Statistical Mechanics: Fundamentals and Modern Applications

Richard E. Wilde and Surjit Singh. Wiley: New York, 1997. 400 pp. ISBN 0471161659. $89.95.

There are many good statistical mechanics texts available, including books by Goodisman and Pathria, and older books by Huang and of course McQuarrie. While these are excellent introductory treatments for chemistry graduate students, there are fewer texts that cover more advanced applications that should be taught, at least in a second-semester course. There is Chandler's well-written book, which covers applications, but it is more than ten years old now and could stand some additional material. Richard Wilde and Surjit Singh's new book steps into this void with an excellent text. It attempts to cover a wide range of modern topics and applications, and does a fine job.

The book is split into three sections: Essentials, Equilibrium Statistical Mechanics, and Non-Equilibrium Statistical Mechanics. The first section, on foundations, is shorter than most treatments, but it covers all the important introductory material on statistical mechanics and offers a lucid and complete discussion. Included is a chapter on quantum statistical mechanics, which I found to be nicely done. It serves mostly as a review of material that a B.S. chemist should have learned. The authors credit Pathria as an influence, and it shows. This is a good thing if you like Pathria's book. Otherwise, the treatment is on the level of Chandler's text. In fact, it seemed odd to me that Chandler was not mentioned in the bibliography, as it is aimed at the same audience.

Section II includes chapters on phase transitions and critical phenomena (including mean field theories), the liquid state, molecular dynamics and Monte Carlo methods, as well as a discussion of polymers, proteins, and spin glass models. I was especially pleased to find these last subjects, as they have not been covered in a book of this level before, and they are areas of intense interest in chemical physics. A section on scaling and universality is also a welcome addition to a text on this level. These chapters are covered well, at a level of detail that promotes understanding without getting bogged down in low-level calculations. Many references are used, so if more detail is desired, it can be readily found from the sources.

Section III is material that is usually not included at this level, and it is very nice to see. Brownian motion, Zwanzig formalism, cellular automata, and activated barrier-crossing problems are presented, among others. Again, a excellent overview of the subjects is presented, and I found reading these sections pleasurable. The level is intermediate and provides a good starting point if more detail is desired. I have not seen a book bring such a wide range of important topics together before.

Overall, the presentation is attractive and clear. A number of problems reside at the end of each chapter, ranging from derivations to some which could be considered small projects. An appendix contains many Fortran computer programs that illustrate the methods discussed in the text, and these are used in many of the problems. The programs are designed to be simple and transferrable. I found them easy to compile and run on my HP UNIX machine, as well as on the PCs available to me.

I would recommend this book most highly to anyone who teaches graduate-level statistical mechanics. There are other choices out there, notably Goodisman's book, but they do not offer the selection of topics that this book does. I am looking forward to using this book for the classes I teach, especially for the advanced applications it offers.

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