

Contents

Preface	vii
Chapter 1 Thermodynamic Behavior. Ensembles	1
1.1 Thermodynamic Systems	1
1.2 Classical Systems and Ensembles	3
1.3 Quantum Systems and Ensembles	7
1.4 Equilibrium States and Thermodynamic Functions	11
Chapter 2 The Thermodynamic Limit for Thermodynamic Functions: Lattice Systems	13
2.1 Limit of an Infinite Volume	13
2.2 Interactions of Quantum Lattice Systems	15
2.3 Thermodynamic Limit for Quantum Lattice Systems	18
2.4 Thermodynamic Limit for Classical Lattice Systems	20
2.5 Some Inequalities for Quantum Systems	25
Chapter 3 The Thermodynamic Limit for Thermodynamic Functions: Continuous Systems	29
3.1 Interactions of Classical Continuous Systems	29
3.2 Stable Interactions	33
3.3 Thermodynamic Limit for the Configurational Micro- canonical Ensemble	41
3.4 Thermodynamic Limit for the Classical Ensembles	52
3.5 Thermodynamic Limit for the Quantum Ensembles	60
Bibliographical Note	68
Exercises	68

Chapter 4 Low Density Expansions and Correlation Functions	71
4.1 Definitions	71
4.2 The Method of Integral Equations	72
4.3 Mayer Series and Virial Expansion	83
4.4 The Algebraic Method	86
4.5 Positive Potentials	93
4.6 Quantum Systems	97
4.7 Construction of a Hilbert Space	100
Bibliographical Note	104
Exercises	104
Chapter 5 The Problem of Phase Transitions	108
5.1 The Theorem of Lee and Yang	108
5.2 Absence of Phase Transitions at High Temperature	112
5.3 Existence of a First-Order Phase Transition at Low Temperature	113
5.4 The Griffiths Inequalities	119
5.5 The Theorem of Mermin and Wagner	129
5.6 One-Dimensional Systems	134
5.7 The Notion of Phase Transition	142
Bibliographical Note	142
Exercises	143
Chapter 6 Group Invariance of Physical States	145
6.1 Description of the State of an Infinite System	145
6.2 Invariant States	147
6.3 Ergodic States	154
6.4 Decomposition of Invariant States into Ergodic States	156
6.5 Pure Thermodynamic Phases as Ergodic States	161
Bibliographical Note	163
Exercises	164
Chapter 7 The States of Statistical Mechanics	168
7.1 B^* -Algebras for Classical and Quantum Statistical Mechanics	168
7.2 Entropy	178
7.3 Thermodynamic Limit of States	184
7.4 A Variational Principle	187
7.5 The Gibbs Phase Rule	190

7.6 Time Evolution of Quantum Lattice Systems and the Kubo–Martin–Schwinger Boundary Condition	192
Bibliographical Note	196
Exercises	197
Appendix Some Mathematical Tools	198
A.1 Some Terminology	198
A.2 Generalities on B^* -Algebras	199
A.3 States on B^* -Algebras	201
A.4 Von Neumann Algebras	205
A.5 Integral Representations on Convex Compact Sets	206
A.6 Groups with an Invariant Mean	208
References	210
Index	217