

Contents

Preface	v
Second Preface	ix
Chapter I: Introduction and Basic Concepts	1
Chapter II: Classical Physics	3
1. Hamilton's Equations	3
2. Phase Space	14
3. Liouville's Theorem	15
Chapter III: The Statistical Ensemble	24
4. Distribution Function and Probability Density	24
5. Mean Values	26
Additive Quantities	30
6. Time Dependence of the Phase Density	33
Chapter IV: Thermal Equilibrium and The Canonical Distribution	40
7. Stationary Mean Values	40
Conditions of Equilibrium	42
8. Constancy of the Distribution Function	43
9. The Canonical Distribution	50
10. Thermodynamic Functions	55
11. The Partition Function	61
12. The Statistical Significance of Entropy	62
Chapter V: Applications of Classical Statistics	74
13. Ideal Monatomic Gases	74
Energy	77
Heat Capacity	77
Entropy	78
Free Energy	78
Distribution in the μ -Space	79
14. The Virial Theorem	80
15. The Equipartition Theorem	92
16. Examples	95
Mean Kinetic Energy	95
Diatomic Molecules	95
Rigid Rotations	98
Vibrations	100
Solids	106
Normal Coordinates	110
Linear Chain	116

Periodic Boundary Conditions	126
Three-Dimensional Solid	133
Black-Body Radiation	138
17. Magnetism	145
Chapter VI: Quantum Statistics	157
18. Basic Elements of Quantum Mechanics	157
19. The Density Matrix	162
20. The Statistical Ensemble	164
21. Time Dependence of the Density Matrix	174
22. Thermal Equilibrium	177
23. The Canonical Distribution	184
24. Thermodynamic Functions and the Partition Function	187
The Nernst Heat Theorem	189
Chapter VII: Applications of Quantum Statistics	193
25. Ideal Monatomic Gases	193
26. Mean Energy of Harmonic Oscillator	197
27. Examples	200
Diatomic Molecules	200
Specific Heat of Solids	209
The Debye Approximation	210
Black-Body Radiation	215
Magnetism	216
Weiss Theory of Ferromagnetism	222
Transition from Quantum to Classical Statistical Mechanics	223
28. Identical Particles	225
29. The Grand Canonical Ensemble	229
30. Fermi Statistics	233
31. Bose Statistics	243
Appendix A: Canonical Transformations and Poisson Brackets	251
Appendix B: General Proof of Liouville's Theorem	258
Appendix C: Molecular Distributions	262
Appendix D: Some Properties of Fourier Series	265
Appendix E: Basic Texts and Monographs	267
Problems	271
Index	297