

Preface

Since the late 1950s, when the race for more and more ambitious projects in aerospace in many countries started, there has been a necessity for a good book in this subject area for engineering students, which is the motivation for writing this book. There is no doubt that a number of books are already available in the market, but either they are generally too mathematical or they cater mainly to the interests of students of physics.

This book is an outgrowth of lectures given by the author to the undergraduate and graduate students of aerospace engineering at the Indian Institute of Technology, Madras, India, specializing in the fields of aerodynamics and propulsion. In their later profession these students are increasingly called to tackle real gas problems of hypersonic flight speeds including reentry and high rate of heat flux in nozzles and reentry bodies and for various exotic and sophisticated high temperature manufacturing processes. It was, therefore, necessary to develop a course of lectures containing the fundamentals of the high temperature gases, the effects of the high temperature on the thermophysical, transport, and other properties, the diagnostic techniques, and the preliminaries about the behavior of the ionized gases in electromagnetic fields. These topics, however, belong to such diversified areas as statistical thermodynamics, kinetic theory of gases, plasma physics, plasma diagnostic techniques, magnetogasdynamics, and conventional gas dynamics. Treatment of these topics has been kept to a level which a student with adequate mathematics and physics background should understand. Therefore at various places in the book the derivation of equations has been done in considerable detail. In this connection mention must be made of the chapter on diagnostic techniques, because some reviewers felt that the optical techniques discussed are too preliminary since very advanced techniques are nowadays used for the collection and evaluation of the optical signals. However this author feels the necessity of an approach with prisms and lenses for the understanding of the fundamentals. No single book can possibly cover all the topics handled in the book adequately and there could be differences of opinion about the best way of treating a topic. For example, the so-called Monte Carlo method may be considered to be the method for radiation gas dynamics, but this author feels that for general engineering students a

more deterministic method would be appropriate. A book, including all the topics above was, therefore, published several years back and in a limited Indian edition, but it is not available now. In the meantime, there has been considerable progress in the subject, and it was thought necessary to rewrite the book with the inclusion of much additional material.

Some of the subject areas of immediate interest, which were developed during the last 30 years, concern two- and multi-temperature plasmas and these have been described in this book in considerable detail. The topics have been chosen no doubt from the personal interest and areas of research of this author. Study of the interaction between the hot gas containing charged particles and the electromagnetic fields, especially the conditions under which Alfvén and other electromagnetic shocks are generated, was, personally speaking, very fascinating. I would be happy to discuss any of the topics in this book with readers if I am contacted through e-mail under “tkbose@earthlink.net.” While the manuscript of this book was originally written at the time the author was a professor of aerospace engineering at the Indian Institute of Technology, Madras (current name: Chennai), India, he has, however, retired in 1998 and moved to California.

Reproduction from several sources has been done in this book with the permission of the authors and publishers. This has been acknowledged at proper places. Thanks are also due to the publisher, Springer Verlag, for the excellent job done in publishing this book, especially in helping to convert from *Corel Ventura*, the desktop language used initially to write the manuscript, to \LaTeX , which is the preferred Springer typesetting system for book production.

The figures for this book were drawn generally with a computer, but where it was too cumbersome, these were drawn originally by Mr. Karuppaiah of the Indian Institute of Technology, Madras. Charts in Appendices are reproduced from my earlier book, which again were reproduced from the book by Bosnjakovic by permission of Verlag Theodor Steinkoff. Similarly the statistical weights and energy levels given in Table 6.2 were published by permission of Springer Verlag and similar tables given in Appendix A from my earlier book. Some other results in Chaps. 8 and 9 were published in my earlier book by permission of Dover Publications. This book was typeset completely on a PC by the author personally. In addition, I would like to thank Professor Heberlein of the High Temperature Lab, Department of Mechanical Engineering, University of Minnesota, Minneapolis, USA, for the use of his figure of a supersonic free plasma jet at moderately low pressures.

Finally, I would like to thank my wife, Preetishree, and the three children, Mohua, Mayukh, and Manjul, for having put up with me during the writing of this book.

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