BOOK REVIEWS

Methods of advanced calculus. By Philip Franklin. McGraw-Hill Book Company, Inc., New York and London, 1944. xii+486 pp. $4.50.

By a careful selection of material the author of this handy book has put into a small volume a wealth of material which should enable a student to acquire some skill in the type of mathematics which he will want to use in his scientific work. Conformal representation, special functions and the partial differential equations of mathematical physics are among the topics that are treated.

Tests are given for the convergence of integrals but the convergence of infinite series is not discussed at length as in many books on advanced calculus. It is thought that the student should get his knowledge of this subject from another text. Books have indeed been written on this one topic.

There are useful chapters on vector analysis, complex variables, elliptic integrals and differential equations. Problems in maxima and minima and in the calculus of variations are also considered.

The skill acquired by solving some of the numerous examples included in the book will give the would be researcher a start in mathematical analysis but he will generally find that his knowledge of the subject is not sufficient to enable him to complete the solution of a problem occurring in practise. He may need the solution of a transcendental equation or some values of a special function. The provision of adequate tables of functions may eventually make it unnecessary for many men to become familiar with the numerous properties of particular functions and the many special devices for solving transcendental equations. Newton's method is, however, explained in the text and is shown to be a special case of the method of the reversion of series.

H. BATEMAN

Modern operational mathematics in engineering. By Ruel V. Churchill. McGraw-Hill Book Company, Inc., New York and London, 1944. X+306 pp. $3.50.

This is a textbook on applications of the Laplace transformation. In the first chapters the transformation is introduced and its elementary properties are deduced and applied. In the third chapter the applications are made to physical problems involving ordinary differential equations, while in the fourth chapter they are made to such problems as the vibrating string and heat transfer (one-dimensional) in solids, which involve partial differential equations.

These chapters are intended for the use of students having little or no experience with partial differential equations. The exposition is straightforward and clear, the notation is adequate and simple, and the numerous problems appear to be well-chosen. Care is taken in every deduction to indicate the restrictions imposed on the functions as to continuity and asymptotic behavior. An interesting section showing how the Laplace transformation may be used to aid in evaluating definite integrals involving parameters is included. Of particular importance is a section at the close of Chapter IV in which the generality of the methods of that chapter is inspected. The necessity for the limitation to linear equations is pointed out; some of the other limitations and also advantages of the methods are explained.

The fifth chapter consists of a rather concise synopsis of the fundamental properties of functions of a complex variable. The various methods of recognizing an analytic function are shown; various types of singularities are defined and illustrated; the fundamental ideas of residue theory are introduced. This chapter is carefully constructed and will serve adequately for reference or review, especially for readers who are already acquainted with the subject. With this background, in the following chapter the contour integral that is the inversion of the Laplace transformation is set up and discussed. A series of ten theorems is proved, having to do with the properties of Laplace transform in the complex plane and the validity of the inversion integral. The restrictions on the function and transform in most of these theorems are rather severe; it seems possible that this is due to the author's having attempted to achieve generality without using advanced mathematical methods. Useful methods of deforming the contour of integration in special cases are illustrated.

In the next two chapters the complete theory now available is applied to boundary-value problems in heat conduction and mechanical vibrations. These applications are characterized by rather extreme attention to the restrictions imposed in the theorems of the preceding chapter. The author points out that the solutions obtained by formal use of the transformation and its inversion can be verified by showing that they satisfy the conditions of the boundary-value problem; nevertheless, in some examples he analyzes them at great length to show that they satisfy the conditions required at infinity, etc., for the theorems, and therefore are valid solutions. It seems doubtful that this material is useful in an engineering course, since engineers are unlikely to adopt such techniques in preference to the more direct procedures.

The reviewer notes the absence of any explicit statement of the well-known methods of determining the initial and asymptotic behaviors of a function by expanding its transform for large and small values of its argument, respectively (see, for example, Doetsch: Theorie und Anwendung der Laplace Transformation; Berlin (1937) p. 243). In engineering applications these methods have been found to be extremely useful.

The final chapters are concerned with Sturm-Liouville systems and finite Fourier transforms, respectively, although these subjects are not intimately connected with the Laplace transformation. This discussion of Sturm-Liouville systems, while concise, represents a sort of generalization that engineers and physicists will find instructive and useful. The finite Fourier transform, however, seems to the reviewer to be a rather artificial conception of little practical importance.

The textbook includes tables of finite sine and cosine transforms, a table of operations (properties of the Laplace transformation), and a rather complete table of Laplace transforms (122 entries).

W. R. SEARS

Chemical engineering nomographs. By Dale S. Davis. McGraw-Hill Book Company, Inc., New York and London, 1944. ix+311 pp. $3.50.

This book is a collection of over 200 nomographs relating to problems in chemical engineering. The accompanying text consists of a discussion of the validity, application, and limitations of these charts, and directions for their use. As a reference textbook for chemical engineering coursework, it would be particularly valuable as a companion volume to the earlier work, "Empirical Equations and Nomography," by the same author. To a practicing engineer, the most important feature of the book is the excellent selection of nomographs. This selection was made from a total of 600 sources; "in most instances, the hundreds of requests for reprints . . . during the past 14 years have guided the choice."

The 19 chapters of the book may be divided roughly into three types:

(1) Those dealing with unit operations (e.g., flow of fluids, distillation, extraction, etc.).

(2) Those giving a specific property (e.g., density, viscosity, thermal conductivity or vapor pressure) of a wide range of substances. Vapor pressure-temperature-concentration relations are particularly well covered.

(3) Those giving a wide range of properties for a particular set of materials; e.g., acid nomographs, milk and cream nomographs, and a large group devoted to problems of the paper industry.

The charts are well grouped and indexed and are printed in a form large enough to be read easily.

R. LEININGER

Tables of Lagrangian interpolation coefficients. Prepared by the Mathematical Tables Project, Work Projects Administration of the Federal Works Agency; conducted under the sponsorship of the National Bureau of Standards. Official Sponsor: Lyman J. Briggs. Technical Director: Arnold N. Lowan. Columbia University Press, New York, 1944. XXXVI+392 pp. $5.00.

The main tables give the Lagrangian interpolation coefficients for interpolation polynomials of the degrees two to ten. The following list gives the range and interval of the argument, and the number of decimal places in the usual notation, the arguments of the equidistant given values of the function being denoted by 0, ± 1, $\pm 2, \cdots$: three point formula [−1(.0001)1; exact], four point formula [−1(.001)0(.0001)1(.001)2; 10D], five point formula [−2(.001)2; 10D], six point formula [−2(.01)0(.001)1(.01)3; 10D], seven point formula [−3(.01)−1(.001)1(.01)3; 10D], eight point formula [−3(.1)0(.001)1(.1)4; 10D], nine point formula [−4(.1)4; 10D], ten point formula [−4(.1)5; 10D], eleven point formula [−5(.1)5; 10D]. Additional tables give three- to eight-point interpolation coefficients for intervals of .1 particularly suited for the purposes of subtabulation, three- to eight-point interpolation coefficients in fractional form for intervals of 1/12, and Lagrangian integration polynomials and coefficients.

W. PRAGER

A treatise on the theory of Bessel functions. By G. N. Watson. Second Edition. Cambridge University Press, Cambridge, England. The Macmillan Company, New York, 1944. viii+804. $15.00.

For those already familiar with Watson's "Bessel Functions" a new edition needs no recommendation, and indeed the fact that a second edition has appeared in the midst of wartime difficulties is in itself sufficient evidence of the book's importance. Only a few minor corrections have been made at this time, but it is still cause for rejoicing that "Watson" is once more readily available. In the preface to the new edition the author regrets that his interest in Bessel functions has waned since the book was first published, and rightly remarks that to have included all the new material which has appeared in the last twenty years would have meant rewriting most of the book. It is unfortunate that he did not find it possible to bring at least the bibliography up-to-date so that for recent work we must still look elsewhere.

Nonetheless, the book remains an invaluable compendium of information for any mathematician whose work ever touches on Bessel functions. While the presentation is mostly designed for the pure mathematician the applications are not completely neglected, and the applied mathematician will find it particularly useful if he regards it as a treatise on the theory of functions of a complex variable, with applications to Bessel functions.

If there are any applied mathematicians whose work has not so far brought them into contact with "Watson" a brief list of some of the topics treated may prove illuminating. Such a list, by no means complete, would include: solutions of Riccati's equation, expansion of functions in series of Bessel functions (including Fourier-Bessel, Dini, Kapteyn and Schlömilch series), addition theorems, methods of evaluating definite and infinite integrals, asymptotic expansions for Bessel functions of large argument and of large order (using the principle of stationary phase and the method of steepest descents), determination of the zeros of Bessel functions, and last but by no means least, tables of various Bessel and related functions.

Both author and publisher are to be congratulated on the successful reissue of this classic treatise. May it long remain in print.

M. C. Gray