

# Textbooks for PHYS 813

## Primary Text for Thermodynamics

- Herbert B. Callen *Thermodynamics and an Introduction to Thermostatistics*, Wiley 1966. Second edition 1985. Axiomatic approach to thermodynamics. Most people agree that this is the best book of this type. The thermodynamics part of this course follows closely this book.

## Primary Texts for Statistical Mechanics

- Walter Greiner, Ludwig Neise, and Horst Stöcker *Thermodynamics and Statistical Mechanics*, Springer 1995. The best book on basics of statistical mechanics, in particular the quantum aspects, that I know. The course will closely follow this book in the quantum statistical mechanics part. Unfortunately, the initial section on thermodynamics is somewhat imprecise and confusing.
- R.K. Pathria *Statistical Mechanics*, Butterworth-Heinemann, 2nd edition, 1996. The book corresponds most closely to the classical statistical mechanics part of this course and also fairly closely to the quantum part. Very precisely written, although perhaps too concise in explanations and therefore sometimes hard to follow. Very few errors. The book is much more extensive than what can be covered in a one-semester graduate course (most of chapters 9-14 is beyond the scope of this course).

## Computer Simulations Textbooks

- D. Frenkel and B. Smit *Understanding Molecular Simulations*, Academic Press 1996, 2002.
- M.P. Allen and D.J. Tildesley *Computer simulations of Liquids*, Oxford 1987.
- M.H. Kalos and P.A. Whitlock *Monte Carlo Methods*, Wiley 1986.

## Examples of Thermodynamics Textbooks

- Enrico Fermi *Thermodynamics*, originally published in 1937, Dover 1956. A classic jewel.
- Several of the textbooks listed under other headers have sections on classical thermodynamics (without invoking statistical arguments).

## Auxiliary Statistical Mechanics Textbooks, recommended reading

- Charles Kittel and Herbert Kroemer *Thermal Physics*, Freeman 1980. This book is below the level of this course, although most of the physical phenomena discussed by us are covered. This is done in the simplest possible way, with as little math as possible. Although the book utilizes some statistical mechanics approach from the very beginning, it is mostly a thermodynamics book. Many arguments are nonrigorous, however, the book may be very useful to get an introduction to more difficult subjects.
- Dirk ter Haar *Elements of Thermostatistics*, 2nd edition, Holt, Rinehart, and Winston 1966. The first edition of 1954 had the title *Elements of Statistical Mechanics*. The third edition was published in 1994 by Butterworth-Heinemann with the title going back to the first edition. I have not seen this edition. A book at the Pathria level, in fact Pathria was probably influenced by this book. A good book to compare with when reading Pathria. Does not, however, contain the material from the last several chapters of Pathria (which are not covered in PHYS 813 anyway).
- Kerson Huang *Statistical Mechanics*, Wiley 1987 (second edition). One of the most popular graduate texts. However, the book is uneven. Some fragments are among best explanations, but other are not so good. Also correlations between different chapters are sometimes hard to follow. The general level of this text is similar to our course.
- Ryogo Kubo *Statistical Mechanics*, North Holland 1965. The latest printing is from Elsevier in 2004. The book authorship includes “collaborators”: Hiroshi Ichimura, Tsunemaru Usui, and Natsuki Hashitsume. This is a completely different book from the *Statistical Physics* books listed below. This book has an unusual proportion of a regular text to examples and problems, all with solutions. In fact, it is more like a collection of problems than a regular text. Excellent learning help (and some of these problems may appear on exams).

- Donald A. McQuarrie *Statistical Mechanics*, Harper and Row, 1976 (new edition 2000?). Fairly advanced but rather different approach from that followed in class. Some people may prefer this way of reasoning. One of the best texts on issues related to liquids and solutions.
- F. Reif *Fundamentals of Statistical and Thermal Physics*, McGraw-Hill 1965. The text is somewhat less advanced than this course, but covers most of the subjects plus some. This book has some of the most accessible explanations of all texts. On the other hand, it is too “wordy” at many places and one may get lost in some detailed explanations. It is difficult to get from this book a consistent general picture of the subject in particular since thermodynamical arguments are intertwined with statistical ones.
- Silvio R.A. Salinas *Introduction to Statistical Physics*, Springer 2001. A very well written text at the level little below this course.

### Other Statistical Mechanics Textbooks

- A. Isihara *Statistical Physics*, Academic 1971. A fairly advanced approach. Appears to be more rigorous than most other texts. However, only a subset of 813 subjects is covered. Several subjects beyond the scope of 813 are covered extensively.
- R. Jancel *Foundations of Classical and Quantum Statistical Mechanics*, Pergamon, 1969. It is indeed a text devoted to the “foundations” of statistical mechanics. The titles of its two parts say it all: I. Ergodic Theory and II. *H*-theorems.
- M. Toda, R. Kubo, and N. Saitô *Statistical Physics I. Equilibrium Statistical Mechanics*, 2nd edition, Springer 1991. This book goes very quickly through the basic statistical mechanics and then continues with two advanced chapters on phase transitions and on the ergodic problem.
- R. Kubo, M. Toda, and N. Hashitsume *Statistical Physics II. Nonequilibrium Statistical Mechanics*, 2nd edition, Springer 1991. Beyond the scope of PHYS 813, but covers a lot of interesting subjects such as the Brownian motion, relaxation and linear response, and quantum-field methods.
- David Chandler *Introduction to Modern Statistical Mechanics*, Oxford University Press, 1987. It would be hard to understand the basic concepts of statistical mechanics from this book for someone who does not know this subject already. On the other hand, some people who like “quick arguments” may find this book useful, in particular since it involves a minimal amount of math. For people who know statistical mechanics, the book contains concise discussions of some subjects hard to find in other texts.
- L.D. Landau and E.M. Lifshitz *Statistical Physics*, Pergamon 1958. A real “classic” text. It is clear that the authors understood the subjects very well, but this does not necessarily transpire to the reader.
- Tomoyasu Tanaka *Methods of Statistical Physics*, Cambridge 2002. Much more advanced than the present course but the first 100 pages shows a modern and elegant way of developing statistical mechanics. Insightful discussion of ensemble theory.
- Michael Plischke and Birger Bergersen *Equilibrium Statistical Physics*, World Scientific 1994 (second edition). The part of this book introducing the material covered in this course cannot be recommended for people learning the subject. However, this book starts where we end and seems to be an excellent guide to advanced subjects.
- L.E. Reichl *A Modern Course in Statistical Physics*, second edition, Wiley 1998.