PHYS 303
Thermal and Statistical Physics
Fall 2015

Lecture Hours: MWF 10:00 – 10:50 AM, in Physics 201
Instructor: Matthew Pelton
Office: Physics 313
Office Hours: MWF 11:00 – 12:00, or by appointment
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Grader: Gordon McDonnell, gmcd1@umbc.edu
Text: Daniel V. Schroeder, An Introduction to Thermal Physics

Course Objectives

This course provides an introduction to thermodynamics and statistical mechanics, from a physics perspective. Thermodynamics is the study of heat and energy in macroscopic systems, and statistical mechanics is the microscopic explanation for the laws of thermodynamics. Together, they are essential to understanding the operation of nearly everything in the physical world, including engines, electronics, chemical reactions, sunlight, the atmosphere, living organisms, astrophysics, and geology. The laws of thermodynamics, as explained by statistical mechanics, are perhaps the most fundamental and inviolable laws of science that we know.

You will have succeeded in this course if, at the end of the semester, you understand and are able to solve problems related to each of the following topics:

• The thermodynamic description of systems, including temperature, entropy, and free energy
• The laws of thermodynamics and the properties of thermodynamic processes
• The statistical interpretation of thermodynamic quantities and laws
• Applications to ideal gases, magnetic systems, radiation, and other model systems

These are the key concepts that will be covered in the course:

• Part 1: Fundamentals
  o Thermal equilibrium and temperature
  o The first law of thermodynamics
  o Kinetic theory
  o The statistical interpretation of equilibrium
  o The second law of thermodynamics

• Part 2: Thermodynamics
  o Mechanical equilibrium and diffusive equilibrium
  o Thermodynamic processes and heat engines
  o The third law of thermodynamics
  o Chemical potential
  o Free energy and the thermodynamic identity
• **Part 3: Statistical Mechanics**
  o Partition functions
  o Canonical and grand canonical ensembles
  o Quantum statistics
  o Ideal gases
  o Magnetic systems, blackbody radiation, and other model systems

**Grading**

Your final grade will be determined by a numerical score, calculated as follows:

- Final exam: 30%
- 2 mid-term exams: 30%
- Homework: 35%
- Quizzes: 5%

In order to convert this numerical score into a letter grade, I will first calculate the average of the scores for the top 10% of the students in the class. This score will be the benchmark for determining letter grades. The benchmark and your letter grade will be based on the final score. *(I.e., I will be comparing your grade to the benchmark only once, at the end of the semester, and not for every exam or homework.)*

A: $\geq 90\%$ of the benchmark
B: $80 – 89\%$ of the benchmark
C: $70 – 79\%$ of the benchmark
D: $50 – 69\%$ of the benchmark
F: $< 50\%$ of the benchmark

**Exams and Quizzes**

Two mid-term exams will take place during the semester, during scheduled class time. The final exam will be in Physics 201, at the date and time set by the University. Exams include all course material covered up to the day of the exam. Quizzes will take place occasionally during the first 10 minutes of class, and will include key concepts covered recently in the course.

All exams and quizzes are closed book, and no electronic devices of any kind may be used. You may bring one page of hand-written notes into the exams; no notes are allowed in the quizzes.

**Homework**

Homework assignments will be available on the Blackboard page by the beginning of class every Monday, and are due at the beginning of class next Monday, unless you are told otherwise. No late assignments will be accepted. The homework assignment on which you got your lowest grade will be dropped, and the remaining assignments will be weighted equally in determining the homework portion of your score. This is meant to allow for things that come up unexpectedly, and additional accommodation will be possible only in extraordinary circumstances. Getting help from other students is allowed and encouraged, but all of the work that you turn in must be your own.
**Academic Integrity**

By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC’s scholarly community in which everyone’s academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, consult the UMBC Student Handbook, the Faculty Handbook, or the UMBC Policies section of the UMBC Directory. Misconduct, such as cheating or plagiarism, will result at a minimum in a zero on the corresponding assignment or exam and a report to the Academic Misconduct Reporting Database.