BOOKS

Thermal Radiation Heat Transfer, Second Edition, Robert Siegel and John R. Howell, Hemisphere Publishing Corporation, 862 pages, $32.00. A solutions manual is available. 1981

Since its publication nine years ago, the first edition of this book has become an essential reference and/or text for nearly everyone seriously interested in radiant heat transfer. Although much of the textual material of the second edition comes directly from the first, there have been several significant additions to and expansions of the topical content. Large numbers of new references make this new edition as up-to-date as its predecessor was when it was published. The strengths of the book lie in the clarity of its presentation, the breadth of its coverage, and the depth of its treatment. To this reviewer's mind, the authors have struck an excellent balance between these first two features and the somewhat conflicting demand of the third.

After a brief introductory first chapter, the next seventy pages are devoted to a clear exposition of black body principles, a good discussion of the meanings of the basic terms used in thermal radiation and an unusually fine exposition of the properties of non-black surfaces. One might have expected that at this point the authors would have launched into radiation exchange. Instead they break the thread a little by devoting the next eighty odd pages to a consideration of radiative properties of surfaces—first from the standpoint of classical electromagnetic theory and then, from the pragmatical basis of real materials.

The next 231 pages are given over to the problems of radiative exchange between surfaces separated by transparent media. The first five chapters of this section include a brief introduction followed by successive chapters on exchange between black, isothermal surfaces; exchange in enclosures with diffuse, gray surfaces; exchange in enclosures having some specular surfaces; and exchange between non-diffuse, non-gray surfaces. A chapter on Monte-Carlo approaches and one on radiation combined with conduction and/or convection complete this section.

The remaining half of the book is devoted to the important subject of radiation exchange where the imbedding medium is non-transparent and may be absorbing, emitting and scattering. A new chapter which has been added, the radiative properties of windows, coatings and transparent solids, will be of particular interest to those concerned with solar energy collection. The reader may be confused to find that this section contains a chapter titled Energy Transfer by Radiation Combined with Conduction and/or Convection. This sounds like a repeat of material referred to above as in the earlier section of the book, but here the imbedding media considered are non-transparent so that important new problems are considered.

A very useful feature of the book is a collection of eight appendices which contain valuable material for solving problems. Appendices B and C are particularly helpful for their extensive lists of data sources and selected equations for configuration factors. This reviewer would have been inclined to put Chapters 4 and 5 of the main text in with these appendices since their content is only secondary to the text's primary concern of solving problems of thermal radiation energy exchange.

In this reviewer's opinion, the book would be improved by some attention to Oppenheim's electrical analogy technique since, despite its limitations, it is appropriate for many practical problems even in this day of high speed computers. However, despite the complexity of the topics treated, any reader willing to read the chapters carefully should be able to understand the clearly presented material. There are a number of problems at the ends of the chapters and, with the solutions manual at hand, the book is ideal for self-study.

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A Heat Transfer Textbook by John H. Lienhard, Prentice Hall, 1981, 516 + xi pages; price $24.95

This is an excellent text for undergraduates in either Mechanical or Chemical Engineering. The organization, which differs markedly from most such texts in some respects, is quite effective. It is aimed at junior or lower-senior level. It is of proper length for two quarters, but too long for full coverage in a single semester of fourteen to fifteen weeks. (This is true, however of most texts of this type). Given these conditions, coverage is as comprehensive as possible and presentation clear, readable and logical. A semester of fluid mechanics is an essential prerequisite.

The first two chapters are conventional in format: general discussion of the modes of heat transfer; the concepts of thermal conductivity, diffusivity and specific heat; Fourier's Law, Newton's law of cooling, thermal resistance and the overall heat transfer coefficient.

The third chapter covers the design of heat exchangers. This is a rather radical departure from the sequence usually observed. As a result, these three chapters constitute a "mini-course in heat transfer" (the author's comment). This is not to imply that one might stop at this point, but rather that the first three chapters present both basic concepts and industrial complexities; and, that much of the rest of the book fills in the details called for by the first three chapters. In chapter three, for instance, convective heat transfer coefficients are used but the prediction of these coefficients is covered in subsequent chapters. As a pedagogical device, this arrangement may prove valuable to the student by giving him a good general view of the course during the first few weeks.

Chapter 4 through 6 cover conduction. These are conventional in format, very clear, with good illustrations. Chapter 6, on numerical analysis (by Dean Roger Eichhorn, University of Kentucky) is exceptional well written but is lacking in 3-dimensional unsteady state problems, — a fault which can be repaired easily by an instructor.

Chapter 7 through 10 on convective heat transfer are excellent. The selection of material, emphasis and mode of presentation are all very good. The coverage of natural convection, film condensation and boiling phenomena will appeal particularly to chemical engineers.

The final chapter (11) covers radiation. The presentation is such that it could be used at almost any point in the course after the first three chapters. The treatment is briefer than usual, but covers all of the material which is needed for undergraduates.

The use of dimensional analysis occurs in the discussion of conduction; and is brought up repeatedly thereafter as required. It is assumed that the student is already acquainted with the methodology in a fluid mechanics course.

The problems are adequate in number and well chosen. A complete solution manual (which has been examined by the present reviewer) will be available to users in May or June. The presentation is almost entirely in S.I. units. This will cause some difficulty for earlier users since American industry is still overwhelmingly carried on in "English" units. The absence of a nomenclature table is a specific fault.

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