Information Theory (Ch. 20))

Final Exam (Tuesday. May 10, 2016, 4:00 – 5:50 pm)