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Book Reviews

Mechanical and Structural Vibrations

Demeter G. Fertis, Wiley, New York, 1995, 804 pp., $84.95

There are many books on vibrational analysis. This current addition covers a very broad range of topics, some of which are not often found in basic texts on the subject. This attribute should make it a valuable addition to the reference library of any practicing structural engineer. The book is appropriate for a two-semester undergraduate course in vibrations, but it also includes several advanced topics that make it appropriate for a graduate-level vibrations course. There are many example problems, as well as homework problems at the end of each chapter. Solutions to selected problems are presented in an appendix. An extensive list of references is also included at the end of the text. Many of the references reflect current topics of research. The main theme found throughout the book is the use of simple yet accurate models to represent complex systems whenever possible. This philosophy should be of great benefit to both the practicing engineer and the student just learning the fundamentals of vibration.

Chapter 1 presents the fundamentals of vibratory motion for both linear and nonlinear systems, and the current subject of chaos and chaotic systems is also discussed. Chapter 2 covers unforced vibration for simple spring-mass and continuous systems. Aspects of damping are also introduced. Chapter 3 deals with the forced response of simple systems using both analytical and numerical methods. Beams, frames, and elastoplastic systems are considered.

Chapter 4 is concerned primarily with vibrations of continuous systems. Static and flutter instabilities are discussed. This chapter also presents the concept of a dynamic hinge and dynamically equivalent systems that have been developed by the author and collaborators. This approach seems to have many useful applications, such as checking the accuracy of modal parameters produced by more complex models. Classical methods of vibration analysis, such as those of Rayleigh, Stodola, and Myklestad, are discussed in Chapter 5. Chapter 6 gives a very thorough presentation of the finite element method. Mass and stiffness matrices are derived for simple structural elements such as beams and plates. Vibrational and dynamic response using direct integration and modal analysis is discussed. Various aspects of the use of the finite element method are also presented, such as element completeness, compatibility, and higher-order effects. Chapter 7 develops Lagrange's equations and presents the use of modal analysis as a tool for determining the dynamic response. Both discrete and continuous systems are considered.

Chapter 8 treats the linear and nonlinear response of members with stiffnesses that vary continuously along their lengths. The author employs his method of equivalent systems to determine the static and vibrational response of these members using relatively simple equivalent mathematical models. Inelastic members are also considered. Chapter 9 examines the dynamic response of spring-mass systems to periodic and nonperiodic excitation using Fourier and Laplace transforms. The treatment of these methods as well as the convolution theorem provide the basis for the analysis of systems subjected to random excitations, as presented in Chapter 10. Both variational and stochastic methods of analysis are discussed. Basic aspects of random vibration analysis, such as expectations, correlation functions, and power spectra, are presented.

The final chapter deals with an important subject that is too seldom found in modern vibrations textbooks—dimensional and model analysis. This chapter discusses the basic principles governing the preparation of scale models and their use to predict the response of a prototype. The principles of dimensional analysis are presented, as well as the Pi theorem and the prediction equation. The text also includes 12 appendices containing useful information such as magnification factors for undamped single-degree-of-freedom systems, rules of matrix algebra, and Laplace transforms. Overall, this textbook is very well written and organized, with a good balance between theory and applications.

Daniel C. Kammer
University of Wisconsin–Madison