Physics 4101: Thermodynamics & Kinetic Theory

Department of Physics, Temple University

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Course description:

Thermodynamics studies the physical laws of a system consisting of large number of particles, typically on the order of ~10^{23}. Similar to the role that Newton¡¯s three laws play in Classical Mechanics, the first and second laws of thermodynamics are the center of thermodynamics. Different from the thermodynamics, which deals with what the thermal equilibrium states are and how energy is transferred among different thermodynamic systems, the kinetics theory of thermal physics focuses on the transport process to reach the equilibrium, e.g. the heat conduction and the chemical reaction speed.

Statistical physics answers the questions like why heat can spontaneously flow from hot objects to cold ones by analyzing the statistical behaviors of the large number of particles that form the object. Thermodynamic functions can be calculated using statistical physics. In this sense, statistical physics is more fundamental than thermodynamics. In addition, since the behaviors of microscopic particles are governed by quantum mechanics, their statistical properties obey different rules for bosons and fermions, which cannot be explained just by thermodynamics itself.

This course will introduce thermodynamics, kinetics, and statistical physics. It focuses on the first and second laws of thermodynamics, thermodynamic functions, and their applications in heat engines and chemical thermodynamics. Heat conduction and particle diffusion will be introduced as fundamental rules in kinetics. Basic concepts in statistical physics will also be introduced, including the Boltzmann statistics and Quantum statistics of non-interacting particles.

Textbook:

An Introduction to Thermal Physics by Daniel V. Schroeder, Addison Wesley 1999 (ISBN 0201380277)

Lectures: Tue and Thu 12:30-1:50 pm (Aug. 26 to Dec. 4) Barton Hall Room A106, no lectures on Oct. 17 (Midterm Exam) or Nov. 27 (Thanksgiving).

Textbook coverage

- Chapter 1 Energy in Thermal Physics
- Chapter 2 The Second Law
- Chapter 3 Interactions and Implications
- Chapter 4 Engines and Refrigerators
- Chapter 5 Free Energy and Chemical Thermodynamics
- Chapter 6 Boltzmann Statistics
- Chapter 7 Quantum Statistics (partial)

Homework: Once a week, mostly from the textbook, posted online, handed in on the following Thursday class.

Exams: Midterm (BA 106, 12:30-1:50 pm, Thursday Oct. 16). Final (BA 106, 10:30am-12:30pm, Thursday Dec. 11) Each exam consists of two parts: A) (50%) Problems to be solved in class. Close book, calculators (not programmable) allowed, necessary formulas will be given. B) (50%) An essay on one of the topics given online at least two weeks before the problems exam. Due before the end of the problems exam.

Attendance: Class attendance will NOT be tracked. However, I highly recommend that you attend every class. If you are not able to come to the class for whatever reason, please email me in advance.

Grading: Higher score of (Final exam 50% + midterm 30% + homework 20% or Final exam 30% + midterm 20% + homework 50%)

LETTER GRADE	POINTS
A	94-100
A-	90-93
B+	87-89
B	84-86
B-	80-83
C+	75-79
C	70-74
D	60-69
F	59% & below