# Preface

This book is the English language version of a course on turbomachines, taught in Dutch by the author at Ghent University from 1992 to 2013. It was composed at the occasion of the change to English as teaching language in master programmes in engineering, starting with the academic year 2013–2014. Meanwhile, the text was adapted to include some modern evolutions in the field of turbomachinery, however avoiding advanced topics, since the objective of the book is to teach fundamentals of turbomachines.

In the first chapter, the basic equations of fluid mechanics and thermodynamics are derived from first principles, formulated for application to turbomachines. With this chapter, the necessary prior knowledge for the study of turbomachines is refreshed. The prior knowledge needed is basic fluid mechanics and basic technical thermodynamics. For fluid mechanics, this comprises topics such as mechanical properties of fluids, fluid statics, equations of flow in integral and differential form, dimensional analysis and internal laminar and turbulent flow of constant density

fluids. For technical thermodynamics, the supposed prior knowledge encompasses thermal properties of fluids, first law and second law of thermodynamics, basic heat engine cycles, gas mixtures, combustion and detailed analysis of steam cycles.

The course on turbomachines is taught at Ghent University in two parts. Chapters 1–10 form a first part, taught to all master students in electromechanical engineering. This part requires basic knowledge of flow past profiles, boundary layer flow and high speed flow of compressible fluids, which are topics often covered in an advanced fluid mechanics course. The necessary fundamentals of these topics are explained in the beginning of Chap. 2 and in Chap. 4. The second part is Chaps. 11–15, taught to students with specialisation in mechanical energy engineering. This part requires somewhat more advanced knowledge of fluid mechanics. Relevant topics are transition, turbulence and heat transfer in boundary layer flows and shock and expansion phenomena in high speed flows of compressible fluids. However, care has been taken not to rely too much on prior knowledge of these topics.

The objective of the book is, as already said, study of the fundamentals of turbomachines. The approach is analysis of all kinds of turbomachines with the same theoretical framework. Basic equations are formulated for a general equation of state of a fluid. Specification of constant density or ideal gas is only done when analysing particular machines. The building up of theory is mixed in the sense that first derivations are general, but that elaboration of the theoretical concepts is done on a particular machine, however taking into account the possibility for reuse on other machines or generalisation from constant density formulation to variable density formulation. The analysis starts with radial and axial fans, because these machines are the simplest ones. The next machines are steam turbines. The order of treating the different types of turbomachines is governed by the possibility of gradually building up the theoretical concepts. For each of the machine types, a balance is sought between fundamental understanding and acquiring knowledge of practical aspects. The main concern is always fundamental understanding and bringing the reader to independent reasoning. The point of view taken by the author is that readers should be able to understand what they see when a turbomachine is opened. They should also be able to make a reasoned choice of a turbomachine for a specific application and understand its operation. Design is not a primary objective. Design requires a more specialised study, although basic design of the simplest turbomachines such as a centrifugal fan, an axial steam turbine or a centrifugal pump is possible with the topics covered in the book.

Ghent, September 2014 Erik Dick

http://www.springer.com/978-94-017-9626-2

Fundamentals of Turbomachines

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2015, XXVIII, 564 p. 337 illus., 16 illus. in color.,
Hardcover
ISBN: 978-94-017-9626-2