Contents

First Part

Field Theory and Thermodynamics

I.	Fur	ndamental Concepts of the Field Theories	÷	•		•		•	4
	1.	The Aim of Classical Field Theory. Deformation			•				4
	2.	Continuity			÷	•			6
	3.	Motion							6
	4.	Material and Spatial Description			÷				8
	5.	Mass and the Material Equation of Continuity						•	12
	6.	Multi-component (superposed) Continua		•	•		•		14
п.	Bal	ance Equations		•	•	•		•	17
	1.	General Balance Equations						•	18
		a) Local Balances						•	19
		b) Substantial Balances					•		21
	2.	Balances of Mass					•		26
	3.	Balances of Charge						,	30
	4.	The Equation of Motion							31
	5.	Balances of Impulse							36
	6.	The Mechanical Equilibrium							43
	7.	Balances of Angular Momentum							45
	8.	Balances of Kinetic Energy						•	49
	9.	Balances of Potential Energy						•	54
	10.	Balances of Mechanical Energy			•	•	÷	•	56
III.	Th	ermodynamics of Continua		•			•		59
	1.	The Local Forms of the First and Second Law			•			•	60
		a) The First Law							60
		b) The Second Law.							61
		c) The Condition of the Cellular (local) Equilibrium							63
	2.	Conservation of Energy and the Balances of Internal	Er	ıer	gy	,			66
	3.	Entropy Balances and Entropy Production							72
	4.	The Linear Kinematical Constitutive Equations							77
		a) Anisotropic Case							78
		b) Curie Principle							80
		e) Isotropic Case							80

Contents

5.	Reciprocal Relations			•		•															84
	a) Anisotropic Case.	•		•		•			•	•	•			•	•		•				85
	b) Isotropic Case	•	•	•	•	•	•	•	•	•	•	•	·	•	•	•		•	•	•	87

Second Part

Variational Principles

0n	the	Variational Principles in General	88
IV.	The	e Principle of Least Dissipation of Energy	89
	1.	Non-equilibrium Potential Functions	90
	2.	The Local Forms of the Principle	93
		a) The Flux Representation	93
		b) The Force Representation	94
		c) Universal Local Form of the Principle	95
	3.	The Gaussian Form of the Local Principle	97
	4.	Applications of the Local Principle for Constraint Problems	100
	5.	The Global Forms of the Principle	104
		a) The Special Forms of the Principle for Adiabatically Isolated	
		Systems	106
		b) The Special Forms of the Principle for Stationary Systems	110
		, 1	
v.	The	e Principle of Minimum Production of Entropy	113
	1.	Stationary States of Discontinuous Systems	113
	2.	Formulation of the Principle for Continua	120
	3.	The Relation between Onsager's and Prigogine's Principles	122
	4.	Applications	124
		a) Heat Conduction in Solid Bodies	124
		b) Stationary States of Thermodiffusional Systems with Chemical	
		Reactions	127
	5.	Generalizations	131
VI	The	n Integral Principle of Thermodynamics	133
71.	1.114		104
	1.	Deduction of the Fourier Equation	134
		a) The Fourier Picture	135
		b) The Energy Picture	130
		c) The Entropy Picture	139
		d) The Generalized " T " Picture \ldots \ldots \ldots \ldots	141
	2.	Formulation of the Integral Principle	143
	3.	Deduction of the Fick Equations of Isothermal Diffusion	140
	4.	Deduction of the General Equation of Motion of Hydrodynamics.	149
	5.	Non-isothermal Transport Equations	155
	C	Deduction of the Transport Equations in a General Form	158
	0.		
	6. 7.	Relations between Integral Principle and Hamilton Principle	162
	6. 7. 8.	Relations between Integral Principle and Hamilton Principle Thermodynamics in Canonical Form	162 167
	6. 7. 8.	Relations between Integral Principle and Hamilton Principle Thermodynamics in Canonical Form	162 167 167
	6. 7. 8.	Relations between Integral Principle and Hamilton PrincipleThermodynamics in Canonical Forma) The Canonical Field Equationsb) Legendre Transformations	162 167 167 171
	6. 7. 8.	Relations between Integral Principle and Hamilton PrincipleThermodynamics in Canonical Forma) The Canonical Field Equationsb) Legendre Transformationsc) The Canonical Form of the Dissipative Integral	162 167 167 171 173

L

Υ.

Contents

Appendix

On the Elements of Vector	ar	ıd	Te	ens	301	C	al	cul	lus	8.			•		•	•				÷	•	175
1. Fundamental Conce	ept	ts a	an	d S	Sir	np	le	0	pei	rat	tio	ns						÷	•		•	176
2. Symmetric and Ant	tis	yn	n	et	ric	Т	'en	so	rs		•			•		•						177
3. Tensor Products .		•					•									•	3	÷	5			178
4. Tensor Derivatives		٠				÷	•		٠	÷			·	•	·	•	ł		•	·	٠	180
References																						182