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minimum stress values; 2.8 Mohr's circles; Exercises; 3 Deformation and motion; 3.1 Coordinates and deformation; 3.2 Strain tensor; 3.3 Linearized deformation theory; 3.4 Stretch ratios; 3.5 Velocity gradient; 3.6 Vorticity and material derivative; Exercises; 4 Fundamental laws and equations; 4.1 Terminology and material derivatives; 4.2 Conservation of mass and the continuity equation; 4.3 Linear momentum and the equations of motion; 4.4 Piola-Kirchhoff stress tensor; 4.5 Angular momentum principle
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4.7 Constitutive equations; 4.8 Thermodynamic considerations; Exercises; 5 Linear elastic solids; 5.1 Elasticity, Hooke's law, and free energy; 5.2 Homogeneous deformations; 5.3 Role of temperature; 5.4 Elastic waves for isotropic bodies; 5.5 Helmholtz's decomposition theorem; 5.6 Statics for isotropic bodies; 5.7 Microscopic structure and dislocations; Exercises; 6 Classical fluids; 6.1 Stokesian and Newtonian fluids: Navier-Stokes equations; 6.2 Some special fluids and flows; Exercises; 7 Geophysical fluid dynamics
7.1 Dimensional analysis and dimensionless form
7.2 Dimensionless numbers; Exercises; 8 Computation in continuum mechanics; 8.1 Review of partial differential equations; 8.2 Survey of numerical methods; 9 Nonlinearity in the Earth; 9.1 Friction; 9.2 Fracture; 9.3 Percolation and self-organized criticality; 9.4 Fractals; References; Index

Sommario/riassunto

Continuum mechanics underlies many geological and geophysical phenomena, from earthquakes and faults to the fluid dynamics of the Earth. This interdisciplinary book provides geoscientists, physicists and applied mathematicians with a class-tested, accessible overview of continuum mechanics. Starting from thermodynamic principles and geometrical insights, the book surveys solid, fluid and gas dynamics. In later review chapters, it explores new aspects of the field emerging from nonlinearity and dynamical complexity and provides a brief introduction to computational modeling. Simple, yet rigorous, derivations are used to review the essential mathematics. The author emphasizes the full three-dimensional geometries of real-world examples, enabling students to apply this in deconstructing solid earth and planet-related problems. Problem sets and worked examples are provided, making this a practical resource for graduate students in geophysics, planetary physics and geology and a beneficial tool for professional scientists seeking a better understanding of the mathematics and physics within Earth sciences.
