



**WORLD WIDE
HEADQUARTERS FOR ...**

**LASER
OPTICAL
SCINTILLATION
SEMICONDUCTOR
THERMOELECTRIC
NEUTRON DIFFRACTION
PLATES**

Special requirements and sizes quoted on request

**FULL SCALE PRODUCTION
Calcium Tungstate
Glass Lasers
Plastic Lasers
Liquid Lasers**

Now Available:

SODIUM TERBIUM BORATE
COBALT MANGANESE FLUORIDE

STOCK LASERS

CaF_2 , BaF_2 , CdF_2 , SrF_2 , TiO_2 ,
 MgO , RbMnF_2 , CaWO_4 , Al_2O_3 ,
 KMnF_2 , SrWO_4 , SrMoO_4 ,
 $\text{SrF}_2 \cdot \text{CaF}_2$, $\text{SrF}_2 \cdot \text{BaF}_2$,
 $\text{SrF}_2 \cdot \text{BaF}_2 \cdot \text{CaF}_2$

Write for comprehensive literature

**SINGLE CRYSTAL DIVISION
Semi-Elements, Inc**

SAXONBURG BLVD. • SAXONBURG, PA. • U.S.A.

Dial 412-352-1548

mathematical techniques, and with special emphasis on the physical meaning of the results. It is agreeable to find how much can be learnt about nonlinear systems using undergraduate mathematics, when knowingly applied.

Magnus classifies oscillations in terms of their mechanism of generation—proper oscillations (normal modes), self-excited oscillations, parametric oscillations, forced oscillations, and coupled oscillations. Each of these is described with reference to a variety of physical examples, and, wherever appropriate, both energy and plane considerations are presented. The examples presented in the text, as well as those given as exercises, are almost entirely of mechanical origin, with only a sprinkling of hydraulic and electromechanical problems. While the motions thus presented certainly span the gamut of important oscillations, it would have been valuable to have at least mentioned more of the electrical and electronic systems which have led to much of the present-day interest in the topics discussed here.

It is quite safe to say that the variety of topics discussed in this book, and the usable information presented about them, cannot be rivaled in any other book of this level or size, currently available, or indeed in many weightier and more profound tomes. In view of its modest size (250 pages) and the clarity of presentation, it seems unfair to quibble about the omission of even a brief discussion of the important stability criteria (Routh and Liapunov) and of the work of Pontriagin and others on adaptive systems. This book should not only prove useful to anyone interested in applications, but provides a desirable complement to the more abstract and elegant mathematical works dealing with stability.

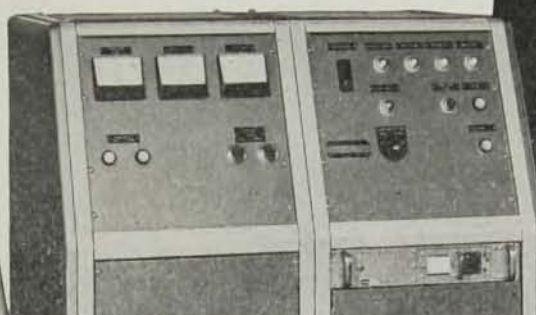
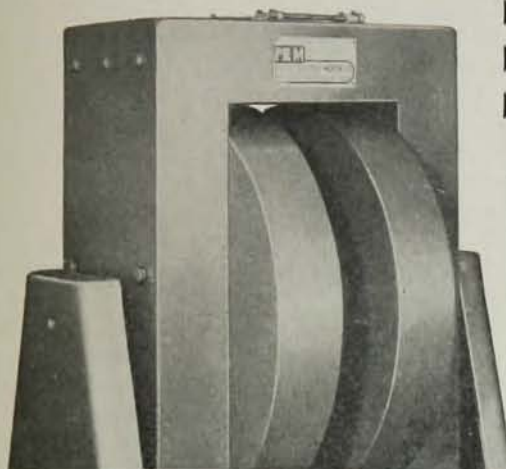
Nonlinear Differential Equations. By Raimond A. Struble. 267 pp. McGraw-Hill Book Co., Inc., New York, 1962. \$7.50. Reviewed by Peter L. Balise, University of Washington.

ALTHOUGH nature is nonlinear, the intractability of nonlinear differential equations has caused physical systems to be largely represented by linear models. Now, nonlinear theory is becoming very important, not only for more accurate representation of natural phenomena, but because deliberate introduction of nonlinearities, especially in automatic controllers, makes possible much better performance. Several recent nonlinear-systems books reflect the need for such applied analysis.

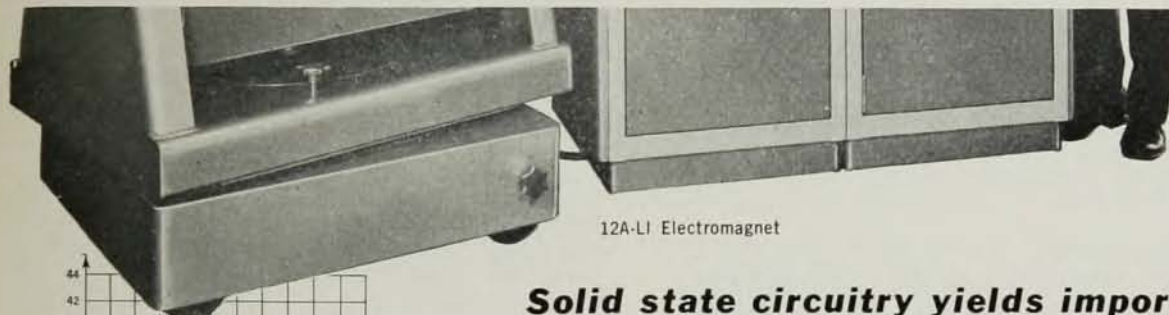
This volume, however, is definitely a mathematics text, concerning theory rather than physical systems, but it is distinguished by the author's regard for the needs and limitations of nonmathematicians. While appropriate for a senior or graduate mathematics course, it should also be a good reference for scientists and engineers. Dr. Struble attractively emphasizes the understanding of concepts and omits details which might be appropriate in a mathematics text but which would obscure the main ideas. And he includes brief introduc-

PEM Complete Magnet Systems featuring Transistorized Power Supplies

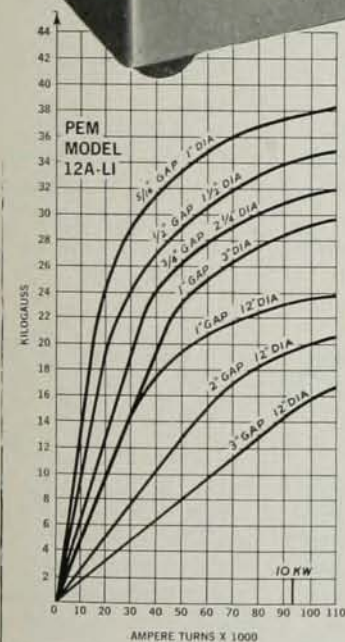
- ✓ **Higher Fields!**
- ✓ **Superior Uniformity!**
- ✓ **Precise Regulation!**



IN STOCK—IMMEDIATE DELIVERY



12A-LI Electromagnet



Illustrated: 12A-LI Electromagnet System. Includes magnet, "Q" Line power supply, N.M.R. equipment and water-to-water heat exchanger. Pole face windings available to increase volume of uniformity



Solid state circuitry yields important performance and maintenance advantages

"Q" Line transistorized power supplies, used in a complete PEM low impedance magnet system, yield unparalleled homogeneity and regulation. In sizes from 5 to 200 KW (larger sizes on request), they are current regulated and stable to 1 part in 100,000. Optimum regulation, minimum drift, and maintenance freedom are "built in" by PEM through use of temperature-controlled shunt and superb components throughout. Easy to operate: double closed loop design and clamp circuits eliminate damage through misuse. Conservative design includes water-cooled heat sinks to minimize heat dissipation into the room. Call or write for details.

POWER SUPPLY SPECIFICATIONS

Current Regulation (voltage variation $\pm 10\%$) $\leq 1 \times 10^{-5}$
 Drift (long term) $\leq 1 \times 10^{-5}$ after 1/2 hour warm-up
 Ripple $\leq 1 \times 10^{-5}$
 For low impedance type magnet load . . . Approx. .1 to 10 ohm loads.

SPECIAL MAGNET FEATURES

- (1) Complete surge and water flow protection.
- (2) 360° rotation about both vertical and horizontal axes.
- (3) Accepts up to 75 KW of continuous DC power.
- (4) Alignment provision for pole caps.

SYSTEM PERFORMANCE DATA (Uniformity)

- 1" air gap/12,000 gauss/12" dia.
 1 pt. 10^{-5} - 2" dia. cyl.
 1 pt. 10^{-4} - 7" dia. cyl.
- 2" air gap/12,000 gauss/12" dia.
 1 pt. 10^{-5} - 1 1/2" dia. cyl.
 1 pt. 10^{-4} - 4" dia. cyl.
- 3" air gap/12,000 gauss/12" dia.
 1 pt. 10^{-5} - 1 1/8" dia. cyl.
 1 pt. 10^{-4} - 2 1/4" dia. cyl.

PEM

PACIFIC ELECTRIC MOTOR CO.

1009 - 66TH AVENUE, OAKLAND 21, CALIFORNIA • LOCKHAVEN 9-7621

- INVESTIGATION OF PHYSICAL PHENOMENA
- BASIC SENSORS
- APPLICATIONS OF NEW MATERIALS & TECHNIQUES
- INSTRUMENTATION SYSTEMS

EXPERIMENTAL PHYSICISTS AND PHYSICAL CHEMISTS

for expansion of a group concerned with the development of basically new techniques and with the solution of advanced instrumentation and measurement problems.

The nature of the problems solved by this group varies widely, so that the principal qualifications required are an inquiring intelligence and a sound background in physics, physical chemistry, and mathematics. Positions are available for both recent graduates and experienced people capable of accepting primary responsibility for specific programs. Present programs include work in the following areas:

- SPACE PHYSICS
- MEASUREMENT OF GEOPHYSICAL AND METEOROLOGICAL PARAMETERS IN AND ABOVE THE ATMOSPHERE
- VISIBLE AND ULTRAVIOLET RADIATION
- NEW TYPES OF ELECTRON MULTIPLIERS
- MASS SPECTROMETRY

Final engineering and packaging are normally carried out by other groups in the organization.

The work is stimulating and satisfying in comfortable and pleasant surroundings in suburban Detroit.

Opportunities for advanced study.

Write or wire **A. Capsalis,**
Research Laboratories Division,
The Bendix Corporation
Southfield, Michigan

**Research Laboratories
Division**



An equal opportunity employer

tory explanations that should be helpful even to the mature readers for whom the book is intended.

Accordingly, the phase-space concept is presented at the beginning, illustrated by the pendulum with Newtonian damping, probably the most effective elementary example of the transition from linear to nonlinear behavior. The phase plane is given considerable attention throughout, although not as much as the engineer or scientist might desire. Background is provided by early chapters on linear equations and existence and uniqueness theorems. Although only one chapter is entitled "Stability in Nonlinear Systems," the last half of the book is devoted primarily to this centrally important topic. It is good to see that Dr. Struble presents Lyapunov's "second method," the principal analytical tool for studying nonlinear stability problems in the Soviet Union, now being introduced in the United States. He also gives considerable attention to Poincaré stability and mentions Laplace stability.

There is now no general approach to nonlinear problems, and the variety of nonlinearities makes a single unifying method seem unlikely. There is much need for mathematical treatments like Dr. Struble's, as well as for important approximating techniques like the describing function (which he does not mention). And this will remain true even as simulation of nonlinear systems by analog and digital computers obviates the necessity for complete analysis.

Eigenfunction Expansions Associated with Second-order Differential Equations, Part 1 (2nd ed.). By E. C. Titchmarsh. 203 pp. Oxford U. Press, New York, 1962. \$6.75. *Reviewed by George Weiss, University of Maryland.*

THIS is the second edition of a mathematical treatise of some interest to physicists. Several chapters have been rewritten and there is now some reference to the work of Levitan. Unfortunately the work still remains forbiddingly difficult to read and only analysts of a high order will be able to appreciate it.

Singularities of Linear System Functions. By Bernhard Gross and Elde Pires Braga. 90 pp. American Elsevier Publishing Co., Inc., New York, 1961. Paperbound \$4.00. *Reviewed by Robert J. Rubin, National Bureau of Standards.*

ALTHOUGH this little book is written in the language of electrical network theory, it is of interest to students and specialists in the fields of dispersion-relation theory, crystal-lattice dynamics, dielectric relaxation, and viscoelastic behavior, where the underlying mathematical structures are identical. The properties of linear networks can be characterized in terms of the singularities in the complex frequency plane of functions such as the driving-point impedance, which in turn is related to the diagonal element of a Green function for the network. In this book several specific examples of linear networks are examined in detail.