# BOOK REVIEWS

Selection of books for review is based on the editor's opinions regarding possible reader interest and on the availability of the book to the editor. Occasional selections may include books on topics somewhat peripheral to the subject matter ordinarily considered acceptable.

## Analysis and Evaluation of Extended Surface Thermal Systems

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| *Author* | Allan D. Kraus |
| *Publisher* | Hemisphere Publishing Corporation, New York (1982) |
| *Pages* | 560 |
| *Price* | $69.95 |
| *Reviewer* | Clifford J. Cremers |

There have been many papers published in the past on extended surface heat transfer. Also, textbooks usually include the solutions of problems of single fins with simple geometries as illustrations of solving a simple form of the heat balance equation. However, it was not until the above author combined with Donald Q. Kern to write *Extended Surface Heat Transfer* (McGraw-Hill, New York, 1972) that much of the material from the literature was brought together under a single cover. Between them, the authors combined their extensive practical experience with heat exchanger design and the cooling of electronic circuits to produce a most useful work. With the present monograph, Professor Kraus goes further and shows in detail how one can combine established solutions for heat transfer from single extended surfaces along with concepts from circuit analysis and graph theory plus the constraints of energy conservation to develop methods for treating very complex arrays of finned surfaces.

The reader is led from a presentation of the fin problem, usually given in undergraduate heat transfer texts, to a slightly different view of the same thing. As the analyses in the book are all restricted to uniform properties and conditions with convective cooling in a one-dimensional situation, the solution of the energy equation is generalized by treating the problem as an initial value one rather than as a two-point boundary volume problem. This results in a linear transformation matrix relating the excess temperatures ($T - T_\infty$) and the heat fluxes at the base and tip of the fin. In this form, the conditions at one end of the fin are given in terms of those at the other so this is of limited use.

The problem is then manipulated into a "two port" one in which any two of the four variables of interest, the two excess temperatures and heat fluxes, can be written in terms of the other two in terms of a set of "two port parameters" that are the four components of the coefficient matrix for the particular problem. For the six possible combinations of the two heat fluxes and two excess temperatures, he reduces all the matrix representations to the form of what he refers to as transmission or inverse transmission parameter matrices. Relationships are then derived between the parameters for all six possible combinations of dependent and independent variables. At this point, the reader is equipped with the general background needed to analyze fins of various geometries within the constraints mentioned above. Three chapters are subsequently devoted to determining the matrix coefficients for several common longitudinal fin shapes, radial fins and spines, and singular fins, which include geometries where the problem cannot be reduced as described above.

All this is preparation for the analysis of thermal systems as announced in the title. With the matrix representations developed as above, four chapters are devoted to the analysis of systems: "Algorithms for the Combination of Fins and Spines," "Node Analysis of Finned Arrays," "Signal Flow Analysis," and "A General Array Method." In these, algorithms are developed for the combination of fins and spines into arrays of extended surfaces in parallel, series, and cluster arrangements. The "glue" joining the components together is the temperature and heat flux continuity that must exist at each junction point. These chapters are well supported by examples that get into odd geometrical arrangements but which illustrate the power of Kraus' methods. For example, looking at the figure accompanying one of the problems, it can be seen how this material might be used to aid in the analysis of dendritic crystal growth as one possibility aside from the normal fin problems. The author caps his work with a final chapter in which he presents a general purpose computer program written in FORTRAN IV. With the background given earlier, this can be used to solve a wide variety of very complex extended surface problems subject to the constraints presented above.

This book is well written and quite readable. There is sufficient detail in the development of all the working equations that the reader need not have any more than an undergraduate level familiarity with heat transfer and matrix algebra to use the material effectively. Anyone dealing with the analysis of convective heat transfer in complex geometries should find this book well worth having.

*Clifford J. Cremers (PhD, University of Minnesota, 1964) served on the faculty of the Georgia Institute of Technology and is currently professor and chairman of the Department of Mechanical Engineering at the University of*

*Kentucky where he has been since 1966. He teaches courses across the spectrum of the thermal sciences and has published more than 60 papers on heat transfer in plasma systems, heat transfer in frost layers, and thermophysical property measurement.*

### Computational Methods in Reactor Shielding

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| *Author* | James Wood |
| *Publisher* | Pergamon Press, Inc., Elmsford, New York (1982) |
| *Pages* | 441 |
| *Price* | $19.50 |
| *Reviewer* | Nicholas Tsoulfanidis |

This book would be very useful to practicing nuclear engineers, especially those involved in "small" shielding problems like designing the shield for a spent fuel assembly or any other portable radioactive source. The book would not be terribly useful to those who want to learn how to design a complete shield for a nuclear reactor. For educational purposes, *Computational Methods in Reactor Shielding* could be used for an undergraduate course and as a supplement to a course for graduate students.

I enjoyed reading the first five chapters. I loved the way the author presents concepts, definitions, and quantities of interest. After a brief introduction describing the structure of the book, the author discusses, in Chap. 2, "Radiation Quantities and Units." The SI units are given in an Appendix only, a surprising omission, since for quite a few years the SI units have been in use along with the rads and rems. The gamma-ray flux-to-dose rate conversion curve is given without a proper reference and it does not coincide with the ANSI/ANS-1977 standard.

"Radiation Sources" are described in Chap. 3 in an excellent form except for Table 3.3, which contains many numbers impossible to read (unfortunately this defect, which is due to the publisher and not the author, is present again in Tables 6.1 and 6.2). In Chap. 4, the "Attenuation of Gamma Rays" is discussed lucidly and succinctly. The concept of the buildup factor is presented very well and a computer program is provided for the calculation of a buildup factor for multilayer shields.

The "Applications of the Point Kernel Technique" make up Chap. 5. All the geometries encountered in practice are included, and the program CASK is supplied for the use of the reader. Many exercises based on CASK are included, exercises which make excellent educational tools if the book is used for instruction.

In contrast to the first five chapters which are excellent, in my opinion, the last two dealing with "Neutron Attenuation" and "Transport Theory Methods" are somewhat disappointing. There is a disparity here, in the following sense: The first five chapters deal with point isotopic sources in simple geometries for which the point kernel techniques apply, especially for photons. For neutrons, however, the same techniques have only limited value and one needs to perform transport calculations. Chapter 7, titled "Transport Theory Methods," would be expected to provide what it claims, but it does not. It discusses the Monte Carlo method in great detail, which is fine. Then, it presents the moments method, which was developed mainly for gammas and has found very limited use in the last 10 yr, perhaps longer. The discrete ordinates method, the main method widely used for both neutrons and gammas (along with Monte Carlo), is missing. This is a major defect in an otherwise very good book.

*Computational Methods in Reactor Shielding* will make a fine addition to a practicing nuclear engineer's library. The only other similar book available is Schaeffer's *Reactor Shielding for Nuclear Engineers*. Having seen both, I side with Mr. Wood's work.

*Nicholas Tsoulfanidis is professor and chairman of the Nuclear Engineering Department at the University of Missouri-Rolla. His undergraduate training in physics was at the University of Athens, Greece followed by graduate studies in nuclear engineering at the University of Illinois. Dr. Tsoulfanidis' research areas are radiation transport and nuclear fuel cycle. He is the author of a book,* Measurement and Detection of Radiation, *published in 1982, and of many technical papers.*