

CONTENTS

Chapter 1 FUNDAMENTAL PRINCIPLES

1-1	Introduction	1
1-2	Empirical Temperature (Zerotherm Law)	3
1-3	Work	4
1-4	Energy and Heat (First Law)	9
1-5	Enthalpy	13
1-6	Partial Molar Quantities	14
1-7	Heat in Open Systems	17
1-8	Entropy and Absolute Temperature (Second Law)	21
1-9	Chemical Potentials and the Gibbs Equation	24
1-10	Relation between Entropy and Heat	27
1-11	Helmholtz Function and Gibbs Function	31
1-12	Characteristic Functions and Fundamental Equations	33
1-13	Gibbs-Duhem Equation	38
1-14	Affinity	39
1-15	Heat Capacity	42
1-16	Components, Chemical Species, Internal Parameters, and Internal Degrees of Freedom	47
1-17	Equilibrium and Stationary State	48
1-18	General Criterion for Equilibrium	49
1-19	Equilibrium in Homogeneous Systems	53
1-20	Equilibrium in Heterogeneous (Discontinuous) Systems	58
1-21	Equilibrium in Continuous Systems	64
1-22	Stability and Critical Phenomena	69
1-23	Thermodynamic Functions for Nonequilibrium States	76
1-24	Entropy Flow and Entropy Production	82
1-25	Phenomenological Equations	88
1-26	Onsager's Reciprocity Relations	90
1-27	Transformations of the Generalized Fluxes and Forces	92
1-28	Irreversible Processes and Equilibrium	100
	References	103

Chapter 2 PROCESSES IN HOMOGENEOUS SYSTEMS

2-1	Introduction	105
2-2	Entropy Balance	106

2-3	Reaction Rates and Affinities	108
2-4	Phenomenological Equations and Onsager's Reciprocity Law	110
2-5	Region of Validity of the Phenomenological Equations	111
2-6	Experimental Example	119
2-7	Coupling of Two Reactions	121
2-8	Coupling of any Number of Reactions	128
2-9	Relaxation Time of a Reaction	133
2-10	Relaxation Times of any Number of Reactions	139
2-11	After-Effects and Relaxation Processes	143
2-12	The Dynamic Equation of State	144
2-13	After-Effect Functions	150
2-14	Velocity of Sound in Fluids	152
	References	155

Chapter 3 PROCESSES IN HETEROGENEOUS (DISCONTINUOUS) SYSTEMS

3-1	Introduction	157
3-2	Mass Balance	158
3-3	Energy Balance	159
3-4	Entropy Balance	161
3-5	Dissipation Function near to Equilibrium	163
3-6	Phenomenological Equations and Onsager's Reciprocity Law	167
3-7	Electrokinetic Effects	172
3-8	Membrane Processes in Isothermal Systems	180
3-9	Processes in Nonisothermal Systems	184
3-10	Thermomechanical Effects (Empirical and Thermodynamic-Phenomenological Description)	191
3-11	Thermomechanical Effects (Experimental Examples)	197
3-12	Thermoosmosis in Binary Systems (Empirical Description)	203
3-13	Thermoosmosis in Binary Systems (Thermodynamic-Phenomenological Description)	208
3-14	Thermoosmosis in Binary Systems (Experimental Examples)	210
	References	213

Chapter 4 PROCESSES IN CONTINUOUS SYSTEMS

A Fundamental Principles

4-1	Introduction	215
4-2	General Form of a Balance Equation	216
4-3	Reference Velocities and Diffusion Currents	218
4-4	Mass Balance	224
4-5	Momentum Balance	228
4-6	Energy Balance	232
4-7	Invariance Properties of the Heat Current	237
4-8	Entropy Balance	238

4-9	Entropy Current.	242
4-10	Local Entropy Production	243
4-11	Entropy of the Total System	244
4-12	Dissipation Function, Generalized Fluxes, and Generalized Forces	245
4-13	Phenomenological Equations	248
4-14	Onsager's Reciprocity Law.	250
4-15	Range of Validity of the Theory	252
B Isothermal Processes		
4-16	Electric Conduction.	254
4-17	Diffusion in Gases and Nonelectrolyte Solutions	271
4-18	Diffusion in Electrolyte Solutions	284
4-19	Concentration Cells with Transference	296
4-20	Diffusion and Sedimentation in Arbitrary Fluid Systems	304
4-21	Sedimentation Potential.	313
4-22	Gravitational and Centrifugal Cells	315
4-23	Pressure Diffusion	321
C Nonisothermal Processes		
4-24	General	325
4-25	Thermoelectric Effects	341
4-26	Thermal Diffusion in Gases and Nonelectrolyte Solutions.	355
4-27	Thermal Diffusion in Electrolyte Solutions	370
4-28	Heat Conduction in Reacting Media	379
4-29	Thermocells	385
4-30	Electrolytic Thermocouples	399
4-31	Transported Entropies of Ions.	402
D Complicated Processes		
4-32	Viscous Flow	409
4-33	Rotating Systems	416
4-34	Matter in an Electromagnetic Field	420
4-35	Reciprocity Relations for Systems in Centrifugal and Magnetic Fields.	444
4-36	Galvanomagnetic and Thermomagnetic Effects	445
4-37	Processes in Anisotropic Systems	454
4-38	Electric Conduction and Electric Polarization in Anisotropic Media.	460
4-39	Heat Conduction in Anisotropic Media	463
4-40	Further Problems	468
	References	470

Chapter 5 STATIONARY STATES

5-1	Introduction	478
5-2	Homogeneous Systems	480

5-3 Heterogeneous (Discontinuous) Systems	483
5-4 Continuous Systems.	489
5-5 Applications to Biological Systems	493
References	495
Appendix: Notes Added to the Dover Edition	497
Author Index	501
Subject Index	505