

# Preface

This book consists of three parts which complement each other

– Part I: **Foundations**

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– Part II: **Applications and Exercises**

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– Part III: **Numerical Methods**

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For convenience, they appear separately but studying the subject of continuum thermodynamics should be simultaneous in all three aspects. Therefore, in Parts II and III we indicate interrelations with Part I of the book as well as the mutual relations between those two Parts. Each Chapter of Part II with exercises begins with a short recall of foundations which are needed for a particular problem and each numerical problem begins with the indication of both theoretical foundations of Part I and the corresponding problem in Part II.

Part II contains in addition the presentation of many general problems which were not included in Part I as they simultaneously form excellent exercises of skills for continuum models. For instance, the debate about the class of universal solutions, such as tension, shear, bending, torsion, inversion, etc. yields questions of material stability which will be discussed in this Part. For similar reasons, the discussion of fundamental rheological

flows and their applications in experimental investigation of non-Newtonian fluids is discussed here. This also concerns the dynamic problems such as propagation of linear acoustic waves in nonlinear media or the propagation of various surface waves.

In Part III, techniques of approximation and numerical solutions of problems presented in Parts I and II will be introduced. Mainly the treatment of these problems by the finite element method will be presented. However, it will also contain a discussion of such fundamental problems as convergence of algorithms, stability of numerical analysis, or remarks on new methods designed for continua, for instance the method of finite volumes. The classical method of finite differences and, developed for flow problems in continua, the method of finite volumes will be particularly emphasized. The method of finite volumes allows for unstructured meshes, uses directly balance equations of continuous media and, for this reason, is particularly useful in problems of continua. Consequently, notions of Delaunay triangulation, Voronoi grid, MUSCL (Monotone Upstream-centered Schemes for Conservation Laws) applicable to hyperbolic field equations will be presented in Part III.

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