UNIVERSITY OF MARYLAND, College Park

Physics 404 Introduction to Thermodynamics and Statistical Mechanics Fall 2008

Description: Physics 404 *(formerly PHYS 414)* is an introductory course on thermodynamics, statistical mechanics and kinetic theory. It is designed for physics majors but also suitable for advanced undergraduate students in astronomy, biology, chemistry, engineering and space sciences. 3 Credits

Prerequisites: Physics 273, Math 241. It is desirable to have some introductory quantum mechanics preparation such as is gained by taking Physics 401 concurrently, but not mandatory.

Lectures: Tu Th 12:30-1:45 pm in Physics Building – Room 1402.

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Textbooks Required: C. Kittel and H. Kroemer (KK) , *Thermal Physics*, 2nd Edition (Freeman, San Francisco, 1980) QC311.5.K52

Supplemantary:
1. D. V. Schroeder, *Thermal Physics* (Addison Wesley Longman, 2000) QC311.15.S32 -- similar level as KK. If you find this easier reading, use it as a supplement to KK.
2. F. Reif, *Fundamentals of Statistical and Thermal Physics* (McGraw-Hill, 1965) QC175.R43 1965 ISBN 0 705 1800 9 -- old but still useful, detailed explanations
3. M. D. Sturge, Statistical and Thermal Physics, (A K Peters, 2003) QC174.8.S87 2003 -- has too many typos, but structure similar to our lectures
4. Ralph Baierlein, *Thermal Physics*, (Cambridge University Press, 2000) QC311.B293 1999 ISBN 0 521 65838 1 (paperback) – good emphasis on concepts

At a more advanced level there are good books by Pathria, McQuarrie, Chandler, Reichl, Feyman. You might find Pathria useful for some of my lectures on topics I intend to present with more depth,

Reading: The approximate progression of topics can be found in the Course Content. To enhance your comprehension of a particular subject to be covered, you *should try to read the material in the text before coming to the lecture*. This will enable you to ask questions about ideas you may not be able to grasp fully on the first reading and to gain a better overall perspective. Read it again after the lecture, study the examples and do the assignment problems. I encourage questions in class (to the extent time permitting) – this could stimulate thoughts and discussions.

Homework: 9 sets of homework problems are planned, the total counting 20% towards your course grade. They are to be worked out and handed in at the beginning of classes on the due dates. No late homework will be accepted. I encourage group discussions but stress strongly the importance of thinking through and working out the problems on your own. *Don't rely on others' help or just passively read the solutions.* It makes a real difference in your grasp of the subject matter and it shows in your examination performance.

Mid-Term Exams: Two 75-minute closed book mid-term exams are scheduled on **October 21 (Tu) and Nov. 25th (Tu) during the lecture periods**. Each exam covers the material assigned since the previous one, and is likely to contain one or more problems based on the assigned homework problems. Each exam counts 25% towards your course grade. If you cannot take an exam (only for certified medical and duty-related reasons, as stipulated in the University Rules), please notify me well in advance or at the earliest possible time. It is unlikely that I would prepare a different exam just for you to take on a different date.

The Final Exam, comprehensive, is worth 30% of the course grade. It is on **Tuesday, December 19, 2008, 1:30-3:30 pm**, in a room to be announced. You must take the final exam to receive a course grade.

Course Grade: Your course grade is made up with the composition of 20% homework, 50% mid-term exams, and 30% from your final exam scores.

PHYSICS 404 CONTENTS and SCHEDULE Fall 2008 Prof. B. L. Hu

Lectures Week of	Readings in Kittel-Kroemer	Outline of Topics (projected dates)	Problem Set # (**approx.** Due date and chapters)

1 9/2, 4 Chaps **1, 2** From micro to macro physics. States and Multiplicity, Configurations and Probability of Occurrence. Entropy and Temperature.

2 9/9, 11 **8** Thermodynamics (Schroeder Chap 1-2) **#1**, 9/11 Chapter 1, 2

3 9/16,18 **8,** Heat and Work (Schroeder Chap 3-4) **#2** 9/30 Chapter 8

4 9/23,25 **3** Boltzmann Distribution, Canonical Ensemble

5 9/30, 10/2 **3** Helmholtz Free Energy (Schroeder Chap 6) **#3** 10/9 Chapter 3

6 10/7,9 **4** Thermal Radiation, Planck Distribution Phonons **#4** 10/23 Chapter 4

7 10/14,16 **4, 5** Chemical Potential, Gibbs Distribution (Schroeder Chap. 5)

8 **FIRST EXAM** on TUESDAY, **OCT. 21**, 2008 *Chapters. 1, 2, 3, 8*

10/23 **5** Grand Canonical Ensemble, Gibbs Free Energy **#5** 11/4 Chapter 5

9 10/28,30 **6** Quantum Statistics (Schroeder Chap 7) #**6** 11/11 Chapter 6

10 11/4,6 **7** Quantum Ideal Gas: Bose-Einstein, Fermi-Dirac Distributions

11 11/11,13 **9** Low Temperature Quantum Gas **#7** 11/20 Chapter 7

12 11/18,20 **10** Chemical Reactions, Phase Transitions

13 **SECOND EXAM** on TUESDAY, **NOV. 25**, 2008 *Chapters 4, 5, 6, 7*

11/27 THANKSGIVING HOLIDAY (*Travel safely. Enjoy time with your family!*)

14 12/2, 4 **14** Kinetic Theory **#8** 12/2 Chapter 9 + 10

15 12/9, 11 **14** Kinetic Theory **REVIEW** **#9** 12/16 to TA, Chapter 14

FINAL EXAM on FRIDAY, **DECEMBER 19**, 2008, 1:30-3:30 PM. C*omprehensive*

HOMEWORK: **Check webpage** for updated Assignments and actual Due date, and up to the minute **ANNOUNCEMENTS** (e.g., schedule changes, review sessions)