going to check the validity of this equation and what value can be attached to it? Other equations in this chapter run for over 20 lines, for no evident reason. The reader is intimidated by this approach and may be tempted to close the book and move on to something else.

There are no original calculations (with one or two exceptions) shown, aside from line drawings, in contrast with the current practice of placing theory against data and verify how good the equations are. It is inevitable that this book will have a rather limited market, particularly in consideration that modern students are averse to heavy mathematical treatment of an engineering subject.

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Thermodynamics

S. Klein and G. Nellis

Cambridge University Press, The Edinburgh Building, Cambridge, CB2 8RU, UK. 2012. 1072pp. Illustrated. £79. ISBN 978-0-521-19570-6.

Thermodynamics is a mature subject on which many textbooks have been written. Aimed at engineering students this comprehensive textbook stands out by its well-balanced presentation that not only motivates and describes thermodynamic problems but details mathematical proofs where they offer insight and provides a good number of real life engineering examples. These are discussed in great detail, giving students guidance in how to approach and solve even very challenging engineering tasks. Mathematically complex problems are solved with the Engineering Equation Solver (EES) for which code is given in the text.

It is palpable that the book, written by two university professors, is the fruit of many years of teaching experience. The book brings together a vast array of knowledge in a highly readable and understandable manner. Chapters are arranged as follows: 1 – Basic Concepts, 2 – Thermodynamic Properties, 3 – Energy and Energy Transport, 4 – General Application of the First Law, 5 – The Second Law of Thermodynamics, 6 – Entropy, 7 – Exergy, 8 – Power Cycles, 9 – Refrigeration and Heat Pump Cycles (counting more than 250 pages), 10 – Property Relations for Pure Fluids, 11 – Mixtures and Multi-Component Phase Equilibrium, 12 – Psychrometrics, 13 – Combustion, 14 – Chemical Equilibrium, 15 – Statistical Thermodynamics, 16 – Compressible Flow.

The emphasis is clearly on engineering problems, which include cooling and heating systems, turbine efficiencies, compressors, air conditioning, explosion pressures and combustions. Summing to more than 1,000 pages, all topics are visualised with insightful illustrations and described in detail without skipping any steps. One of the aspects that particularly impressed me was the book's clarity on central terms in thermodynamics, such as the definition of `a system' and of `heat', which are often brushed over leaving novices in doubt.

Having worked in Physics Departments for a few years, I have found that thermodynamics is one of the most difficult subjects to learn for students and teach for lecturers. This book navigates the subject with precision and in a friendly and reassuring tone. I was particularly impressed with the chapter on statistical thermodynamics that was unexpectedly detailed and insightful. Quantum terminology is introduced naturally, including Bose-Einstein and Fermi-Dirac statistics, leading to the derivation of the Maxwell-Boltzmann distribution of the ideal

gas from which macroscopic properties such as pressure, internal energy and entropy are derived in a clear manner.

The care that has gone into putting this book together is extraordinary and the result is one of the best textbooks on thermodynamics available, not only for engineering but also for physicists and chemists. I recommend it highly as a course textbook to undergraduates and university lecturers and as a solid reference for researchers.

Dr J. Anders, Dept. Physics and Astronomy, University of Exeter

Advanced Aircraft Design: Conceptual Design, Analysis and Optimisation of Subsonic Civil Airplanes

E. Torenbeek

John Wiley and Sons, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK, 2013. 410pp. Illustrated. £75, ISBN 978-1-118-56811-8.

Professor Torenbeek set the standard for the reference book used by aspiring and practicing preliminary design specialists some 38 years ago. That book – *Synthesis of Subsonic Airplane Design* (Delft University Press, 1976) was targeted, perhaps too modestly, at final-year undergraduates specialising in aircraft design. The new book is targeted at the postgraduate, academics, researchers and preliminary design specialists in industry. As such it is complementary to, rather than an alternative to, or replacement for, the earlier book, with only a small amount of material common to both.

The emphasis is on analytical methods of optimisation built on reasonable approximations to the full, complex, representation of an aeroplane as an integrated system. The limitations of synthesis and the risks that the methods of multi-disciplinary optimisation might obscure the message are acknowledged. The author emphasises clear design thinking. The flexibility of the analytical approach is demonstrated through evaluation of the continuum of possibilities from the conventional tube-and-wing to the all-wing aircraft. Canard, three-surface, non-planar lifting surface, twin-fuselage and alternative fuel configurations are reviewed.

The first four chapters cover the now well-trodden ground of preliminary layout and sizing. The importance of well-written requirements is highlighted. Measures of efficiency are reviewed. Propulsion and drag chapters include consideration of open rotors and of novel configurations. Chapter 5 explores the range of alternatives to the tube-and-wing configuration using analytical methods. Chapter 6 is more a discussion of possible developments of the tube-and-wing, with analysis limited to CG envelopes, cruise efficiency and some aspects of structural weight.

Chapter 7 is a review of optimisation techniques leading in to Chapters 8 through 11 which address optimisation of empty weight, propulsion weight and MTOW, of engine size, wing configuration and wing weight. The treatment of the latter is much more extensive than in the earlier book. The outcomes of optimisation are demonstrated but it is left to readers to provide the data necessary to repeat the process for their own concepts contrary to the earlier approach.

The final chapter applies optimisation to cruise performance for concepts with known aerodynamic and propulsion characteristics. The method accommodates propeller and high-bypass power plants with thrust and fuel consumption sensitive to speed and