Int. J. Heat Mass Transfer. Vol. 5, pp. 1207–1208. Pergamon Press 1962. Printed in Great Britain.

BOOK REVIEWS

Bessel's Functions and their Application to Problems on Cylinder Cooling: P. P. YUSHKOV, Byelorussian Academy of Science Press, Minsk, 1962 (Funktsii Besselya i ikh prilozheniya k zadacham ob okhlazhdenii tsilindra), 170 pp.

SCIENTIFIC literature devoted to Bessel's functions is very extensive. There are excellent monographs on the Bessel functions in Russian and foreign languages. Some of them are very successful among mathematicians and physicists.

However, for persons who graduated from an ordinary Engineering Institute it is very difficult to study the theory of Bessel's functions with the help of these monographs. This is partly explained by the fact that when considering cylindrical functions of any order it is also necessary to know some special sections of mathematics which, at Engineering Institutes, are not being studied thoroughly enough, if at all.

Meanwhile many mathematical-physical problems of direct technical applications, in particular, those connected with the study of a physical state of bodies of cylindrical symmetry cannot be solved without clear representation of main properties of the Bessel functions, mainly, of zero and first orders.

This monograph is a successful attempt to simply elucidate complex special questions. For example Chapter I does not give any special mathematical knowledge except elementary representation from the theory of power series and linear differential equations of the second order. The author accompanies his exposition by very useful applications of the theory of the Bessel functions to the basic problems of thermal physics of non-stationary processes.

This book consists of five chapters.

Chapter I deals with the Bessel functions of material argument. It thoroughly studies functions of zero and first orders of the first and second kind and includes some formulae refering to functions of the n-th order without any proof.

A number of formulae, containing the Bessel functions which are important for engineering purposes, are derived in Chapter I, Section 7. The last sections are devoted to the expansion of functions in Fourier–Bessel's series. Information on the most widely used tables of the Bessel functions with a short characteristic of these tables is very useful for practical workers.

Chapter II includes applications of the theory of the Bessel functions to problems on a heat state of an infinite solid cylinder. At first the concept on initial and boundary conditions in problems of mathematical physics is given, and transformation of the Laplace operator to cylindrical co-ordinates is presented. The solution of the Fourier equation under various boundary conditions of the first and third kind by the classical method of separation of variables is considered in detail.

Sections, analysing the solutions obtained, are useful for practical application of the formulae obtained.

The last section of Chapter II presents an equation for heat rate and at the same time establishes some relations between roots of those transcendental equations, containing the Bessel functions, which we may come across while solving problems on a heat state of a solid cylinder.

Chapter III describes temperature fields of an infinite hollow cylinder in which the Bessel functions of both the first and second kind are obviously used. Here problems are solved only by the method of separation of variables, at first the simplest problem at zero temperature of surfaces being considered and then it is gradually complicated. For example, Section 19 deals with a temperature field of an infinite tube, the internal surface of which is maintained at constant temperature and an external one is thermally insulated.

Sections 20–21 consider just the same problem in the presence of a constant heat source and in Section 23 the heat source is a time function. It is valuable that the author gives references in which it is possible to find information on roots of transcendental equations, containing the Bessel functions of the first and second kind. The table of the first roots depending on the relation of an external cylinder radius to an internal one is given for one of such equations.

Chapter IV gives main information on the Bessel functions of imaginary argument. Here much attention is paid to the Bessel functions of the first and second kind of zero and first order. The aim of two sections is to acquaint a reader with the available tables of the Bessel functions of imaginary argument and their plots. A short discussion of the Hankel functions is given at the end of this chapter. Theoretical results of this chapter are used in the following chapter.

Chapter V deals with the application of integral transformations to problems on cooling of solid and hollow cylinders. In this monograph the infinite integral Laplace transformation is presented rather concisely, because the author thinks that this question is thoroughly developed in excellent monographs of A. V. Luikov, H. Carslaw and J. Jaeger.

Hankel's finite integral transformations are given in detail. With the help of these transformations the problems earlier considered in Chapters II and III, are solved again in some sections, and heat conduction problems for more complex cases may be easily solved in the presence of inversion formulae obtained while studying the simplest problems. Section 35 presents the problem on a heat state of a hollow cylinder under boundary conditions of the third kind.

This monograph is written with great pedagogical skill, contains some of the author's results and is thoroughly edited. We may hope that it appears to be very useful for persons who wish to get acquainted with the fundamentals

of the theory of cylindrical functions and to use these mathematical methods to solving applied problems.

The edition of this monograph is excellent and to our mind it will be of great use for specialists in applied thermal physics and designers. It is a pity that only a small number of copies of this monograph is published.

K. I. STRAKHOVICH

Fundamentals of Radiation Heat Transfer: A. G. BLOKH, Gosenergoizdat, Moscow–Leningrad, 1962, 330 pp.

AT THE present time engineers and students of senior and post-graduate courses concerned in their work with the problems of radiative heat transfer and corresponding engineering calculations often use for their work separate sections of general books available on heat transfer.

Rare monographs, specially devoted to radiation heat transfer, are either out of date or elucidate only separate narrow problems. In general, in books on heat transfer chapters dealing with radiation are usually incomplete. They contain pure phenomenological presentation of the principal radiation laws, methods for calculation of the simplest cases of radiation heat transfer of bodies in a transparent medium, and general data on radiation of triatomic gases.

The problem of radiation of dusted media and luminous flames, methods for calculation of furnaces, etc. are almost not discussed and relevant material is completely unavailable. Methods for measuring radiant flows, temperature and emissivity of flame and some other measuring technique problems are badly elucidated.

These works are not systematical text-books which are to help readers to study profoundly the fundamental problems of the radiant transfer theory and its application to the solution of many problems in thermal engineering.

Therefore, publication of *Fundamentals of Radiation Heat Transfer* by A. G. Blokh—designed for thermal engineers, students of senior and post-graduate courses of thermal engineering—is a very welcome event.

This book, filling an urgent want in literature on heat transfer, proves of tremendous value and interest.

The book contains seven chapters discussing all the basic problems of radiation heat transfer which are extremely important for various branches of thermal physics and thermal engineering.

Chapter 1 deals with the basic laws of black body radiation. The second chapter is devoted to radiation of non-black bodies.

Chapters 3 and 4 deal with fundamental problems of radiative heat transfer in transparent absorbing and dispersed media. In the fifth chapter experimental data on turbid media radiation are presented, including the data of the author's original works on dusted flows.

The sixth chapter is devoted to heat transfer in furnaces of steam boilers. Here experimental data of the author on absorbability of a dust coal torch are presented which show the necessity to revise some methods for heat-transfer calculation in boiler furnaces such as for calculation of emissivity of a boiler furnace.

Chapter 7 presents some principal problems of experimental methods for radiative heat-transfer investigations.

The book is very well written, both lucid and concise. The author has found an adequate approach to presentation of complicated problems of radiative heat transfer. In this book greater attention is given to physical mechanism of radiative heat transfer than in other available engineering works on heat transfer.

Therefore, the book by A. G. Blokh may be of great use for different engineering investigations, for designing high temperature thermal engineering apparatuses, and for the choice of special radiation measuring instruments, etc. In all these cases one should know how radiative heat transfer will change with these or those working conditions (e.g. when new fuel or conditions of burning are used).

This is the first systematic presentation of vast material on absorption and dispersion of heat radiation of solid particles, spectral and integral absorptivity of dusted flows, radiation of luminous flames, etc. available in thermal engineering literature.

Derivation of the Planck formula according to Einstein appears to be sound. Peculiarities of dielectrics and metals are discussed fairly completely for thermal engineers. A detailed analysis of heat-transfer problems in dispersed media is given.

The book contains a wealth of experimental facts on various problems of radiative heat transfer, such as radiation of turbid media, which are treated in the book from a fairly elementary and qualitative point of view.

Thermal engineers will find much of interest and value in numerous materials of different works and papers which are presented in the book in the form allowing the reader to profoundly study recent data on the considered problem.

The author makes an attempt to give the reader an idea of physical nature of semi-transparent media radiation and in most cases his attempts are successful. Furthermore, the author avoids long and tedious calculations of geometrical character with simplified and often physically unsound notions of the essence of the processes of radiative heat transfer.

Heat transfer by radiation is of great importance in the operation of various thermal apparatuses such as steam boilers, furnaces, etc. Therefore the author is quite right to include a chapter on heat transfer in boiler furnaces describing specific radiation processes in industrial plants and possibility to use the general regularities and presented experimental materials for calculation of heat transfer by radiation.

Publication of the book under review, which is an authoritative text-book for all workers in this field, is an important event.

This valuable monograph on heat transfer is a great contribution to the general theory of heat and mass transfer.

I. I. PALEYEV