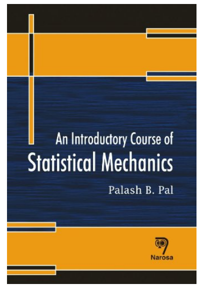

A different perspective

An Introductory Course of Statistical Mechanics
Palash B. Pal, 394 Pages, Narosa Publishing (Rs.334)

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The reviewer works on the physics of stellar compact objects (white dwarfs, neutron stars) for her livelihood and writes a blog about life in academia as a hobby.

An Introductory Course of Statistical Mechanics (Pal 2008) is a pedagogic textbook primarily meant for graduate and advanced undergraduate physics students. Palash Baran Pal, a theoretical physicist, working at Saha Institute of Nuclear Physics (Kolkata) is a prolific author. Besides authoring a number of research monographs and advanced physics textbooks, he has also written several popular science books. However, Prof. Pal is known best for his ability to explain complex concepts in simple terms, and writing these down in easily understandable format. He is an exceptional teacher in a classroom setting. He is also an exceptional teacher through written words - for students who can have the privilege of learning across vast distances whether such distances are measured in kilometers or in years. Happily, this particular book under consideration bears this hallmark characteristic of Prof. Pal.

In an earlier generation, the best physics teachers typically had the reputation of being hard taskmasters. Consequently, most students had to cut their teeth on two heavy volumes of Statistical Physics by Landau & Lifshitz (Landau & Lifshitz 1980a; Landau & Lifshitz 1980b). Though the uphill task of working through Landau would usually be made a little easier by the companionship of Pathria (1996), the beloved old faithful for generations of physics students. Of course, advanced students, leaning towards Condensed Matter Physics, used to move on to Huang (1986) and Ma (1985) in their later years.

Despite the existence of this rich collection of classic textbooks on Statistical Mechanics, the perspective has usually been quite unidirectional. Most of the concepts and techniques and examples have been geared towards the discipline of Condensed Matter Physics, one notable exception being the discussion of white dwarfs in Pathria. Systems composed of relativistic particles have also been mostly ignored. Naturally, for students aspiring to join other branches of Physics (particularly Astrophysics and Particle Physics) something more to orient them towards other applications of Statistical Mechanics has been long overdue. Prof. Pal's book fits right into this niche, left unaddressed by treatise written primarily by Condensed Matter experts.

Prof. Pal himself discusses this issue in the introduction, saying - "I am not a specialist in Statistical Mechanics in the conventional sense of the term. My research work is in the field of Elementary Particle Physics with interests bordering on Astrophysics and Cosmology. Statistical Mechanics is a theoretical framework for attacking many particle problems. Statistical Mechanics is not only useful but is indispensable for practitioners in all branches of Physics. Thus, whether or not I will be adjudged an expert on Statistical Mechanics, I certainly fall in the category of people who are regular users of the methods of this branch of physics." Naturally, his book pays serious attention to relativistic systems, and provides many examples from disciplines like Astrophysics, Cosmology, Nuclear Physics etc.

I myself have had the peculiar experience of teaching Statistical Mechanics in places with diametrically opposite composition - first in a department full of Condensed Matter experts and then in an ‘Astrophysics-only’ institute. In both instances (for completely different reasons) there has been a need to incorporate examples from Astrophysics in the course material. It has been a pleasant surprise to find that Prof. Pal has devoted an entire chapter on stellar physics (regular stars as well as white dwarfs and neutron stars) and has done so after systematically building up the appropriate formalism. Moreover, this has not been done at the cost of non-relativistic systems or standard Condensed Matter applications either.

All this, however, is not to say that the merit of the book lies only in its unconventional perspective of Statistical Mechanics. Even otherwise, it is an excellent textbook because of its entirely methodical and systematic approach to the subject. A basic knowledge of Hamiltonian dynamics and quantum mechanics has been assumed and other advanced topics have been introduced by building on this foundation. However, what I liked best is the axiomatic treatment of thermodynamics. In my opinion, this is far more straightforward and mathematically structured than the traditional approach of using the somewhat difficult concept of ‘thermodynamic engines’ to build the theory up.

My only and entirely personal (coming from my own involvement with neutron stars) complain is a total absence of any mention of superfluidity. Of course, the scope of a textbook on Statistical Mechanics (or any subject for that matter) is finite. A discourse on superfluidity may not fit in with the general flow of the book and may even be too complex for the level at which the book is aimed. Yet, that is one area where people, not formally trained in Condensed Matter Physics, encounter maximum difficulty. Even a simple minded discussion of the relevant concepts, the overall behaviour of a superfluid/superconducting system would go very far for a student choosing a different (from Condensed Matter) area of physics as a career, whether or not s/he actually works on systems that exhibit superfluid behaviour.

References

Huang K., 1986, Statistical Mechanics. Wiley Eastern Ltd., Bombay

Landau L. D., Lifshitz E. M., 1980a, Statistical Physics I, A Course of Theoretical Physics V5. Pergamon Press, New York

Landau L. D., Lifshitz E. M., 1980b, Statistical Physics II, A Course of Theoretical Physics V9. Pergamon Press, New York

Ma S.-K., 1985, Statistical Mechanics. World Scientific, Singapore

Pal P. B., 2008, An Introductory Course of Statistical Mechanics. Alpha Science International Limited, Oxford

Pathria R. K., 1996, Statistical Mechanics. Butterworth-Heinemann, Oxford