PHYS 4031 Statistical Mechanics (2016-17 Term 1)
Teacher: HUI Pak Ming

Book List

Lecture Notes

There will be hand-written lecture notes. Students **SHOULD DOWNLOAD** class notes from course page BEFORE coming to lectures. It will be very useful if students could *READ* the notes ***before*** the lectures ***AND BRING A COPY OF THE NOTES to classes*.**

There are many books on statistical mechanics or statistical physics or statistical thermodynamics. The contents are quite standard. However, I could not find one that is reasonably priced and fits to our course perfectly. Therefore, I will NOT select a textbook. Instead, I suggest a list of reference books. These books are available at the **reserved books section in the University Library**. There are many "new" statistical physics textbooks published in recent years, as the importance of the subject has been increasingly recognized at the undergraduate level. Some of these books are also available in E-book form (free access via Library), as marked below.

Reference Books:
([R] = available at the reserved books sections in University Library for 2-day loan)

[R] F. Mandl, *Statistical Physics*, 2nd ed. John Wiley & Sons. [QC174.8.M27 1988] (A standard textbook for final year students in the British university system under the Manchester series.)

[R] Tony Guenault, *Statistical physics*, 2nd ed. Chapman & Hall. [QC174.8 .G84 1995] (An short book that uses probably the simplest approach in getting the key results in equilibrium statistical physics. Good for students learning the subject for the first time and for those who want to get at the key results without bothering too much about formalism. The level is "easy". There is a newer edition.)

[R] D.H. Trevana, *Statistical Mechanics: An introduction*, Ellis Horwood [QC174.8.T63 1993] (Same approach as in Guenault and similar in coverage. Another easy and practical book.)

[R] Harald J. W. Muller-Kirsten, *Basics of Statistical Physics – A Bachelor Degree Introduction*, World Scientific 2010. The chosen topics are exactly those in our course. A strong point of the book is that there are many worked examples. The author also wrote other textbooks on other subjects in physics in the same style.

[R] L. G. Benguigui, *Statistical Mechanics for Beginners*, World Scientific 2010. [QC174.8 B46 2010] It is a well written recent textbook for first-time learners. We will cover all the topics in this book. For some topics, our treatment will be deeper. The strong points are: the book is short (147 pages) and the simplest/direct approach is chosen.

[R] W.G.V. Rosser, *An introduction to statistical physics*, Ellis Horwood. [QC174.8.R67] (Very detailed discussions on how to develop the theory from the basics. The starting point is similar to the book by Guenault, but the book takes the readers farther. Excellent discussion on the connections between statistical mechanics and thermodynamics, although wordy in places.)

[R] R. Bowley and M. Sanchez, *Introductory Statistical Mechanics*, Oxford University Press. [QC311.5. B684 1999] (2 copies reserved in library) (The level of presentation fits to a standard undergraduate course. The coverage is slightly more than that in our course. But the book has lost its market share to the more recent books, e.g. Blundell and Blundell (see below).)

[R] C. Kittel and H. Kroemer, *Thermal physics*, 2nd ed. WH Freeman. [QC311.5 .K52 1980] (A standard undergraduate textbook in US universities. It mingles thermodynamics and statistical mechanics – so statistical thermodynamics.)

[R] F. Reif, *Fundamental of Statistical and Thermal Physics*, McGrawHill. [QC175.R43] (Similar to Kittel and Kroemer.) The approach is similar to that in Kittel and Kroemer. A simpler version of the book is F. Reif, *Statistical Physics*, Berkeley Physics Course, Vol.5, McGrawHill. [QC21.4445 v.5].

[R] K. Huang, *Introduction to Statistical Physics*, Taylor & Francis. [QC174.8.H82 2001] (This is an interesting book. Only 270 pages in length, the author gave a concise and precise introduction to the key ideas in statistical mechanics. But readers need to digest every sentence carefully. The discussions are quite deep in places. The lack of worked examples is a weak point of the book. The author wrote a classic textbook "Statistical Mechanics" [QC175.8.H8 1987] back in 1963, which gives a rigorous treatment on the subject at the graduate level.)

[R] D.J. Amit, *Statistical physics: An introductory course*, World Scientific. [QC174.8.A45 1999] (An excellent book for self-learning written by an excellent author well known for his clarity. The coverage is similar to our course. The author also wrote "Field Theory, the renormalization group, and critical phenomena" [QC173.4.C74A44 1984], from which many researchers learned how to investigate

critical phenomena using field theoretical approaches.)

[R] D. Chandler, *Introduction to Modern Statistical Mechanics*, Oxford University Press. [QC174,8 C47] (This is a popular book in US universities at the beginning graduate level. The first 4 chapters (out of 8) fit into our course, but they are too brief (as they are treated as a review in the book). There are two chapters that give an excellent introduction to the theory of phase transitions and the applications of Monte Carlo simulations.)

[R] M. Gitterman and V. Halpern, *Phase transitions: A brief account with modern applications*, World Scientific (2004). [QC175.16.P5 G57 2004] (A good introduction that takes the readers into the area of phase transitions and critical phenomena.)

Statistical mechanics is the microscopic theory of thermodynamics. Therefore, we will use some background knowledge of THERMAL PHYSICS.
Two classics standard texts for reviewing (learning) are:
[R] C.J. Adkins: *Equilibrium Thermodynamics* [QC311.A3 1983]
A.B. Pippard: *The Elements of Classical Thermodynamics*

Mathematical Methods (for quick review on topics such as how to count, probability, distributions, partial derivatives, Lagrange multipliers, Gaussian integrals, gamma functions):
[R] K.F. Riley, M.P. Hobson, S.J. Bence, "Mathematical Methods for Physics and Engineering" (2nd edition) (Cambridge Univ. Press 2002). [QA300.R495 2002] (Low-price edition available in Mainland)

[R] E. Steiner, "The Chemistry Maths Book" (Oxford Science Publications 1996). [QA37.2 .S7985 1996] (A cute and practical book that covers a topic nicely in a few pages)

Electronic Books available at University Library
There are some books on Statistical Physics that cover nearly the same topics as in our course and **you can access e-version through the University Library on-line materials free!** They are typically newer books and they are good! They include:

D. Yoshioka, *Statistical Physics: An Introduction* (Springer 2007) [An excellent book written in a concise and precise way, with insights. 90% of the book is related to the topics in our course.]

C. Hermann, *Statistical Physics* (Springer 2005) [This book is at the same level of our course, with nice discussions on applications.]

S.J. Blundell and K.M. Blundell, *Concepts in Thermal Physics* (Oxford Univ. Press 2006) [QC 254.2.B58 2006] [A thorough undergraduate coverage on thermodynamics and statistical physics with interesting applications, all in one book. Materials are delivered in short chapters each focusing on only a few major results. An excellent single book that covers all you need to know about thermodynamics and statistical mechanics at the undergraduate level and slightly beyond.]

Low-price editions of the following books are available in book stores across the border or by online shopping

There are some good Statistical Physics books that are available in low-priced editions in bookstores in ShenZhen and Guangzhou (sometimes in MongKok). The next time you go across the border, you may want to get a copy. They include:

R.K. Pathria, *Statistical Mechanics* (2^{nd} edition) (Oxford Univ. Press 1996). [This is a standard graduate level statistical mechanics book, and it is a good book for undergraduates who will be going to graduate schools. The first 8 chapters (about first 40% of the book) reflect the topics and the depth covered in our course.]

Greiner, Neise, and Stocker, *Thermodynamics and Statistical Mechanics* (Springer). [As in the other books in the series by Greiner, the discussions are thorough and there are many worked examples. The book covers both thermodynamics and statistical mechanics at typical undergraduate level.]

汪志诚 热力学. 统计物理 （第三版）高等教育出版社 (2002) [A standard and popular textbook in China on the subject. The syllabus of thermodynamics and statistical physics is fixed nationally in Mainland. Thus, every book covers almost the same topics. Chapters 1-5 are on thermodynamics (good for self-revision if you think you need that) and Chapters 6-11 are on statistical physics. Chapters 6-10 will be covered in our course (at some points the treatment in our course will be more general and deeper).]

M. Kardar, *Statistical Physics of Particles* (Cambridge Univ. Press 2007) [Part I of a series of 2 books. The coverage is similar to that in our course, but we will use plane language. It reflects an undergraduate course at MIT on the subject. Part II is entitled “Statistical Physics of Fields”, which corresponds a graduate-level course.]

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