Elements of airplane performance

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Preface

About the contents

This book presents a teaching text on airplane performance. This field has to do with the translational motion of flight vehicles, in which we study such questions as maximum flight speed, maximum rate of climb, range, and takeoff distances.
A number of books on the dynamics of flight have appeared in the last decades, aimed at a variety of subjects.
Concerning the treatment of the capability of airplanes to perform specific maneuvers and their operational tasks, most of the existing books are of limited scope. However, the technological developments and the growing importance for all airplane types to function economically have introduced the need for a comprehensive, modern book on the principles and practice of airplane performance prediction suited for use as a primary text in undergraduate engineering courses. The present book is intended to fulfill that need.
The book is a description of the regular courses on airplane performance as have been taught for many years by the author at the Faculty of Aerospace Engineering of Delft University of Technology (TUD), The Netherlands, and at the Faculty of Applied Sciences of the Brussels Free University (VUB), Belgium.
In the text, three fairly well-defined parts may be distinguished.
The first part comprises the chapters 1 to 7, which deal with some basic concepts of the airplane and its motion, the properties of the atmosphere, and the general equations of motion. Furthermore, these supporting chapters include the basics of the generation of aerodynamic forces and moments, the operating principles of the air data instruments and their application to flight, some fundamental aspects and operating characteristics of airplane propulsion systems, and the theory of the propeller. These subjects represent the required background knowledge necessary for the subsequent analysis of the performance of powered and unpowered airplanes.
The second part is formed by the chapters 8 to 13, where especially are discussed the classical methods of predicting the performance values of airplanes that pertain to a given point of time or a given point on the flight path (point performance). To illustrate the applications of the theory in practical problems, numerous worked examples, employing the SI-system of units and notation, are included in these chapters.
The last part of the main text (chapters 14 to 16) is devoted to giving an account

of the most common techniques used for estimating the performance items that are related to the course of the flight (integral performance).
In analyzing the performance in chapters 8 to 16, use is made of both analytical and graphical techniques.
In order to provide a clear understanding of the fundamental equations of motion, in Appendix A the essentials of Newtonian mechanics are described. In Appendix B are listed a number of conversion factors between English and metric units and between technical units and the equivalent Si units. In Appendix C is given a table of values for the International Standard Atmosphere up to an altitude of 32 km. Finally, in Appendix D, one-dimensional steady flow equations are reviewed of which the knowledge is a prerequisite for an appreciation of the aerodynamics and the many technical aspects of atmospheric flight.
References to the literature are indicated in the text and listed at the end of the book. In addition, a few more general references have been included.
My special thanks are due to the late Mr. Dirk M. van Paassen, who was a colleague in much of the preparation of the material presented, and without whose cooperation this book could not have been written.

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In this second edition, apart from a few minor adjustments, all the material from the first edition has been retained and the errors found in the first edition have been rectified.

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