Physics 3400B – Introduction to Thermal Physics
2014 Course Syllabus

Instructor
Eugene Wong, PhD, FCCPM
Associate Professor
Physics and Astronomy Building, Office 233
University of Western Ontario
Phone: 519-661-2111 x86419
Email: ewong4@uwo.ca
Office hours: Mon 11:30-12:30 pm and by appointment.

Course Description
Introduction to Thermal Physics: This course will introduce you to Thermodynamics in both the classical formulation and in Statistical Mechanics. Concepts in thermodynamics will be illustrated with simple models (ideal gas, solids, magnetism, *etc*). In parallel, we will learn the formulation of Statistical Mechanics, derive and understand some of the thermodynamics relationships from first principles.

Requisites
Pre-requisites: Physics 2101, 2102 and 2900.
Anti-requisite: None.

<u>Note</u>: It is the **student's responsibility** to ensure that all pre-requisite, co-requisite and anti-requisite conditions are met or that special permission to waive these requirements has been granted by the Faculty.

Course Outline
1. Introduction: Thermodynamics and Statistical Mechanics; Temperature (T) and the Zeroth law of thermodynamics; units, systems, interactions, thermodynamic processes.
2. Equations of State (ideal and real gases); basic assumptions, microscopic view of gas pressure, internal energies (gas, liquid and solid phases), equipartition theorem.
3. Internal energy (U), heat transfer (Q), work done by system (W), number of particles (N) and the First Law of Thermodynamics.
4. Application of the First law: Heat capacities, adiabatic processes, free expansion, engine and refrigeration cycles.
5. Entropy (S) from thermodynamics, the Second Law of Thermodynamics
6. Statistical Mechanics: Micro-canonical ensembles: Macrostates, microstates, multiplicities and entropy (S); the Third Law of Thermodynamics
7. Entropy for an ideal gas and Einstein's solid from Statistical Mechanics
8. Entropy for reversible and irreversible processes
9. The ideal gas: Maxwell-Boltzmann's molecular speed distribution and heat capacities
10. Canonical Ensemble: Boltzmann's factor, partition function, and Helmholz Free energy
11. Heat capacities of diatomic molecules and Einstein's solid
12. Paramagnets; magnetization; phase transition to ferromagnets
13. Photon gas: Blackbody radiation
14. Chemical potentials (μ); grand canonical ensembles; gas-liquid phase transition

15. Bose-Einstein and Fermi-Dirac statistics (time permitting)
16. Transport theory of gas, diffusion (time permitting)

Course Delivery & Resources

- *Lectures*:   3 lecture hours per week, Mon, Wed, Fri, 10:30-11:20 AM, PAB 148.

- Course Management System (http://owl.uwo.ca). Syllabus, additional course materials and assignments will be posted under the course website on owl.

- *Required Textbook*: **An Introduction to Thermal Physics**, by Daniel Schroeder; available in the Bookstore at Western (www.bookstore.uwo.ca).

Evaluations

Assignments – Problem solving   30%   (5 distributed throughout term)
                        Collaborative project 10%   (See details below)
Midterm Examination   25%
Final Examination   35%

Examinations will be *closed* book; formula sheet will be provided. Calculators are required.

Collaborative Project:

The two primary purposes for this assignment are:

(1) to allow additional coverage of material of particular interest to you; and

(2) to help you better learn the concepts in this course.

Topic: Following the midterm, you will be asked to form small groups. Each group will select from a list of projects a research topic.

Report: Each group will prepare an online Wiki webpage prior to the oral presentations to allow entire class to access and study them. Details will follow.

Presentation: The oral presentations are scheduled near the end of the term (i.e. end of March or early April). The group presentations will be 12 min in length, with 3 min allowed for questions (i.e. 15 min in total length).

Evaluation: 6% of the course grade for the report and 4% for the presentation, yielding a total of 10%.

Important Dates

Lectures: Mon Jan 6 – Wed Apr 8, excl. Reading Week (Feb 17 – Feb 21)
Midterm: March 3rd 2014, time and location to be announced
Final: Date, time and location to be announced

Western University Policies

Please refer to Western's Handbook of Academic and Scholarship Policy http://www.uwo.ca/univsec/handbook/ for further details on the policies in practice here.

1. Absences & Illness:

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see: http://www.uwo.ca/univsec/handbook/appeals/medical.pdf.

A student requiring academic accommodation due to illness should consult http://www.westerncalendar.uwo.ca/2013/pg117.html. A Student Medical Certificate is required when visiting an off-campus medical facility or request a Records Release Form (located in the Dean's Office) for visits to Student Health Services. See Medical Documentation here: https://studentservices.uwo.ca/secure/.

Students who are feel they are in distress should refer to Mental Health at Western http://www.uwo.ca/uwocom/mentalhealth/ for a list of options about how to obtain help.

Western's policy on absence due to religious holidays can be found here: http://www.westerncalendar.uwo.ca/2013/pg119.html.

The only acceptable excuses for missing an examination are documented serious personal illness, immediate-family bereavement, or approved religious conflicts.

2. Scholastic Offenses:

Cheating: University policy states that cheating is a scholastic offence. Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.westerncalendar.uwo.ca/2013/pg113.html.

Plagiarism: Plagiarism is a form of cheating. Students must write their assignments and essays in their own words. Copying solutions from another student or any other sources is considered cheating. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence.

The commission of a scholastic offence is attended by academic penalty, which may include expulsion from the program. If you are caught cheating, there will be no second warning. Cheating includes having available any other electronic devices than a watch and a calculator during a test or exam. You may not use a cell phone even if it is for its calculator or time.

3. *Accessibility*:

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.