COURSE SYLLABUS, Spring 2022

PHYSICS 334

Macroscopic Phenomena and Thermodynamics

Instructor: **Tariq H. Gilani**
Office: R 236

Phone: 871-7449

Office Hours:
MWF 9:30 – 11 AM
F (virtual) 7 – 8 PM
or by appointment

E-mail: tariq.gilani@millersville.edu

Prereq: PHYS 232. Coreq: MATH 311.

1. **Required Text:** D. Schroeder, *Thermal Physics*, Addison Wesley, 1999.

Suggested Texts:

1. Harvey Gould and Jan Tobochnik, *Statistical and Thermal Physics—With Computer Applications*, Princeton University Press, 2010.
2. Sears and Salinger, *Thermodynamics, Kinetic Theory and Statistical Mechanics*, Addison Wesley, 1986.
3. Notes and handouts (if required).

Purpose: Students learn to describe, in the language of calculus, the behavior of macroscopic systems (laboratory size systems) and their response to external perturbations. The macroscopic properties, especially thermal properties of the systems will be studied. Students explore the relationship of macroscopic to microscopic properties of the system. This will prepare them for applications and basis for learning statistical mechanics in depth.

Method of Conducting Course: Class period will include lectures, discussion, problem solving, and occasional computer simulations. Supplementary topics and problems will be assigned for study outside of class. **Homework assignments must be turned in on time**. Late assignments may be accepted with reduced credit, on discretion of the instructor.

Assessment:

Final grade is derived from each of the following constituents:

1. Homework (20%)
2. Exam-1 (20%)
3. Exam-2 (20%)
4. Exam-3 (20%)
5. Final Comprehensive Exam. (20%)

Grading Scale:

93-100% A, 90-92.9% A-, 87-89.9% B+, 83-86.9% B, 80-82.9% B-, 77-79.9% C+, 70-76.9% C, 60-69.9% C-, 55-59.9% D+, 50-54.9% D, <49.9% F. The minimum score for any grade may be lowered based on the difficulty of quiz or examination questions.

Millersville University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to comply with the requirements of Title IX of the Education Amendments of 1972 and the University's commitment to offering supportive measures in accordance with the new regulations issued under Title IX, the University requires faculty members to report to the University's Title IX Coordinator incidents of sexual violence shared by students. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. ***Faculty members are obligated to report to the person designated in the University Protection of Minors policy sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred.***

Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at: www.millersville.edu/titleix

Tentative Schedule

Exam-1: **(Ch 1, 2 and 3)**

Macroscopic behavior, Fundamental quantities, Math refresher, Thermal Equilibrium, Ideal Gas, Equipartition of Energy, Heat and Work, energy and 1st law of thermodynamics, Temperature, Models of Matter, Thermodynamic equation of states, Heat Capacities, Enthalpy, Heat Conduction, Conductivity of Ideal gas, Viscosity, Diffusion, Fick's Law, 2nd law of thermodynamics, Entropy and Heat, Paramagnetism, Mechanical Equilibrium and Pressure, Diffusive Equilibrium and Chemical Potential.

Exam-2: **(Ch 4 & 5)** Heat engine, refrigerator, Free energies, Fuel Cells and batteries, Thermodynamic Identities, Phase Transformations, Chemical Equilibrium.

Exam-3: (**Ch 6 & Ch. 7**)

Boltzmann Statistics: Boltzmann Factor, Average Values, Paramagnetism, Equipartition Theorem, Partition functions and Free energy, Ideal Gas Revisited.

Quantum Statistics: The Gibbs Factor, Bosons and Fermions, Degenerate Fermi Gas, Density of states, Black body radiation,

Rules of probability, Mean values, Uncertainty, Probability distribution, Introduction to statistics, Simple Thermal interactions, Microstates of simple magnetic systems, a particle in one-, two- and three-dimensional box, Non-interacting identical particles in semi classical limit, Micro canonical, canonical and grand canonical ensembles, Debye Theory of Solids, Bose-Einstein Condensation (if time allows).