

Contents

| | |
|---|-----|
| Preface | ix |
| Chapter 1. Some Continuous Media and Their Mathematical Modeling | 1 |
| 1. The physical problems | 1 |
| 2. Kinematics | 1 |
| 3. Kinetics and thermodynamics of deformation | 5 |
| 4. Standard materials in small strains | 7 |
| 5. Incompressible viscous fluids | 13 |
| 6. Finite elasticity | 15 |
| Chapter 2. Variational Formulations of the Mechanical Problems | 19 |
| 1. Preliminaries | 19 |
| 2. Quasi-static viscoplasticity | 24 |
| 3. Time-dependent flows of-viscoplastic fluids | 32 |
| 4. Elastoviscoplasticity in small strains | 34 |
| 5. Static finite elasticity | 37 |
| Chapter 3. Augmented Lagrangian Methods for the Solution of Variational Problems | 45 |
| 1. Introduction and synopsis | 45 |
| 2. Augmented Lagrangian methods in quadratic programming | 46 |
| 3. Application to the Stokes problem | 66 |
| 4. Decomposition of variational problems by augmented Lagrangian techniques | 79 |
| 5. Relations between augmented Lagrangian methods and alternating direction methods | 89 |
| 6. Application to the solution of linear and nonlinear eigenvalue problems | 105 |
| 7. Liquid crystals theory and further comments | 111 |

| | |
|---|-----|
| Chapter 4. Viscoplasticity and Elastoviscoplasticity in Small Strains | 123 |
| 1. Introduction | 123 |
| 2. Mixed variational formulations of elastoviscoplasticity | 124 |
| 3. Finite-element formulations of elastoviscoplasticity | 128 |
| 4. Quasi-static viscoplasticity | 137 |
| 5. Numerical algorithms | 141 |
| 6. The problem in plastic strain rates | 150 |
| 7. Numerical results | 158 |
| Chapter 5. Limit Load Analysis | 169 |
| 1. Limit loads in plasticity | 169 |
| 2. Limit load analysis | 177 |
| 3. Viscoplastic regularization and numerical algorithm | 180 |
| 4. Computation of $G_*(\mathbf{f}, \mathbf{g})$ and convergence results | 183 |
| 5. Examples of computations of limit loads | 187 |
| Chapter 6. Two-Dimensional Flow of Incompressible Viscoplastic Fluids | 197 |
| 1. Classical formulation of the flow problem | 197 |
| 2. Stream function formulation | 198 |
| 3. Approximation of the steady-state problem | 200 |
| 4. Approximation of the time-dependent problem (2.8) | 204 |
| 5. Solution of Problems (3.1) and (4.2) by augmented Lagrangian methods | 205 |
| 6. Numerical experiments | 211 |
| 7. Further comments | 213 |
| Chapter 7. Finite Elasticity | 217 |
| 1. Classical formulations | 217 |
| 2. Augmented Lagrangian formulation | 219 |
| 3. Finite-element discretization | 224 |
| 4. Iterative numerical solution of the augmented Lagrangian formulations | 233 |
| 5. Solution of local problems formulated in deformation gradients | 235 |
| 6. Numerical results | 240 |
| 7. Equilibrium problems with contact | 248 |
| Chapter 8. Large Displacement Calculations of Flexible Rods | 259 |
| 1. Introduction and description of the physical problem | 259 |
| 2. Mathematical modeling of the torsion-free static problem | 260 |

| | |
|--|-----|
| 3. Finite-element approximation of the static problem | 262 |
| 4. Augmented Lagrangian solution of the static problem | 266 |
| 5. Applications and extensions | 270 |
| 6. Solution of the dynamical problem | 280 |
| References | 287 |
| Index | 293 |