

# Preface

*Do not say anything against Mechanics!  
Isn't it the most beautiful science?*

Honoré de Balzac (The Magic Skin, 1831)

This book results from a two-semester course that the authors offered for many years at the University of Magdeburg. Its understanding requires some basic knowledge in Mechanics and Mathematics as they are taught in the first semesters for practically all engineering students of universities.

The entire book is restricted to small deformations (geometrically linear theory). For the general (non-linear) theory including large deformations, the reader is referred to further literature<sup>1</sup>.

The focus of this book lies on material modelling. This is probably a topic that cannot be substituted and will never be completed. Consequently, we start with an overview of the most important branches of material theory, initially in a one-dimensional form. For extending this into a fully three-dimensional one, there is a need for appropriate mathematical and notational tools. For Continuum Mechanics, these are the calculus of tensors, for which we give a brief introduction. Here we limit our considerations to the most simple form of it by using exclusively orthonormal bases ("Cartesian tensors"). Afterwards we can outline Continuum Mechanics in a direct tensor notation.

In the three-dimensional material theory, we will again introduce elasticity, viscoelasticity, and plasticity, all in a more general format. We also have to include thermodynamics, as far as it is needed for material theory.

The content of the whole book is classical, little is really new. It only differs from other literature in its selection of topics and, to some extent, their representation. As EUGEN ROTH already remarked:

*Die Wissenschaft, sie ist und bleibt,  
was einer ab vom andern schreibt -  
doch trotzdem ist, ganz unbestritten,  
sie immer weiter fortgeschritten.*

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<sup>1</sup> such as A. Krawietz: *Materialtheorie*. Springer-Verlag, Berlin (1986) and A. Bertram: *Elasticity and Plasticity of Large Deformations - an Introduction*. Springer-Verlag, 3. ed. (2012)

In each chapter of the book, we give selected references to the most important literature in the field. For Chapter 4.1 (elasticity) the author has been mainly inspired by GURTIN (1972), and for Chapter 4.2 (thermoelasticity) by CARLSON (1972) (both in the *Encyclopedia of Physics* VIa/2). ARNOLD KRAWIETZ contributed particularly to Chapter 4.4.6 (thermoplasticity). He also critically reviewed the entire manuscript and gave numerous suggestions, which shall be gratefully acknowledged here.

The understanding of many parts of the book is additionally supported by a number of *Problems*, which are due to the second author R.G. They contain a selection of applications, which have been worked out and collected by different tutors through the years. These were in chronological order WOLFGANG LENZ, THOMAS BÖHLKE, MICHAEL SCHURIG, GERRIT RISY and RAINER GLÜGE. In particular, we have to mention MICHAEL SCHURIG for the Problems 12, 16, 17, and 18. Problems 12, 16, and 20 have been adopted from the textbooks by GÖLDNER (1991) and IEŞAN (2004). As is common for textbooks on classical material like Continuum Mechanics, not all sources can be mentioned. The authors want to apologize for sources that they used without mention.

In all the years in which we gave this course, this manuscript has been continuously reworked and improved. The authors would like to thank all the students and readers who have helped us in this process by their suggestions and comments. In addition, such suggestions will be highly welcome in the future and can be directly given to the authors.

The German version of this book can be freely downloaded from the authors' internet site.

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