PHYSICS 140: Thermodynamics and Kinetic Theory (#82405)

Fall 2007

CALIFORNIA STATE UNIVERSITY, FRESNO
Department of Physics

Course No: Phys 140          Unit Value: 3
Instructor: Daqing Zhang       Office Number: McLane 260
Email: dzhang@csufresno.edu     Telephone: 278-7096
Class Hours: 09:00—09:50am MWF  Class Room: McLane 167
Office Hours: 10:00—11:00am MTWF, 1:00—2:00pm Thu, or by appointment
Class Website: http://physics.csufresno.edu/dzhang/phys140.htm
Grading: Letter (A, B, C, D, F)

Course Textbook:
Thermal Physics, Ralph Baierlein (required)
An Introduction to Thermal Physics, Daniel V. Schroeder (recommended)
Classical and Statistical Thermodynamics, Ashley Carter (recommended)

Prerequisites: Physics 102, Math 81

Course Description:
This course is designed for physics-major upper division undergraduate students and gives them a
good foundation in the field of Thermodynamics and Statistical Mechanics. Being one semester-
long course, only major key topics and ideas will be covered which will give students what they
need to be successful in more advanced courses. The concepts will be taught in this class
including (but not limited to) temperature, work and energy, the 1st and 2nd laws of
thermodynamics, entropy, macro- and microstates, macro- and microscopic ideal gas, partition
function, chemical potential, and the free energy. And the course will be concluded with the 3rd
law of thermodynamics if time allowed.

Course Goals:
Thermodynamics and statistical mechanics is a quite broad topic. This course is just at an
introduction level but it is an introduction to a big, complex subject. The primary goals of this
course for students are to understand the basic ideas, fundamental concepts and principles in the
field of thermodynamics and statistical mechanics; to practice their logic and reasoning skills by
applying their knowledge of physics and mathematics to physical situation (problem-solving).

Course Objectives (Student Learning Outcomes):
This course is designed for Physics-major upper division undergraduate students to learn one of
the most important areas in classic physics: thermodynamics and statistical mechanics. Through
the course lectures, problem-solving practice and discussion,
1. Students will be familiar with most fundamental principles, concepts, physical quantities,
laws, and characteristic of thermodynamics and statistical mechanics.
2. Students will be able to apply the following to the solution of thermodynamics and statistical mechanics problems: thermodynamic property data, micro- and macroscopic quantities, concepts of multiplicity, entropy, energy, heat, work, and thermo processes and states.

3. Students will be able to perform the 1st and 2nd law of thermodynamics on an arbitrary open or closed thermo system.

4. Students will be able to apply the concepts of quantum and statistical mechanics (microstates) on thermodynamic (macrostates) systems.

5. Students will demonstrate an awareness of the impact of thermodynamics and statistical mechanics on the realistic applications such as air conditioner, power plant, automobile, and thermo-electric converter, to name a few.

Homework:
Each homework including approximately 1~5 problems will be assigned in lecture on a weekly basis. The homework is due one week after assigned in lecture (at the beginning of class). Graded homework will be returned in class. Homework solutions will be provided after grading. LATE HOMEWORK WILL NOT BE ACCEPTED. Work together with classmates or consult with fellow students is encouraged but copying the homework of another is considered cheating. You will get zero point in this case. Also remember that just copying your classmate’s solution will not increase your knowledge and you will not learn what you will need to know for the exams. Start as early as possible on them.

Exam Schedule (tentative dates):
- 1st midterm: Monday, October 08
- 2nd midterm: Friday, November 16
- Final exam: 08:45 – 10:45 AM Monday, December 17, (Comprehensive)

Exams:
All midterm tests and final exam are CLOSED BOOK exams. You are allowed to bring in one 8x11 formula sheet each test. Physical constants will be provided if needed. A non-programmable calculator is allowed to use in midterm and final exams. There is no make up exams (documented medical or legal excuses must be provided at least three days before a missed exam if allowances are to be made).

Course Grading:
Your grade in this class will be based on:
- Homework: 30%
- 2-50min midterm tests: 40%
- Final exam (comprehensive): 30%

Final Grades:
- A 85-100, B 75-84.9, C 60-74.9, D 60-74.9, F 0-49.9

Attendance:
If you are absent from class, it is your responsibility for the material presented in the lecture, reading assignments, the homework, and to check on announcements made while you were away.

Right to Changes:
The instructor reserves the right to change the course policy during the term due to unforeseen problems in the course pace, fairness, conflicts, etc.
Cheating and Plagiarism: “Cheating is the actual or attempted practice of fraudulent or deceptive acts for the purpose of improving one's grade or obtaining course credit; such acts also include assisting another student to do so. Typically, such acts occur in relation to examinations. However, it is the intent of this definition that the term 'cheating' not be limited to examination situations only, but that it include any and all actions by a student that are intended to gain an unearned academic advantage by fraudulent or deceptive means. Plagiarism is a specific form of cheating which consists of the misuse of the published and/or unpublished works of others by misrepresenting the material (i.e., their intellectual property) so used as one's own work.” Penalties for cheating and plagiarism range from a 0 or F on a particular assignment, through an F for the course, to expulsion from the university. For more information on the University's policy regarding cheating and plagiarism, refer to the Schedule of Courses (Legal Notices on Cheating and Plagiarism) or the University Catalog (Policies and Regulations).

Disruptive Classroom Behavior: “The classroom is a special environment in which students and faculty come together to promote learning and growth. It is essential to this learning environment that respect for the rights of others seeking to learn, respect for the professionalism of the instructor, and the general goals of academic freedom are maintained. ... Differences of viewpoint or concerns should be expressed in terms which are supportive of the learning process, creating an environment in which students and faculty may learn to reason with clarity and compassion, to share of themselves without losing their identities, and to develop and understanding of the community in which they live ... Student conduct which disrupts the learning process shall not be tolerated and may lead to disciplinary action and/or removal from class.”

Students with Disabilities: Upon identifying themselves to the instructor and the university, students with disabilities will receive reasonable accommodation for learning and evaluation. For more information, contact Services to Students with Disabilities in Madden Library 1049 (278-2811).

Course Content / Tentative Course Schedule:

Subject to Change: This syllabus and schedule are subject to change in the event of extenuating circumstances. If you are absent from class, it is your responsibility to check on announcements made while you were absent.

COURSE OUTLINE (weekly basis)

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<th>TOPIC</th>
<th>READINGS</th>
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<td>Chapter 1</td>
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<td>2. The 1st Law of Thermodynamics and Thermodynamic Processes</td>
<td>Chapter 1</td>
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<td>3. The 2nd Law of Thermodynamics</td>
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<td>4. Entropy and Efficiency</td>
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<td>5. Quantum Microstates, Statistical Mechanics, and Temperature</td>
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<td>6. The Canonical Probability Distribution and Partition Function</td>
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<td>7. The Planck Distribution: Photons and Phonons</td>
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<td>8. The Chemical Potential</td>
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<td>9. Quantum Statistics and the Quantum Ideal Gas</td>
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<td>10. Fermions and Bosons at Low Temperature</td>
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<td>12. Phase equilibrium</td>
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<td>13. The 3rd Law of Thermodynamics</td>
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