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Book Review

Nonequilibrium Statistical Mechanics. Gene F. Mazenko, Wiley-VCH, Weinheim, Germany, 2006.

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This book is the third volume of a series of graduate texts written by the author. The first two volumes, *Equilibrium Statistical Mechanics* and *Fluctuations, Order and Defects*, have appeared. The fourth volume will contain more advanced treatments of nonlinear models.

The book is divided into three main sections. Chapters 1–4 are entitled: Systems Out of Equilibrium; Time-Dependent Phenomena in Condensed-Matter Systems; General Properties of Time-Correlation Functions; and Charged Transport. These chapters discuss systems close to equilibrium. Chapters 5–8 are entitled: Linearized Langevin and Hydrodynamical Descriptions of Time-Correlation Functions; Hydrodynamic Spectrum of Normal Fluids; Kinetic Theory; and Critical Phenomena and Broken Symmetry. This part focuses on linear hydrodynamics and the generalized Langevin equation. The third section discusses nonlinear processes and contains three chapters entitled: Nonlinear Systems; Perturbation Theory and the Dynamic Renormalization Group; and Unstable Growth.

A good deal of the book relies on articles by P.C. Martin and his collaborators. The other major players are Alder, Green, and Kubo, Mori and Zwanzig, Widom and Kadanoff, Kawasaki, de Gennes and Ma and Mazenko. The book contains approximately 480 pages and covers a vast number of topics. The mere writing of the book is a tour de force, and it would be unreasonable to expect that all the presentations would be deep and insightful. As far as I can tell, there are none of the misconceptions concerning statistical mechanics and thermodynamics that have appeared in many of the books I have reviewed.

There are references and a problem set for each chapter. Most of the problems involve analytic manipulations and rarely provide new physical insights. Most of the specific systems studied are hydrodynamic or magnetic.

I found none of the arguments presented incorrect. However, I found some of them clumsy and without sufficient physical motivation. Whether or not a derivation is considered to be clumsy is at best partially a question of personal taste, but that is the prerogative of a reviewer.

The discussions of the Brownian motion in Chapter 1 and linear response in Chapter 2 seemed to me to be clumsy and not sufficiently motivated. On the other hand, Chapter 3 is well done, particularly in the discussion of the fluctuation-dissipation theorem and the analytic properties of the response function. Chapter 4 is fine, but the presentation of the Langevin and hydrodynamic equation is clumsy, and the difference between the force and the fluctuating force is not sufficiently emphasized. Again, Chapter 6 on the hydrodynamic spectrum is well done, and there is a good discussion of thermodynamics.

Chapter 7 on kinetic theory is adequate though the interesting discussions of long-time tails and non-analyticity are postponed to Chapter 9. Chapter 9 on nonlinear systems contains lots of interesting material though again there is a clumsy discussion of mode coupling theory and generalized Langevin and Fokker-Planck equations.

Finally, Chapters 8 on critical phenomena, 10 on the renormalization group, and 11 on unstable growth are well done. The only unpleasant thing in Chapter 8 is the way Eq. (2) is split between the front and back of the same page.

This book contains a vast amount of interesting material. I would like to have seen more physical insight and connection between the formalism and the physical world. It is a fine reference book and might be suitable as a text for an advanced course in statistical mechanics.

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