

in vacuum tubes. There is a useful series of mathematical appendices and a brief bibliography.

The author's bright and perspicuous style makes the book a pleasure to read. It is highly recommended.

Theory and Application of Liapunov's Direct Method. By Wolfgang Hahn. English ed. prepared by Siegfried H. Lehnigk. Transl. from German by Hans H. Hosenthien and Siegfried H. Lehnigk. 182 pp. Prentice-Hall, Englewood Cliffs, N. J., 1963. \$9.00.

Oscillations in Nonlinear Systems. By Jack K. Hale. 180 pp. McGraw-Hill, New York, 1963. \$9.00.

Nonlinear Problems. Rudolph E. Langer, ed. Symp. Proc. (Madison, Wisc., Apr.-May 1962). 321 pp. Univ. of Wisconsin Press, Madison, 1963. \$7.50. *Reviewed by Peter L. Balise, University of Washington.*

NONLINEAR analysis is characterized by its mathematical intractability, its pertinence to actual systems, and its appearance as the subject of many new books. Here are three different types of books on the subject.

The English translation of *Theory and Application of Liapunov's Direct Method* is most welcome, both because of the subject's importance and the presentation's excellence. Liapunov's work is the dominant basis for analysis of nonlinear control systems in Russia, and it is now receiving much attention here. Essentially, the method states that if a positive definite function V of the system-state variables can be found such that dV/dt is negative semidefinite, the system is stable; if dV/dt is negative definite, the system is asymptotically stable. The reasonableness of this is indicated by a particular V function, a system's energy, but usually a more complex function is required. Dr. Hahn gives many examples of the construction of suitable V functions, as well as a general introduction to the stability theorems. He also considers the converse problem of inferring the existence of a V function from knowledge of a system's stability. Other interesting topics are rate of decay (degree of stability), sensitivity to perturbations, and critical cases, where the equilibrium is stable but not exponentially stable. With the best bibliography on nonlinear analysis that this reviewer has seen, the volume is warmly recommended.

Indicating the subject's importance, *Oscillations in Nonlinear Systems* is the first volume in the publisher's new series, "Advanced Mathematics with Applications," whose consulting editors are LaSalle and Lefschetz, authors of apparently the first (1961) American monograph on Liapunov's method. Most appropriately, Dr. Hale introduces his book by explaining how the applicability of superposition is the basic characteristic of a linear system, so that knowledge of its behavior near the origin applies everywhere in the state space. This seems more desirable to merely stating the form of the linear differential equation. The rest of the introductory material is much more succinct, being a good summary for one who well understands matrix representation of system behavior. A large part of the work

Magnetohydrodynamic Shock Waves

by J. Edward Anderson, Minneapolis-Honeywell.

This monograph examines MHD shock-wave occurrence criteria in relation to plane shocks for which the collision frequency is large compared with cyclotron frequency. Steady-state shock relations are discussed in sufficient detail to provide a basis for analysis of existence and stability, and two novel features appear: first, a graphical representation of shock end states in three dimensions, and second, an exact solution for the shock adiabatic curve in a particularly convenient form. Analysis of the effect of small disturbances is based on the work of Russian authors, expanded to elucidate the conclusions reached. The concept of group velocity is discussed in detail. The existence and uniqueness properties of the shock layer are analyzed using a new set of equations that include the effects of current inertia and charge separation. Inclusion of current inertia so complicates the analysis that previous methods cannot produce general conclusions, but the author discovers more powerful topological arguments which do produce positive conclusions concerning existence and uniqueness. 1963 240 pages \$6.50

Waves in Anisotropic Plasmas

by W. P. Allis, S. J. Buchsbaum, and A. Bers.

A systematic treatment of plane waves in an unbounded plasma in a magnetic field, and of guided-wave propagation in plasmas and the associated conservation principles of energy and power flow. 1963 280 pp. \$7.50

Properties of the Thirty-Two Point Groups

by G. F. Koster, J. O. Dimmock, R. G. Wheeler, and H. Statz.

Computed character tables, basis functions, and coupling coefficients for irreducible representations of each of the 32 crystallographic point groups. 1963 160 pages \$5.00

Field-Coupled Surface Waves:

A Comparative Study of Surface-Coupled EHD and MHD Systems

by James R. Melcher, Notre Dame.

Describes the behavior of some simpler kinds of surface-coupled continuum-mechanical systems. 1963 224 pages \$5.00

* * *

The M.I.T. Press, Cambridge 42, Mass.:

Send me the titles I've circled, above, for 10-day examination.

NAME

ADDRESS

I enclose \$..... Bill me ☐

☐ Send your Fall List of new titles.

BOOKS ABOUT NEUTRON THEORY AND PRACTICE FROM

IAEA

NEUTRON DOSIMETRY

53 papers and discussions from a Harwell symposium on detection, dosimetry and standardizations. Contents: (Vol. 1) Flux and spectrometric measurements (Review papers, Thermal and epithermal neutrons, Fast neutrons and neutrons of wide energy range, High-temperature operations), (Vol. 2) Dosimetric measurements (Review papers, Methods and instruments for evaluation of dose, Survey measuring methods, Mixed radiations, Special topics), Calibration, absolute measurements and intercomparisons, Neutron source standardization.

Each volume:

Vol. I, 652 pp. In USA and Canada: US \$13
Vol. II, 630 pp. 1963 Elsewhere: 78s.stg

EFFECTS OF NEUTRON IRRADIATION IN NON-FISSIONABLE METALS AND ALLOYS

A bibliography of 735 references compiled from bibliographical references published in the years 1956-1961. The titles are given in their original language and translated occasionally into English or Russian. Abstracts that were available are quoted, some in English, some in Russian.

171 pp. In USA and Canada: US \$1.50
1962 Elsewhere: 9s.stg

INELASTIC SCATTERING OF NEUTRONS IN SOLIDS AND LIQUIDS (1961)

Proceedings of an IAEA symposium. 50 papers on theoretical and experimental aspects of this basic subject. Contents: General theory; Methods of neutron spectrometry; Liquids and molecules other than water; Water; Cold moderators; Solids; and Neutron spectra.

656 pp. In USA and Canada: US \$12
1961 Elsewhere: 72s.stg

INELASTIC SCATTERING OF NEUTRONS IN SOLIDS AND LIQUIDS (1963)

Proceedings of a symposium held by the IAEA in cooperation with UNESCO at Chalk River, Canada consisting of 67 papers. Contents: (Vol. I) General problems; Experimental Technique; Liquids and molecules. (Vol. II) Solids.

Vol. I 484 pp. In USA and Canada: US \$9
Elsewhere: 54s.stg

Vol. II 341 pp. In USA and Canada: US \$7
1963 Elsewhere: 42s.stg

In the U.S.: National Agency for International Publications, Inc., 317 East 34 St., New York 16, N.Y.

In Canada: The Queen's Printer, Ottawa

For a list of IAEA books on reactor physics and reactors, please write to "Reactor Physics and Reactors List", IAEA.



**INTERNATIONAL ATOMIC
ENERGY AGENCY**

VIENNA

AUSTRIA

concerns periodic solutions of nonlinear equations with small perturbations, for which a general theory is given, based largely on the work of the author and Cesari. Interesting clarification is provided by detailed analyses of the application to several common nonlinear equations. The last part of the book considers almost periodic solutions and integral manifolds, also illustrated by interesting examples. Much of the subject is quite difficult; because the terse writing style omits explanations which this reviewer finds desirable in his classes, the book is perhaps not the introduction for graduate students that the author intended. But it certainly is a valuable contribution because of its original material and its unifying approach.

Nonlinear Problems consists of the lectures and abstracts of the papers of a symposium conducted by the Mathematics Research Center, US Army. As is to be expected from the state of nonlinear theory, the volume presents diverse research results rather than a connected study; there are almost as many different topics as there are authors. However, besides the very specialized papers, some articles survey areas of wider application, such as nonlinear hyperbolic systems of conservation laws, nonlinear eigenvalue problems, periodic solutions of ordinary differential equations, and Liapunov's method. A few papers have a physical setting: magnetogasdynamics, Navier-Stokes equations, and elastic stability. Anyone with a serious interest in nonlinear analysis will want to read parts of this volume.

As one author observed, "nonlinear" is only the negation of a field for which there is a rich theory, so it is to be expected that the literature in nonlinear analysis will continue to be characterized by a variety of approaches inspired by different physical problems or suggestive mathematical structures.

Non-Equilibrium Statistical Mechanics. By I. Prigogine. Vol. 1 of Monographs in Statistical Physics and Thermodynamics, edited by I. Prigogine. 319 pp. Interscience, New York, 1962. \$12.50. Reviewed by R. Landshoff, Lockheed Missiles & Space Company.

Statistical mechanics links the phenomenological concepts of thermodynamics to the laws of mechanics. Following Gibbs, this is achieved by the study of ensembles of points in phase space which move according to the laws of mechanics. Such an ensemble is represented by a density ρ which obeys Liouville's equation. In the original application to thermodynamic equilibrium, one restricts the investigation to stationary ensembles. In that case, the time derivative $\partial\rho/\partial t$ in Liouville's equation is zero.

To study nonequilibrium processes, one applies the Liouville equation to densities functions where $\partial\rho/\partial t$ is not zero. This idea goes back to Boltzmann who succeeded in formulating a theory which explained the second law of thermodynamics and made it possible to calculate transport coefficients.

Despite its success, this theory is not entirely satis-