Int. J. Heat Mass Transfer. Vol. 7, pp. 401–403. Pergamon Press 1964. Printed in Great Britain

BOOK REVIEWS

Guide to the Application of the Laplace Transforms: GUSTAV DOETSCH. D. Van Nostrand Company Ltd. Translation Editor: W. A. MC.A. FAIRBAIRN. 225 pp. 45*s*.

PROFESSOR DOETSCH is an authority on Laplace transforms. In the present book he is mainly concerned with those results and methods of the general theory which are of particular interest in physical applications. Conciseness and clarity are achieved by stating certain theorems, stressing the conditions under which they hold, and referring the reader to an earlier work for the proofs. This enables the author to follow various important routes through the theory without overwhelming the reader with too much detail. Furthermore, this approach has allowed such topics as boundary conditions to be discussed more deeply than is usual.

The applications of the theory to problems in electrical engineering form the basis of the book. For this purpose, the range of topics discussed is admirable. At the outset, a physical meaning is developed for the Laplace transform from the theory of Fourier series and the Fourier integral. This is followed by chapters on those Linear Differential Equations, Finite Difference Equations, Linear Partial Differential Equations and Integral Equations, to which the Laplace transform technique is applicable. The chapter on Finite Difference Equations leading to the Z-transform and sampled-data systems, is particularly good.

The book is rounded off with a discussion of the complex inversion formula and a brief chapter on asymptotic expansions. Stability is discussed in a paragraph and some of the standard methods are not mentioned. There is a useful table of Laplace transforms at the end of the book.

J. MURPHY

Engineering Heat Transfer: SHAO TI HSU. D. Van Nostrand, 1963, 613 pp.

TEXT-BOOKS on heat transfer, once so scarce, are now abundant, and prospective authors on this subject must surely ask themselves if they have anything new to offer before they set pen to paper. This remark applies, of course, to the senior undergraduate and uninitiated graduate level, for whom the preface of this new book tells us it is intended; at higher levels, there will be a continuous need for texts which explain and summarize the results of recent research advances. Lately there has been something of a vogue for giving the whole subject a slightly new look by exploiting the similarities of convective heat transfer processes with those of momentum and mass transfer, and producing text-books which deal with all three. At least two have appeared so far, bearing titles which contain different permutations of the words mass, momentum and heat—four other possibilities remain!

Although Professor Hsu's book does contain short chapters on fluid flow (*alias* momentum transfer) and mass transfer, the major part is devoted to heat transfer and the general treatment is fairly conventional. Separate chapters deal with the different modes, heat-exchangers, thermal properties, etc. and much factual information and many useful explanations are given. It is probably in the latter respect that this book differs from most of its predecessors. The author has clearly gone to a great deal of trouble to give full accounts of many of the simple yet basic notions which tend to be glossed over in other contemporary works. Explanations are generally presented in a commendably lucid form but there are, alas, occasional lapses in accuracy and rigour which hinder and confuse the arguments. Partial differentials mysteriously change into full differentials and similar triangles have to have corresponding sides parallel as well as proportional! Furthermore, certain statements occur which could, by their emphasis, be misleading to the unaided student as, for instance, the closure to the section on dimensional analysis which states that ". . . it is *quite useful* in correlating experimental data" (reviewers italics).

Treatment of the different topics is, in most cases, comprehensive but the cursory account of the heat and momentum transfer analogy is surprising, the Prandtl–Taylor, von Kármán and subsequent developments being mentioned only by name. The book is well supplied with worked examples, references and end-of-chapter exercises, the numerical answers to which are, for some curious and unexplained reason, given for the even-numbered ones only.

As a first book on this subject, there are strong points in its favour and it might well be recommended to the newcomer. For the initiated, the advantages of the book appear to be marginal as it is not likely to contain much in excess of what will already be available in other more compact but less didactic texts.

H. COHEN

Hydrodynamics and Heat Transfer in a Fluidized Bed: S. S. ZABRODSKY. Gosenergoizdat, 1963, 488 pp., 1.61r.

THE book under review deals with a promising industrial process with a wide range of applications. Topics covered in this book are dealt with in scores of works published annually and are discussed at meetings and symposia.

The appearance of S. S. Zabrodsky's monograph is timely and useful as it sheds light on and, in many respects, generalizes a vast mass of information compiled by numerous investigators of various countries.

On a number of subjects the author advances and justifies his own original viewpoint. Even though some of them remain debatable, it will stimulate progress in this field of science, foster better understanding of the complicated phenomena of hydrodynamics and heat transfer in a fluidized bed and in other fluid–solid systems considered.

The author has aimed at the difficult task of providing different specialists with a guide to conscious and creative application of fluidization in their field. He has largely succeeded thanks to his permanent desire to penetrate the mechanisms of complicated phenomena and to convey them with sufficient simplicity.

Model (analogy) presentation and, on its basis, analysis of experimental results allowed the author to separate main things from minor ones, systematize and explain a great deal that had previously appeared anomalous.

The book is notable for progressive exposition of the material. The book starts with a discussion of the fixed bed and fluid flow through it. This is followed by consideration of the onset of fluidization for fixed and moving beds. The author presents also an original approach to the problem of an inlet distributor design.

An original expression is derived for the efficiency of lifting of solid material by means of fluidization. The expansion of particulate and aggregative fluidized beds is considered. The causes of irregular change in fluidized bed non-uniformity with increasing fluid velocity are analysed, and the author explains the re-appearance of bed uniformity at high fluid velocities.

An interesting suggestion is advanced in which the mechanism of particle separation by their size in uniform and non-uniform fluidized beds is revealed.

Brief mention is made of a suspended bed, i.e. a system that follows a fluidized bed at high fluid velocities, and a "falling" bed. The author shows the dependence between choking velocity of the vertical pneumatic conveying and feeding rate of material. The causes are explained and the conditions of unstable operation of a "falling" bed are shown.

Further, when studying a spouted bed, the author draws a generalized analogy with channeling at fluidization.

Elutriation from a fluidized bed is a phenomenon of great importance in the practice of industrial fluidization. The experimental data are analysed in the light of a more basic idea of the mechanism of the process.

The author offers a convincing solution to the most intricate and principal problem of heat transfer between particles of a fluidized bed and the surrounding medium. He explains the possibility of combining the classical idea on rather high minimum values of Nu for a particle with very low effective values of Nu for fine particles obtained in experiments on measuring mean fluid and solid temperatures. He suggests and justifies the idea of the most significant role of micronon-uniformity of fluid distribution in a bed, flow "micro-breaks" confined to small regions in a bed. The importance of slight invisible aggregation of particles is shown. A means of intensifying heat transfer between a gas and particles of a fluidized bed are outlined. The reason for the lack of good correlation of the type $Nu = f(Re)$ for agreggative fluidized beds is explained.

The data available on the effective heat conduction of fluidized beds are analysed, and recent advances in this field made by the author's research group are briefly covered.

Full consideration is given to the important problem of heat transfer between a fluidized bed and a heating (cooling) surface immersed. With the help of the model proposed, theoretical expressions have been derived for the heat-transfer coefficient of a uniform fluidized bed. The analysis of experimental data proves these theoretical expressions to explain many results obtained in experiments on aggregative fluidized beds. For a more profound analysis of heat transfer between an aggregative fluidized bed and heating surfaces, the author has suggested a more adequate theoretical model than those available, that takes into account particle diameter in aggregates (packets).

Conception on effective porosity of an aggregative fluidized bed has been introduced and justified as a measure of relative contacting time of a heating surface with pure fluid (discontinuous phase). A simple experimental way of determining effective porosity is demonstrated.

Fresh experimental data obtained by the author's coworkers on some interesting details of heat transfer between an aggregative fluidized bed and heating surfaces is cited: as on cavity formation at one side of horizontal and vertical tubes immersed in an aggregative fluidized bed. Frequent agreement in average values of the heat-transfer coefficient in spite of great divergence of local values is revealed.

The concluding chapter of the book meets the demand for overcoming the shortcomings of fluidization as a technological method, or, as the author points out, it shows how the characteristics of a fluidized bed can be altered at will.

S. S. Zabrodsky's monograph is also valuable because it provides an excellent systematic survey of present-day knowledge in this field, information which is scattered throughout the scientific literature and, mainly, periodicals. Original solution of a number of important problems is of great interest.

The book is therefore a valuable contribution to the heat- and mass-transfer theory of dispersed media.

This is a book which can be recommended for translation into English.

A. V. LUIKOV

Proceedings of the 1963 Heat Transfer and Fluid Mechanics Institute: Ed. A. ROSHKO, B. STURTEVANT and D. R. BARTZ. Stanford University Press. 288 pp. 70*s*.

THIS volume contains a collection of eighteen papers presented to the sixteenth annual meeting of the Heat Transfer and Fluid Mechanics Institute, which was held