## Contents

Preface	
Acknowledgments	

### Chapter I. Basic Theory

1.1	Scope of the Chapter	1
1.2	Coordinates	2
1.3	Deformation, Motion	4
1.4	Deformation Gradients, Deformation, and Strain Tensors	6
1.5	Length and Angle Changes	9
1.6	Strain Invariants	11
1.7	Area and Volume Changes	16
1.8	Compatibility Conditions	17
1.9	Kinematics, Time Rates of Vectors and Tensors	19
1.10	Global Balance Laws	22
1.11	Local Balance Laws	25
1.12	Local Balance Laws in the Reference Frame	31
1.13	Constitutive Equations of Thermoelastic Solids	34
1.14	Isotropic Thermoelastic Solids	43
1.15	Linear Theory	47
1.16	Quadratic Theory	51
1.17	Field Equations	55
1.18	Restrictions on Material Moduli	60
1.19	Resume of Basic Equations of Thermoelasticity	65
1.20	Curvilinear Coordinates	69

xi

xv

#### Chapter II. Propagation of Singular Surfaces

2.1	Scope of the Chapter	77
2.2	Fundamental Formulas for Moving Surfaces	78
2.3	Singular Surfaces	85
2.4	Geometrical Conditions of Compatibility	87
2.5	Kinematical Conditions of Compatibility	89
2.6	Singular Surfaces Associated with the Motion of a Medium	91
2.7	Dynamical Conditions of Compatibility	94
2.8	Classification of Singular Surfaces Associated with Motion	95
2.9	Shock Waves	95
2.10	Shock Waves in Incompressible Materials	101
2.11	Weak Shock Waves	107
2.12	Acceleration Waves	113
2.13	Propagation of Acceleration Waves in Isotropic Materials	118
2.14	Acceleration Waves in Incompressible Solids	127
2.15	Growth of the Acceleration Waves	131

#### Chapter III. Finite Motions of Elastic Bodies

3.1	Scope of the Chapter	146
3.2	Quasi-Equilibrated Motions of Incompressible Bodies	147
3.3	Radial Oscillations of a Cylindrical Tube	148
3.4	Radial Oscillations of a Spherical Shell	162
3.5	Simple Waves—Special Theory	171
3.6	Plane Waves in Incompressible Elastic Solids	191
3.7	Riemann Problem for an Isotropic Elastic Half-Space	194
3.8	Simple Waves-General Theory	208
3.9	Reflection and Transmission at an Interface	215
3.10	Some Solutions for Special Materials	235
3.11	Other Solutions	243

# Chapter IV. Small Motions Superimposed on Large Static Deformations

4.1	Scope of the Chapter	246
4.2	Fundamental Equations	247
4.3	Plane Waves in Homogeneously Deformed Elastic Materials	259
4.4	Surface Waves in Prestressed Materials	267
4.5	Torsional and Longitudinal Oscillations of an Initially Stretched	
	Circular Cylinder	277
4.6	Oscillations of an Initially Twisted Circular Cylinder	285
4.7	Other Solutions	295

#### Appendix A. Tensor Analysis

A.1	Scope of Appendix A	297 298
A.3	Tensors	302
A.4	Physical Components	304

#### Contents

A.5 A.6 A.7	Tensor Ca The Riem Two-Poin	alculus ann–Christoffel Curvature Tensor t Tensor Fields	305 312 313
App	endix B.	Quasilinear System of Hyperbolic Equations with Two Independent Variables	
<b>B</b> .1	Character	istics	315
<b>B.2</b>	The Simp	le Wave Solutions	320
B.3	Riemann	Problem	325
Refe	erences		327
Inde:	x		335