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Book reviews

R. Bellman, **Perturbation techniques in mathematics, engineering and physics,** Dover Publications, Inc., New York, 1972, 118 pp. price $2,—.

This Dover edition is a republication of the work originally published by Holt, Rinehart and Winston, Inc. in 1966. A German translation was published in 1967 by R. Oldenbourg Verlag, and reviewed in the Journal of Engineering Mathematics, Vol. 2 (1968), p. 152.

The booklet provides an introduction to a number of perturbation techniques for ordinary differential equations, the manipulations being outlined through specific examples. There are three parts: 1. Classical perturbation techniques, 2. Periodic solutions of nonlinear differential equations and renormalization techniques, 3. The Liouville–WKB approximation and asymptotic series.

The work is not very up-to-date: well-known perturbation techniques such as the method of matched asymptotic expansions or two-variable expansions, being used frequently nowadays in singular perturbation problems are not dealt with. Also, averaging methods for nonlinear oscillations, such as that of Krylov–Bogoliubov–Mitropolski have not been included.

For undergraduate students in applied mathematics, engineering and physics, the booklet may serve as an attractive (but rather incomplete) elementary introduction to the field of analytical approximation techniques for ordinary differential equations.

H. W. Hoogstraten

G. E. O. Giacaglia, **Perturbation Methods in Non-Linear Systems,** *Applied Mathematical Sciences*, Vol. 8, Springer Verlag, Berlin–Heidelberg–New York, 1972. IX + 369 pp., price DM 27.80, US $8.80.

This book gives an extensive survey of recent developments in methods of perturbation for non-linear systems of ordinary differential equations with special emphasis on non-linear oscillations and celestial mechanics. The main goal is to describe perturbation techniques, discuss their advantages and limitations and give some examples. Attention has been given to the extension of methods to high orders of approximation, required now by the increased accuracy of measurements in all fields of science and technology. The main theorems relevant to each perturbation technique are outlined, but they only provide a foundation and are not the objective of the work.

There are five chapters: 1. Canonical transformation theory and generalizations, 2. Perturbation methods for Hamiltonian systems; Generalizations, 3. Perturbations of integrable systems, 4. Perturbations of area preserving mappings, 5. Resonance. Each chapter concludes with a detailed survey of the pertinent literature, supplemental information and, when necessary, more examples to complement the text. There is an appendix discussing some open questions and research topics.

The book is very up-to-date and written in a pleasant style. It will be welcomed warmly by all workers in the field.

H. W. Hoogstraten

Annual Review of Fluid Mechanics, Volume 5, 1973, edited by M. van Dyke, W. G. Vincenti and J. V. Wehausen. Annual Reviews Inc., Palo Alto, California, USA. 443 pages, price $10.50.

This volume appears in the unusually short interval of seven months after Volume 4 because of a rearrangement of publishing schedules. Henceforth the volumes of the *Annual Review of Fluid Mechanics* will appear regularly in the first month of each year. By this volume the high standard of the series has been maintained and it is to be hoped for that the editorial committee will succeed in keeping it high for many years to come.

The contents of Volume 5, 1973, are:

Ludwig Prandtl in the nineteen-thirties: reminiscences, by Irmgard Flügge-Lotz and Wilhelm Flügge,

Use of lasers for local measurement of velocity components, species densities, and temperatures, by S. S. Penner and T. Jerskey,

Experiments in gasdynamics of explosions, by A. K. Oppenheim and R. I. Soloukhin,

Longitudinal dispersion and turbulent mixing in open-channel flow, by H. B. Fischer,

Spherical-cap bubbles, by P. P. Wegener and J.-Y. Parlange,

Intermittency in large-scale turbulent flows, by E. Mollo-Christensen,

Transonic airfoils: recent developments in theory, experiment, and design, by G. Y. Nieuwland and B. M. Spee,

Buoyant plumes and wakes, by J. A. Fay,

Hydrofoils and hydrofoil craft, by A. J. Acosta,

The fluid mechanics of lubrication, by E. A. Saibel and N. A. Macken,

Instability, transition, and turbulence in buoyancy-induced flows, by B. Gebhart,

Secondary flows: theory, experiment and application in turbo-machinery aerodynamics, by J. H. Horlock and B. Lakshminarayana,

Noise from aircraft turbo-machinery, by J. E. McCune and J. L. Kerrebrock,

Mixing-controlled supersonic combustion, by A. Ferri,

Three-dimensional boundary layers, by E. A. Eichelbrenner,

Hydrodynamic flow visualization, by H. Werlé,

Molecular gas dynamics, by M. N. Kogan,

Prandtl's boundary-layer theory from the viewpoint of a mathematician, by K. Nickel.

H. W. Hoogstraten

J. H. Ferziger and H. G. Kaper, **Mathematical theory of transport processes in gases,** North-Holland Publ. Comp., Amsterdam 1972. 570 pp., price Dfl. 120.00 (ca. $35.25).

When Boltzmann formulated the celebrated equation named after him he opened up three fields of research, which have been lively cultivated ever since. The first field is the problem of justifying the equation on the basis of the equations of motion of all molecules. The second field is the generalization of the equation to other systems than dilute gases. The third field is the solution of the equation and the study of its consequences, mainly the calculation of transport coefficients from the intermolecular forces. The principal tool in this field is the method of Chapman and Enskog, described in the standard work by Chapman and Cowling, which appeared in 1939. A later account, more directed towards practice, was given by Hirschfelder, Curtiss and Bird in their comprehensive textbook of 1954. The present authors have undertaken to present a new treatise, in which theory and practice are balanced in such a way as to make it suitable to graduate students in aeronautical, mechanical, and chemical engineering, and to include more recent developments.

The material in the book fairly closely parallels that of Chapman and Cowling, but there is a new chapter on polyatomic gases and one on rarified gases, including the problem of

their boundaries. The treatment of dense gases has been updated and even includes a discussion of the theory of Bogolyubov and its difficulties – which shows that the authors are interested in physics beyond the needs of graduate students in engineering. Quantum mechanics is only occasionally mentioned in a rather lapidary and sometimes incomprehensible way, see p. 263. The level of mathematical sophistication is not higher than required by the subject, except for a few embellishments.

The authors did succeed in making this book more modern and less forbidding than Chapman and Cowling. It will therefore constitute a valuable help for research workers in the field. There is some reason to doubt, however, that students will derive great profit from it, because the inherent complexity of the material is compounded by a number of obscure or confusing, if not incorrect, statements, which may easily mislead those who have not yet a certain familiarity with the subject. At any rate they will not be able to afford the price.

N. G. van Kampen