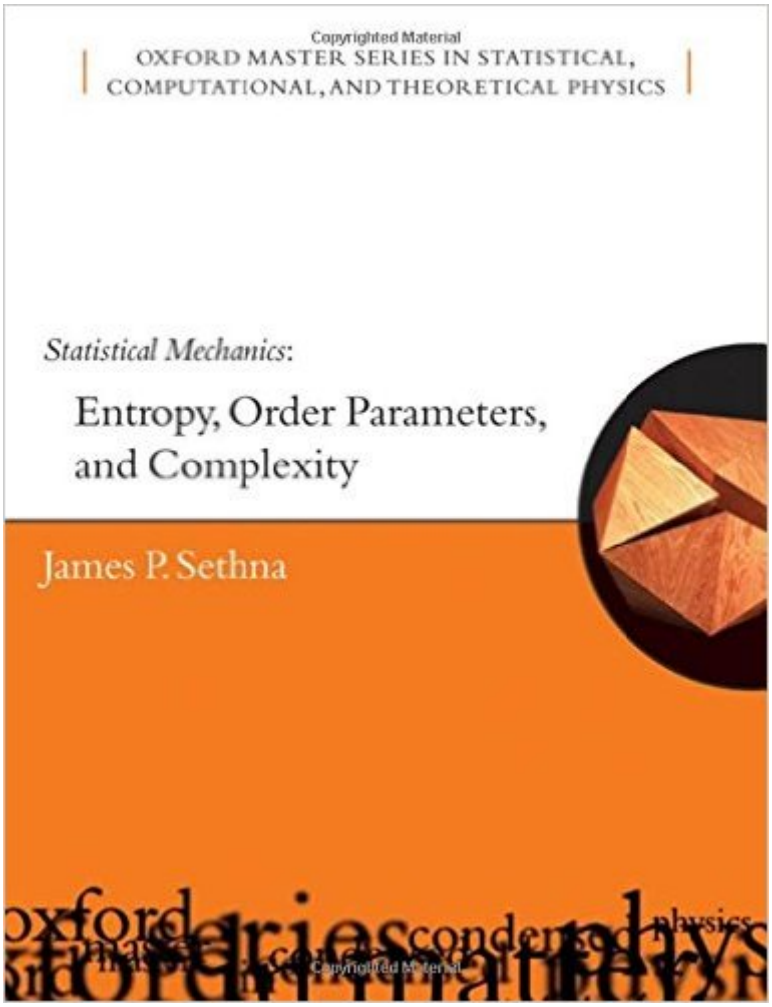
Statistical Mechanics: Entropy, Order Parameters And Complexity (Oxford Master Series In Physics)



Synopsis

In each generation, scientists must redefine their fields: abstracting, simplifying and distilling the previous standard topics to make room for new advances and methods. Sethna's book takes this step for statistical mechanics--a field rooted in physics and chemistry whose ideas and methods are now central to information theory, complexity, and modern biology. Aimed at advanced undergraduates and early graduate students in all of these fields, Sethna limits his main presentation to the topics that future mathematicians and biologists, as well as physicists and chemists, will find fascinating and central to their work. The amazing breadth of the field is reflected in the author's large supply of carefully crafted exercises, each an introduction to a whole field of study: everything from chaos through information theory to life at the end of the universe.

Book Information

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Customer Reviews

I haven't yet had a chance to read this book from cover to cover. However, after several hours with it, some of its strengths and weaknesses became evident. Many of these complement each other.It covers an exciting range of contemporary applications -- take a look at the table of contents. The problems are long, discursive, and even more intriguing than the main text, covering topics like the cosmic microwave background, origami microstructures, Langevin equations, snowflakes, biochemical reaction rates and NP-completeness. The book is rich in illustrations, and in footnotes that give an informal commentary on the main text.One downside is that, being so wide, the

coverage is also a bit thin in places. Many of the most interesting contemporary topics, such as the statistical mechanics of networks, are covered *only* in exercises. Thermodynamics is dismissed in less than 10 pages in the middle of the book, owing to that subject's being "cluttered" with a "zoo of partial derivatives, transformations and relations."The exercises look to be more fun and tempting than usual in books on this subject. So it's a definite bummer that the book neither includes answers or hints, nor states problems in closed form ("Show that this stuff = X"). The book's web site contains only some hints for computational exercises, plus a bunch of additional problems (again, without answers). If you're interested in self-study, this tease is frustrating - an automatic one-star deduction.There's more good news/bad news with the author's aim to be relevant to fields outside traditional physics -- e.g. in econophysics and social science. This certainly makes the book up-to-date and attractive, and was one of the reasons I bought it.

The book Statistical Mechanics: Entropy, Order Parameters and Complexity by James Sethna is excellent. I have used it as the main textbook in my course on Statistical Physics for first year graduate students at the Universidade Estadual de Campinas (UNICAMP) in Brazil. The students and I liked it very much.I think that the main quality of the book is that it presents Statistical Physics as a very dynamical subject, interconnected with several subjects within physics, as well as outside it.Since the book is aimed for a one semester course on the subject, the author had to make important choices. I really liked his choices. For instance, the book does not discuss approximate methods used to treat systems with interacting particles, instead the author has chosen to have a chapter on Calculation and Computation. Although these methods have played an important role in the past, nowadays the study of the relevant problems in the field require computer simulations. The chapter on Computer Simulation is excellent. Instead of only discussing how to perform a Monte Carlo simulation, it proofs mathematically in detail (except for the Perron-Frobenius theorem) why one ends up with an equilibrium probability distribution after a number of Monte Carlo steps. Another important subject covered in the book is that of Abrupt Phase Transitions. For most Statistical Physics books, only Second Order or Continuous Transitions exist. The exercises are also another very important and interesting choice made by the author. They are very different from the usual exercises one can find in a regular textbook on Statistical Physics. The exercises are in general very intelligent and they appear in a broad range of difficulty, from those which can be solved by inspection to those that are small projects.

This is not a very good textbook to learn statistical mechanics.My major complaints are as follows:-

The problems at the end of the book are only generally connected to the content of that chapter. In my opinion there is too much that the author assumes the reader already knows. The information needed to complete some problems is often found in the chapters succeeding the questions. Not only that, but many of the questions are not clear, despite the paragraphs of explanation preceding them; they're just poorly worded. Often key points of the chapter are left as exercises for the students. This is particularly difficulty because of the next complaint.- Far too often the author defines important words and concepts through examples. It is not helpful for the students to say, "This system can be considered _____," and use that as the definition of the word. If you cannot write a clear definition of a word without using it in context or in an example, it is going to be confusing for the student.- Far too many footnotes that really don't enhance the text. They're distracting, and with so much background noise it is difficult to filter out what is important. It really breaks up the flow and diminishes the student's understanding of the main points of the paragraphs.- Inconsistent assumptions of the reader. The author generally assumes the reader to have a very deft mathematics knowledge, and at other times assumes the student has never taken a mechanics class.- There's often phrases in the text that are incorrect, and the author even mentions so in the footnotes. There's so much fluff and not enough content that it doesn't even feel like I'm reading a physics book, it reminds me more of an economics text in terms of its presentation.

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