

Contents

LIST OF CONTRIBUTORS	ix
PREFACE	xi
CONTENTS OF PREVIOUS VOLUMES	xiii

Part I. Polar Field Theories

A. Cemal Eringen and Charles B. Kafadar

INTRODUCTION	2
1. MICROPOLAR CONTINUA	4
1.1 Scope of the Chapter	4
1.2 Kinematics	5
1.3 Strains	8
1.4 Balance Laws	12
1.5 Constitutive Theory and Thermodynamics	17
1.6 Micropolar Elasticity	24
1.7 Micropolar Fluid Dynamics	29
2. MICROMORPHIC CONTINUA	33
2.1 Scope of the Chapter	33
2.2 Kinematics	33
2.3 Strains	35
2.4 Balance Laws	39
2.5 Spatial Forms of the Balance Laws	45
2.6 Constitutive Theory and Thermodynamics	47
2.7 Microelasticity	53
2.8 Microfluids	59
3. HIGHER-ORDER MICROMORPHIC CONTINUA	63
3.1 Scope of the Chapter	63
3.2 Kinematics	63
3.3 Strain Measures	65

3.4 Balance Laws	66
3.5 Micromorphic Elasticity	69
REFERENCES	71

Part II. Nonlocal Field Theories

Dominic G. B. Edelen

INTRODUCTION	76
1. GLOBAL BALANCE LAWS AND VARIATIONAL FORMULATIONS	80
1.1 Scope of the Section	80
1.2 Global Statements and the Passage to Local Laws	80
1.3 Conservation of Mass	86
1.4 Balance of Linear Momentum	91
1.5 Balance of Moment of Momentum	100
1.6 Balance of Energy	101
1.7 Summary of Results for Thermomechanical Systems	104
1.8 Conservation of Charge and Magnetic Flux	105
1.9 Variational Considerations and Carrier Fields	106
1.10 Invariance, Conservation, and Balance	124
1.11 Protoelasticity, a Simple Nonlocal Variational Theory	125
2. CONSTITUTIVE THEORY AND RELATED TOPICS	132
2.1 Scope of the Section	132
2.2 Determinism, Thermodynamics, and Constitutive Equations	133
2.3 Internal Energy and Entropy	135
2.4 Combination of the Internal and External Energy Equations	145
2.5 Invariance under Superimposed Rigid Body Motions	146
2.6 Entropy Production and the Second Law	153
2.7 Onsagerian Irreversible Thermodynamics of Nonlinear Continua	154
2.8 An Alternative Approach: Complete Solutions of the Clausius–Duhem Inequality	166
2.9 Variational Theories	186
2.10 Examples	186
2.11 Appendix: Variational Inferences	191
REFERENCES	201

Part III. Nonlocal Polar Field Theories

A. Cemal Eringen

INTRODUCTION	205
1. Scope of Part III	208
2. Balance Laws	208
3. Constitutive Assumptions	215

CONTENTS	vii
4. Constitutive Equations of Nonlocal Micropolar Elastic Solids	217
5. Linear Theory of Nonlocal Micropolar Elasticity	228
6. Field Equations	235
7. Nonlocal Elasticity	236
8. Examples of Nonlocal Effects	246
9. Nonlocal Micropolar Fluids	250
10. Linear Theory of Nonlocal Micropolar Fluids	258
11. Field Equations	262
12. Nonlocal Fluid Dynamics	263
13. Surface Tension	264
REFERENCES	265
INDEX	269