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Essential Graduate Physics

Lecture Notes and Problems

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Part SM:
Statistical Mechanics

Last edit: July 2, 2024

B/W paperback copies of this volume are also available on *Amazon.com*:
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Supplemental file **Exercise Problems with Model Solutions** (156 problems, 252 pp.)
is available online:
https://essentialgraduatephysics.org/Files/SM%20exercises.pdf .

B/W paperback copies of these materials are available on *Amazon.com*:
https://www.amazon.com/gp/product/B0D8461WPS .

Additional file **Test Problems with Model Solutions** (26 problems, 25 pp.)
is available for course instructors from the author upon request – see *Front Matter*.

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Introductory Remarks

This graduate-level course in statistical mechanics (including a succinct review to thermodynamics in Chapter 1) has a more or less traditional structure, with two notable exceptions.

First, because of the growing interest in nanoscale systems and ultrasensitive physical measurements, large attention is paid to fluctuations of various physical variables. Namely, their discussion (in Chapter 5) includes not only the traditional topic of variances in thermal equilibrium but also the characterization of their time dependence (including the correlation function and the spectral density), and also the Smoluchowski and Fokker–Planck equations for Brownian systems. A part of this chapter, including the discussion of the most important fluctuation-dissipation theorem (FDT), has an unavoidable overlap with Chapter 7 of the QM part of this series, which is devoted to open quantum systems. I tried to keep this overlap to a minimum, for example by using a different (and much shorter) derivation of the FDT in this course.

The second deviation from the tradition is the inclusion of Chapter 6 on physical kinetics basics. It reflects my belief that such key theoretical tools as the Boltzmann kinetic equation and such key facts as the difference between the electrostatic and electrochemical potentials in conductors, and energy band bending in semiconductors have to known to every educated scientist.

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