ject in a form "allowing the use of computers for finding solutions." The book consists of four parts: Mathematical Description of Vibrating Systems (56 pages), Time-Invariant Vibrating Systems (200 pages), Time-Variant Vibrating Systems (33 pages), and Mathematical Background (30 pages).

Part I begins with an introductory discussion of the various classifications of vibrations. This is followed by a very brief review of kinematics, Lagrange's equations, and the momentum principles. The section closes with a chapter on the linearization of the equations of motion and their state-space representation.

Part II is devoted to the study of autonomous systems. It begins with a chapter on the fundamental matrix of the system and its use in generating the general solution of the equations of motion. A chapter on stability and boundedness follows. Here, stability criteria based on the characteristic equation as well as on Liapunov's matrix equation are discussed. This is followed by chapters on free vibrations, forced vibrations, and resonance. Mode shapes, lightly damped systems, periodic excitation, vibration absorption, and parameter identification are some of the topics explored. The final chapter of this section is devoted to random vibrations.

Part III consists of two chapters: the first is concerned with the solution of the (nonautonomous) equations of motion and its stability, while the second addresses parametrically excited and forced vibrations. The final part of the book presents background material on matrix algebra – one chapter on its analytical aspects and a second on its numerical aspects. It also has a brief chapter on controllability and observability.

I beleive the authors do achieve their aim of presenting the results in a form convenient for computer implementation. The results are presented in such a way that when analyzing a given system, one merely needs to select a set of generalized coordinates and write down the position vectors of the various particles in terms of these coordinates. It is then a matter of "substituting into a sequence of appropriate formulas". In fact, even the simplest of examples (e.g., the double pendulum) is worked out in the book in this mechanistic manner.

This book is concerned with the mathematical results associated with various aspects of linear vibration theory. The physics of the subject is underplayed. My primary criticism of the book is that I found it to be extremely concise; often, the authors simply state results (both elementary and advanced) without explanation, e.g., the section on Floquet Theory in Chapter 10.

On the positive side, this book is a comprehensive source for mathematical results in linear vibration theory of discrete systems. It discusses the subject through both a state-space formulation as well as directly through the equations of motion. This is a useful feature, since it helps link the traditional mechanical engineering approach to vibrations with the more modern literature. A second attractive feature is that in order to illustrate the theory, the authors repeatedly use the same four mechanical systems throughout the text, thereby giving the book additional coherence.

Parametric Random Vibration, by R. A. Ibrahim, Wiley, New York, 1985. 342 pages. Price: $59.95.

REVIEWED BY T. FANG[4] AND E. H. DOWELL[5]

This is the first book devoted to parametric random vibrations. It systematically presents the methods and recent results on the subject. The book is really a summary of the state-of-the-art culled from hundreds of published papers and technical reports. It consists of nine chapters, dealing with the mathematical basis, analytical techniques, and theoretical and experimental results for the behavior of random parametric systems.

The first chapter is an introduction, in which different kinds of motions, i.e., chaotic responses, random responses due to pseudo-random excitations or random initial conditions, and parametric random vibrations, are briefly reviewed.

The next four chapters introduce the related mathematics of stochastic analysis. Fundamental concepts of random processes and elements of stochastic calculus are outlined in Chapters 2 and 3, respectively. Chapters 4 and 5 contain the essential tools for modeling and analyzing random parametric systems, i.e., the Itô and Stratonovich stochastic calculus, the Wong-Zakai and Khas'miniskii Limit theorems, the Fokker-Planck-Kolmogorov equation and its applications, and the moment equation method. The latter two chapters are particularly well written with an emphasis on clarifying the controversies and disputes which occurred in the 1960's.

The last four chapters discuss parametric random vibrations per se. Chapter 6 describes various stochastic averaging methods, together with their applications to the study of stochastic behavior of linear or nonlinear systems. The recently developed method of stochastic averaging of the energy envelope appears to be very useful for "quasi-conservative" nonlinear systems. Chapter 7 is devoted to parametric stochastic stability. Various types of stochastic stability are summarized. Two of them, i.e., the stability of moments and almost sure stability, are discussed in some detail. Stability boundaries obtained by different theorems for typical problems are compared. Parametric random responses are considered in Chapter 8. A number of techniques are presented here to determine the random responses of linear and nonlinear dynamic systems, including helicopter rotor blades in atmospheric turbulent flow, liquid sloshing under parametric random excitations, and coupled beams with autoparametric resonance. Special attention is given to the moment equation method. Both Gaussian and non-Gaussian closure techniques are used and the corresponding results are compared with each other and also compared with those obtained by stochastic averaging methods. It appears that non-Gaussian closure schemes are more reasonable for nonlinear systems. The last chapter compiles the experimental results reported in the literature.

Historical reviews of the techniques, theories, and their applications are distributed in related chapters. An extensive list of references is appended. Among the total of 545 references, 408 of them are cited explicitly.

The book is of a graduate level, well written, and useful to engineering researchers and scientists working in those fields involving parametric random vibrations.

[4]Visiting Professor on leave from Northwestern Polytechnical University, Xian, China.

[5]J. A. Jones Professor, Dean, School of Engineering, Duke University, Durham, North Carolina 27706.

Numerical Simulation of Fluid Flow and Heat/Mass Transfer Processes (Lecture Notes in Engineering), edited by N. C. Markatos, D. G. Tatchell, M. Cross, and N. Rhodes. Springer-Verlag, New York, 1986. 482 pages. Price: $36.00.

REVIEWED BY P. D. RICHARDSON[6]

The first decision one faces in implementing numerical studies in applied mechanics is whether to generate one's own

[6]Professor of Engineering and Physiology, Brown University, Providence, RI 02912. Fellow ASME.