TABLE OF CONTENTS

Glossary of Symbols and Physical Constants	ix
Historical Introduction	1
Part A Equilibrium Phenomena	9
Chapter 1 Phase Space and Ensembles Phase spaces – Concept of ensembles – Canonical ensemble – Thermodynamical relations in a canonical ensemble – Microcanonical ensemble – Grand canonical ensemble – Information theory and statistical mechanics – Problems	11
Chapter 2 Properties of Gases Partition function for the system and for the particles – Translational partition function – Gibbs' paradox: Sackur-Tetrode equation – Boltzmann equipartition theorem – Rotational partition function – Vibrational contributions to thermodynamic quantities – Electronic partition function – Maxwell distribution of velocities – Problems	34
Chapter 3 Bose-Einstein and Fermi-Dirac Statistics Symmetric and antisymmetric wave functions – Bose-Einstein and Fermi-Dirac distributions – Weak and strong degeneracy of perfect gases – Bose-Einstein condensation – Blackbody radiation: photons – Problems	57
Part B Non-Equilibrium Theory	77
Chapter 4 Kinetic Theory of Gases Mean free path – Viscosity of gases – Heat conduction in gases – Effusion phenomena – Problems	79
Chapter 5 Fluctuations and Brownian Motion Energy fluctuations in a canonical ensemble – Fluctuations in a grand canonical ensemble – Number fluctuations in quantum gases – Fluctuations in a microcanonical ensemble – Brownian motion: Langevin equation for random motions – Random walk problem – Diffusion: Einstein relation for mobility – Problems	91

vi CONTENTS

Chapter 6 Time Dependence of Fluctuations Power spectrum of fluctuations – Persistence and correlation of fluctuations – Wiener-Khinchin theorem – Johnson noise: Nyquist theorem – Shot noise – Problems	107
Chapter 7 Irreversible Thermodynamics Onsager reciprocity relations – Derivation of the Onsager relations – Thermoelectric phenomena – Linear response theory – Kubo relations: fluctuation dissipation theorem – Problems	123
Part C Some Applications	137
Chapter 8 Phonons in Solids Dulong and Petit's law - Einstein's model of solids - Debye's model of solids: phonons - Born-Karman model: lattice dynamics - Other thermal properties of solids - Problems	139
Chapter 9 Electrons in Metals F.D. degeneracy of electron gas in metals – Heat capacity of metallic electrons – Electrical and thermal conductivities – Thermionic emission and photoelectric emission – Remarks on the band theory of metals – Semiconductor statistics – Problems	157
Chapter 10 Dielectric and Magnetic Phenomena Dielectric constant of gases – Internal field in condensed matter: dielectric ordering – Paramagnetism: Langevin–Brillouin functions – Ferromagnetism: Weiss model – Quantum theory of magnetic ordering – Problems	175
Chapter 11 Imperfect Gases and Gas Condensation Van der Waals' equation – Second virial coefficient – General virial coefficients and cluster diagrams – The gas-liquid condensation – Problems	191
Chapter 12 Cooperative Phase Transitions Cooperative processes – Bragg-Williams approximation – Comparison with experiments near the transition temperatures – The Ising problem and its solution for a linear chain – Series expansion method for the 3-dimensional Ising problem – Estimation of thermodynamic quantities – Problems	209

CONTENTS	vii
Chapter 13 Chemical Reactions Equilibrium constant of reactions – Saha ionization formula – Dissociation of a gas – Thermodynamic properties of reacting systems – Isotopic exchange reactions: ortho and para hydrogen – Langmuir monolayer adsorption isotherm – B.E.T. multilayer adsorption isotherm – Problems	225
Chapter 14 Polymers and Biopolymers Molecular weight distributions in linear condensation polymers – Size distribution of polymer molecules – Rubber elasticity – Flory–Huggins polymer solution theory – Helix-coil transitions in polymers – Problems	245
Solutions to Problems	270
Index	297