

Contents

<i>Preface to Second Edition</i>	ix
----------------------------------	----

<i>Preface to First Edition</i>	xi
---------------------------------	----

I. Viscoelastic Stress Strain Constitutive Relations

1.1.	Introduction	1
1.2.	Integral Form of Stress Strain Constitutive Relations, Stieltjes Convolution Notation	3
1.3.	Consequences of Fading Memory and the Distinction between Viscoelastic Solids and Fluids	9
1.4.	Differential Operator Form of Stress Strain Constitutive Relations	14
1.5.	Relaxation and Creep Characteristics, Mechanical Models	16
1.6.	Steady State and Fourier Transformed Stress Strain Constitutive Relations	21
1.7.	Accelerated and Retarded Processes	25
1.8.	Alternative Mechanical Property Functions	26
1.9.	Spectra	28
	Problems	32
	References	34

II. Isothermal Boundary Value Problems

2.1.	Formulation of the Boundary Value Problem	35
2.2.	Uniqueness of Solution	37
2.3.	Separation of Variables Conditions	41
2.4.	Steady State Harmonic Conditions	44
2.5.	Integral Transform Methods	45
2.6.	Effect of Inertia Terms	46
2.7.	Steady State Harmonic Oscillation Example	47
2.8.	Quasi-Static Response Example	48
2.9.	Pressurization of a Cylinder	52
2.10.	Pressurization of a Spherical Cavity	57
2.11.	Free Vibration	60
2.12.	Limitations of Integral Transform Methods	66
2.13.	Summary and Conclusions	71
	Problems	73
	References	75

III. Thermoviscoelasticity

3.1.	Thermodynamical Derivation of Constitutive Relations	77
3.2.	Restrictions and Special Cases	83
3.3.	Relationship to Nonnegative Work Requirements	86
3.4.	Formulation of the Thermoviscoelastic Boundary Value Problem	87
3.5.	Temperature Dependence of Mechanical Properties	90
3.6.	Thermorheologically Simple Materials	94
3.7.	Glass Transition Criterion	105
3.8.	Heat Conduction	113
	Problems	119
	References	120

IV. Mechanical Properties and Approximate Transform Inversion

4.1.	Introduction	122
4.2.	Relaxation and Creep Procedures	125
4.3.	Steady State Harmonic Oscillation Procedures	127
4.4.	Wave Propagation Procedures	131
4.5.	Temperature Dependent Effects	138
4.6.	Approximate Interrelationships among Properties	141
4.7.	Approximate Inversion of the Laplace Transform	145
4.8.	Approximate Solutions for Dynamic Problems	149
	Problems	153
	References	155

V. Problems of a Nontransform Type

5.1.	Contact Problem	157
5.2.	Extended Correspondence Principle	162
5.3.	Crack Growth—Local Failure Model	167
5.4.	Crack Growth—Energy Balance Approach	171
5.5.	Thermoviscoelastic Stress Analysis Problem	179
	Problems	183
	References	185

VI. Wave Propagation

6.1.	Isothermal Wave Propagation	188
6.2.	Dynamic Response Problems	194
6.3.	Harmonic Thermoviscoelastic Waves in Unlimited Media	202
6.4.	Reflection of Harmonic Waves	208
6.5.	Moving Loads on a Viscoelastic Half Space	214
6.6.	Viscoelastic Rayleigh Waves	221

Problems	227
References	227

VII. General Theorems and Formulations

7.1. Uniqueness of Solution of Coupled Thermoviscoelastic Boundary Value Problem	229
7.2. Representation in Terms of Displacement Functions	232
7.3. Reciprocal Theorem	234
7.4. Variational Theorems	237
7.5. Minimum Theorems	248
7.6. Optimal Strain History	255
Problems	260
References	260

VIII. Nonlinear Viscoelasticity

8.1. Derivation of Constitutive Relations for Solids	263
8.2. Reduction to Linear Theory	271
8.3. Simple Shear Deformation Example	273
8.4. Viscoelastic Fluids	278
8.5. Simple Shear Flow Example	283
Problems	289
References	290

IX. Nonlinear Mechanical Behavior

9.1. A Nonlinear Theory of Elastomeric Solids	293
9.2. Nonlinear Acceleration Waves	303
9.3. Viscometric Flows	310
9.4. Nonviscometric Flows	316
9.5. Viscoelastic Lubrication	325
9.6. Nonlinear Theory Mechanical Properties	331
Problems	348
References	349

Appendixes

A. Step Functions and Delta Functions	353
B. Laplace Transformation Properties	354
References	357

<i>Index</i>	359
--------------	-----