**SYLLABUS**

Thermal Physics – CRN4626, PHY308-201

Time: TR: 1:00 pm – 2:00 pm, Spring 2017

Location: S281

**Instructor**

Thomas E Wilson, Ph.D.

Office: S153

Lab: S154

Phone: 696-2752

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**Office Hours**

MWF 3:00-4:00 pm or by appointment.

**Text**

*Introduction to Thermal Physics*, 5th edition, Schroeder (Addison Wesley). Most of the assigned reading will be drawn from the text, with some ancillary material taken from other sources.

**Overview**

The level of the course will be aimed at students who have completed the introductory calculus-based physics sequence. One should be conversant with *partial* derivatives and common integrals. There is much to learn in a first course in thermal physics. Be forewarned - many of the assigned problems are challenging so plan to invest between three to five hours per week on them. I will not spend a great deal of time re-reading the textbook to you. Rather, I intend to help you learn by solving a fair number of textbook problems, and also will ask for student volunteers to also present their solutions (for bonus points).

**Attendance**

Attendance of all class meetings is expected, but allowance will be made for extenuating circumstances. Students are responsible for material presented in lecture, whether they are in attendance or not.

**Special Needs**

Students with special needs (as documented by the Office of Disability Services) should identify themselves at the beginning of the semester. Every effort will be made to accommodate the special needs of these students.

**Disruptive Behavior**

Students are expected to conduct themselves in a manner that creates a productive learning environment for all members of the class. To this end, disruptive behavior will not be tolerated. Disruptive behavior is any behavior that interferes with the normal conduct of lecture, including sleeping. In particular, electronic devices (computers, tablets, cell phones) should be turned off before entering the class.

**Academic Integrity**

It is expected that students will discuss homework with each other, but any solutions presented should be substantially one’s own work. For general university policy on academic integrity as well as other issues, see: <http://muwww-new.marshall.edu/academic-affairs/policies/>. Anyone caught cheating on exams will receive a score of 0%, and if egregious enough, an F for the course grade.

**Grade Determination**:

An unexcused (lack of a notification to me from the Dean of Student’s Office) absence for an exam will result in a score of 0%. Arrangements can be made for a make-up exam for an excused absence. Volunteers will be requested to solve assigned problems at the board: 10% bonus points

Exams I, II, III, and Final: 25% each

Overall Course Average: A = 90% or above, B=80% or above, C=70% or above, D=60% or above, F=less than 60%

**Problem Solving at the Black Board**

Most assigned problems will taken from those found in the text. I may ask for volunteers on Thursdays typically, to present assigned problem solutions at the blackboard. Points will be given for accuracy, clarity, and adequate verbal description and defense of one’s solutions.

**Exam Schedule**

Exam I: Tuesday, February 7

Exam II: Tuesday, March 7

Exam III: Tuesday, April 4

Comprehensive Final Exam: Tuesday, May 2 (12:45 pm – 2:45 pm)

**Topics Covered from Chapters 1-6**

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| Part I: Fundamentals* Chapter 1: Energy in Thermal Physics. An overview of temperature, ideal gases, equipartition, the first law, heat capacities, and transport processes.
* Chapter 2: The Second Law. Fundamental statistical ideas applied to two-state systems and the Einstein solid model; analysis of two interacting Einstein solids, leading to the second law; multiplicity of an ideal gas; statistical definition of entropy.
* Chapter 3: Interactions and Implications. Temperature, pressure, and chemical potential as partial derivatives of the entropy; the relation between entropy and heat; prediction of heat capacities and other thermal properties of a paramagnet, Einstein solid, and ideal gas (all microcanonical).

Part II: Thermodynamics* Chapter 4: Engines and Refrigerators. Derivation of limits on efficiency from the laws of thermodynamics; Carnot cycle; realistic cycles for internal combustion engines, steam engines, and refrigeration; methods of reaching very low temperatures.
* Chapter 5: Free Energy and Chemical Thermodynamics. Definitions and interpretations of Helmholtz and Gibbs free energies; applications to electrochemistry, phase transformations, mixtures, dilute solutions, and chemical equilibrium.

Part III: Statistical Mechanics* Chapter 6: Boltzmann Statistics. Boltzmann factors and partition functions, including applications to atomic and molecular excitations, paramagnetism, equipartition theorem, Maxwell distribution, ideal gases.
* Chapter 7: Quantum Statistics. Gibbs factors; Fermi-Dirac and Bose-Einstein distributions; degenerate electron gases; blackbody radiation; Debye theory; Bose-Einstein condensation.
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