# *BOOK REVIEW – BUCHBESPRECHUNG*

BUTENIN, N. V.

**Elements of the Theory of Nonlinear Oscillations**

Translated from Russian by Scripta Technica. Blaisdell Publishing Company. Division of Ginn and Company. New York—Toronto—London 1965, pp. 226

Oscillations and vibrations become more and more important in many technical fields such as in mechanical, electrical and electronic engineering, automation etc. While at the commencement linear theory was almost sufficient, presently, nonlinear methods are necessary to examine and elucidate the nonlinear phenomena and processes. At the same time the study of the performance of nonlinear systems, i.e. systems whose behavior is described by nonlinear differential equations, involves a deeper investigation of vibrational or oscillatory phenomena and processes than does the study of linear systems. Unfortunately, there is no complete mathematical treatise of the nonlinear problems. Therefore competent and useful books, like the present one, are very desirable which summarize purely and simply the main methods and factors of nonlinear oscillations offering a very good introduction to the investigation of nonlinear problems.

To give a deep insight into the contents of the work in question the best method is perhaps recapitulating the titles of each chapter. Chapter I. Methods of Studying Nonlinear Autonomous Systems with One Degree of Freedom. Chapter II. Oscillations in Nonlinear Autonomous Systems with Two Degrees of Freedom. Chapter III. Degenerate Systems. Chapter IV. The Effect of an External Harmonic Force on a Self-Excited System with One Degree of Freedom. Chapter V. The Effect of an External Harmonic Force on a Self-Excited System with Two Degrees of Freedom.

There are 122 figures included in text. The bibliography refers to 61 items. An index of four pages serves as completion or supplement.

Nonlinear oscillations and vibrations are regarded as a Russian speciality due to the School of MANDEL'SHTAM, ANDRONOV, WITT, HAYKIN, PAPALEXI and their followers. The author of this book is a well-known member of the group mentioned. Therefore the translation is really approvable thus making accessible this interesting and concise book also to the readers who are not familiar with Russian language.

F. CSÁKI

AIZERMAN, M. A.—GANTMACHER, F. R.

**Absolute Stability of Regulator Systems.**

Translated by E. POLAK. HOLDEN-DAY, INC. San Francisco, London, Amsterdam. 1964, pp. 172

In this book dynamic processes occurring in automatic control systems and in mechanical or electrical problems are considered which can be described by the following system of differential equations:

$$\frac{dx_i}{dt} = \sum_{j=1}^{n} a_{ij} x_j + b_i y \quad (i = 1, 2, \ldots n)$$

$$y = q(\sigma)$$

$$\sigma = \sum_{k=1}^{n} c_k x_k$$

where $a_{ij}$, $b_i$, $c_k$ are real constant coefficients and the characteristic $\varphi(\sigma)$ is an arbitrary, single-valued, piecewise continuous real function, defined for all real values of $\sigma$ and satisfying the condition $\varphi(0) = 0$ and one of the additional inequalities

$$0 \leqq \frac{\varphi(\sigma)}{\sigma} \leqq k\,; \qquad 0 < \frac{\varphi(\sigma)}{\sigma} \leqq k; \qquad 0 < \varepsilon \leqq \frac{\varphi(\sigma)}{\sigma} \leqq k$$

where $k$ can be either a finite number or infinity, while $\varepsilon$ is a sufficiently small positive number. The class of dynamic processes is said absolutely stable if for any $\varphi(\sigma)$ which satisfies one of the above inequalities the zero solution $x_1 = x_2 = \ldots x_n = 0$ is globally asymptotically stable, that is, the zero solution is asymptotically stable in the LIAPUNOV sense and the region of attraction for the origin of the coordinate system is the whole state space.

The purpose of the present book which was translated from the Russian is to study the possibly sufficient and necessary conditions for the absolute stability.

Chapter I gives the formulation and a short history of the problem. Here are mentioned the contributions of LUR'E, POSTNIKOV, YAKUBOVITCH, MALKIN, LASALLE, LEFSCHETZ, PLISS, ROSENVASSER, AIZERMAN, POPOV and LETOV.

In Chapter II is shown how the problem can be solved by the so-called direct method and the resolving equations of LUR'E. This method is connected with the construction of LIAPUNOV functions consisting of a quadratic form plus an integral of the nonlinear term.

Chapter III is devoted to the frequency method of V. M. POPOV.

Chapter IV presents the connection between the POPOV criterion and the existance of a LIAPUNOV function. There are further refinements of the frequency criteria also given for the absolute stability of particular cases.

Chapter V is a brief review of the present state of the absolute stability problem.

Finally, the Appendix based on recent works of V. A. YAKUBOVITCH and R. E. KALMAN, further clarifies the connection between the method of LUR'E resolving equations and the POPOV frequency method.

The use of the book is facilitated by an index as well as by a bibliography of 105 items and additional references of 30 papers.

The book in question is a very valuable work, indeed, which is intended originally as a reference text for the scientific researchers, but it may be used also as a text for graduate level courses on the theory of nonlinear systems.

F. CSÁKI

DEAN, K. J.

**Digital Instruments. Modern Electrical Studies.**

Chapman and Hall Ltd. London

One of the most characteristic features in the development of modern technics is the ever increasing use of digital technics in the most different fields of production and in scientific research. This is accompanied by the gaining of gr und of the digital instrum nts, too.

The use of the said instruments is primarily advantageous in cases, where the first demand is the high accuracy of measurement, or the representation of the results of measurement in the accustomed decimal form. The latter circumstance diminishes greatly the danger of improper instrument readings.

On the basis of the above said it is very important for the experts using digital instruments to clearly understand the basic working principles of these instruments and the main aspects of their use.

The book to be reviewed summarizes the material published up to now in a scattered way in different technical papers and textbooks on the subject mentioned above and by this fact it renders considerable help to the electro-engineers wishing to get acquainted with the subject.

The book consists of 9 chapters and appendixes. The first two chapters deal with the fundamentals of Information Theory, Digital Code Theory and Transistor Switching Technics, allowing to understand the working without a preliminary special computation-technical skill. From the topic of Information Theory the book explains the conceptions of information quantity and redundancy. From among the arithmetical fundamentals of digital technics the book informs on the

binary and binary-decimal codes, further on error-correction codes.

In the past dealing with Transistor Switching Technics the book shows the structure of transistorized logical fundamental circuits, of bistable elements, shift registers and of counters.

Chapters 3. and 4. of the book deal with the Input and Output Unity of digital machines.

Chapter 5. surveys digital instruments suitable for the measurement of Frequency and Time.

Chapter 6. 7 and 8 discuss in detail the Digital Voltmeters working on different principles (Successive Approximation Voltmeters, Ramp Function Digital Voltmeters, Voltage-Frequency Conversion Voltmeters).

Chapter 9 shows, how the digital instruments can be used, besides the measurement of voltages, also for the measurement of other electrical quantities (resistances, phase shifts, etc.).

The appendix of the book evaluates the accuracy of the Digital Voltmeters.

The logical composition of the material, the easy and clear style of the book facilitate the understanding and appropriation of the subject. This same purpose is served by the control questions to be found in the supplement of the book as well.

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