

Preface

This book arose out of a conversation that took place in a bookshop in Berkeley, California, almost a decade ago. The original motivation was to provide a text on continuum thermodynamics that would allow a systematic derivation and discussion of free-energy functionals for materials with memory, including in particular explicit expressions for the minimum and related free energies, which were being developed at the time.

Progress was very slow, due to other commitments. The vision of what the book would explore broadened considerably over the years, in particular to include minimal states and a new single-integral free-energy functional that explicitly depends on the minimal state. Also, it was decided to include a detailed description of an alternative approach to the analysis of the integrodifferential equations describing the evolution of viscoelastic materials under varying loads, using minimal states and free-energy functionals depending on the minimal state. This is a novel approach to a well-known topic.

Our desire was to make the work as self-contained as possible, so chapters dealing with the general theory of continuum mechanics were included, with sections devoted to classical materials, specifically elastic bodies and fluids without explicit memory-dependence. These provided essential background to the more general and modern developments relating to materials with memory.

It was furthermore felt that certain other topics had not been covered previously in book form and should be included, in particular control theory and the Saint-Venant and inverse problems, as well as some discussion of nonsimple behavior, for materials with memory.

The book is divided into four parts. The mathematical presentation in the first three parts is largely accessible not only to applied mathematicians but also to mathematically oriented engineers and scientists. However, a higher standard is required for some of the chapters in the final part.

The authors wish to thank S. Chirita, A. Lorenzi, M.G. Naso, and V. Pata for their aid in writing Chapters 19 (Naso), 20 (Chirita), 22 (Pata), and 23 (Lorenzi). One of the authors gratefully acknowledges support for research travel from the Dublin Institute of Technology during the period of preparation of this work. All of

us express our thanks to Gennaro Amendola for his very useful advice and help on certain deeper aspects of \LaTeX .

Pisa, Bologna, Dublin,
February 2011

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Thermodynamics of Materials with Memory
Theory and Applications

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2012, XVI, 576 p., Hardcover

ISBN: 978-1-4614-1691-3