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BOOK REVIEWS

S. L. DIXON, **Thermodynamics of Turbomachinery** (3rd edition). Pergamon Press, Oxford (1978). 366 pp. Price $12.75 (flexi), $37.00 (case).

IN 250 pages of text and a further 100 of worked examples, the author provides a thorough account of the theory of turbomachine thermodynamics. Axial and radial machinery is analysed, together with cascade design and blading characteristics; cavitation and three-dimensional flows receive more detailed treatment than in earlier editions, and a list of symbols is now included.

The text contains few printing or grammatical errors although unattached participles (and confusion between p and ρ, and between singles and plurals) can be found, together with some mathematical slips such as that in equation (2.1) which defines mass flow. Generally, however, the book is both concise and clear which will greatly assist its use in education.

Using this book as an introduction to the state of the art, the reader might expect the author to have updated more of his references and included more new data. For example, in a reference to IFR gas turbines, "recent NASA design studies" prove to have been quoted in a paper dated 1959, and in several chapters it is difficult to find quoted work which is less than ten years old. However, since the book is more concerned with the essentials of turbomachine thermodynamics than with collation of recent data, these criticisms are of less importance.

The book should prove valuable to those students already having a grasp of thermodynamic fundamentals, and intending to specialize in turbomachinery. It is, however, essentially concerned with the latter and does not consider installation problems in much detail; even though the performance of a turbomachine cycle can be powerfully influenced by the characteristics of inlet and outlet components. Additionally the performance of turbomachinery at off-design conditions is of vital concern in many important applications and could perhaps have been given more space in the text. Within the constraints of its title, however, the book provides a coherent treatment of turbomachinery thermodynamics and, by concentration on this aspect, should provide third-year students and intending specialists with a firm grounding in the subject.

L. H. TOWNEND

A. M. A. REZK (Editor) **Heat and Fluid Flow in Power System Components.** Pergamon Press, Oxford (1979). £24.00 (U.S. price $55.00).

THIS book consists of a collection of 20 individual papers selected from a total of 170 which were presented at the Second Conference on Mechanical Power Engineering held at the Faculty of Engineering, Ain-Shams University, Cairo, Egypt, in September 1978. The reasons for the choice of the particular 20 papers included in this compilation are not quite clear, especially since it is stated in the Preface that all papers will appear in the conference proceedings. In spite of this apparent duplication of publication, the included papers do appear to be reasonably well written, of varying technical depth, and cover a relatively wide range of topics which are loosely grouped together under the books' stated title.

The papers are divided into three sections dealing with heat transfer in power system components, non-reactive (chemically) flows, and reactive flows, respectively. Papers in the first section primarily deal with the effects of various parameters upon the rate of heat transfer between solid surfaces and single or two-phase fluids, whereas papers in the second section are concerned with hydrodynamics in various geometries. The third section, consisting of just three papers, includes only combustion studies. The mix of papers encompasses the entire span of theoretical analysis to equipment performance, with a decided tilt towards the former. Some of the diverse topics included consist of forced convection heat transfer, condensation, film cooling, pool boiling, heat pipe performance, multi-pass heat exchangers, two-phase instabilities, turbine performance, impinging jet sprays, flame propagation and so on.

Individuals involved in basic research directed towards phenomenological understanding of power system components would find this book interesting. However, I do not feel that it would be a useful addition to one's personal library. University or corporate libraries may consider its purchase, especially if the complete conference proceedings are not available.

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FRANCIS G. SHINSKEY, **Energy Conservation Through Control.** Academic Press, New York (1978). £12.00.

IT IS well established, if insufficiently recognised, that improved control of energy intensive processes offers a prolific means of energy saving. Consequently a book on the subject, intended specifically for practising control engineers, is most welcome—especially when, as in the this case, the author is widely experienced in the field. At the same time, despite the title, it is not confined to either energy conservation or control, its essentially practical orientation ensuring that wider issues receive generous consideration, including such aspects as overall system design, economics, product quality and plant reliability.

Some indication of the scope of the book is provided by the chapter headings: Thermodynamics and Energy Conversion; Combustion Control Systems; Steam Plant Management; Compressor Control Systems; Refrigeration; Evaporation; Drying of Solids; Distillation; Heating, Ventilating and Air Conditioning. Excluding Chapter 1, which introduces the thermodynamic concepts of available work and irreversibility, each chapter reviews the basic features and characteristics of typical types of plant in the field in question, and goes on to deal with alternative control arrangements with particular (but by no means exclusive) reference to energy saving. Although the descriptions of plants will be of interest to those unfamiliar with them, and are notably comprehensive (the chapter on Heating, Ventilating and Air Conditioning, for example, includes both heat pumps and solar heating), it is in the treatment of control that the author's expertise really tells. Apart from his considerable practical knowledge of systems, his attention to detail is at times remarkable, extending not only to recommending suitable control parameters, but also to providing meticulous advice on instrumentation requirements. Herein undoubtedly lies the great merit of the book, which can in no way be dismissed as a mere theoretical treatise.

Inevitably there are some detailed shortcomings. Thus, while absolute rigour is not to be expected, the use made of approximations at times borders on the misleading. Examples of this are the extensive reliance on perfect gas relations, even when dealing with vapours, and the treatment of variables, such as plant efficiencies, as constant, resulting in a tendency to optimism in estimating the benefits of control system modifications. Lack of rigour extends also to the symbology and terminology used, no discrimination being made between absolute and Fahrenheit temperatures, and the somewhat confusingly termed "head at 100% efficiency" being used rather than enthalpy increase for a compressor (p. 156). Confusion of a different kind appears a possible effect of the derivation of available work relations (themselves unexceptionable) in Chapter 1, but it seems nevertheless unfortunate that these are not more fully exploited subsequently (notably in relation to refrigeration where the Carnot cycle is suddenly introduced instead, and in the 'entropy analyses' of mass-transfer processes). Finally, the absence of any reference to microprocessors–in part, no doubt, a reflection of the original date of publication—is noteworthy.

The above points notwithstanding the overriding impression is of the sheer quantity and quality of information packed into the 300 or so pages of this volume.

IAN J. G. BERRY

M. NECATI ÖZISIK, **Heat Conduction**. John Wiley, New York (1980). 687 pp. £14.90.

CONDUCTION heat transfer is a satisfying subject for both students and teachers of engineering science alike. It may be studied and taught at almost any level of mathematical and physical complexity; the physical significance of its problems and solutions are always apparent; and there are many non-experimental methods whereby the problems may be solved, including different analytical and numerical methods for a single problem. In addition it has its analogies in the fields of electricity and the diffusion of matter and momentum. For all these reasons, it can serve as a paradigm for the relationship between science, engineering and mathematics, including computer-driven numerical models. Of course there are already several outstanding, advanced works devoted to its study including Fourier's (1822), Carslaw and Jaeger (1946, 1959), Schneider (1955), Arpaci (1966) and Myers (1971). Professor Özisik's book is a worthy, welcome and timely addition to this collection, for although most of the topics in it are covered adequately in the earlier books, now they are brought together, carefully arranged, thoroughly discussed and conveniently presented.

In his preface the author states: "To follow the material in this book, all the reader needs is an understanding of the methods of advanced calculus and of the solution of elementary partial differential equations. The book is intended to contribute to effective teaching at graduate level and to serve as a reference volume for scientists, engineering graduates, and industry." This is a fair claim, though possibly one that somewhat underplays the the degree of mathematical fluency required for a ready assimilation of the contents.

The book is fairly comprehensive in coverage. The methods of solution include: separation of variables; integral transforms; Laplace transforms; approximate analytical methods; and numerical methods. Some are discussed for several co-ordinate systems, the basic equation having been presented earlier in general orthogonal curvilinear co-ordinates. A few chapters are devoted to special topics including: phase-change problems; non-linear problems; and composite and anisotropic media. Finite-difference numerical solution methods are also presented, but finite element methods have been intentionally excluded (for lack of space). Solutions of basic transient problems in chart form are not included, but these are readily available elsewhere. With space limited and an evident intention to deal thoroughly with methods of solution, it is inevitable that much less attention and space is given to engineering applications and illustrations than in some other books. Nevertheless, Professor Özisik's *Heat Conduction* can be warmly recommended.

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NORMAN CHIGIER (Editor), **Energy and Combustion Science**, Pergamon Press, Oxford (1979). 325 pp. £8.75 (U.S. price $19.50).

THE BOOK is composed of articles which have been selected from the first three volumes of the journal *Progress in Energy and Combustion Science* published since 1975. The objective of the editor was to gather a number of review articles which are ... "intermediate between the concise articles printed in scientific journals and the extensive treatment provided by textbooks"....

For a more attractive presentation, the volume has been subdivided into five sections, with the respective titles: Pollution, Gas, Oil, Coal and Engines. From this layout, one can see that emphasis has been given to the study of pollution. Indeed, the word "Pollution" is included in the titles of five chapters, out of a total of fourteen.

This volume can certainly be recommended as a textbook in the field of combustion, but, in my opinion, only for *post-graduate* courses at a rather high level. Furthermore, one can imagine that, to facilitate the teaching time-table, many professors will probably adopt a more conventional and more logical planning, starting with "Fundamentals of Combustion" and ending with "Pollution Control".

With such an objective we would suggest the following chronological order, for studying the book:

a first group of three chapters (5, 6, 7) is devoted to: "Fundamentals of Gas Combustion", with the following main topics: burning velocities, diffusion flame structure, laminar aerated-flames, catalytic flames and ignition. Special emphasis is given to turbulence theory, stream mixing and age mixing, with their influences on chemical reaction efficiencies;

a second group of four chapters (8, 9, 10, 11) concerns the "Combustion of Particles". The combustion of a single droplet of light fuel is first considered, then that of heavy fuel, afterwards the atomization and burning of liquid fuel sprays, and finally the combustion of solid particles;

a third group of three chapters (12, 13, 14) is devoted to "Spark-Ignition and Diesel Engines", specially to the influence of turbulence on efficiency, fuel economy and pollutant formation.

As a matter of fact, the formation of pollutants is examined by almost all the authors, in the course of the more general treatment of each topic.

However, a fourth group of three chapters (1, 3, 4) presents the general basis of "Pollutant Formation", Control and Destruction" in combustion.

Of course, the book does not cover all the aspects of combustion, but the topics which are discussed constitute a representative sample of the industrial applications of combustion science, and will thus be useful for teaching purposes.

The very large number of references given at the end of each chapter will also be very useful for students.

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